DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

DIVISION OF CHEMISTRY

REPORT OF THE DOMINION CHEMIST

FRANK T. SHUTT, M.A., D.Sc., F.I.C.

FOR THE YEAR ENDING MARCH 31, 1930

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Close grazing experiment, June 26. Plot "A" cut weekly, showing White Dutch clover in bloom.

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As in the past the work of the division has been carried forward with two main functions in view; the investigation of problems affecting Canadian agriculture and the assistance of farmers, through correspondence and by analytical work, in matters related to soils, manures, feeding stuffs, well waters, etc.

In addition to these two main branches of work, the Division officially examines and reports on meat and canned foods and other packing house products from the Health of Animals' Branch; canned, preserved and fresh fruits from the Fruit Branch; condensed and evaporated milks, milk and cream powders, etc., from the Dairy and Cold Storage Branch.

Further, the division has rendered chemical assistance to the following branches of the Government service: Customs and Excise Branch, Department of National Revenue, National Parks Branch, Department of the Interior, Entomological Branch, Live Stock Branch, Seed Branch, Department of Agriculture, Department of National Defence, Public Printing and Stationery Department, Marine and Fisheries Department.

TABLE No. 1.—SAMPLES RECEIVED FOR EXAMINATION AND REPORT FOR TWELVE MONTHS ENDING MARCH 31, 1930

—	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	Total
Soils	109	3	10	2	182	287	26	20	42	681
Manures and fertilizers	9	1	2	1	33	26	22	9	4	107
Forage plants, fodders and feeding stuffs, cereals	36	271	105	44	713	141	450	83	3	1,846
Samples from Health of Animals Branch	.....	.....	.....	.....	.....	.....	.....	.....	.....	917
Samples from Fruit Branch	.....	.....	.....	.....	.....	.....	.....	.....	.....	704
Samples from Dairy and Cold Storage Branch	.....	.....	.....	.....	.....	.....	.....	.....	.....	247
Waters	9	2	5	5	73	26	11	9	2	142
Miscellaneous, including insecticides and fungicides	87	33	23	10	496	78	17	52	11	807
										5,451

The number of classified samples received for examination during the year is 5,451, approximately 1,200 more than during the preceding year. A comparison of the tables for the two past years shows that there has been an increase in every branch of the division's activities, with the exception of well waters—the most marked increase being in the phase of work dealing with cereals, feeding stuffs and forages.

SOILS

During the past year 681 samples of soil have been received for analysis. A considerable number of these samples have been submitted by farmers with a request for advice in respect to fertilizing, manuring, liming, etc. The division has endeavoured to examine and report on such samples with as little delay as possible.

A number of special soil investigations have been undertaken and some of these are still in progress. Of those completed a brief report is here given. These comprise a series of soils from the Barnwell-Tabor area of Southern Alberta, a series from the Experimental Station, Lethbridge, Alta., and a series submitted by the Cereal Division of the Central Farm, Ottawa, Ont.

SOILS FROM THE BARNWELL-TABOR DISTRICT, ALBERTA

During the summer of 1928 the Superintendent of the Experimental Station, Lethbridge, Alta., asked the help of the division in solving what was thought at that time to be a soil problem, viz., that wheat, oats and barley crops sown on land that had been in sugar beets for two or three years, made but little growth, the plants being spindley and in some cases wilting, while the same crops sown on land that had been in grain the year previous were exceptionally good. It was thought by some of the farmers of the district "that the poor condition of the grain crop was due to a lack of fertility in the soil." To obtain data on this point the following soil samples were submitted by the Superintendent at Lethbridge for analysis.

Lab'y No. 94022-23.—Surface soil 0-6" and subsoil 6"-12" from the farm of B. McM. Barnwell, Alta., collected July 2, 1928. Crop, barley. Previous cropping: 1927, sugar beets; 1926, sugar beets; 1925, wheat; 1924, alfalfa; 1923, alfalfa. Barley crop was poor, height of grain being about 11 inches. Land never manured.

Lab'y No. 94024-25.—Surface soil 0-6" and subsoil 6"-12" from the farm of B. McM. Barnwell, Alta. Collected July 2, 1928. Crop, barley. Previous cropping: 1927, barley; 1926, alfalfa; 1925, alfalfa; 1924, alfalfa; 1923, alfalfa. The barley crop was exceptionally good, height of grain being 24 inches; land never manured. These samples were collected at a distance of 20 feet from the two previous samples.

Lab'y No. 94026-27.—Surface soil 0-6" and subsoil 6"-12" from the farm of L. J., Barnwell, Alta. Collected, July 2, 1928. Crop, wheat. Previous cropping: 1927, sugar beets; 1926, sugar beets; 1925, sugar beets; 1924, oats; 1923, barley. The wheat crop was very poor—height 18", land never manured.

Lab'y Nos. 94028-29.—Surface soil, 0-6" and subsoil 6"-12" from the farm of L. J. Barnwell, Alta. Collected July 2, 1928. Crop, wheat. Previous cropping: 1927, sugar beets; 1926, sugar beets; 1925, sugar beets; 1924, oats; 1923, barley. The wheat crop was very good—height 32". Land manured at the rate of 20 tons per acre in the spring of 1927. These samples were collected at a distance of 25 feet from Nos. 94026-27.

On both of the above farms the soil is a sandy loam underlaid by a sandy subsoil.

The data from the analysis of the above described soils are presented in table No. 2.

TABLE No. 2.—SOILS FROM THE BARNWELL-TABER DISTRICT, LETHBRIDGE, ALTA.

(Moisture-free basis)

Lab'y. No.	Depth	Farm	Moisture	Loss on ignition (organic matter)	Insoluble mineral matter	Oxide of iron and alumina (Fe_2O_3 Al_2O_3)	Lime (CaO)	Magnesia (MgO)	Nitrogen	Phosphoric acid		Potash		Water soluble salts		Resistance in ohms	Remarks
										Total	Available	Total	Available	Before ignition	After ignition		
			p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.		
94022	0–6″.....	B.McM's....	2·27	3·81	89·98	4·97	0·76	0·606	0·128	0·142	0·044	0·393	0·027	0·27	0·14	538·2	Barley after beets: poor crop.
94023	6″–12″.....	"	2·58	8·69	79·35	4·82	6·28	0·892	0·154	0·175	0·014	0·341	0·011	0·20	0·12	518·2	
94024	0″–6″.....	"	2·41	4·24	89·44	4·90	0·86	0·579	0·142	0·137	0·043	0·382	0·021	0·21	0·12	645·9	Barley following barley, after alfalfa: good crop.
94025	6″–12″.....	"	2·36	5·33	87·00	5·00	2·12	0·645	0·141	0·128	0·027	0·440	0·023	0·27	0·12	496·1	
94026	0″–6″.....	L.J.'s.....	2·37	4·53	87·99	5·03	1·61	0·660	0·125	0·144	0·031	0·386	0·025	0·18	0·09	690·8	Wheat after beets: crop very poor, never manured.
94027	6″–12″.....	"	2·37	9·63	76·48	4·50	8·12	1·010	0·121	0·156	0·010	0·276	0·007	0·16	0·09	957·7	
94028	0″–6″.....	"	2·40	4·41	88·81	4·81	1·10	0·642	0·138	0·137	0·044	0·368	0·037	0·20	0·08	705·9	Wheat after beets; crop very good, manured heavily in spring of 1927.
94029	6″–12″.....	"	2·33	6·38	83·54	4·80	4·23	0·887	0·116	0·139	0·011	0·309	0·015	0·18	0·08	650·3	

The data of table No. 2 do not support the view that lack of plant food is the cause of the poor growth of barley and wheat following the culture of sugar beets. It is more probable that the poor crops recorded were due to seasonal or other conditions. This deduction is substantiated by the fact that the crops recovered to large a degree before the end of the 1928 season.

In a letter dated March 19, 1930, the Superintendent of the Lethbridge Station writes: "The barley on the B.McM. farm was decidedly inferior on the sugar beet land at the time the samples were secured in July, 1928, but as the season progressed it improved and we estimated that it was about three-quarters as good as the adjacent barley crop at time of harvest.

"We have not been able to decide just what caused the difference in these fields. . . . No one in the district appears to have had any similar experience in 1929."

THE INFLUENCE OF IRRIGATION ON TILTH AND PLANT FOOD CONTENT OF SOILS, EXPERIMENTAL STATION, LETHBRIDGE, ALTA.

It has been observed that irrigation practised over a number of years may appreciably affect the tilth of certain types of soil, rendering it more or less difficult to obtain a friable, mellow seed bed. Thus, the Superintendent of the Experimental Station, Lethbridge, Alta., in bringing this matter to the attention of the Division writes as follows: "After a few years of irrigation the soil 'runs together', acting when ploughed in the spring more or less as a refractory clay loam, i.e., it does not readily break down into a good tilth; it lacks friability. a desirable looseness of texture and does not crumble into a good mulch. Similar soil, on a dry land area that has never been irrigated can be ploughed in the spring and worked down into a very desirable seed bed, such as one would expect from our sandy loam soil. In short, the 'hardening' effect of irrigation to which we refer, would seem to change the soil from an easily worked sandy loam to a refractory clay soil."

"This problem is of more importance to the sugar beet grower than to the ordinary farmer, for, with the exception of the small seeds, such as clover, there is no great difficulty met with. Grain does not require a fine seed bed but can be drilled in two or three inches; it will usually germinate satisfactorily before the surface dries out. The effect of irrigation is to make a proper seed bed preparation difficult; apparently it is not a question of soil fertility, except perhaps as fertility may be affected by an adverse physical condition of the soil. Further, the hardening of the soil from irrigation makes the digging of root crops more difficult."

To learn more exactly what changes might be brought about by subjection to continued irrigation in structure and composition of the sandy loams as occurring at Lethbridge, it was decided as a first step, to examine chemically samples from an area judged originally to be fairly uniform as to type and structure, a part of which had received very little irrigation water, and an adjoining part which had been irrigated heavily.

The collection at the points chosen consisted of a soil slab 6 inches thick and 1 foot wide taken to a depth of 3 feet. These slabs unbroken, were closely boxed *in situ* and shipped to the laboratories at Ottawa, where they arrived in good condition. Six samples (A, B, C, D, E, F) were made from each slab, representative of each succeeding six inches from the surface to the depth of three feet.

The particulars of the areas from which the soil slabs were taken, as furnished by the superintendent are as follows:—

No. 1 (Lab'y. No. 90808).—Irrigated land in grass. Seeded to Kentucky blue grass in 1922 (five years previous to collection of sample); from 1916 to 1922 this area was under a crop rotation of peas, potatoes and oats. Irrigated *slightly* in 1922 and 1923; no irrigation water applied since 1923. The Superintendent states this soil to be in "fairly good condition structurally".

No. 2 (Lab'y. No. 90809).—Collected within eighteen feet of No. 1. Irrigated land in mixed grasses (Kentucky blue, Western Rye, Meadow Fescue and alfalfa). Previous cropping was similar to that of Area No. 1. Irrigated *heavily* and *continuously* since the spring of 1922, the land having received three inches of water every two weeks during the growing season. The Superintendent states that "the structural conditions of No. 2 seem to have been changed materially by the water application and the soil is in a poor condition physically."

The data from the chemical analysis of the soil from each of the two locations, at depths of A 0″-6″, B 6″-12″, C 12″-18″, D 18″-24″, E 24″-30″ and F 30″-36″, are presented in table No. 3.

DISCUSSION OF CHEMICAL DATA

In studying the data of table No. 3 it will be noticed that the chief point of difference between the two areas is in the carbonate of lime content of the soil. The percentages of this constituent present in the soil may perhaps be studied to better advantage from the arrangement of the data as presented in the following table:—

	Area No. 1 (Slightly irrigated)	Area No. 2 (Heavily irrigated)
Percentages of carbonate of lime to a depth of 6″	1.79	1.09
" " " to a depth of 12″	5.36	1.05
" " " to a depth of 18″	9.80	1.47
" " " to a depth of 24″	12.74	3.04
" " " to a depth of 30″	13.39	5.11
" " " to a depth of 36″	13.39	7.08

These data show that the slightly irrigated land contains almost twice as much carbonate of lime as the heavily irrigated land to a depth of three feet, while to a depth of two feet it contains 4 times as much. The surface foot shows an even greater difference, the carbonate of lime content being 5 times as great on the slightly irrigated area. Evidently, there has been a steady removal of carbonate of lime under heavy irrigation to a depth of over two feet. Between two and one-half and three feet this constituent of the soil is considerably higher on the heavily irrigated land, indicating that there has probably been some deposition of the lime removed from the surface layers. It would appear that the poor tilth occurring in the surface soil of the heavily irrigated land may be due, at least, partially to this removal of carbonate of lime.

In order, if possible, to obtain further light on this difficult problem, two similar soil slabs were collected, one from a dry land virgin area and the other from a garden which had been heavily manured and irrigated for the past 18 years. The data are appended (table No. 4) but it is felt that they are not useful for the discussion of this problem for it is evident that they do not present soils which were originally similar to Nos. 1 and 2.

TABLE No. 3.—SOILS FROM IRRIGATED AREAS, EXPERIMENTAL STATION, LETHBRIDGE, ALTA.
(Chemical Composition—Water-free Basis)
Collected September, 1927

Constituents	No. 1. Irrigated slightly in 1922-3. In grass since 1922. Lab'y. No. 90808.						No. 2. Irrigated heavily (3 inches every 2 weeks). In grass since 1922. Lab'y. No. 90809.					
	A 0-6 inches	B 6-12 inches	C 12-18 inches	D 18-24 inches	E 24-30 inches	F 30-36 inches	A 0-6 inches	B 6-12 inches	C 12-18 inches	D 18-24 inches	E 24-30 inches	F 30-36 inches
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Carbonate of lime.....	1·79	8·93	18·67	21·55	15·99	13·43	1·09	1·01	2·31	7·73	13·43	16·90
Carbonate of magnesia.....	1·47	2·07	0·97	3·32	0·99	1·03	1·31	1·37	1·70	2·51	1·19	3·00
Oxide of iron and alumina....	7·43	7·91	6·68	6·49	7·61	7·50	7·47	7·96	7·69	6·90	8·08	7·10
Phosphoric acid (P_2O_5).....	0·151	0·191	0·242	0·197	0·221	0·182	0·173	0·171	0·170	0·183	0·209	0·184
Potash (K_2O).....	0·570	0·486	0·484	0·400	0·374	0·363	0·587	0·522	0·534	0·454	0·414	0·382
Mineral matter insoluble in acid (sand, clay, etc.).....	84·94	78·41	71·91	66·65	71·39	74·80	86·12	87·04	85·76	80·13	73·53	70·66
Undetermined (organic matter, etc.).....	3·649	2·003	1·044	1·393	3·425	2·695	3·250	1·927	1·836	2·093	3·147	1·774
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Nitrogen.....	0·158	0·132	0·102	0·062	0·047	0·029	0·160	0·096	0·099	0·080	0·076	0·058

TABLE No. 4.—SOILS FROM DRY LAND AND IRRIGATED AREAS, EXPERIMENTAL STATION, LETHBRIDGE, ALTA.

(Chemical Composition—Water-free Basis)

Constituents	No. 3. Dry land: virgin prairie. Lab'y. No. 90807						No. 4. Irrigated and cultivated: in garden for several years. Lab'y. No. 93725					
	A 0-6 inches	B 6-12 inches	C 12-18 inches	D 18-24 inches	E 24-30 inches	F 30-36 inches	A 0-6 inches	B 6-12 inches	C 12-18 inches	D 18-24 inches	E 24-30 inches	F 30-36 inches
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Carbonate of lime	2·10	2·22	18·92	21·44	18·73	18·92	2·39	3·08	14·37	15·52	15·44	13·91
Carbonate of magnesia	1·28	1·65	2·67	3·31	2·30	2·47	1·82	1·93	2·91	3·07	3·74	3·62
Oxide of iron and alumina	6·24	7·86	6·49	6·46	6·92	6·70	7·24	7·42	6·01	6·24	6·63	6·84
Phosphoric acid (P_2O_5)	0·205	0·179	0·170	0·157	0·150	0·176	0·239	0·249	0·226	0·225	0·223	0·223
Potash (K_2O)	0·497	0·584	0·426	0·496	0·359	0·442	0·579	0·681	0·379	0·387	0·414	0·469
Mineral matter insoluble in acid (sand, clay, etc.)	84·82	83·12	66·46	66·30	68·60	71·48	83·53	83·41	74·25	70·53	72·30	73·40
Undetermined (organic matter, etc.)	4·858	4·387	4·864	1·837	2·941	.....	4·202	3·230	1·855	4·028	1·253	1·538
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Nitrogen	0·152	0·208	0·143	0·084	0·057	0·041	0·187	0·158	0·093	0·048	0·041	0·033

THE INFLUENCE OF SOIL ON THE CHARACTER VARIABILITY OF OATS

In connection with a study of character variability in oats and wheat varieties by the Dominion Cerealist, this Division was requested to submit to analysis a number of soils used in the greenhouse in this investigation, the object being to trace the effect of soil differences on certain characters which are valuable in variety identification.

The series comprised representative samples of surface soil collected on nine Experimental Farms and Stations, as follows: Charlottetown, P.E.I.; Nappan, N.S.; Fredericton, N.B.; Lennoxville, P.Q.; Ottawa, Ont.; Brandon, Man.; Indian Head, Sask.; Scott, Sask.; and Lacombe, Alta.

Tables No. 5 and 6 present the data from the mechanical and chemical analyses of these soils. In addition to their future use by the Cereal Division in this enquiry they are valuable as records of soils as occurring on Experimental Stations in eight provinces of the Dominion. The data should prove useful in connection with soil fertility and crop rotation studies conducted at the above Stations.

TABLE No. 5.—SOILS COLLECTED BY THE CEREAL DIVISION FROM NINE EXPERIMENTAL STATIONS IN CONNECTION WITH OAT AND WHEAT VARIETY STUDIES

Mechanical Analysis on Moisture-free Basis

Lab'y. No.	Expt. Station	Stones, rock fragments, percentage left on 2 mm. sieve	Fine gravel 2-1 mm.	Coarse sand 1-0·5 mm.	Medium sand 0·5-0·25 mm.	Fine sand 0·25-0·1 mm.	Very fine sand 0·1-0·05 mm.	Total sand	Silt 0·05-0·005 mm.	Clay 0·005-0·00 mm.	Classification
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	
95387	Charlottetown, P.E.I.	8·89	1·36	2·24	6·48	33·15	22·12	65·35	22·63	12·02	Sandy loam
88	Nappan, N.S.	6·83	1·93	3·32	8·26	22·63	26·70	62·84	24·27	12·89	"
89	Fredericton, N.B.	0·29	0·69	2·92	6·27	15·89	23·59	49·36	34·53	16·11	Loam
90	Lennoxville, Que.	7·83	1·56	1·70	1·52	2·70	7·87	15·35	52·27	32·38	Clay
91	C.E.F., Ottawa, Ont.	1·28	1·67	4·79	7·26	19·32	7·09	40·13	21·68	38·19	"
92	Brandon, Man.	0·69	0·09	0·20	0·65	6·80	10·59	18·33	36·99	44·68	"
93	Indian Head, Sask.	1·83	0·98	1·41	2·38	7·82	7·42	20·01	30·88	49·11	"
94	Lacombe, Alta.	0·09	0·06	0·49	1·45	6·08	10·20	18·28	45·76	35·96	"
95	Scott, Sask.	1·14	1·20	2·44	3·59	8·21	28·63	44·07	33·80	22·13	Clay loam

TABLE No. 6.—SOILS COLLECTED BY THE CEREAL DIVISION FROM NINE EXPERIMENTAL STATIONS IN CONNECTION WITH OAT AND WHEAT VARIETY STUDIES

Chemical Analysis

Lab'y. No.	Station	Moisture	Moisture-free Basis										
			Loss on ignition (organic matter, etc.)	Insoluble mineral matter	Oxide of iron and alumina (Fe_2O_3+Al_2O_3)	Lime (CaO)	Magnesia (MgO)	Nitrogen (N.)	Total phosphoric acid (P_2O_5)	Available phosphoric acid (P_2O_5)	Total potash (K_2O)	Available potash (K_2O)	pH. Value.
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	
95387	Charlottetown, P.E.I.	1·60	6·20	87·84	5·39	0·148	0·401	0·174	0·140	0·056	0·188	0·019	5·81
88	Nappan, N.S.	1·74	5·56	87·26	6·27	0·218	0·531	0·147	0·116	0·041	0·204	0·018	6·22
89	Fredericton, N.B.	2·61	7·12	81·94	9·64	0·240	0·835	0·151	0·161	0·034	0·241	0·015	6·36
90	Lennoxville, Que.	2·58	10·31	78·16	10·04	0·240	1·02	0·314	0·274	0·132	0·358	0·018	5·00
91	C.E.F., Ottawa Ont.	3·67	7·86	75·30	12·25	1·62	2·13	0·263	0·287	0·104	0·869	0·039	7·02
92	Brandon, Man.	6·51	9·98	73·91	12·02	1·91	1·68	0·318	0·200	0·070	0·722	0·042	7·71
93	Indian Head, Sask.	6·62	9·41	72·14	12·75	2·86	2·02	0·244	0·200	0·033	0·896	0·050	8·20
94	Lacombe, Alta.	5·59	14·91	72·87	9·67	1·05	1·06	0·558	0·209	0·025	0·427	0·029	6·00
95	Scott, Sask.	3·61	7·25	84·52	6·72	0·487	0·614	0·293	0·147	0·024	0·450	0·035	5·54

INVESTIGATIONAL WORK WITH FERTILIZERS

Due to the ever increasing use of fertilizers in agricultural activities, the experimental work with these materials as carried on by this division has been enlarged during the past year or two more particularly to obtain data with respect to certain "high analysis" products and a number of the newer fertilizers placed on the market.

In Eastern Canada further data have been obtained with respect to the use of nitrogenous fertilizers and to the highly concentrated material, Nitrophoska. In addition, the work with fertilizers and lime compounds, generally, has been continued.

Fertilizers for wheat, Carberry, Man., 1930. Right—triple superphosphate at 100 pounds per acre, drilled in with seed. Centre—unfertilized strip. Left—ammonium phosphate at 100 pounds per acre drilled in with seed.

In Western Canada much interest has been shown in the use of triple superphosphate and ammonium phosphate as a means of increasing crop yields in the Prairie Provinces. As yet, the data obtained in this work are insufficient to make any definite pronouncements but it would appear that under favourable conditions, nitrogenous and phosphatic fertilizers—more particularly the latter—may be used to advantage to increase the yields of grain in certain sections of the Prairie Provinces.

MANURE AND FERTILIZER EXPERIMENT, ROSTHERN, SASK.

An experiment was commenced in 1926 at the Experimental Station, Rosthern, Sask., to obtain data relative to the economic employment of manures and fertilizers in that district. Two four-year crop rotations were used to measure the effect of the fertilizers. In the first rotation of sunflowers, wheat, oats and hay the fertilizers were applied broadcast for the sunflower crop; in the second rotation of summer-fallow, wheat, wheat and oats they were applied for the first wheat crop. The plan of work was repeated on new areas each year for four years in order that each crop of the rotation might be represented. The fertilizers were applied broadcast on the prepared land and harrowed in. The plots—1/62 of an acre area were layed out in duplicate.

In the following table, No. 7, the treatments employed and a summary of the crop yields to date are given.

TABLE No. 7.—MANURE AND FERTILIZERS—EXPERIMENTAL STATION, ROSTHERN, SASK.—AVERAGE CROP YIELDS PER ACRE

Plot No.	Fertilizing materials per acre	Rotation (A) Sunflowers,* wheat, oats, hay				Rotation (B) Summerfallow, wheat*, wheat oats		
		1926-29 Sunflowers* (average of 4 years)	1927-29, wheat (average of 3 years)	1928-29, oats (average of 2 years)	1929, hay	1926-29, wheat* (average of 4 years)	1927-29, wheat (average of 3 years)	1928-29, oats (average of 2 years)
		tons	bush.	bush.	tons	bush.	bush.	bush.
1	Manure—16 tons	12·77	22·8	44·6	0·50	25·6	23·7	36·9
2	Manure—8 tons	10·25	20·9	35·1	0·35	25·6	25·3	36·7
3	Manure—8 tons Nitrate of soda—150 pounds Superphosphate—300 pounds Muriate of potash—75 pounds	10·50	02·7	46·0	0·37	26·4	26·6	37·4
4	Manure—8 tons Nitrate of soda—75 pounds Superphosphate—150 pounds Muriate of potash—37½ pounds	11·36	21·6	42·8	0·40	25·9	24·7	39·2
5	Check (no fertilizer)	10·10	21·3	45·1	0·26	22·3	23·1	44·2
6	Nitrate of soda—150 pounds Superphosphate—300 pounds Muriate of potash—75 pounds	9·19	23·6	35·0	0·36	27·2	21·3	36·2
7	Nitrate of soda—150 pounds Superphosphate—300 pounds	11·25	23·8	40·0	0·20	27·4	21·5	37·4
8	Nitrate of soda—150 pounds	11·29	21·5	38·3	0·38	21·7	20·2	40·8
9	Superphosphate—300 pounds	11·85	21·6	41·0	0·46	26·0	26·1	40·1
10	Check (no fertilizers)	11·89	22·9	41·5	0·40	23·6	21·9	41·0

*Fertilizers applied for this crop.

The data tabulated in table No. 7 show that a fairly substantial increase in yield was obtained where fertilizers were applied for the first year wheat crop on summer-fallow. The results indicate that the phosphoric acid constituent of the fertilizer has accounted for the larger part of this increase.

Since the inauguration of this experimental work, it has been demonstrated that a much greater response from the fertilizer treatment has resulted from the practice of drilling in the fertilizer with the seed, than has been the case where the fertilizer has been applied to the surface soil and harrowed in. No

doubt the moisture content of the soil at time of seeding is an important factor in this regard. When the fertilizer is placed at the same depth as the seed where the soil moisture is greater than on the surface, the crop apparently can make better and quicker use of the plant food supplied than when the fertilizing materials are applied broadcast.

MANURE AND FERTILIZER EXPERIMENT, EXPERIMENTAL STATION, WINDERMERE, B.C.

This experiment was commenced in 1928 to obtain data with respect to the plant food requirements of the soil of the district. The soil may be described as a light chocolate-brown silty loam which contains considerable coarse gravel below a depth of 10 inches. It was considered to be more or less exhausted by poor farming methods.

The experiment comprised three duplicate ranges, each range consisting of seven fertilized and three check plots. The fertilizer treatments were applied for the potato crop of a 4-year rotation of potatoes, peas, oats and sweet clover. They included a complete mixture composed of nitrate of soda 130 pounds, sulphate of ammonia 100 pounds, superphosphate 600 pounds, and muriate of potash 160 pounds per acre, combinations of each two of the three elements of plant food supplied by these materials and also single applications. On two ranges "N" and "F" the fertilizers were applied in conjunction with an application of manure at the rate of 12½ tons per acre; on ranges "M" and "E" they were applied following the ploughing under of a green crop (sweet clover) the previous fall; on ranges "L" and "D" no manure or green manure was included in the treatment. The crops were grown under irrigation on plots one-hundredth of an acre in area.

The average yields of potatoes for the years 1928 and 1929 are given in table No. 8.

TABLE NO. 8.—MANURE AND FERTILIZER EXPERIMENT: WINDERMERE, B.C.

Plot No.	Fertilizers applied for the potato crop (pounds per acre)	Yield of potatoes per acre —average two years —1928-29		
		Ranges N and F	Ranges M and E	Ranges L and D
		Manured at the rate of 12½ tons per acre	Green crop of sweet clover ploughed under	Fertilizers only (no manure or green manure)
		bush.	bush.	bush.
1, 6, 10	Average of check plots	216·1	129·5	87·2
2	Nitrate of soda—130 Sulphate of ammonia—100 Superphosphate (16%)—600 Muriate of potash—160	286·2	262·9	247·5
3	Nitrate of soda—130 Sulphate of ammonia—100 Superphosphate—600	255·0	217·5	191·2
4	Superphosphate—600 Muriate of potash—160	282·9	227·5	216·6
5	Nitrate of Soda—130 Sulphate of ammonia—100 Muriate of potash—160	252·9	120·0	92·0
7	Nitrate of soda—130 Sulphate of ammonia—100	227·1	135·4	73·7
8	Superphosphate—600	266·2	202·5	163·7
9	Muriate of potash—160	196·7	124·5	77·5

The results tabulated in table No. 8 may be briefly summarized as follows:—

(1) A very marked increase in yield resulted when the fertilizer treatments were supplemented by an application of barnyard manure or green manure. The range of plots treated with barnyard manure gave much larger yields than the plots on which green manure was ploughed under.

(2) On all three ranges the beneficial influence of the complete fertilizer treatment is apparent. The increase is chiefly due to the effect of phosphoric acid; it will be noted that as a general rule the larger yields were obtained from the plots on which an application of this element of plant food was included in the fertilizer treatment. Potash and nitrogen apparently have had considerable beneficial influence when applied in conjunction with phosphoric acid but the two former elements applied alone or in combination do not appear to have been very instrumental in increasing the yields. This result is particularly noticeable on the "green manure" and "fertilizer only" ranges of plots. Superphosphate applied alone has given large increases in yield.

Fertilizers for turnips, Ste. Helene, P.Q. Right—fertilized with 1,000 pounds per acre of 3-9-6 mixture; yield 19.6 tons per acre. Left—Unfertilized; yield 6.6 tons per acre.

EXPERIMENTS WITH NITROPHOSKA

Nitrophoska is a concentrated fertilizer mixture made from ammonium nitrate, diammonium phosphate and muriate or sulphate of potash. There are four grades of this material. The grade used in this experimental work is designated as "Nitrophoska I" and contains 15 per cent of nitrogen, 30 per cent of available phosphoric acid and 15 per cent of water-soluble potash.

Experimental work with nitrophoska was commenced on a small scale in 1928 at the Central Farm, Ottawa, and at the branch Experimental Station, Kentville, N.S.

At Ottawa, the nitrophoska was applied broadcast for the potato crop on a light clay loam soil and compared with a mixture prepared from nitrate of soda, superphosphate and muriate of potash. The work was conducted on duplicate plots of one-sixtieth acre area. The yields of potatoes obtained in 1928 and of oats in 1929 are as follows:—

TABLE No. 9.—EXPERIMENT WITH NITROPHOSKA—1928, OTTAWA, ONT.

Plot No.	Fertilizers applied (pounds per acre in 1928)	Plant food supplied (pounds per acre)			Average yields		
		Nitrogen	Phosphoric acid	Potash	1928 Potatoes	1929 Oats	
						Grain	Straw
					bush.	bush.	lb.
1	Nitrophoska..... 133	20	40	20	238·5	17·6	1,026
2	" 267	40	80	40	286·5	17·0	1,017
3	Nitrate of soda..... 260 Superphosphate..... 500 Muriate of potash..... 80	40	80	40	295·5	19·9	1,275
4	Check (no fertilizer).....	.....	.....	.....	248·0	21·0	1,167

At Kentville, N.S., nitrophoska was applied for the turnip crop on a gravelly loam soil. For comparative purposes complete fertilizer mixtures in which the nitrogen was furnished by (1) sulphate of ammonia and (2) nitrate of lime, were employed. The treatments and yields per acre in 1928 are given in table No. 10.

TABLE No. 10.—EXPERIMENT WITH NITROPHOSKA—1928, KENTVILLE, N.S.

Plot No.	Fertilizer applied (pounds per acre)	Plant food supplied (pounds per acre)			Average yield of turnips per acre
		Nitrogen	Phosphoric acid	Potash	
					bush.
1	Sulphate of ammonia.....190 Superphosphate.....500 Muriate of potash..... 80	40	80	40	171·6
2	Nitrate of lime.....260 Superphosphate.....500 Muriate of potash..... 80	40	80	40	168·9
3	Nitrophoska.....200	40	80	40	158·4
4	Check.....	.....	.....	.....	Crop failure

At both Ottawa and Kentville, N.S., the yields obtained in 1928 from the application of nitrophoska compare very favourably with those from the treatments in which the standard mixtures were employed. The yields of turnips on the fertilized plots at Kentville though not large are nevertheless quite remarkable since the crop on the unfertilized check plot was practically a complete failure.

In 1929, further experimental work with nitrophoska was conducted at the following branch Farms and Stations: Charlottetown, P.E.I.; Nappan and Kentville, N.S.; and Fredericton, N.B.

At Charlottetown and Nappan, nitrophoska was compared with a mixture prepared from sulphate of ammonia, superphospate and muriate of potash at two rates of application, viz., the equivalent of 1,000 and 1,500 pounds of 4-8-4 per acre. The crop was potatoes. At Charlottetown, the soil was a sandy loam, at Nappan it was a light clay loam. The fertilizer treatments and yields per acre are given in table No. 11.

TABLE NO. 11.—EXPERIMENTS WITH NITROPHOSKA—1929, CHARLOTTETOWN, P.E.I., AND NAPPAN, N.S.

Plot No.	Fertilizers applied (pounds per acre)	Plant food supplied (pounds per acre)			Charlottetown		Nappan	
					Yields of potatoes per acre (average of quadruplicate plots)		Yields of potatoes per acre (average of triplicate plots)	
		Nitrogen	Phosphoric acid	Potash	Total	Marketable	Total	Marketable
					bush.	bush.	bush.	bush.
1	Nitrophoska.....267	40	80	40	141·3	92·0	83·7	65·0
2	Sulphate of ammonia.....200 Superphosphate.....500 Muriate of potash..... 80	40	80	40	160·0	118·2	82·7	62·4
3	Nitrophoska.....400	60	120	60	144·0	98·7	93·9	73·1
4	Sulphate of ammonia.....300 Superphosphate.....750 Muriate of potash.....120	60	120	60	154·2	106·7	97·6	79·5
5	Check (no fertilizer).....	.....	.....	.....	82·1	44·3	36·3	24·0

The yields of potatoes are below average particularly those at the Nappan Farm, a result which may be largely attributed to the dry seasonal conditions during the growing period. At Charlottetown, the yields obtained from the nitrophoska plots are slightly below those from the plots receiving the so-called "standard" mixture; at Nappan the differences are negligible. At both Stations the fertilized plots gave large increases over the unfertilized plots. At Charlottetown the increased yield ranged from 59·2 bushels (plot 1) to 77·9 bushels (plot 2) per acre, and at Nappan from 46·4 bushels (plot 2) to 61·3 bushels (plot 4).

Fertilizers for mangels, Agassiz, B.C., 1930. Right—fertilized with nitrate of soda 200 pounds, superphosphate 500 pounds and muriate of potash 100 pounds per acre. Left—no fertilizer.

Increasing the rate of application of the fertilizer did not appreciably affect the yields at Charlottetown; at Nappan, the heavier dressing gave 10·2 bushels more per acre with the nitrophoska treatment and 14·9 bushels more with the standard mixture, than did the small dressing.

At Kentville, N.S., and Fredericton, N.B., nitrophoska was compared with two mixtures in which (1) nitrate of soda and (2) sulphate of ammonia were used as the source of nitrogen. The rate of application was the equivalent of 1,500 pounds of 4-8-4 per acre. The crop was potatoes. At Kentville the soil was a gravelly loam; at Fredericton, it was a medium clay loam. The fertilizer treatments and yields per acre are given in table No. 12.

TABLE NO. 12.—EXPERIMENT WITH NITROPHOSKA—1929, KENTVILLE, N.S., AND FREDERICTON, N.B.

Plot No.	Fertilizers applied (pounds per acre)	Plant food supplied (pounds per acre)			Kentville		Fredericton	
					Yields of potatoes per acre (average of quadruplicate plots)		Yields of potatoes per acre (average of quadruplicate plots)	
		Nitrogen	Phosphoric acid	Potash	Total	Marketable	Total	Marketable
					bush.	bush.	bush.	bush.
1	Nitrophoska.....400	60	120	60	202·7	180·0	252·0	194·7
2	Nitrate of soda.....400 Superphosphate.....750 Muriate of potash.....120	60	120	60	216·0	192·0	236·7	192·0
3	Sulphate of ammonia.....300 Superphosphate.....750 Muriate of potash.....120	60	120	60	218·7	190·7	242·7	196·0
4	Check (no fertilizers).....	.....	.....	.....	145·3	124·0	132·6	103·3

Substantial increases in the yield of potatoes resulted from the application of the fertilizers at both Stations; at Fredericton they were remarkably large. At Kentville the increases ranged from 57·4 bushels per acre with the nitrophoska treatment to 70·7 and 73·4 bushels with the complete mixtures in which nitrate of soda and sulphate of ammonia were used, respectively, as the source of nitrogen. At Fredericton nitrophoska gave the largest yield, an increase of 119·4 bushels per acre over the unfertilized plot being recorded for this treatment, while the increases from the mixtures in which nitrate of soda and sulphate of ammonia were used were 104·1 and 110·1 bushels, respectively.

Data from a further experiment conducted at Kentville, N.S. in 1929 and dealing with fertilizers for the oat crop permit of a comparison between the fertilizing value of nitrophoska and a mixture prepared from nitrate of soda superphosphate and muriate of potash. The fertilizer treatments and yields, per acre, are presented in table No. 13.

TABLE No. 13.—FERTILIZERS FOR THE OAT CROP—1929, KENTVILLE, N.S.

Plot No.	Fertilizers applied (pounds per acre)	Plant food supplied (pounds per acre)			Yields of oats per acre (average of quadruplicate plots)	
		Nitrogen	Phosphoric acid	Potash	Grain	Straw
					bush.	lb.
1	Nitrophoska—125	19	38	19	20·7	1,344
2	Nitrate of soda—125 Superphosphate—235 Muriate of potash—38	19	38	19	25·4	1,248
3	Nitrophoska—250	38	76	38	30·1	1,568
4	Nitrate of soda—250 Superphosphate—469 Muriate of potash—75	38	76	38	33·9	1,696
5	Check (no fertilizer)	.....	.....	.....	19·7	1,152

The yields of oats are much below the average for this crop at Kentville. Nitrophoska has not given as good results in this experiment as the prepared mixture although at the larger rate of application the former has given a very satisfactory percentage increase over the unfertilized plot.

The preceding data show that for hoed crops such as potatoes, turnips, etc., nitrophoska compares very favourably with a mixture prepared from commonly used materials such as sulphate of ammonia or nitrate of soda, superphosphate and muriate of potash. A feature of this material which may be considered of importance is its relatively small bulk per unit of plant food, a factor which may enter largely into the cost price of fertilizer in localities where freight and hauling charges are high.

EXPERIMENTS WITH LIME

Further data from the experiments dealing with the application of lime compounds at Kentville, N.S., and Fredericton, N.B., emphasize the beneficial effects on crop yields from liming acid soils.

FERTILIZERS AND GROUND LIMESTONE EXPERIMENT, KENTVILLE, N.S.

Two ranges of plots in this experiment received 2 tons of ground limestone every three years from the commencement of the experiment in 1914 until 1923 and two ranges of plots were left unlimed. The limed ranges have not received any lime since 1923. The fertilization of the limed and unlimed ranges was the same. During the three rotation period 1926-1928 the following average yields from the plots of the limed and unlimed ranges were obtained:

AVERAGE YIELDS PER ACRE

—	Plots formerly limed	Unlimed plots	Increase per acre from liming
1926—Mangels	398·2 bush.	227·1 bush.	171·1 bush.
1927—Wheat	25·5 bush.	16·5 bush.	9·0 bush.
1928—Clover hay	1·73 tons	0·60 tons	1·13 tons

RATES OF APPLICATION OF LIME, KENTVILLE N.S.

This experiment was commenced in 1927 and deals with rates of application of ground limestone, ground burned lime and hydrated lime. In addition three sources of phosphoric acid were compared viz: superphosphate, bessemer slag and fortified slag. The applications of the lime compounds and phosphatic fertilizers were made for the oat crop in 1927. In 1928 the crop was clover hay and in 1929 potatoes were grown for which crop a uniform application of 1,200 pounds per acre of a 5-8-5 fertilizer was made to all plots. The soil is a light sandy loam and at the commencement of the experiment was quite low in fertility and had a strong acid reaction. The area was broken in 1924 and had never been manured.

The results obtained during the three crops of the rotation 1927-29, clearly show the beneficial effects of lime and phosphoric acid. All three forms of lime have given good results. With respect to the rates of application of the lime compounds, the data show that an application of 1,000 pounds of ground limestone per acre has given as satisfactory yields during the three year rotation as a dressing of 2,000 or 3,000 pounds per acre. Further, the light application of the ground limestone (applied in 1927 for the oat crop) did not result in any scab development on the potatoes (in 1929); at the 2,000 pounds rate, 2·8 per cent of the tubers showed scab and at the 3,000 pound rate, 7·2 per cent of the crop was affected with scab.

GROUND LIMESTONE AND GYPSUM EXPERIMENT, FREDERICTON, N.B.

This experiment was commenced in 1928, ground gypsum was applied for the oat crop in the spring of 1928 at rates of 500, 1,000 and 2,000 pounds per acre. Ground limestone was applied at the rate of 2,000 pounds per acre. The soil is a sandy loam cultivated for the first time in 1924.

The results of the clover hay crop of 1929 are as follows:

Treatment (1928)	Yield of clover hay, per acre 1929 Lb.
Gypsum— 500 pounds	1,172
Gypsum—1,000 pounds	1,113
Gypsum—2,000 pounds	1,332
Ground limestone—2,000 pounds	3,750
Check (no gypsum or limestone)	1,182

The beneficial effect of an application of one ton of ground limestone is evident from the above data. The treatments with gypsum did not result in any material increases in yield of the clover hay crop.

SOURCES OF NITROGEN

A considerable amount of experimental work has been conducted at the branch Farms and Stations of the Maritime Provinces dealing with the use of nitrogenous fertilizers for grain, hay and hoed crops. The sources of nitrogen, employed included nitrate of soda, sulphate of ammonia, nitrate of lime, nitrochalk and urea. These materials have, as a rule, been applied in conjunction with phosphatic and potassic fertilizers. The results of this investigational work have shown that all the above sources of nitrogen have given excellent results. Evidently, in selecting a source of nitrogen not the least important factor to consider is the price per unit, though it doesn't necessarily follow that the cheapest source is always the best for all types of soil and all classes of crops.

MISCELLANEOUS FERTILIZER MATERIALS

ASHES

The data of analysis of eight samples of ashes are given in table No. 14. The following remarks refer to their origin and value for fertilizing purposes.

Lab'y No. 93276.—Ashes from the incinerator plant of the town of Timmins, Ont. These ashes are low in phosphoric acid and potash but contain an appreciable amount of lime. Although of very little value as a fertilizer they might be used to advantage as a soil amendment for heavy clay land.

Lab'y No. 98700.—Ashes from the incinerator plant of the city of Kingston, Ont., representative of the fine material passing through the grates.

The data show this material to have a definite fertilizing value; the percentages of phosphoric acid, lime and potash are all notable. For acid soils and soils deficient in lime and heavy clay loams this ash should prove an excellent amendment.

Lab'y No. 95723.—Peat ashes from the vicinity of Tétreauville de Montréal, P.Q.

These ashes are quite low in fertilizing constituents but their rather high content of lime makes them an excellent soil amendment for clay soils and soils in need of lime.

Lab'y No. 97374.—Ashes from sawmill at Thurso, P.Q. The low potash content indicates that these ashes may have been leached through exposure to rains. Unleached wood ashes of good quality will contain from 4 to 6 per cent of potash and about 2 per cent of phosphoric acid. Containing more than 56 per cent of lime these ashes would make an excellent source of lime for acid soils and would also furnish notable amounts of phosphoric acid and potash.

Lab'y No. 98074.—Wood ashes from Rivière Paquette, Ste. Rose, Que. This sample is characterized by a rather high phosphoric acid content and contains a very satisfactory percentage of lime making the ashes very useful for application to acid soils. The potash content is somewhat low.

Lab'y No. 102276.—Ashes—"Bussières"—from various sources and stated to be "gathered here and there" submitted from Pont-Rouge, Portneuf Co., P.Q. These ashes have very little value and apparently have been severely leached.

Lab'y No. 101874.—This sample was from the power plant of a flax mill, Blyth, Ont., in which "the shives from the broken straw are used as part of the fuel."

The data show this material to have a distinct fertilizing value, containing about one half as much potash and slightly more phosphoric acid, than that found in good unleached wood ashes.

Lab'y No. 102275.—Tobacco ashes "Rock City" from a tobacco manufacturing plant, Quebec, Que.

These ashes, containing 1·54 per cent of phosphoric acid and 17·56 per cent of potash, have a high fertilizing value and may be regarded as a valuable source of potash.

TABLE No. 14.—ASHES—1929-30

Lab'y. No.	Source	Moisture	Insoluble residue	Oxide of iron and alumina	Lime	Magnesia	Phosphoric acid	Potash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
93276	Incinerator ashes, Timmins, Ont.	27·39	43·99	12·18	6·87	1·02	1·15	0·92
98700	Incinerator ashes, Kingston, Ont.	.....	39·41	.....	17·50	.....	3·33	3·80
95723	Peat Ashes, Tetreauville de Montreal, P.Q.	.....	28·45	23·52	30·24	1·32	1·66	0·62
97374	Sawmill Ashes, Thurso, Que.	.....	10·14	1·63	56·42	3·35	2·07	1·79
98074	Wood Ashes, Rivière Paquette, Ste. Rose, Que.	.....	5·46	.....	37·10	.....	4·04	3·46
102276	Wood Ashes, Pont Rouge, Que.	.....	56·44	11·50	2·38	0·47	1·66	traces
101874	Flax Waste Ashes, Blyth, Ont.	.....	42·10	13·10	15·82	.....	3·01	2 5[illegible]
102275	Tobacco Ashes, Quebec, Que.	.....	23·75	1·10	16·10	3·74	1·54	17·5[illegible]

SEWAGE SLUDGE

Lab'y No. 97695.—This is a sample of sludge from the sewage disposal plant of Regina, Sask.

Analysis	Per cent
Moisture	1.53
Loss on ignition (organic matter, etc.)	42.40
Mineral matter soluble in acid*	16.03
Mineral matter insoluble in acid	39.99
	100.00
Fertilizing constituents—	
Nitrogen	1.58
*Containing—Phosphoric acid	1.05
Lime	3.75
Potash	....

This sample contains a considerable proportion of organic matter and a notable, though not high, percentage of nitrogen. These are its most valuable constituents and together with the small amounts of lime and phosphoric acid present give the sludge a distinct though small fertilizing value.

Lab'y Nos. 101692 and 102692.—These two samples of sludge are from a deposit formed in a mill dam at German Mills, Ont., from sewage dumped in the river by the city of Kitchener. The deposit was stated to be from one to four feet deep in the dam and to cover an area of ten to fifteen acres. No. 101692 was collected at the bottom and No. 102692 was taken near the surface.

Analysis	No. 101692 (Bottom)	No. 102692 (Surface)
	p.c.	p.c.
Moisture	3.38	4.60
Loss on ignition (organic matter, etc.)	15.69	21.73
Mineral matter soluble in acid*	32.93	27.92
Mineral matter insoluble in acid	48.00	45.75
	100.00	100.00
Fertilizing constituents—.		
Nitrogen	0.58	0.82
*Containing—Phosphoric acid	0.64	0.44
Potash	trace	trace
Reaction	alkaline	alkaline

Compared with other sewage sludges which have been examined by the division, these two samples are decidedly poor in fertilizer constituents. It is doubtful if this material could be economically used for soil treatment, unless the costs of handling and hauling were very low.

SEAWEED

Lab'y No. 98489.—Dried and ground seaweed, *Fucus vesciculosus* (bladder weed) from Leonardville, N.B. It contained a few fragments of shell and some small stones which were removed before preparing the sample for analysis.

Analysis	Per cent
Moisture	20.34
Organic matter	60.83
Ash	18.83
	100.00
Fertilizing constituents—	
Nitrogen	1.09
Phosphoric acid	0.26
Potash	0.87

The data show this seaweed to contain notable amounts of plant food, particularly nitrogen and potash. It does not, however, contain as high a percentage of potash as is usually found in this type of seaweed.

The correspondent in writing with respect to this material states "The farmers along the seashore highly recommend it for certain vegetables and spread it on the grass fields. There are thousands of tons of it here, which could be shipped to the inland farmers at a very low price."

Provided the cost of hauling and spreading etc. is not too high, this material could be used to advantage as a fertilizer for most crops.

GYPSUM

Lab'y No. 99520.—This sample of gypsum was collected from a deposit of the material occurring on a farm at St. Andrews, N.S.

Analysis	Per cent
Sulphate of lime (gypsum)	92.25
Carbonate of lime	2.95
Oxide of iron and alumina	0.26
Mineral matter insoluble in acid	1.54
	100.00

This material is gypsum or land plaster of good quality. Since the lime in gypsum is largely present as sulphate of lime this material has no value for the treatment of sour or acid soils. Its chief agricultural value would probably be in the encouragement of legume crops—clover, alfalfa etc. and in the improvement of the physical condition of heavy clay loams.

POULTRY MANURE

Lab'y No. 98430.—Dried poultry manure from "The Woods," Shanty Bay, Ont. The sample was fibrous and somewhat lumpy.

Analysis	Per cent
Moisture	9.89
Loss on ignition (organic matter, etc.)	62.13
Mineral matter soluble in acid	10.68
Mineral matter insoluble in acid	17.30
	100.00
Fertilizing constituents—	
Nitrogen	3.51
Phosphoric acid	3.33
Potash	1.51

In fertilizing constituents this sample is in close accord with the average data obtained from the analysis of dried, prepared poultry manures received by the division in the past. This product is approximately three times as rich as fresh poultry manure.

RABBIT MANURE

Lab'y No. 93221.—Fresh rabbit manure, free from litter and in the form of very fibrous pellets. Submitted from Huntingdon, Que.

Analysis	Per cent
Moisture	46.84
Loss on ignition (organic matter, etc.)	51.06
Mineral matter soluble in acid	0.85
Mineral matter insoluble in acid	1.25
	100.00
Fertilizing constituents—	
Nitrogen	0.93
Phosphoric acid	0.15
Potash	0.25

The data show that, compared with farmyard manure, this material is considerably drier, contains more nitrogen and is somewhat lower in phosphoric acid and potash.

SLAUGHTER HOUSE WASTE

Lab'y No. 93394.—Submitted as "dried blood" by a correspondent at Islington, Ont. It contained a fairly large amount of bone in rather large pieces.

Analysis	Per cent
Nitrogen	6.81
Phosphoric acid	12.19
Ash (mineral matter)	29.63

This material is not dried blood; usually the nitrogen in good brands of dried blood runs about 12 per cent and the phosphoric acid 2 per cent or less. This sample contains a rather high proportion of bone, apparently steamed, and its analysis is very similar to that of "fertilizer tankage," good brands of which will contain 6 per cent of nitrogen and 12 to 15 per cent of phosphoric acid.

GUANO

Lab'y No. 94824.—Collected from the resting grounds of the Double Crested Cormorant on the North Shore of the gulf of St. Lawrence. This sample was submitted by the National Parks Branch, Department of Interior.

As received, this guano was a wet, black, pasty mass with an occasional fish bone. Due to fermentation subsequent to collection it had a very offensive smell.

Analysis	Per cent
Water	74.26
Organic matter	11.12
Mineral matter soluble in acid	13.29
Mineral matter insoluble in acid	1.33
	100.00

	As received p.c.	Water-free basis p.c.
Fertilizing constituents—		
Nitrogen	0.93	3.61
Phosphoric acid	5.58	21.68
Potash	0.08	0.31

This guano, even in its fresh moist condition, has a very considerable fertilizing value, more particularly from its high phosphoric and nitrogen content.

BENTONITE

Bentonite is a very impervious clay, characterized by its exceedingly sticky condition when wet. In Canada, it occurs largely in British Columbia and the prairie provinces among the cretaceous rocks.*

Physically, it resembles the colloids. It forms suspensions in water, often stable for long periods of time. This stability is largely influenced by the presence or absence of electrolytes. Flocculation and precipitation of the suspensoid is accomplished by the addition of a mineral acid or of electrolytes. The flocculation is effected in the presence of an alkali.

Chemically, bentonite is composed of silica, alumina and water in the approximate percentages of 61, 18, 10. These three constituents make up about 90 per cent. The remaining ten per cent is composed of iron, magnesia, lime and the alkalis. The structural relationship which exist between the water, silica and alumina are still improperly understood.

The possession of strong adsorptive powers by bentonite has made it an object of interest in agricultural circles. Light sandy soils, as is well known are subject to the leaching of their soluble constituents, and susceptible to the rapid loss of their moisture during a drought. In this respect the suggestion has been advanced that incorporation of bentonite in light soils would tend to increase their retention of cations and of moisture.

The retention of cations is illustrated by the two following experiments.

EXPERIMENT I.—The adsorption of the ammonium ion from a solution of ammonium chloride by sand was compared, under similar conditions with the adsorption by a mixture of sand and bentonite containing ten per cent of bentonite. For this experiment two large glass percolation cylinders were used. The outlet was closed with a large pebble covered with a little glass wool. One thousand grams of sand passing a 2 mm. sieve were placed in one of the cylinders and one thousand grams of the mixture in the other. A half normal solution of ammonium chloride was added continuously and carefully to each cylinder. The ammonia nitrogen was determined in each successive five hundred cubic centimeters of the percolates.

* Bentonite, by H. S. Spence, Department of Mines, No. 626.

Nitrogen in original solution per 500 cc.	Nitrogen in successive 500 cc. percolates	
	Sand	Sand and bentonite
	grms.	grms.
3·44 grams	3·30	2·82
	3·38	3·25
	3·46	3·30
	3·45	3·45
	3·44	.....

EXPERIMENT II.—In a third cylinder the sand-bentonite mixture was treated, similarly, with a solution of calcium chloride. The lime in the first 65 cc. of the percolate was determined.

Results

CaO in 65 cc. of original solution—0·0863 grams
CaO in 65 cc. of percolate—0·0445 grams.

Undoubtedly, therefore, bentonite added to a light sandy soil would increase the adsorptive power of that soil for certain ions from solutions of that ion. This conclusion, however, does not furnish any information as to how much more strongly adsorbed the ions are by the sand-bentonite mixture than by the sand alone. That is to say, it does not furnish any information concerning resistance to leaching.

To determine this it was planned at the conclusion of the above two experiments to leach out the percolators with distilled water and determine the ammonia so displaced. In the case of the sand-bentonite mixture, however, the percolation completely ceased after about two hundred cubic centimetres of percolate had been collected. Apparently, as soon as the solution of the electrolyte held mechanically in the pore spaces had been displaced, the bentonite entered the deflocculated condition and rendered the mixture impervious to water.

This is a serious condition, interfering as it does with proper drainage. Since it was occasioned by the addition of bentonite to sand, under the conditions of the experiment, it was felt that, as a soil amendment, bentonite showed little promise of value. Further investigation was, therefore, abandoned.

THE MANURIAL VALUE OF SWEET CLOVER

The object of this investigation is to obtain data with respect to the best time at which to plough down sweet clover for soil enrichment. For this purpose six plots were laid out at Brandon, Man., in 1926 and cropped to the following rotation: first year, oats seeded down to sweet clover (1926); second year, sweet clover (1927); third year, wheat. A seventh plot was included in which a summer-fallow replaces the sweet clover crop in the second year. The dates of ploughing down the sweet clover are as follows: May 25, June 8, and June 20, 1927. Other dates of ploughing were July 2 (immediately after the first cutting for hay), July 21 (three weeks after the first cutting for hay), and August 3 (immediately after the second cutting for hay).

The data from which deductions are to be drawn are obtained by the analysis of the foliage (leaves and stems) and roots of the 1927 crop of sweet clover. Owing to the fact that the nitrogen contained in the legume plants is obtained largely from the air, there will be a distinct gain of this element in the soil when the whole crop is ploughed down. Further, the phosphoric acid and potash taken from the soil during the growth of the plant are returned to the

soil by this practice and by the decomposition of the green matter these latter elements are rendered more readily available for subsequent crop growth. The samples for analysis were collected on the above mentioned dates from an area four feet by four feet and to a depth of 9 inches in each plot.

The results obtained in 1927 are tabulated in tables No. 15 and No. 16.

TABLE No. 15—MANURIAL VALUE OF SWEET CLOVER

Experimental Farm, Brandon, Man., 1927

Fertilizing Constituents in 100 pounds of Dry Matter

Lab'y. No.	Plot	Date of ploughing down	Nitrogen	Phosphoric acid	Potash	Lime
			lb.	lb.	lb.	lb.
89513 15	1	May 25, foliage (height 6 inches)	3·61	0·81	3·25	3·22
14 16		May 25, roots	2·00	0·57	3·10	0·95
89782 84	2	June 8, foliage (height 13½ inches)	3·65	0·82	4·94	3·04
83 85		June 8, roots	1·49	0·45	2·96	0·95
99924 26	3	June 20, foliage (height 27 inches)	3·04	0·59	4·51	2·68
99923 25	.....	June 20, roots	1·50	0·36	3·16	0·79
89928 30	4	July 2. (immediately after 1st cutting for hay) stubble, (stems and leaves, height 8 inches)	1·05	0·30	3·38	0·86
89927 29	.....	July 2, roots	1·46	0·35	2·65	0·86
90981 83	5	July 21 (3 weeks after 1st cutting for hay) Foliage	2·09	0·54	3·27	1·73
90980 82	.....	July 21, roots	1·04	0·41	2·55	0·78
90985 87	6	August 3 (immediately after 2nd cutting) Stubble (stems and leaves, height 8 inches)	0·96	0·31	1·76	0·98
90984 86	.....	August 3, roots	1·00	0·38	1·97	0·76

DISCUSSION OF DATA

A detailed discussion of the data presented in tables 15 and 16 will be deferred until the close of the investigation which will be carried on for a number of years. It will be, however, interesting at this stage to note:

(1) The percentages of nitrogen in the dry matter of the foliage as collected on May 25 (height 6 inches) and June 8 (height 13 inches) are considerably higher than that of the foliage collected June 20 when the height of the crop was 27 inches (see table 15).

(2) The nitrogen content of the dry matter in the 8-inches stubble, collected immediately after the first cutting of the crop for hay (July 2) is approximately one-third that of the whole crop above ground on June 20.

(3) The percentage of nitrogen in the roots is highest during the earlier weeks of growth. Three weeks after the first cutting for hay the nitrogen content of the roots (dry matter basis) had fallen from 1·46 per cent (July 2) to 1·04 per cent (July 21).

(4) The amounts of dry matter and nitrogen per acre in the foliage and roots (as given in table 16) increase with the growth of the crop, i.e. from the date of the first collection (May 25) to June 20 (plots 1, 2 and 3).

(5) Considered from the point of view of manurial value, it would appear from the data of table 16 that the best time to plough down sweet clover is when the crop approaches the stage of growth at which it is desirable to cut it for hay.

TABLE NO. 16.—MANURIAL VALUE OF SWEET CLOVER

Experimental Farm, Brandon, Man., 1927

Fertilizing constituents in pounds per acre

Lab'y. No.	Plot	Date of ploughing down	Green weight per acre	Dry matter	Nitrogen	Phosphoric acid	Potash	Lime
			lb.	lb.	lb.	lb.	lb.	lb.
89513	1	May 25, foliage (height 6 inches)...	3,910·0	494·4	17·86	4·01	16·08	15·93
15								
14		Roots...	2,295·0	298·7	5·99	1·69	9·27	2·85
16								
		Total...	6,205·0	793·1	23·84	5·70	25·35	18·78
89882	2	June 8, foliage (height 13½ inches)...	13,797·0	1,278·0	44·47	10·35	63·63	26·49
84								
83	.....	Roots...	2,183·6	440·0	6·37	1·94	12·66	4·26
85								
		Total...	15,980·0	1,718·6	50·84	12·29	76·29	30·75
99924	3	June 20, foliage (height 27 inches)...	21,272·1	1,597·8	48·09	9·27	72·72	40·68
26								
99923	.....	Roots...	2,656·3	562·0	8·40	1·97	17·61	4·44
25								
		Total...	23,928·4	2,159·8	56·49	11·24	90·33	45·12
89928	4	July 2 (immediately after 1st cutting						
30	.....	for hay) foliage (stubble height 8 inches)...	5,047·3	991·5	10·35	2·84	33·51	9·21
27	.....	Roots...	2,641·8	528·3	7·71	1·37	14·07	4·59
29								
		Total...	7,689·1	1,519·8	18·06	4·71	47·58	13·80
90981	5	July 21 (3 weeks after 1st cutting for						
83	.....	hay) foliage...	6,481·3	1,267·2	26·46	6·78	41·49	21·96
90980	.....	Roots...	2,184·5	551·4	5·70	2·22	13·98	4·29
82								
		Total...	8,665·8	1,818·6	32·16	9·00	55·47	26·25
90985	6	Aug. 3 (immediately after 2nd cutting for hay) foliage (stubble						
87		height 8 inches)...	1,003·9	760·2	7·29	2·34	13·14	7·44
90984	.....	Roots...	701·3	568·7	5·67	2·31	11·65	4·20
86								
		Total...	1,705·2	1,328·9	12·96	4·65	24·79	11·64

CLOSE GRAZING EXPERIMENT

THE COMPOSITION AND YIELD OF GRASS, CHIEFLY MEADOW FOXTAIL, (ALOPECURUS PRATENSIS) AS INFLUENCED BY FREQUENCY OF CUTTING AND THE APPLICATION OF FERTILIZER

This chapter presents the data from the third season of this inquiry, 1929; it, further, permits of a review of the yields and composition of the herbage of the plots as affected by seasonal conditions and fertilizer applications during the past three years.

A detailed account of the plan of the investigation has already appeared and therefore it will only be necessary here to briefly outline the main features of the scheme and method of procedure.*

* Detailed results of the first season's work in this investigation are given in the Annual Report of this Division for year ending March 31, 1928; those for the second season are in report, March 31, 1929.

A series of four adjacent plots (A, B, C, D) were laid out in a meadow of which the predominating grass at the inception of the experiment was meadow foxtail. The herbage showed strong, vigorous growth. The soil is a moderately heavy clay loam of high fertility.

To simulate the rotational close-grazing by stock the plots were cut as follows: A, weekly; B, fortnightly; C, every third week and D, for hay (seed formed) with aftermath. For plots A, B and C, a lawn-mower was used, leaving a close cut sward; D was cut with a scythe followed by a lawn mower. The cuttings were immediately weighed (for yield data), samples and dry matter content determined; the remainder was rapidly air-dried and ground for analysis.

For the growth of the first year (1927) no fertilizer was used. In the autumn of 1927 after the last cutting the following mixture was applied:

	Pounds per acre
Ammonium sulphate	50
Superphosphate	350
Muriate of potash	100

In the spring of 1928, as growth started, a top dressing of nitrate of soda at the rate of 160 pounds per acre was applied broadcast.

At the close of the 1928 season the plots were fertilized with

Superphosphate	350 pounds per acre
Muriate of potash	100 pounds per acre

In the spring of 1929, nitro-chalk (nitrogen=15·5 per cent) at the rate of 160 pounds per acre was applied and a further dressing of this fertilizer at the same rate given in July.

DRY MATTER CONTENT OF GRASS

The data for dry matter content of the 1929 herbage as affected by frequency of cutting are as follows:—

—	Plot A. 16 cuttings	Plot B. 10 cuttings	Plot C. 7 cuttings	Plot D. 2 cuttings
	p.c.	p.c.	p.c.	p.c.
Maximum	29·89	27·11	27·06	40·55
Minimum	17·88	19·22	17·42	29·64
Average	23·45	22·80	22·57	35·10

The maximum, minimum and average data for the dry matter content of the herbage, for the four plots and the three seasons during which this experiment has been in operation, are presented in table 17.

As between the herbage of A, B and C for the same season the differences in dry matter are not of a significant magnitude, although certain of the data might be interpreted as indicating a trend towards a slightly higher content as the period of growth lengthens. For practical purposes it would appear that in respect to dry matter content—and hence, in a large measure succulency—there is no material falling off with the lengthening of the growing period up to three weeks.

The grass of Plot D, cut for hay, is markedly higher in dry matter than that of the frequently cut plots. This is true for all three seasons. The lowest average, 31·19 per cent is for the year 1928, in which the length of season and ample rainfall permitted the cutting of two aftermaths. In 1929, contrary to the results obtained in the two preceding seasons, the aftermath was higher in dry matter than the hay cut; it was a meagre growth of 12 weeks during a very dry season and was dry, yellowish brown and badly rusted.

TABLE No. 17.—DRY MATTER CONTENT OF GRASS AS CUT, 1927, 1928, 1929

—	A. Cut weekly			B. Cut fortnightly			C. Cut every third week			D. Cut for hay with aftermath		
	1927	1928	1929	1927	1928	1929	1927	1928	1929	1927	1928	1929
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Maximum	33·24	27·08	29·89	31·80	28·85	27·11	31·48	31·30	27·06	36·53	35·59	40·55
Minimum	22·61	17·39	17·88	24·72	19·62	19·22	26·13	16·40	17·42	32·13	25·01	29·64
Average	26·48	21·34	23·45	27·62	21·32	22·80	28·34	22·84	22·57	34·33	31·19	35·10

DRY MATTER YIELDS

The yields of dry matter from the several plots for the season of 1929, calculated to the acre basis, are as follows:—

Weight of Dry Matter per Acre, 1929

	Lb.
A (16 cuttings)	3,601
B (10 cuttings)	4,288
C (7 cuttings)	3,834
D (2 cuttings)	4,772

Comparing these yields, the least weight, as in past years, was obtained from plot A, cut weekly. Plot B, as in 1928, gave the highest yield of the frequently cut areas. Plot C, unfortunately suffered somewhat from flooding and gullying, as in 1928, and this no doubt affected its growth and reduced its yield. From the general trend of dry matter yields as affected by frequency of cutting, it would seem justifiable to conclude that but for the injury referred to, the yield of dry matter of this plot would have exceeded that of B.

The yield of plot D in 1929 is the highest of the series, as in former seasons. The "spread" in dry matter yields between D and the other plots, however, is somewhat less marked than in 1927 and much less than in 1928, due to the lighter and less evenly distributed precipitation in 1929. The season of 1928 permitted two good aftermaths of fairly succulent grass whereas in 1929 one aftermath only, and that a short scanty growth of poor quality, was obtained.

Table 18 presents the seasonal yields of dry matter, for the years 1927, 1928 and 1929.

TABLE No. 18.—SEASONAL YIELDS, DRY MATTER PER ACRE

—	Plot A. Cut weekly	Plot B. Cut fort-nightly	Plot C. Cut every third week	Plot D. Cut for hay with aftermath
	lb.	lb.	lb.	lb.
1927	2,918	3,344	4,304	5,311
1928	3,770	4,610	4,048	9,306
1929	3,601	4,288	3,834	4,772

1927. The yields of 1927 were obtained before any application of fertilizer was made to the experimental area. The herbage, except on plot A towards the close of the season, showed no clover or other legume. The results for this first year of the experiment gave evidence of the depressing effect of frequency of cutting on dry matter yields—the more frequent the cutting the less weight of dry matter. Confirmatory evidence of this relation of weight of dry matter to period of growth has been furnished by the data of the two succeeding years. Plot D, as cut for hay, with aftermath, gave the highest yield of dry matter per acre.

1928. The precipitation of 1928 was heavy and also well distributed throughout the growing season. This, with the influence of the fertilizer applications is largely responsible for the yields being materially heavier than those obtained in 1927.

The yields of plots A and B again increase with the lengthening of the growing period. Plot C, owing to damage, did not produce its full crop. In this year (1928) white Dutch clover formed a considerable portion of the herbage on A and B and, to a lesser degree, on C. This may be a further factor in influencing the *yield* of dry matter—that of the clover probably being greater than that of the displaced grass.

The exceptionally high yield of plot D is to be accounted for by the very favourable seasonal conditions and the fertilizer applications, which resulted in a very heavy cut of hay on July 3 and two vigorous aftermaths, cut August 27 and October 26. The season opened early and was an unusually long one.

1929. The season opened fairly early, with an ample and well distributed precipitation in May. With the exception of a few heavy showers at scattered intervals, the remainder of the season was marked for the most part by very light showers and several periods of two weeks or more of comparative drought. The total rainfall for the four months May-August was 12·75 inches, 3·87 inches less than in 1927 and 5·37 inches less than in 1928.

In consequence of the unfavourable character of the season the yields on all the plots are lower than in 1928, but it is significant that the falling off of the frequently-cut plots—A, B and C—is very much less than that of D, cut for hay. The explanation of this probably lies in the more rapid recovery of clover than grass after cutting and following a rain; the herbage of plots A, B and C in 1929 were largely clover whereas that of D was grass.

The yield of D is but little more than one-half that of this plot in 1928 and less even than that of 1927. This, in spite of the fact, that the bottom growth had considerably thickened since the beginning of the experiment and that the plot had been well fertilized. The very large falling off from the yield of 1928—amounting to 2¼ tons of dry matter per acre—must be attributed to the lack of rain.—Owing to drought and somewhat high temperatures the grass on this plot was ready to be cut for hay one week and ten days earlier than in 1927 and 1928, respectively—and owing to the same conditions the aftermath was very slow in starting.

PROTEIN CONTENT OF GRASS

The protein content of the 1929 herbage (dry matter basis) stated in maximum, minimum and average percentages of the four plots under investigation, is as follows:—

—	Plot A. 16 cuttings	Plot B. 10 cuttings	Plot C. 7 cuttings	Plot D. 2 cuttings
	p.c.	p.c.	p.c.	p.c.
Maximum	31·70	30·41	25·83	14·09
Minimum	24·24	21·48	18·50	8·29
Average	29·15	26·38	22·89	11·19

Considering the results from plots A, B and C, cut weekly, fortnightly and every third week, respectively, a distinct decline in protein content is observed with the lengthening of the growth period between cuttings. However, in addition to the well-established fact that the younger the grass the higher its percentage of protein there is a further contributing factor, viz., the incoming of clover consequent upon frequent cutting. Plot A, cut weekly was essentially all clover. At the opening of the season there was very little grass. On plot B, cut fort-

nightly, the clover towards the middle of the season was almost as thick as on A. The herbage of plot C, cut every third week, by June was practically one-half clover.

The significant fact brought out by the data of plots A, B and C is that the herbage of a close-grazing scheme is a high protein concentrate, diluted, it is true, with water, but with a much narrower nutritive ratio and higher nutritive value than that of ordinary pasture.

The average protein content of the herbage of plot D is less than one-half that of the lowest of the frequently cut plot (C)... This comparatively low percentage of protein is attributable to two factors: the long period of growth (the plot being harvested as hay) and the absence of any appreciable amount of clover.

The data of 1929 are in accord with those of the two preceding seasons and conclusively show that the essential feature of the scheme is the conversion of a low protein pasturage into one furnishing high protein herbage.

Table 19 presents the maximum, minimum and average data for the protein content of the herbage of all four plots for 1927, 1928 and 1929. It also gives the average of the protein content of each of the plots for the three years of the enquiry. This is the average of the three yearly averages.

TABLE No. 19.—PROTEIN CONTENT OF GRASS: 1927, 1928, 1929

Dry Matter Basis

	Plot A. Cut weekly			Plot B. Cut fortnightly			Plot C. Cut every third week			Plot D. Cut for hay with aftermath		
	1927	1928	1929	1927	1928	1929	1927	1928	1929	1927	1928	1929
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Maximum	22·57	32·60	31·70	20·60	26·04	30·41	18·52	25·72	25·83	11·32	16·34	14·09
Minimum	18·69	25·24	24·24	15·73	17·80	21·48	15·33	14·52	18·50	9·0	11·61	8·29
Average	21·20	28·95	29·15	18·60	22·54	26·38	17·17	20·74	22·89	10·16	13·30	11·19
Average for three seasons	26·43			22·50			20·26			11·55		

These data are of special interest and significance in revealing the effect of close-grazing. Plot A, in the first season has the highest maximum, minimum and average protein content with B second and C, third, a trend undoubtedly dependent upon the differences in length of growing period. The protein content of all these "close-grazed" plots has increased since the first season—this having resulted from the increasing proportion of clover in the herbage and to some degree no doubt from the beneficial effect of fertilizing. A, the plot on which the White Dutch clover first took possession shows as high a protein average for 1928 as for 1929. This is in accord with field observations. At the beginning of the second season this plot was almost entirely carpeted with clover. The average protein percentage for Plot B shows an increase of 4 per cent in 1928, over that for 1927 and is 4 per cent higher in 1929 than in 1928. Plot B was not covered with clover until well into the summer of 1929. Plot C also shows an increase in protein content each season. At the end of the growing period for 1929 about two-thirds of its area was in clover. The incursion of clover in these plots has been, roughly, inversely proportional to the length of the growing period—frequent cutting favouring the coming in of the legume.

FIBRE CONTENT OF GRASS

The fibre content of the herbage for 1929 is closely associated with that of the protein. The data show that the average fibre content increases with the

lengthening of the growing period. The converse of this is true of the protein content. Hence, as in preceding seasons, low fibre is associated with high protein and vice versa.

—	Plot A. 16 cuttings	Plot B. 10 cuttings	Plot C. 7 cuttings	Plot D. 2 cuttings
	p.c.	p.c.	p.c.	p.c.
Maximum	17·67	18·99	21·01	30·07
Minimum	12·23	11·18	13·09	23·75
Average	15·05	15·42	17·11	26·91

Table No. 20 presents the maximum, minimum, and average fibre content of all the plots for the three seasons.

TABLE NO. 20.—FIBRE CONTENT OF GRASS: 1927, 1928, 1929

Dry matter Basis

—	Plot A. Cut weekly			Plot B. Cut fortnightly			Plot C. Cut every third week			Plot D. Cut for hay with aftermath		
	1927	1928	1929	1927	1928	1929	1927	1928	1929	1927	1928	1929
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Maximum	25·39	18·82	17·67	26·74	21·57	18·99	27·13	23·86	21·01	32·90	34·33	30·07
Minimum	18·48	12·39	12·23	15·52	12·65	11·18	17·64	11·96	13·09	24·40	17·54	23·75
Average	19·38	16·53	15·05	20·50	18·88	15·42	22·07	19·77	17·11	28·65	26·85	26·91

The data here presented show that the average fibre content of each plot decreases with each succeeding season. This undoubtedly, as in the case of the increasing protein content, is due to the gradual displacement of grass by clover, the fibre content of clover being about 8 per cent lower than grass of the same age.

PROTEIN YIELDS

The season of 1929 furnished the following weights of protein:—

Weight of Protein per Acre, 1929

A. (16 cuttings)	1,058 pounds
B. (10 ")	1,078 "
C. (7 ")	1,053 "
D. (2 ")	500 "

There are no significant differences among the yields from the three frequently cut plots, nor is there reason to believe that the herbage from these plots differs much in respect to digestibility. It should, however, be again pointed out that plot C, due to damage from gullying, did not yield a representative crop and might, in all probability, have produced a greater weight of protein than A or B if the grass on about one-third of its area had not been considerably thinned by flooding.

Contrary to the results for 1927 and 1928, the protein yield of D is less than that for A, B, or C. This plot suffered seriously from the dry season, the hay crop being very light and the aftermath a growth of short, badly rusted grass.

Table 21 presents the seasonal yields of protein for the years 1927, 1928 and 1929.

TABLE 21 No.—SEASONAL YIELDS: PROTEIN PER ACRE

—	Plot A. Cut weekly	Plot B. Cut fort-nightly	Plot C. Cut every third week	Plot D. Cut for hay with aftermath
	lb.	lb.	lb.	lb.
1927	439	466	571	520
1928	1,078	1,008	766	1,119
1929	1,058	1,078	1,053	500

1927. As with the dry matter yields, the yield or weight of protein from plots A, B, and C increases with the lengthening of the growing period.

The yields of protein for this first season on these plots were less than those of 1928 and 1929. This may be accounted for in part by the fact that clover had not appeared on the plots as it did in subsequent seasons, due to the operation of the close-grazing scheme, by which through the influence of light, the growth and spread of the legume is encouraged and the stand of grass thickened.

1928. For this season the yields of protein from A, B, and C did not increase with the lengthening of the growing period. The more rapid spread of the protein-rich-clover on A has resulted in a greater weight of protein from this plot than from B or C. The lowest yield from these three plots was that of C, due in part to damage by flooding of this plot over about one-third of its area.

The outstanding feature of the 1928 results is perhaps the high yield of protein from D—the hay plot of the series. This no doubt resulted from the exceptionally favourable seasonal conditions which produced an unusual hay yield and two vigorous aftermaths rich in protein.

1929. The weights of protein for A, B, and C are practically the same. A slight increase in the proportion of clover on B and a still greater increase on C no doubt accounts for this change in the ranking among the plots.

Plot D produced only one-half the weight of protein of A, B, or C. Unfavourable seasonal conditions—periods of drought and high temperatures—adversely affected the yield of hay and the development of the aftermath. It is interesting to observe that the comparatively dry and hot season of 1929 affected more seriously the dry matter and protein yields of D, the hay plot, than those of the close-grazed plots.

DIGESTIBLE DRY MATTER AND PROTEIN

Of the factors affecting the economics of the "close-grazing" plan of pasture management the most important for consideration is the amount of nutritive material—roughly, the digestible dry matter and protein—produced per unit area. To calculate the data for this digestible material as produced under the scheme of cutting adopted, the mean of the highest and lowest digestion coefficients obtained by Woodman, Blunt, and Stewart have been used.*

Coefficients of Digestion
(Woodman, Blunt & Stewart)

—	Pasture grass	Hay
Organic matter	79	61
Protein	81	59

* Nutritive value of pasture: Journal of Agricultural Science, Vol. XVI, Part 2 (April, 1926).

TABLE No. 22.—DRY MATTER AND PROTEIN: TOTAL AND DIGESTIBLE 1927, 1928 AND 1929

Plot	Dry matter		Protein	
	Total	Digestible	Total	Digestible
	lb.	lb.	lb.	lb.
A (Cut weekly)	10,289	8,128	2,575	2,086
B (Cut fortnightly)	12,242	9,671	2,552	2,067
C (Cut every third week)	12,186	9,627	2,390	1,936
D (Cut for hay with aftermath)	19,389	11,827	2,139	1,262

DISCUSSION OF RESULTS

DRY MATTER.—Under the conditions of this inquiry plot D, cut for hay with aftermath, has given the highest three-year yield in both total and digestible dry matter. Plots B and C rank second, with practically equal yields. Plot A is third. Evidently, frequent cutting (close-grazing) tends to lower the dry matter yield.

PROTEIN.—Though the highest yield of protein—both total and digestible—is from A, the most frequently cut plot, the data for B, cut fortnightly, are almost close enough to be accounted for by experimental error.

The somewhat lower results for C, cut every third week, are in a large measure to be accounted for by the damage to the plot in 1928, but also in a certain degree to the fact that it was only in 1929 that clover constituted a fairly large proportion of its herbage.

It would seem probable from the results obtained and observations made during the conduct of this work that, for the highest yield of digestible protein, a period of from two to three weeks should be allowed for the recuperation of the close-grazed area.

In spite of a good aftermath in both 1927 and 1929 and two heavy succulent aftermaths in 1928, the hay plot, D, is the lowest in the series in respect to protein, both total and digestible.

The main conclusion from this investigation is that the close-grazing scheme furnishes throughout the season pasturage rich in protein of a highly digestible nature. The dry matter of the herbage is really a high protein concentrate. Further, it is the best scheme of pasture management so far devised for producing the maximum amount of digestible protein per unit area.

DYKE AND UPLAND HAYS, EARLY AND LATE CUT, 1929

EXPERIMENTAL FARM, NAPPAN, N.S.

This section of the report presents the analytical data from our examination of the dyke and upland hays, early and late cuttings, collected in 1929, on the Experimental Farm, Nappan, N.S. The series comprises two species, timothy and couch.

These hays on botanical examination were found to be essentially pure, traces only of other grasses being noted. The samples might therefore be considered as quite satisfactory for the purposes of this inquiry, viz., to determine the relative nutritive value (as far as this might be possible from chemical analysis) of these two grasses, early and late cut, as grown on upland and dyke lands, respectively.

The plots from which the hays were cut are in adjacent pairs and weather conditions at the times of both cuttings were favourable for haying. It was considered locally that the period of one month between the dates of July 18 and August 17 might fairly represent the interval required for the grass to advance from a stage, early for hay, to one regarded as late.

NOTES ON ANALYTICAL DATA

COUCH GRASS.—The earlier cut has a higher protein content; this is true of the hay from both upland and dyke. Contrasting hay of the same "cut" from upland and dyke, that from the upland area is decidedly the richer in protein.

TIMOTHY.—The earlier cut hay from both upland and dyke is the higher in protein.

Comparing the upland and dyke hays the "early" from the dyke is almost a per cent higher in protein; the protein content of the "late" cut is practically the same for both hays—upland and dyke.

Considering the nutritive value of the grasses from the standpoint of protein content, these results may be summarized as follows:—

(1) Hay from dyke lands: that there is very little difference between couch and timothy of the early cut but a slight superiority of the couch hay from the late cut.

(2) Hay from upland: "couch" hay from both early and late cuttings has a higher percentage of protein than the corresponding cuttings of timothy.

(3) Apparently "couch" yields richer hay from upland than from dyke lands and the reverse is true of timothy.

(4) While the difference between timothy and couch grass and between their hays as grown on upland and dyke are not such as to permit, at this stage of the inquiry, any emphatic statement as to marked superiority, the differences in protein content between early and late cut are such as to definitely show that the "early" cut is the more nutritious.

Attention may specially be drawn to the differences in protein between the early and late cut hays. These differences are in both grasses fairly large. This inquiry has given additional and weighty support to the statement made from previous investigations that there is a marked decrease in protein with a concomitant falling off in nutritive value, as the grass matures. The earlier cut hay is much the richer.

TABLE No. 23.—DYKE AND UPLAND HAYS—EXPERIMENTAL FARM, NAPPAN, N.S.

Crop of 1929

Lab'y. No.	Variety	Cutting	Date of cutting	As received						Water-free				
				Moisture	Protein	Ether extract	Carbo-hydrates	Fibre	Ash	Protein	Ether extract	Carbo-hydrates	Fibre	Ash
				p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
99947	Dyke couch	Early	18·7	5·55	4·94	2·18	47·46	35·10	4·77	5·23	2·31	50·25	37·16	5·05
48	Dyke couch	Late	17·8	5·29	3·78	2·28	53·13	29·63	5·89	3·99	2·40	56·10	31·29	6·22
49	Dyke timothy	Early	18·7	5·83	5·37	2·28	45·50	35·30	5·72	5·70	2·42	48·31	37·50	6·07
50	Dyke timothy	Late	17·8	5·28	2·75	1·65	51·61	34·18	4·53	2·91	1·74	54·48	36·09	4·78
51	Upland couch	Early	18·7	5·44	6·91	2·50	48·76	31·17	5·28	7·31	2·64	51·56	32·91	5·58
52	Upland couch	Late	17·8	5·85	6·34	2·80	50·80	29·10	5·11	6·73	2·97	53·96	30·91	5·43
53	Upland timothy	Early	18·7	5·83	4·59	2·30	47·86	35·53	3·89	4·87	2·44	50·83	37·73	4·13
54	Upland timothy	Late	17·8	5·42	2·75	1·78	48·82	38·23	3·00	2·91	1·88	51·62	40·42	3·17

WESTERN PRAIRIE FORAGE PLANTS

In the annual report of this division for 1928 the analysis of thirty-five plants gathered in 1927 and representative of the native prairie forage plants (and more particularly of those found on the Federal Reserve at Manyberries, Alta.) was reported. The object of the investigation is to classify, according to nutritive value the more commonly occurring prairie plants found to be palatable and, thus, be in a position to encourage the growth and spread of the more valuable ones.

This report presents the analytical data of a further collection of fifty plants from Manyberries and adjacent districts in Alberta gathered during, and after, the growing season of 1928.

The samples include the more commonly found grasses, legumes, sages, etc., and in several instances the species are represented by samples collected at two or more stages of growth.

The following table (No. 24), in addition to analytical data, gives the botanical and common names of the specimens, dates of collection, stages of growth and descriptions of the plants as received after air-drying.

The following comments may be made upon the data contained in this table:—

1. The first four groups of samples are grasses, viz., *Stipa comata* (spear grass), *Koelcria gracilis* (June grass), *Agropyron Smithii* (Blue Joint), and *Bouteloua gracilis* (Blue Grama grass). Collections of these were made at several stages of growth and also after months of weathering. As in the 1927 series the 1928 collection (table No. 25) shows the younger grasses to be the richer in protein and that a considerable loss of protein follows the weathering of the samples. Further, some of the 1927 growth was allowed to weather until March of 1928 and these samples show a still lower protein content. The nutritive value of these weathered samples was almost negligible, due to loss of leaf, with a concomitant increase in fibre content—which ranges from 36 to 41 per cent, the highest percentages in the series.

TABLE No. 25.—PROTEIN CONTENT OF GRASSES AT SEVERAL STAGES OF GROWTH

(Dry Matter basis)

Stage of growth	Spear Grass	June Grass	Blue Joint	Blue Grama Grass
	p.c.	p.c.	p.c.	p.c.
Emerging from sheath	14·51	15·53	.....	.....
Pre-flowering	.....	.....	16·44	.....
Early and late flowering	.....	9·72	15·86	11·54
Dough stage	8·60	8·20	.....	8·09
Cured (weathered until November)	4·91	.....	3·33	3·33
1927 growth weathered until March 1928	2·83	2·29	3·32 (upland) 2·53 (flats)	2·87

2. A sample of wild barley, Lab'y No. 96770, pre-flowering stage, on May 25, is noteworthy on account of its high protein content—28·59 per cent. This sample possessed a large proportion of leaf. This feature and the early stage of growth are undoubtedly contributory factors to the high percentage of protein.

TABLE No. 24.—WESTERN PRAIRIE PLANTS COLLECTED BY

Lab'y. No.	Ident. No.	Name	Locality	Date of collection	Stage of maturity
96748	No. 1	Stipa comata (Spear Grass).....	Federal Ranch, Manyberries, Alta.	Mar. 25, 1928..	1927 growth.....
49	" 2	" "	" " ..	June 3, 1928..	Emerging from sheath.
50	" 3	" "	" " ..	July 4, 1928..	Dough.....
51	" 4	" "	" " ..	Nov. 20, 1928..	Cured.....
52	" 5	Koeleria gracilis (June Grass).....	" " ..	Mar. 25, 1928..	1927 growth.....
53	" 6	" "	" " ..	May 23, 1928..	Emerging from sheath.
54	" 7	" "	" " ..	July 1, 1928..	Late flowering..
55	" 8	" "	" " ..	July 4, 1928..	Dough.....
56	" 9	Agropyron Smithii (Blue Joint).....	" " ..	Mar. 25, 1928..	1927 growth from uplands.
57	" 10	" "	" " ..	" 25, 1928	1927 growth from flats.
58	" 11	" "	" " ..	June 5, 1928..	Pre-flowering..
59	" 12	" "	" " ..	July 4, 1928..	Late flowering..
60	" 13	" "	" " ..	Nov. 20, 1928..	Cured.....
61	" 14	Bouteloua gracilis (Blue Grama Grass).	" " ..	Mar. 25, 1928..	1927 growth.....
62	" 15	" "	" " ..	July 4, 1928..	Early flowering.
63	" 16	" "	Big Stick Lake.....	Aug. 27, 1928..	Nearly ripe.
64	" 17	" "	Federal Ranch, Manyberries, Alta.	Nov. 25, 1928..	Cured.....
65	" 18	Poa laevigata (Meadow Grass).....	" " ..	Mar. 25, 1928..	1927 growth.....
66	" 19	" "	" " ..	May 23, 1928..	Emerging from sheath.
67	" 20	Beckmannia erucaeformis (Slough grass).	" " ..	June 25, 1928..	Early flowering
68	" 21	Festuca scabrella (Tall fescue grass).	Cyprus Hills.....	July 14, 1928..	Early dough....
69	" 22	Calamovilfa longifolia (Sand grass).	Federal Ranch, Manyberries, Alta.	June 14, 1928..	Pre-flowering...
70	" 23	Hordeum jubatum (Wild barley)....	" " ..	May 25, 1928..	"
71	" 24	Avena Hookerii (Hooker's Oats)....	Cyprus Hills.....	July 14, 1928..	Late flowering..
72	" 25	Festuca ovina (Sheep's fescue).....	"	June 24, 1928	"
73	" 26	Deschampsia atropurpurea (Swamp grass).	Federal Ranch, Manyberries, Alta.	June 28, 1928..	Pre-flowering...
74	" 27	Schizachyrium scoparium (Beard Grass).	Sand Hills Area.....	Aug. 27, 1928..	Ripe.....
75	" 28	Muhlenbergia cuspidata.....	Federal Ranch, Manyberries, Alta.	Mar. 25, 1928..	1927 growth.....
76	" 29	Calamagrostis Montanensis (Blue-stem).	" " ..	" 25, 1928..	1927 growth.....
77	" 30	Calamogrostis Langsdorfii (Pine Grass).	Coleman, Alta.....	Oct. 15, 1928..	Cured.
78	" 31	Distichlis stricta (Alkali grass).....	Federal Ranch, Manyberries, Alta	Mar. 25, 1928..	1927 growth.....
79	" 32	" "	" " ..	June 13, 1928..	Pre-flowering...
80	" 33	Carex sp. (Slough sedge).....	" " ..	May 24, 1928..	"
81	" 34	" (Broad-leafed sedge).....	Cyprus Hills.....	July 14, 1928..	Dough.....
82	" 35	Homalobus caespitosus (Dwarf pea)	Federal Ranch, Manyberries, Alta.	May 23, 1928..	Flowering.....
83	" 36	Homalobus tenellus (Dwarf white pea).	" " ..	May 23, 1928..	"
84	" 37	Astragalus sp. (Purple vetch).....	" " ..	May 24, 1928..	"
85	" 38	Gutierrezia Sarothrae (Brownweed)	" " ..	May 25, 1928..	Pre-flowering...
86	" 39	Diholcos bisulcatus (Bushy purple pea).	" " ..	May 27, 1928..	Early flowering.
87	" 40	Artemesia granphaloides.....	" " ..	May 22, 1928..	Pre-flowering...
88	" 41	Salsola pestifer (Russian Thistle)....	" " ..	June 4, 1928..	" ..
89	" 42	Psoralea lanceolata (Sand vetch)....	Sand Hills.....	June 24, 1928..	Flowering.....
90	" 43	Eurotia lanata (Silver sage).....	Federal Ranch, Manyberries, Alta.	May 30, 1928..	Pre-flowering...
91	" 44	Dondia depressa (Sea blite).....	" " ..	" 25, 1928..	" ..
92	" 45	Artemesia frigida (Prairie Sage)....	" " ..	" 30, 1928..	" ..
93	" 46	Ctenophyllum pectinatum (Bushy white pea).	" " ..	" 22, 1928..	Flowering.....
94	" 47	Atriplex nuttalii (Salt sage).....	" " ..	" 25, 1928..	Pre-flowering....
95	" 48	Astragalus tenellus (Decumbent white pea).	" " ..	" 30, 1928..	Early flowering
96	" 49	Astragalus sp. (Decumbent purple pea).	" " ..	" 27, 1928..	Flowering.....
97	" 50	Tium Drummondii (Silver pea).....	Cyprus Hills.....	" 27, 1928..	Flowering.....

Remarks	As received						Water-free				
	Moisture	Protein N.x6·25	Crude fat	Carbohydrates	Crude fibre	Ash	Protein N.x6·25	Crude fat	Carbohydrates	Crude fibre	Ash
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Light straw colour, leaves very withered, no seed.	7·00	2·63	1·36	46·21	37·29	5·45	2·83	1·46	49·72	40·13	5·86
Pale green colour, dry and brittle, no flowers.	7·91	13·36	3·34	44·96	26·06	4·37	14·51	3·63	48·82	28·30	4·74
Pale green, seed present, some leaves.	6·91	8·01	1·71	45·81	33·69	3·87	8·60	1·84	49·21	36·20	4·15
Dry and brittle, not much leaf or seed.	7·89	4·52	2·35	49·36	27·07	8·81	4·91	2·55	53·58	29·39	9·57
Stems and fruiting parts light straw colour, leaves weathered and grey.	7·24	2·12	0·90	46·70	35·97	7·07	2·29	0·97	50·34	38·78	7·62
Pale green, heads and leaves intact.	8·87	14·16	1·95	42·43	26·06	6·53	15·53	2·14	46·56	28·61	7·16
Pale green, heads intact.....	8·78	8·87	1·68	41·48	30·97	8·22	9·72	1·84	45·46	33·96	9·02
Much more ripe than No. 7....	8·64	7·49	1·29	42·34	30·93	9·31	8·20	1·41	36·34	33·86	10·19
Light straw colour, leaf very weathered; no seed.	8·19	3·06	1·67	43·56	37·46	6·06	3·32	1·82	47·45	40·81	6·60
Leaf intact.....	8·61	2·31	1·15	46·89	29·48	11·56	2·53	1·26	51·31	32·25	12·65
Coarse growth, no heads.....	9·21	14·98	1·24	39·94	25·44	9·19	16·44	1·37	44·02	28·03	10·14
Fine growth, not quite ripe....	9·14	14·40	1·42	40·46	28·32	6·26	15·86	1·56	44·51	31·18	6·89
Straw colour, weathered but clear, no seed.	7·11	3·09	1·08	55·17	26·01	7·54	3·33	1·16	59·39	28·00	8·12
Same as No. 13.....	7·52	2·66	0·65	47·66	33·68	7·83	2·87	0·71	51·53	36·42	8·47
Pale green, brittle stems, few leaves.	7·19	10·71	1·07	45·19	29·76	6·08	11·54	1·15	48·70	32·06	6·55
Still somewhat green, no loss of seed.	5·66	7·64	1·83	47·21	32·31	5·35	8·09	1·94	50·04	34·26	5·67
Completely ripe, no seed.....	9·60	3·01	1·24	50·33	28·38	7·44	3·33	1·37	55·68	31·39	8·23
Very few leaves.....	9·77	2·23	1·08	44·33	37·24	5·34	2·47	1·20	49·14	41·27	5·92
Light green.....	10·02	12·45	1·82	42·54	28·09	5·09	13·84	2·02	47·07	31·21	5·66
Thick stemmed, fine leaved, preserved.	9·29	10·30	1·42	41·78	31·03	6·18	11·36	1·56	46·05	34·22	6·81
Stems still green.....	8·72	5·45	1·44	43·12	33·95	7·32	5·97	1·58	47·25	37·18	8·02
Light green colour, well preserved.	8·69	9·65	1·43	48·14	28·41	3·68	10·57	1·56	52·72	31·12	4·03
Much leaf.....	11·69	25·24	3·58	29·09	20·55	9·85	28·59	4·05	32·94	23·27	11·15
Still somewhat green.....	8·66	5·73	1·42	41·55	33·48	9·16	6·27	1·56	45·49	36·65	10·03
Ripening.....	8·71	5·65	1·95	47·01	30·44	6·14	6·20	2·18	51·62	33·27	6·73
Coarse growth, stems dry.....	9·25	6·83	1·48	34·75	38·32	9·37	7·53	1·63	38·29	42·23	10·32
Seed dropping, red and downey heads.	8·29	4·51	2·12	45·86	34·83	4·38	4·93	2·31	50·01	37·97	4·78
Very dry and brittle, all seed gone; few weathered leaves.	11·25	3·64	2·43	46·96	29·69	6·03	4·10	2·73	52·93	33·45	6·79
Very dry, seed still on heads, some leaves present.	9·28	2·05	1·40	40·57	35·86	10·84	2·26	1·54	44·73	39·52	11·95
Very dry and brittle; well ripened; no seed on head.	9·84	3·21	2·10	18·22	49·07	17·56	3·56	2·33	20·21	54·43	19·47
Dry, weathered, no seed.....	8·88	3·13	1·71	56·41	22·26	7·61	3·43	1·88	61·91	24·43	8·35
Stems ripening, light green colour.	8·67	14·09	1·78	43·47	24·38	7·61	15·43	1·95	47·60	26·69	8·33
Light green, smooth and waxy, tough and flexible (not brittle).	8·87	20·21	2·56	38·89	19·48	9·99	22·18	2·81	42·67	21·38	10·96
Light green leaves.....	8·66	12·69	2·02	41·93	27·78	6·92	13·90	2·21	45·91	30·41	7·57
Very dry and brittle.....	8·02	15·26	2·40	37·77	28·77	7·78	16·59	2·61	41·06	31·28	8·46
Mouldy appearance.....	9·39	14·21	2·30	35·78	30·03	8·29	15·66	2·59	39·50	33·11	9·14
Fresh and green, seed pods unformed, flowering.	9·91	19·38	2·43	41·61	18·44	8·23	21·52	2·70	46·21	20·45	9·12
Dark green, sage-like odour....	7·70	17·91	3·78	47·81	12·76	10·04	19·40	4·10	51·81	13·82	10·87
Very dry, all leaves broken, stems brittle.	8·56	17·73	2·58	40·10	21·97	9·06	9·39	2·82	43·86	24·02	9·91
Stems light yellow.....	9·72	16·53	6·19	39·10	20·95	7·51	18·31	6·86	43·31	23·20	8·32
Fine leaved, green, with some dry stems.	5·94	12·89	1·96	44·18	11·29	23·74	13·71	2·08	46·98	12·00	25·23
Well preserved leaves, stems dry and brittle.	8·79	14·40	6·33	45·25	19·29	5·94	15·79	6·94	49·62	21·14	6·51
Light green stems, tough and flexible.	10·86	17·36	1·97	28·74	26·27	14·80	19·47	2·21	32·24	29·47	16·61
Leaves black, stems dark brown, rank odour, damp clammy feel (dried 100°C.)	1·69	28·89	3·31	25·28	9·63	31·20	29·39	3·37	25·71	9·79	31·74
Small soft downy leaves.....	8·31	13·54	5·31	39·37	25·76	7·71	14·77	5·79	42·94	28·09	8·41
Leaves green, flowers still yellow.	9·00	22·28	2·92	36·88	21·50	7·42	24·22	3·17	41·17	23·37	8·07
Leaves broken off, very light green.	14·41	17·84	2·13	33·96	11·17	20·49	20·84	2·49	39·69	13·04	23·94
Very fine leaved, stiff coarse stems dark green.	11·23	12·98	2·95	40·98	26·79	5·07	14·62	3·32	46·17	30·18	5·71
Light green, purple flowers....	13·26	17·20	1·40	37·81	19·49	10·84	19·87	1·61	43·59	22·46	12·47
Light downy, white colour, coarse stemmed.	9·92	25·61	2·33	35·11	18·93	8·10	28·43	2·58	38·98	21·02	8·99

3. Slough Sedge, Lab'y No. 96780, collected May 24 at the pre-flowering stage, has also a high protein content (22·18 per cent). The slough sedge of the 1927 series collected August 10 possessed only half the protein of this specimen (10·93 per cent) due chiefly to the later stage of growth at which it was cut.

4. Lab'y Nos. 96782, 96783, 96784, 96786, 96789, 96793, 96796, and 96797 are different species of legumes (peas or vetches). All have a fairly high protein content, ranging from 16 to 28 per cent.

5. The larger number of the sages analysed contained markedly high percentages of protein. This confirms the results obtained from the 1927 series. In many instances the protein content exceeds that of the legumes.

THE INFLUENCE OF "EARLY TOPPING" ON THE COMPOSITION AND YIELD OF TURNIPS

The practice of "topping" turnips some weeks before the date of "pulling" in order to use the leaves while still green in the feeding of live stock, appears to be common in certain parts of Prince Edward Island. The question arose, is this an economic practice; in other words is there a loss in yield of dry matter (including sugar) per acre when the turnips are "topped" (defoliated), say, one month before the crop is "pulled"?

To obtain data which would answer this question an experiment was instituted at Rustico and at the Experimental Station, Charlottetown, P.E.I., the chief particulars of which are as follows: The turnip crop at both places was divided, one part was topped October 11, the other remaining with its leaves until the date of pulling, October 30, when the roots from both sections were harvested. The green weight per acre of leaves and roots was obtained and samples of both submitted to analysis—from which yields of dry matter and sugar per acre have been calculated. The data are presented in tabular form.

TABLE NO. 26.—THE INFLUENCE OF EARLY TOPPING ON THE COMPOSITION AND YIELD OF TURNIPS, CHARLOTTETOWN, AND RUSTICO, P.E.I., 1929

Locality	Variety	Date of topping	Roots or leaves	Yield per acre	Dry matter	Sugar	Dry matter per acre	Sugar per acre
1929				lb.	p.c.	p.c.	lb.	lb.
Experimental Station, Charlottetown, P.E.I.	Bangholm Club-root Resistant	Oct. 11	Leaves	21,864	10·65	.....	2,329	.....
			Roots	36,791	10·76	0·61	3,959	224
		Oct. 30	Leaves	14,324	13·72	.....	1,964	.....
			Roots	39,204	12·85	1·20	5,036	470
Rustico, P.E.I., (Illustration Station)	Hall's Westbury.	Oct. 11	Leaves	15,983	11·49	.....	1,837	.....
			Roots	56,393	9·38	0·61	5,289	344
		Oct. 30	Leaves	10,253	13·31	.....	1,365	.....
			Roots	66,043	10·71	0·71	7,073	469

It will be observed that the leaves of the early topped turnips contain a lower percentage of dry matter than the leaves of the crop not topped till the date of harvesting (October 30).

Similarly, the dry matter content of the roots from the early topped crop, at the date of harvesting, is lower than that of the roots not topped till harvested. Comparing the sugar content of the roots from the early topped and topped-at-

harvesting crops, the latter is decidedly the richer. From these data it may be safely concluded that *weight for weight* the turnips from the non-topped crop have the higher food value.

Considering food values of the two crops per acre, the data are interesting and significant. There is a decrease in the weight of dry matter of leaf between the dates of October 11 and October 30, accompanied by a marked increase in dry matter of root. It is evident that there is a notable transfer of nutrients (dry matter) from the leaves to the roots during the last month of growth.

Summarizing the results, the data from the Charlottetown experiment show that the untopped crop contained per acre 7,000 pounds of dry matter (leaves and roots) including 470 pounds of sugar as against 6,288 pounds of dry matter and 224 pounds sugar from the early topped crop.

The results from the Rustico experiment are in accord with those from Charlottetown. They show 8,438 pounds dry matter (leaves and roots) including 469 pounds of sugar from the untopped crop as against 7,126 pounds of dry matter and 344 pounds of sugar from the early topped crop.

This inquiry has furnished satisfactory evidence of the marked growth of the untopped crop during the latter weeks of the season; the leaves during this period continue to function as lungs and stomach, resulting in a heavier yield. The practice of topping the crop three weeks or a month prior to the date of pulling has been shown to result in a lower yield, per acre, of nutritients and is therefore non-economic.

INVESTIGATIONAL WORK IN CEREAL CHEMISTRY

WHEAT AND FLOUR: COMPOSITION OF THE WHEAT KERNEL AS INFLUENCED BY DATE OF CUTTING (STAGE OF GROWTH) AND OF THE CORRESPONDING FLOURS FROM THESE WHEATS: CROP OF 1929

REWARD WHEAT, EXPERIMENTAL STATION, LACOMBE, ALTA.
CROP 1929

For the past two years an investigation has been in progress, at the Experimental Station, Lacombe, Alta., to ascertain the changes in the composition of the wheat kernel, as it proceeds towards maturity. In 1928 samples of Garnet wheat, at stages from "late milk" to "firm dough" were forwarded to this division and analysed. The results of this work are to be found in the annual report of this division for 1929.

The samples of the 1929 crop (13 in number) were of Reward wheat cut at two day intervals from August 1 to August 25. These, after grading and valuing, were forwarded to Ottawa for analysis.

Flours were milled from these wheats by the Cereal Division and also analysed.

Table No. 27 presents the data for the wheats, table No. 28 that for the flours.

TABLE No. 27.—REWARD WHEAT—DATE OF CUTTING EXPERIMENT, EXPERIMENTAL STATION, LACOMBE, ALBERTA—CROP 1929

Lab'y. No.	Cutting	Date of cutting	Stage of Maturity	Weight of 1,000 kernels	Moisture	Protein (N x 5·7)		Ash	Grade
						13·5 per cent moisture basis	Water-free basis	Water-free basis	
				gms.	p.c.	p.c.	p.c.	p.c.	
100037	1st	Aug. 1	Milk	14·89	9·18	16·34	18·89	2·26	Feed wheat.
38	2nd	" 3	Late milk	18·25	8·35	15·76	18·23	2·67	No. 6 Northern.
39	3rd	" 5	Early dough	22,15	8·07	14·57	16·85	2·02	No. 5 "
40	4th	" 7	Soft "	23·81	10·84	13·61	15·73	1·87	No. 5 "
41	5th	" 9	Soft to medium dough	26·32	9·85	13·76	15·91	1·78	No. 4 "
42	6th	" 11	Medium dough	27·18	18·84	15·03	17·38	1·69	No. 4 "
43	7th	" 13	.. ..	28·76	9·41	17·23	19·92	1·35	No. 3 "
44	8th	" 15	Medium to firm dough	30·36	8·87	17·69	20·46	1·35	No. 3 "
45	9th	" 17	Firm dough	32·19	8·40	18·28	21·13	1·43	No. 2 "
46	10th	" 19	Firm to 75 p.c. glazed	31·57	7·52	17·54	20·27	1·42	No. 1 "
47	11th	" 21	Firm, 100 p.c. glazed	31·71	9·73	17·91	20·70	1·35	No. 1 "
48	12th	" 23	Hard dough	32·06	9·53	18·12	20·95	1·39	No. 1 "
49	13th	" 25	Hard	31·73	9·13	18·12	20·95	1·30	No. 1 "

TABLE No. 28.—FLOURS FROM REWARD WHEAT—DATE OF CUTTING EXPERIMENT, EXPERIMENTAL STATION, LACOMBE, ALBERTA
Crop 1929

Lab'y. No.	Milling No.	Cutting	Date of cutting	Moisture	Protein (N. x 5·7)		Ash
					13·5 per cent moisture basis	Water-free basis	Water-free basis
				p.c.	p.c.	p.c.	p.c.
100942	29·160	1st	Aug. 1	12·91	15·69	18·13	0·94
43	29·161	2nd	" 2	12·98	15·24	17·62	0·83
44	29·162	3rd	" 5	12·73	13·96	16·14	0·71
45	29·163	4th	" 7	13·12	13·13	15·18	0·75
46	29·164	5th	" 9	13·16	13·23	15·30	0·61
47	29·165	6th	" 11	12·86	14·60	16·89	0·66
48	29·166	7th	" 13	13·48	17·44	20·17	0·54
49	29·167	8th	" 15	13·42	17·51	20·24	0·53
50	29·168	9th	" 17	13·71	17·48	20·20	0·41
51	29·169	10th	" 19	14·15	17·19	19·87	0·43
52	29·170	11th	" 21	13·60	16·29	18·84	0·42
53	29·171	12th	" 23	13·64	17·25	19·94	0·38
54	29·172	13th	" 25	13·13	17·08	19·75	0·43

WHEATS

WEIGHT OF KERNEL.—The weight of kernel steadily increases from the first to the ninth cutting inclusive (August 17), after which it remains practically constant.

PROTEIN.—The percentage of protein (dry matter basis) decreases markedly from the first to the fifth cutting (August 9) and then increases for the next two cuttings; from the seventh to the last cutting (the thirteenth) the protein content is fairly well maintained at the maximum figure.

These trends, in respect to both weight of kernel and protein content, are similar to those observed in previous investigational work on this problem.

RELATION OF PROTEIN TO GRADE.—Admitting that protein content may bear a relationship to grade, provided that variety and degree of maturity are constant factors, then it would appear that the wheat of the ninth cutting (August 17) should be graded No. 1 rather than No. 2.

ASH.—The percentage of ash decreases with the development of the kernel. It is maintained at a practically constant level from the seventh cutting to the end of the series.

From the data of this series, using the results for weight of kernel and protein content, yield and quality had reached their optima, approximately, eight days before the last cutting.

FLOURS

The trends already noted as occurring in the protein and ash of the wheat are observed to be present in the flours. With milling procedure standardized and carefully controlled it might be expected that the composition of the wheat would be reflected in that of the flour.

From the data of this series the following deductions may be made with respect to the relative composition of wheat and its corresponding flour:—

PROTEIN.—In protein flour averages about 0·75 per cent lower than the corresponding wheat.

ASH.—In ash the flour averages about 1·2 per cent lower than the wheat from which it was milled.

WHEAT—COMPOSITION OF THE WHEAT KERNEL AS INFLUENCED BY HEREDITY AND ENVIRONMENT—CROPS OF 1925, 1926 and 1927

For several years (1924-1928) inclusive, series of wheats, comprising about 50 varieties have been grown by the Cereal Division at a number of the Experimental Farms and Stations of the Dominion Experimental Farms system. These series have been analysed and the data have permitted a study of the influence of heredity and environment on the composition (particularly the protein content) of these wheats.

By growing a number of varieties at the same Station and, therefore under the same environmental conditions, a knowledge of differences in composition due to inherited qualities is obtained. By a study of the data of the same wheat grown at different Stations, the influence of environment may be ascertained.

The analytical results for the 1924 crop were published in the Annual Report of this Division for 1926, those for 1928 appeared in the 1929 report.

The tables here presented contain the data from the analysis of the crops for 1925, 1926 and 1927, grown at the several Farms and Stations of the Experimental Farms System in the western prairie provinces.

TABLE No. 29—WHEAT—COMPOSITION OF THE WHEAT KERNEL AS INFLUENCED BY HEREDITY AND ENVIRONMENT—CROP OF 1925

Lab'y. No.	Milling No.	Locality	Variety	Weight of 1,000 kernels	Moisture	Protein (N x 5·7)	On Water-free basis	
							Protein (N. x 5·7)	Ash
				grms.	p.c.	p.c.	p.c.	p.c.
83263	25-1	Experimental Farm, Brandon, Man.	Garnet O. 652	22·74	8·16	12·80	13·95	1·75
64	2	" "	Marquis O·15	29·79	9·81	10·51	11·65	2·22
77	15	" "	Brownie	19·03	11·81	11·26	12·77	2·02
78	16	" "	Ceres (M. x K. 1658)	27·90	11·20	13·04	15·70	2·48
79	17	" "	Cuddlis Sel	19·80	11·52	12·20	13·79	2·24
80	18	" "	Early Triumph	19·94				
81	19	" "	Garnet	23·14	11·01	13·47	15·13	1·63
82	20	" "	Kitchener	19·95	11·20	11·80	13·29	2·47
83	21	" "	Kota	26·95	10·58	14·11	15·78	2·20
84	22	" "	Marquis O·15	27·68	9·93	14·05	15·39	1·98
85	23	" 11-15-44	Marquis x Iumillo	30·31	10·90	14·42	16·18	2·49
86	24	" "	Parkers Sel	29·07	11·07	14·77	16·62	2·28
87	25	" "	Quality (Burbanks)	31·26	11·31	12·12	13·67	2·09
88	26	" "	Red Fife	21·05	11·80	12·79	14·51	2·08
89	27	" "	Reward	30·04	10·97	14·80	16·62	2·06
90	28	" "	Ruby	19·81	10·88	13·11	14·71	2·38
91	29	" "	Supreme	18·18	11·75	11·66	13·22	2·23
65	3	Experimental Station, Morden, Man.	Garnet O. 652	28·68	10·76	12·72	14·25	1·66
66	4	" "	Marquis O. 15	28·13	8·12	14·30	15·56	1·72
92	30	" "	Aurora (Velmorin)	28·97	10·20	13·53	15·07	1·87
93	31	" "	Brownie	26·87	9·48	13·05	14·42	1·66
94	32	" "	Ceres (M. x K. 1658)	34·01	9·07	12·99	14·29	1·85
95	33	" "	Crown	27·23	9·82	13·19	14·62	1·99
96	34	" "	Duchess					
97	35	" "	Early Red Fife					
98	36	" "	Early Triumph	28·05	9·34	11·89	13·11	2·02
99	37	" "	Garnet	26·86	8·86	12·93	14·15	1·56
300	38	" "	Huron	30·35	9·00	13·37	14·69	2·04
01	39	" "	Kitchener					
02	40	" "	Kota	30·87	9·65	12·53	13·87	1·89
03	41	" "	Kubanka	36·16	9·25	13·98	15·40	1·95
83304	25-42	" "	Lacombe Sel	37·31	8·96	12·17	13·37	1·95
05	43	" "	Major	27·80	8·23	14·74	16·06	1·98
06	44	" "	Marquis O·15	29·20	8·81	14·20	15·59	2·11
07	45	" "	M.X.R.B. 1655					
08	46	" "	M. x Kota 1656	36·11	8·26	12·77	13·92	2·06
09	47	" "	Orchard Sel	30·37	9·10	11·97	13·17	1·90
10	48	" "	Quality	36·44	8·32	13·13	14·32	1·85
11	49	" "	Red Quality A	35·60	8·90	13·47	14·79	2·02
12	50	" "	Reward	35·49	10·07	16·13	17·94	2·13
13	51	" "	Ruby	25·10	8·59	12·93	14·14	1·95
14	52	" "	Supreme	27·76	9·86	10·90	12·09	2·00
83267	5	Experimental Farm, Indian Head, Sask.	Garnet O. 652	19·44	7·70	16·01	17·34	2·07
68	6	" "	Marquis O·15	21·86	8·02	16·76	18·22	1·94
83315	53	" "	Brownie	22·90	11·08	14·37	16·15	2·01
16	54	" "	Garnet	24·36	8·57	14·30	15·64	1·58
17	55	" "	Golden	30·13	10·17	13·80	15·37	1·76
18	56	" "	Kitchener	31·36	10·01	12·69	14·10	1·63
19	57	"	Kota	30·35	9·99	14·88	16·54	1·46
20	58	" "	Marquis O·15	30·33	8·30	15·01	16·37	1·64
21	59	" "	Ceres (M. x K. 1658)	30·70	10·19	14·29	15·92	1·70
22	60	" "	Orchard Sel	30·19	10·09	15·83	17·61	1·97
23	61	" "	Parker's Sel	33·11	9·84	15·76	17·48	1·79
24	62	" "	Red Bobs	29·42	9·75	13·29	14·72	1·50
25	63	" "	Red Fife	31·20	9·93	14·12	15·68	1·63
26	64	" "	Renfrew	33·02	9·56	11·38	12·58	1·57
27	65	" "	Reward	28·75	9·90	15·25	16·92	1·62
28	66	" "	Supreme	30·51	9·87	12·53	13·90	1·54
29	67	" "	U. of A. 222	30·18	10·26	11·35	12·65	1·48
83273	11	Experimental Station, Swift Current, Sask.	Garnet O. 652	23·74	7·95	15·76	17·12	1·55
74	12	" "	Marquis O. 15	26·10	7·81	16·97	18·41	1·38
330	68	" "	Early Red Fife	32·56	10·04	15·33	17·04	1·51
31	69	" "	Garnet	25·34	7·95	16·16	17·57	1·63
32	70	" "	Kitchener	28·70	9·40	14·44	15·94	1·46
33	71	" "	Kota	25·89	10·69	17·17	19·23	1·40
34	72	" "	Marquis O. 15	27·50	8·65	17·20	18·83	1·64
35	73	" "	Red Bobs	29·41	10·28	15·04	16·72	1·48
36	74	" "	Reward	27·63	10·29	17·23	19·21	1·51
37	75	" "	Ruby	23·18	10·55	15·93	17·81	1·59
38	76	" "	Supreme	28·88	10·57	15·02	16·80	1·38
83269	7	Expermental Station, Rosthern, Sask.	Garnet O. 652	26·91	9·95	14·18	15·75	1·66
70	8	" "	Marquis O·15	31·54	10·02	14·80	16·45	1·55
339	77	" "	Brownie	24·14	10·27	15·54	17·32	1·55
40	78	" "	Ceres (M. x K. 1658)	28·41	10·27	15·56	17·34	1·61
83341	25-79	" "	Early Triumph	24·67	10·18	15·96	17·77	1·90
42	80	" "	Garnet	24·00	9·87	15·45	17·16	1·48
43	81	" "	Kitchener	28·84	9·70	13·83	15·32	1·53
44	82	" "	Kota	27·40	9·61	17·16	18·99	1·63
45	83	" "	Marquis O·15	31·56	10·00	15·39	17·10	1·79
46	84	" "	Orchard Sel	28·37	10·05	15·87	17·65	1·72

TABLE No. 29.—WHEAT: COMPOSITION OF THE WHEAT KERNEL AS INFLUENCED BY HEREDITY AND ENVIRONMENT—CROP OF 1925—*Concluded*

Lab'y. No.	Milling No.	Locality	Variety	Weight of 1,000 kernels	Moisture	Protein (N x 5·7)	On Water-free basis	
							Protein (N. x 5·7)	Ash
				grms.	p.c.	p.c.	p.c.	p.c.
47	85	Experimental Station, Rosthern, Sask.	Preston	29·52	10·23	15·06	16·78	1·72
48	86	" "	Reward	30·99	10·81	17·35	19·45	1·61
49	87	" "	Red Fife	27·20	10·69	15·59	17·46	1·70
50	88	" "	Ruby	26·93	10·78	16·03	17·97	1·50
51	89	" "	Supreme	26·40	10·59	14·33	16·03	1·71
83271	9	Experimental Station, Scott, Sask.	Garnet O·652	27·52	10·73	13·72	15·59	1·28
72	10	" "	Marquis O·15	34·41	10·37	14·63	16·32	1·84
83352	90	" "	Brownie	28·53	11·05	15·62	17·56	1·34
53	91	" "	Early Triumph	37·34	10·81	13·93	15·63	1·25
54	92	" "	Garnet	31·82	9·93	14·55	16·15	1·34
55	93	" "	Golden	34·59	11·54	15·70	17·74	1·40
56	94	" "	Kitchener	36·65	10·25	13·25	14·77	1·31
57	95	" "	Kota	35·34	11·10	16·14	18·15	1·44
58	96	" "	Marquis O·15	35·78	9·78	15·63	17·32	1·39
59	97	" "	Red Fife	33·14	6·93	15·57	16·73	1·18
60	98	" "	Red Bobs	36·81	10·02	14·14	15·71	1·27
61	99	" "	Reward	35·01	10·39	17·45	19·47	1·52
62	100	" "	Supreme	35·60	9·30	13·68	14·75	1·31
63	101	Experimental Station, Lacombe, Alta.	Early Red Fife	37·23	8·99	14·56	16·00	1·32
64	102	" "	Triumph	33·88	8·28	14·16	15·44	1·16
65	103	" "	Garnet O·652	26·22	11·00	15·80	17·75	1·63
66	104	" "	C. 14733 Hard Federation	37·94	10·51	14·14	15·81	1·39
67	105	" "	Kitchener	35·11	8·94	12·81	14·07	1·34
68	106	" "	Kota	33·40	8·77	15·99	17·53	1·35
69	107	" "	Huron O·3	31·25	9·32	15·97	17·61	1·36
70	108	" "	Marquis O·15	33·69	9·73	14·34	15·88	1·66
71	109	" "	Pioneer	27·88	7·34	16·95	18·29	1·32
72	110	" "	Quality	39·28	9·95	13·01	14·45	1·32
73	111	" "	Renfrew	36·04	6·94	16·93	18·19	1·38
74	112	" "	Reward	32·00	10·47	18·24	20·37	1·39
75	113	" "	Ruby	29·13	8·28	16·56	18·05	1·56
76	114	" "	Supreme	32·43	10·16	.....	.....	1·30
77	115	" "	Producer O·17	40·55	10·24	14·43	16·08	1·27
78	116	" "	Univ. of A. No. 222	31·83	10·36	14·61	16·39	1·17
83275	13	Experimental Station, Lethbridge, Alta.	Garnet O·652	28·96	10·32	12·17	13·57	1·85
76	14	" "	Marquis O·15	26·90	8·93	17·00	18·66	1·76
79	25–117	" "	Ceres (M. x K. 1658)	24·23	10·97	16·67	18·72	1·57
80	118	" "	Kitchener	25·37	9·38	16·68	18·41	1·92
81	119	" "	Kota	24·83	9·86	17·19	19·07	1·83
82	120	" "	Marquis O·15	21·21	8·13	17·84	19·42	1·91
83	121	" "	Marquis (weathered)	22·40	9·89	18·01	20·00	1·95
84	122	" "	Red Fife (dup.)	24·24	9·30	18·88	20·82	1·95
85	123	" "	Reward (weathered)	24·77	9·61	17·76	20·46	1·80
86	124	" "	Renfrew (original)	26·79	10·10	15·76	17·53	1·69
87	125	" "	Supreme (weathered) (duplicate)	24·60	9·95	15·63	17·36	1·41
88	126	" "	U. of A. 222 (duplicate)	26·49	9·68	15·10	16·72	1·55
89	127	" "	Garnet (weathered) duplicate	29·04	9·34	14·14	15·60	1·72
90	128	" "	Kitchener	40·05	8·70	13·32	14·59	1·47
91	129	" "	Marquis O·15	35·74	8·54	13·30	14·54	1·70
92	130	" "	" 10 B. (weath.)	36·33	7·59	12·99	14·06	1·54
93	131	" "	Reward	35·34	10·40	17·30	19·31	1·70
94	132	" "	" (weathered) dup.	36·37	10·09	16·85	18·74	1·63
95	133	" "	Ruby (weathered)	30·73	8·43	15·91	17·37	1·66
96	134	" "	Supreme (weathered)	34·45	6·33	13·15	14·04	1·47
83397	135	Experimental Station, Beaverlodge, Alta.	Early Red Fife	34·20	9·97	15·71	17·45	1·49
98	136	" "	Early Triumph	29·98	9·20	15·45	17·01	1·30
99	137	" "	Garnet	23·01	7·32	14·75	15·94	1·90
400	138	" "	Huron O·3	28·40	10·66	15·22	17·03	1·41
01	139	" "	Kitchener	30·12	8·17	14·86	16·18	1·33
02	140	" "	Marquis O·15	32·24	8·22	16·51	17·99	1·71
03	141	" "	Red Bobs	31·22	8·04	15·29	16·63	1·32
04	142	" "	Reward	31·89	10·11	17·57	19·55	1·27
05	143	" "	Ruby	26·56	7·84	16·24	17·62	1·40
06	144	" "	Garnet	24·45	9·15	14·34	15·78	1·44
07	145	" "	Marquis O·15	28·52	8·51	14·76	16·13	1·32
08	146	" "	Reward	33·92	10·11	16·09	17·79	1·39
09	147	Experimental Station, Fort Vermilion, Alta.	Garnet O·652	32·94	9·79	14·69	16·28	1·58
10	148	" "	Huron O·3	39·26	10·97	11·93	13·40	1·47
11	149	" "	Kitchener	38·74	8·53	12·13	13·26	1·72
12	150	" "	Marquis O·15	37·53	10·02	15·22	16·91	1·79
13	151	" "	Red Fife O·17	40·48	9·39	14·38	15·87	1·73
14	152	" "	Reward	37·04	9·11	15·91	17·50	1·80
15	153	" "	Red Bobs	38·38	8·82	14·43	15·82	1·67
16	154	" "	Renfrew U. of A. 111	41·53	10·04	13·79	15·34	1·93
17	155	" "	Ruby	32·69	11·40	14·14	15·96	1·86
18	156	" "	U. of A.	.....	.....	.....	.....	.....

TABLE No. 30.—WHEAT: COMPOSITION OF THE WHEAT KERNEL AS INFLUENCED BY HEREDITY AND ENVIRONMENT: CROP OF 1926.

Lab'y. No.	Milling No.	Locality	Variety	Weight of 1,000 kernels	Moisture	Protein (N. x 5·7)		Ash (Water-free basis)
						13·5 Moisture basis	Water-free basis	
				gm.	p.c.	p.c.	p.c.	p.c.
80127	26-1	Brandon, Man.	Axminster	28·05	11·46	15·81	18·27	1·93
28	2	"	Ceres	32·05	11·53	16·28	18·82	1·74
29	3	"	Garnet 0·652	26·91	10·37	15·70	18·14	1·59
30	4	"	Kota	27·18	10·86	16·12	18·63	1·73
31	5	"	Marquillo	34·28	12·18	14·85	17·12	2·25
32	6	"	Marquis 0·15	29·79	10·43	15·74	18·20	1·69
33	7	"	Parker's Sel.	30·65	11·14	16·13	18·65	1·65
34	8	"	Quality	30·06	11·34	12·95	14·97	1·78
35	9	"	Reward 0·928	35·30	11·44	16·15	18·68	1·66
36	10	"	Red Fife 0·17	22·70	11·36	12·76	14·74	2·05
37	11	"	Renfrew	31·70	10·86	15·68	18·12	1·76
38	12	Morden, Man.	Garnet	25·05	10·79	9·94	11·49	1·81
39	13	"	Marquis	25·51	10·74	10·35	11·98	2·06
40	14	"	Reward	38·17	10·67	14·82	17·15	1·99
41	15	Indian Head, Sask.	Ceres	32·99	12·48	12·55	14·51	1·82
42	16	" "	Early Red Fife 0·16	38·97	12·10	11·70	13·54	2·23
43	17	" "	Garnet 0·652	26·72	10·54	12·04	14·06	1·41
44	18	" "	Kitchener	33·04	12·34	12·33	14·26	1·95
45	19	" "	Kota	31·40	12·41	14·15	16·36	1·72
46	20	" "	Marquis 0·15	30·24	10·03	12·83	14·84	1·60
47	21	" "	Parker's Sel.	33·12	12·35	13·62	15·75	1·97
48	22	" "	Red Fife 0·17	30·98	12·23	12·70	14·68	2·09
49	23	" "	Reliance	34·52	12·30	11·55	13·36	1·96
50	24	" "	Renfrew	33·30	11·68	12·55	14·49	1·83
51	25	" "	Reward 0·928	32·70	11·76	13·55	15·66	1·65
52	26	" "	Supreme	31·14	12·42	12·25	14·16	1·52
53	27	Swift Current, Sask.	Early Red Fife 0·16	30·70	10·90	15·69	18·13	1·60
54	28	" "	Early Triumph	25·71	10·64	16·19	18·72	1·34
55	29	" "	Garnet 0·652	23·28	10·62	16·29	18·82	1·56
56	30	" "	Kitchener	25·81	11·67	14·69	16·98	1·66
57	31	" "	Kota	25·68	11·09	17·88	20·67	1·64
58	32	" "	Marquis (North Cote)	27·02	10·13	16·48	19·05	1·69
59	33	" "	Reward 0·928	28·59	9·93	17·72	20·49	1·57
60	34	" "	Supreme	26·00	11·69	16·63	19·22	1·47
61	35	Rosthern, Sask.	Ceres	30·19	11·89	14·64	16·92	1·52
62	36	"	Early Red Fife	32·62	12·02	14·01	16·19	1·25
63	37	"	Early Triumph	30·66	11·99	13·41	15·50	1·31
64	38	"	Garnet 0·652	21·15	10·41	14·01	16·19	1·24
65	39	"	Kitchener	28·74	11·99	13·75	15·90	1·50
66	40	"	Kota	28·36	11·92	15·55	17·99	1·41
67	41	"	Marquis 0·15	24·92	9·59	14·93	17·26	1·29
68	42	"	Red Fife 0·17	26·28	10·99	16·02	18·51	1·64
69	43	"	Reward 0·928	29·25	11·17	15·60	18·03	1·30
70	44	"	Supreme	27·45	11·26	13·71	15·85	1·35
71	45	Scott, Sask.	Early Red Fife	35·00	11·21	15·65	18·09	1·42
72	46	"	Early Triumph	31·16	10·90	16·36	18·91	1·45
73	47	"	Garnet 0·652	24·68	9·78	17·21	19·90	1·71
74	48	"	Kitchener	30·32	10·59	15·20	17·58	1·50
75	49	"	Marquis 10 B.	29·98	9·54	16·29	18·84	1·39
76	50	"	Red Fife 0·17	29·78	10·91	17·21	19·89	1·44
77	26-51	"	Reward 0·928	33·28	11·02	15·90	18·38	1·54
78	52	"	Supreme	31·47	11·05	16·06	18·57	1·41
79	53	Lethbridge, Alta.	Ceres	23·12	11·22	15·42	17·82	1·69
80	54	" "	Early Triumph	28·02	11·24	13·77	15·92	1·44
81	55	" "	Garnet 0·652	28·96	10·60	15·03	17·38	1·91
82	56	" "	Kitchener	29·72	10·74	13·92	16·10	1·58
83	57	" "	Kota	27·10	11·15	16·06	18·58	1·62
84	58	" "	Marquis 10 B.	28·96	10·51	15·01	17·36	1·51
85	59	" "	Red Fife 0·17	26·58	11·86	16·36	18·91	1·59
86	60	" "	Renfrew	31·61	11·54	14·21	16·43	1·86
87	61	" "	Reward	27·79	10·56	16·50	19·07	1·60
88	62	" "	Supreme	27·78	10·47	13·68	15·81	1·32
89	63	" "	Early Triumph	33·78	10·79	11·74	13·57	1·76
90	64	" "	Garnet 0·652	28·00	10·86	11·49	13·28	1·80
91	65	" "	Marquis 10 B.	36·24	9·93	13·54	15·65	1·57
92	66	" "	Red Fife 0·17	33·30	10·45	11·63	13·46	1·89
93	67	" "	Renfrew	38·77	10·80	11·02	12·74	1·75
94	68	" "	Reward 0·928	31·82	10·40	12·82	14·82	1·86
95	69	" "	Garnet 0·652	31·31	10·99	12·46	14·40	1·37
96	70	" "	" 0·652	31·18	10·93	12·89	14·90	1·45
97	71	" "	" 0·652	29·38	10·97	14·22	16·44	1·84
98	72	" "	Marquis 0·15	32·46	10·53	13·61	15·74	1·61
99	73	" "	" 0·15	30·30	10·11	13·27	15·35	1·58
200	74	" "	Renfrew	38·10	11·02	13·13	15·18	2·02
01	75	" "	Reward	35·41	10·54	16·73	19·34	1·59
02	76	Beaverlodge, Alta.	Early Red Fife 0·16	35·84	10·44	11·68	13·50	1·43
03	77	" "	Early Triumph	32·83	10·23	11·84	13·70	1·24
04	78	" "	Garnet 0·652	27·32	10·61	12·03	13·91	1·26
05	79	" "	Huron 0·3	34·80	10·21	12·10	13·99	1·40
06	80	" "	Kitchener	36·06	11·22	11·04	12·76	1·22
07	81	" "	Marquis 0·15	31·31	10·03	14·29	16·51	1·49
08	82	" "	Red Bobs	35·52	10·90	12·26	14·17	1·26
09	83	" "	Reward 0·928	34·05	8·99	14·79	17·10	1·30
10	84	" "	Ruby 0·623	30·46	10·73	13·15	15·20	1·19

TABLE No. 31.—WHEAT: COMPOSITION OF WHEAT KERNEL AS INFLUENCED BY HEREDITY AND ENVIRONMENT: CROP OF 1927

Lab'y. No.	Milling No.	Locality	Variety	Weight of 1,000 kernels	Moisture	Protein (N. x 5·7)		Ash (Water-free basis
						13·5% Moisture basis	Water-free basis	
				gms.	p.c.	p.c.	p.c.	p.c.
94243	104	Brandon, Man.	Axminster	28·33	10·02	11·45	13·23	2·12
44	105	"	Ceres	28·82	10·19	11·81	13·67	2·25
45	106	"	Garnet	16·85	10·08	10·14	11·72	1·90
46	107	"	Kota	23·58	10·03	11·51	13·30	2·06
47	108	"	Marquillo	32·82	9·76	12·31	14·23	2·00
48	109	"	Marquis	32·48	10·56	11·88	13·73	1·83
49	110	"	Parker's Sel	28·54	10·49	11·98	13·85	2·12
50	111	"	Quality	27·36	10·18	11·37	13·15	2·09
51	112	"	Renfrew	21·76	10·25	10·21	11·80	2·38
52	113	"	Rewnrd	28·77	10·49	12·29	14·21	2·06
94187	12	Morden, Man.	Aurora	29·52	11·30	11·19	12·93	2·10
88	13	"	Axminster	32·30	10·79	13·01	15·04	2·04
89	14	"	Ceres	27·36	11·07	13·46	15·55	2·00
90	15	"	Garnet	28·34	11·04	11·33	13·10	2·02
91	16	"	Kota	28·60	10·86	14·14	16·35	2·23
92	17	"	Marquillo	34·64	10·84	13·50	15·61	1·99
93	18	"	Marquis	30·90	11·11	12·44	14·38	2·16
94	19	"	Parker's Sel	33·40	11·20	13·93	16·10	2·09
95	20	"	Quality	37·26	11·18	13·13	15·18	2·08
96	21	"	Reward	35·61	11·40	14·79	17·10	2·14
94253	114	Indian Head	Ceres	33·70	9·72	14·06	16·25	1·98
54	115	"	E. Red Fife	34·62	8·98	11·17	12·91	1·85
55	116	"	Garnet	28·36	10·28	13·65	15·81	1·89
56	117	"	Kitchener	36·02	9·76	11·54	13·35	1·90
57	118	"	Kota	27·40	9·98	14·36	16·62	2·06
58	119	"	Marquis 0-15	34·69	10·11	13·23	15·30	1·96
59	120	"	Red Bobs No. 222	28·16	9·87	13·25	15·32	1·93
60	121	"	Red Fife	29·10	9·78	13·82	15·99	2·11
61	122	"	Reliance	32·90	9·82	12·69	14·33	1·86
62	123	"	Renfrew	39·26	10·46	12·90	14·58	2·02
63	124	"	Reward	35·87	11·23	15·75	18·22	1·88
64	125	"	Supreme	32·68	10·11	12·65	14·62	1·79
94176	27-1	Rosthern, Sask.	Ceres	35·09	11·24	13·90	16·06	1·50
77	2	"	Early Red Fife	29·06	10·31	9·70	11·21	1·74
78	3	"	Triumph	31·45	11·10	12·06	13·95	1·73
79	4	"	Garnet	28·56	9·87	13·02	15·06	1·68
80	5	"	Kitchener	29·82	9·37	10·62	12·28	1·77
81	6	"	Kota	31·64	10·25	14·27	16·49	1·75
82	7	"	Marquis 0·15	33·71	10·12	12·44	14·37	1·77
83	8	"	Preston	31·59	11·23	12·01	13·89	1·71
84	9	"	Reward	35·12	10·81	15·46	17·87	1·78
85	10	"	Red Fife	29·06	11·39	12·28	14·20	1·61
86	11	"	Supreme	28·52	11·59	11·04	12·76	1·71
94207	44	Scott, Sask.	E. 0·16	31·42	11·09	13·29	15·37	1·45
208	45	"	Early Triumph	24·52	10·64	13·24	15·31	1·70
209	46	"	Garnet 0·652	26·48	11·48	12·89	14·90	1·41
210	47	"	Kitchener	28·08	10·12	14·06	16·26	1·65
211	48	"	Marquis 0–15	29·61	10·33	15·06	17·41	1·49
212	49	"	" 10–B	29·05	10·62	15·71	18·17	1·61
213	50	"	Red Fife 0–17	23·84	10·36	15·91	18·40	1·86
214	51	"	Renfrew	30·62	10·52	14·17	16·38	1·20
215	52	"	Reward 0–928	32·77	10·83	16·58	19·16	1·68
216	53	"	Ruby	24·94	10·89	13·80	15·96	1·64
217	54	"	Supreme	24·30	11·13	12·89	14·90	1·56
218	61	Swift Current, Sask.	Ceres	32·30	10·99	15·10	17·45	1·57
19	62	" "	E. Red Fife 0·16	34·46	10·77	11·84	13·69	1·52
20	63	" "	Garnet S.C. 31	30·72	10·64	12·68	14·66	1·49
21	64	" "	Kitchener	32·40	10·26	12·44	14·37	1·42
22	65	" "	Mnrquis (S.C. 103 Northcote)	35·09	11·02	12·67	14·64	1·69
23	66	" "	Suprome	28·64	10·15	12·01	13·89	1·51
24	67	" "	Reliance	34·35	10·15	13·45	15·55	1·49
25	68	" "	Renfrew	34·86	10·71	13·71	15·83	1·61
26	69	" "	Rewnrd	34·12	10·80	16·26	18·79	1·76
27	70	Lacombe, Alta.	Ceres	33·92	11·31	15·50	17·93	1·84
28	71	"	Early Red Fife	37·84	10·31	12·01	13·90	1·73
29	72	"	Early Triumph	37·59	10·86	11·19	12·93	1·75
30	73	"	Garnet 0-652	33·49	11·59	13·21	15·28	1·76
31	74	"	Kitchener	36·94	10·39	11·41	13·19	1·91
32	75	"	Huron	35·60	9·97	13·45	15·94	1·74
33	76	"	Kota	31·08	11·09	15·46	17·87	2·00
34	77	"	Marquis 10–B	37·62	10·86	13·53	15·64	1·83
35	78	"	" 0–15	38·25	10·85	13·89	16·05	1·77
36	79	"	Prelude	31·76	10·89	14·00	16·18	1·78
37	80	"	Producer 0–197	29·19	10·64	13·69	15·82	1·69
38	81	"	Red Bobs No. 222	36·93	10·46	12·98	15·01	1·68
39	82	"	Renfrew U. of A.	33·66	10·36	11·93	13·79	1·86
40	83	"	Reward	37·96	10·63	15·24	17·62	1·75
41	84	"	Ruby	34·24	9·99	14·78	17·08	1·79
42	85	"	Supreme	34·82	10·39	11·53	13·34	1·69
65	160	Lethbridge, Alta.	Ceres	33·90	9·90	14·90	17·24	1·74
66	161	" "	Early Red Fife	36·64	10·84	12·60	14·56	1·88
67	162	" "	Early Triumph	35·06	10·41	12·28	14·19	1·62

TABLE No. 31.—WHEAT: COMPOSITION OF WHEAT KERNEL AS INFLUENCED BY HEREDITY AND ENVIRONMENT: CROP OF 1927—*Concluded*

Lab'y. No.	Milling No.	Locality	Variety	Weight of 1,000 kernels	Moisture	Protein (N. x 5·7)		Ash (Water-free basis)
						13·5% Moisture basis	Water-free basis	
				gms.	p.c.	p.c.		p.c.
68	163	Leth, ridge, Alta.	Garnet	29·66	10·32	12·33	14·25	1·53
69	164	" "	N. Fisher's 1. B.	34·10	9·74	13·76	15·91	1·67
70	165	" "	" 2. B.	37·94	10·10	11·67	13·49	1·50
71	166	" "	Hard Federation 31	37·22	10·53	13·41	15·50	1·78
72	167	" "	" " 71	37·40	9·75	12·31	14·23	1·73
73	168	" "	" " 4733	36·20	10·28	12·86	14·87	1·87
74	169	" "	White Federation 4981	45·90	10·83	12·71	14·69	1·75
75	170	" "	Kitchener	37·42	10·11	12·69	14·67	1·65
76	171	" "	Kota	28·93	10·36	16·10	18·61	1·95
77	172	" "	Marquis 0·15	30·94	10·49	14·00	16·18	1·78
78	173	" "	" 10-B	34·68	11·11	13·76	15·91	1·71
79	174	" "	Red Fife 0-17	32·24	9·78	15·12	17·48	1·81
80	175	" "	Renfrew	34·60	10·13	14·04	16·23	1·74
81	176	" "	Reward	36·01	11·43	15·24	17·62	1·67
82	177	" "	Ruby	28·90	10·53	14·13	16·33	1·50
83	178	" "	Supreme	32·44	10·52	12·80	14·80	1·60
84	179	" "	Red Bobs No. 222	32·51	9·97	13·11	15·16	1·54
85	180	" "	Huron	33·10	10·81	14·22	16·44	1·57
86	181	" "	928 QQ 2	30·56	9·83	14·71	17·00	1·69
87	184	" "	Early Triumph	34·52	10·36	12·37	13·97	1·48
88	185	" "	Garnet	27·24	11·69	12·71	14·69	1·55
89	186	" "	Marquis	30·94	10·79	13·73	15·87	1·58
90	187	" "	Reward	31·55	11·02	15·01	17·35	1·52
91	188	" "	Ruby	28·32	9·62	14·44	16·69	1·63
94197	22	Fort Vermilion, Alta.	Garnet	35·05	11·33	13·47	15·57	1·59
98	23	" "	Huron 0·3	39·32	11·61	12·41	14·35	1·73
99	24	" "	Kitchener	38·36	11·96	11·91	13·77	1·40
94200	25	" "	Marquis 0·15	37·14	11·05	14·22	16·44	1·64
201	26	" "	Prelude 0·135	33·64	11·82	18·36	21·22	1·91
202	27	" "	Red Bobs No. 1	37·90	11·66	14·32	16·56	1·66
203	29	" "	Renfrew	41·74	11·41	13·11	15·17	1·55
204	30	" "	Reward 0·928	38·55	11·40	17·38	20·09	1·96
205	31	" "	Ruby 0·63	33·60	11·69	15·92	18·40	1·76
206	32	" "	Red Fife 0·17	40·38	11·81	11·76	13·59	1·83

It is of the greatest importance to Canada as one of the chief grain producing countries of the world that all possible information, from scientific enquiry should be obtained regarding the influence of heredity, of soil and seasonal conditions on the composition and quality of the wheat berry. A study of this character must necessarily be carried on over a period of years before conclusions of permanent value can be drawn. Already this inquiry has been prosecuted for five years with a large number of well established and newly developed varieties, and valuable data have been recorded. It would seem desirable to defer detailed discussion of the results until data from a sufficient number of years have been accumulated to justify final pronouncements on these important and fundamental factors towards success of the wheat growing in Canada.

It will, however, be of interest at this juncture to summarize the protein content of the three principle varieties of wheat—Marquis, Garnet and Reward, since they are the varieties represented every year at nine Stations and are those, at the present time, which are more particularly under investigation as to relative value.

The following table (No. 32) presents the maxima, minima and average protein data for these three varieties, classified as to provinces for the five years 1924 to 1928, inclusive.

TABLE NO. 32.—MARQUIS, GARNET AND REWARD WHEATS, GROWN ON EXPERIMENTAL FARMS AND STATIONS IN MANITOBA, ALBERTA AND SASKATCHEWAN.—PROTEIN DATA (WATER-FREE BASIS)—CROPS 1924-1928 (INCLUSIVE)

Variety	Manitoba Exp. Farm—Brandon Exp. Station—Morden			Saskatchewan Ex. Farm—Indian Head Exp. Station—Swift Current Exp. Station—Rosthern Exp. Station—Scott			Alberta Exp. Station—Lethbridge Exp. Station—Beaverlodge Ex. Station—Fort Vermilion			Manitoba Alberta Saskatchewan (9 Stations)		
	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
1924												
Marquis	14·04	14·52	14·58	17·75	15·78	17·05	17·78	15·04	16·32	17·78	14·52	16·34
Garnet	14·37	14·36	14·37	17·83	16·32	16·95	17·81	14·83	15·86	17·83	14·36	15·90
Reward	18·19	17·38	17·79	18·66	17·55	18·13	20·25	12·31	16·46	20·25	12·31	17·49
1925												
Marquis	15·59	11·65	14·55	18·83	16·32	17·38	19·42	16·13	17·49	19·42	11·65	16·78
Garnet	15·13	13·95	14·37	17·57	15·59	16·54	17·75	13·57	15·86	17·57	13·57	15·83
Reward	17·94	16·62	17·28	19·47	16·92	18·76	19·55	17·50	18·80	19·55	16·62	18·48
1926												
Marquis	18·20	11·98	15·09	19·05	14·84	17·50	17·36	16·51	16·94	19·05	11·98	16·75
Garnet	18·14	11·49	14·82	19·90	14·96	17·47	17·38	13·91	15·64	19·90	11·49	16·35
Reward	18·68	17·15	17·92	20·49	15·66	18·17	19·07	17·10	18·09	20·49	15·66	18·07
1927												
Marquis	14·38	13·73	14·06	18·17	14·37	15·53	16·44	15·64	16·04	18·17	13·73	15·68
Garnet	13·10	11·72	12·41	15·81	14·66	15·11	15·57	14·25	14·95	15·81	11·72	14·50
Reward	17·10	14·21	15·66	19·16	17·87	18·51	20·09	17·35	18·17	20·09	14·21	17·80
1928												
Marquis	18·36	16·63	17·50	18·55	15·48	17·23	17·59	14·56	16·16	18·55	14·56	16·93
Garnet	13·53	12·30	12·92	16·14	14·45	15·33	19·42	12·00	15·64	19·42	12·00	14·90
Reward	19·33	19·25	19·29	19·86	15·01	18·09	20·93	18·09	19·12	20·93	15·01	18·70
Average for 5 years of all varieties for each province.			15·51			17·18			16·77			

Comparing these three wheats as to protein content, Reward stands highest, Marquis second and Garnet last. The average difference between Reward and Marquis is 1·62 per cent, between Reward and Garnet, 2·62 per cent. This order is that found for these varieties in previous years, as noted in the annual report of this division for 1929.

The results stand as follows:—

MARQUIS, GARNET AND REWARD WHEATS

Average protein content for five years at nine stations.

	Protein p.c.
Marquis	16.49
Garnet	15.49
Reward	18.11

Comparing the averages for protein in the three provinces, Saskatchewan has given the highest (17·18 per cent), Alberta the second (16·77 per cent) and Manitoba the third (15·51 per cent).

WHEAT, OATS AND PEAS GROWN TO PRODUCE HIGH PROTEIN GRAIN MIXTURE

The chemical work in this investigation was undertaken at the request of the Cereal Division, to ascertain by analysis and calculation what crop of grain—peas, wheat or oats—singly or in combination would produce the crop which, capable of being harvested by the binder, yielded the highest weight of protein per acre.

The experimental plots consisted of five rows of grain each 16½ feet long. Three varieties of peas, Lemaire, Early Blue and Chancellor were sown, Lemaire at the rate of 2½ bushels per acre; Early Blue and Chancellor 2

bushels to the acre, also two varieties of wheat, Reward and Hard Federation, each at the rate of $1\frac{3}{4}$ bushels per acre; and two varieties of oats, Gold Rain and Alaska, $2\frac{1}{2}$ bushels to the acre. When two kinds of grain were sown each variety of peas was mixed with each variety of wheat and of oats at the rate of $1\frac{3}{4}$ bushels peas to 1 bushel wheat or of oats; when three kinds of grain were sown, peas, wheat and oats were sown in all possible combinations, peas at the rate of $1\frac{3}{4}$ bushels per acre, wheat and oats, each, $\frac{1}{2}$ bushel per acre.

In addition 9 plots were sown in 3 groups of 3 plots each. In the first group Chancellor, Reward, Gold Rain were combined. On each plot $\frac{1}{2}$ bushels of wheat and $\frac{1}{2}$ bushels of oats were sown together with 1 bushel peas on the first plot, $1\frac{3}{4}$ bushels on the second and $2\frac{1}{2}$ bushels on the third.

In the second group Chancellor peas and Reward wheat were grown together, 1 bushel of wheat being sown with $1\frac{1}{4}$ bushels peas, $1\frac{3}{4}$ bushels and $2\frac{1}{4}$ bushels on each of the three plots, respectively.

In the third group Chancellor peas and Gold Rain oats were used, oats at the rate of 1 bushel per acre, and the peas on the three plots at the rate of $1\frac{1}{4}$, $1\frac{3}{4}$, and $2\frac{1}{4}$ bushels, per acre.

Table No. 33 presents the analysis of the series (40 plots) arranged in order of plot number. The data given comprise, in addition to the rates of sowing, the percentage by weight of the grain as harvested, percentage of moisture as ground and of protein as ground and on the dry matter basis, and lastly, the yield of protein in grams per plot.

TABLE NO. 33.—HIGH PROTEIN MIXTURE: WHEAT, OATS AND PEAS—CROP OF 1929

Lab'y. No.	Plot No.	Grains and their variety	Rate sown per acre	Weight of components of harvested grain	Total weight of harvested grain	Percentage by weight as harvested (grain)	Moisture (as ground)	Protein (N. x 6·25)	
								As ground	Yield per plot
			bush.	gms.	gms.		p.c.	p.c.	gms.
101897	1	Peas: Lemaire	$2\frac{1}{2}$	1,114·0	1,114·0	100·0	8·28	25·71	286·4
98	2	Peas: Lemaire	$1\frac{3}{4}$	473·7	740·8	63·9	7·71	23·56	174·5
		Wheat: Reward	1	267·1	.....	36·1	.....	.....	.....
99	3	Peas: Lemaire	$1\frac{3}{4}$	449·5	620·4	72·5	7·82	22·62	140·3
		Wheat: Hard Federation	1	170·9	.....	27·5	.....	.....	.....
900	4	Peas: Early Blue	$1\frac{3}{4}$	796·1	959·1	83·0	6·52	24·57	235·6
		Wheat: Reward	1	163·0	.....	17·0	.....	.....	.....
901	5	Peas: Early Blue	$1\frac{3}{4}$	801·3	904·6	86·6	7·26	24·03	217·4
		Wheat: Hard Federation	1	103·3	.....	11·4	.....	.....	.....
902	6	Peas: Early Blue	2	1,248·8	1,248·8	100·0	7·51	25·60	319·7
903	7	Peas: Chancellor	$1\frac{3}{4}$	603·1	818·0	73·7	6·81	24·18	197·8
		Wheat: Reward	1	214·9	.....	26·3	.....	.....	.....
904	8	Peas: Chancellor	$1\frac{3}{4}$	744·5	839·7	88·6	6·89	24·57	206·3
		Wheat: Hard Federation	1	95·2	.....	11·4	.....	.....	.....
905	9	Peas: Lemaire	$1\frac{3}{4}$	363·0	1,153·6	31·5	5·78	18·16	209·5
		Oats: Alaska	1	790·6	.....	68·5	.....	.....	.....
906	10	Peas: Lemaire	$1\frac{3}{4}$	126·0	1,263·1	10·0	5·33	14·94	188·7
		Oats: Gold Rain	1	1,137·1	.....	90·0	.....	.....	.....
907	11	Peas: Chancellor	2	1,263·1	1,263·1	100·0	7·11	24·68	311·7
908	12	Peas: Early Blue	$1\frac{3}{4}$	566·3	1,332·7	42·5	4·85	19·88	265·1
		Oats: Alaska	1	766·4	.....	57·5	.....	.....	.....
909	13	Peas: Early Blue	$1\frac{3}{4}$	349·7	1,307·9	20·7	6·32	16·69	218·3
		Oats: Gold Rain	1	958·2	.....	73·3	.....	.....	.....
910	14	Peas: Chancellor	$1\frac{3}{4}$	607·4	1,233·1	49·3	4·78	20·34	250·9
		Oats: Alaska	1	625·7	.....	50·7	.....	.....	.....
911	15	Peas: Chancellor	$1\frac{3}{4}$	459·9	1,313·6	35·0	5·46	18·03	236·8
		Oats: Gold Rain	1	853·7	.....	65·0	.....	.....	.....
912	16	Wheat: Reward	$1\frac{3}{4}$	424·2	424·2	100·0	6·83	18·66	79·3

TABLE No. 33.—HIGH PROTEIN MIXTURE: WHEAT, OATS AND PEAS—CROP OF 1929—*Concluded*

Lab'y. No.	Plot No.	Grains and their variety	Rate sown per acre	Weight of components of harvested grain	Total weight of harvested grain	Percentage by weight as harvested (grain)	Moisture (as ground)	Protein (N. x 6·25)	
								As ground	Yield per plot
			bush.	gms.	gms.		p.c.	p.c.	gms.
913	17	Peas: Lemaire	1¾	267·0		32·6			
		Wheat: Reward	½	110·5	819·3	13·5	6·04	19·97	163·6
		Oats: Alaska	½	441·8		53·9			
914	18	Peas: Lemaire	1¾	119·9		13·7			
		Wheat: Reward	½	95·1	872·3	10·9	5·51	15·69	136·9
		Oats: Gold Rain	½	657·3		75·4			
915	19	Peas: Lemaire	1¾	332·0		40·7			
		Wheat: H. Federation	½	73·6	814·9	9·0	5·58	19·87	161·9
		Oats: Alaska	½	409·3		50·3			
916	20	Peas: Lemaire	1¾	194·0		22·6			
		Wheat: H. Federation	½	74·3	859·3	8·6	6·42	16·25	139·6
		Oats: Gold Rain	½	591·0		68·8			
917	21	Wheat: Hard Federation	1¾	254·8	254·8	100·0	6·66	13·88	35·4
918	22	Peas: Early Blue	1¾	670·7		70·0			
		Wheat: Reward	½	66·0	958·0	6·9	5·89	23·10	221·5
		Oats: Alaska	½	221·3		23·1			
919	23	Peas: Early Blue	1¾	502·5		53·3			
		Wheat: Reward	½	63·8	908·6	7·0	6·17	20·84	189·4
		Oats: Gold Rain	½	342·3		37·7			
920	24	Peas: Early Blue	1¾	594·9		65·0			
		Wheat: H. Federation	½	50·6	915·2	5·5	6·08	21·88	200·2
		Oats: Alaska	½	269·7		29·5			
921	25	Peas: Early Blue	1¾	505·4		53·4			
		Wheat: H. Federation	½	63·6	945·8	6·7	6·27	20·50	193·9
		Oats: Gold Rain	½	376·8		39·9			
22	26	Oats: Alaska	2½	1,270·9	1,270·9	100·0	6·15	16·13	205·0
23	27	Peas: Chancellor	1¾	644·2		70·8			
		Wheat: Reward	½	50·0	909·6	5·5	4·85	23·53	213·7
		Oats: Alaska	½	215·4		23·7			
24	28	Peas: Chancellor	1¾	490·4		54·5			
		Wheat: Reward	½	66·6	899·4	7·4	3·70	21·78	195·9
		Oats: Gold Rain	½	342·4		38·1			
25	29	Peas: Chancellor	1¾	618·1		68·7			
		Wheat: H. Federation	½	58·2	899·1	6·5	3·78	23·00	206·8
		Oats: Alaska	½	222·8		24·8			
26	30	Peas: Chancellor	1¾	598·3		56·5			
		Wheat: H. Federation	½	56·5	1,059·2	5·3	6·00	21·00	222·4
		Oats: Gold Rain	½	404·4		38·2			
27	31	Oats: Gold Rain	2½	1,565·0	1,565·0	100·0	6·26	14·13	221·1
28	32	Peas: Chancellor	1	423·8		42·2			
		Wheat: Reward	½	78·4	1,005·5	7·8	5·84	19·35	194·5
		Oats: Gold Rain	½	503·3		50·0			
29	33	Peas: Chancellor	1¾	523·2		55·7			
		Wheat: Reward	½	52·3	938·2	5·7	5·85	20·95	196·6
		Oats: Gold Rain	½	362·7		38·6			
30	34	Peas: Chancellor	2½	556·6		57·1			
		Wheat: Reward	½	60·8	974·3	6·2	6·18	21·03	204·8
		Oats: Gold Rain	½	356·9		36·7			
31	35	Peas: Chancellor	1¾	662·0	837·0	79·1	6·95	23·97	200·6
		Wheat: Reward	1	175·0		20·9			
32	36	Peas: Chancellor	1¾	821·0	967·6	84·8	6·26	24·41	236·2
		Wheat: Reward	1	146·6		15·2			
33	37	Peas: Chancellor	2¼	887·9	995·8	89·2	7·81	24·62	245·1
		Wheat: Reward	1	107·9		10·8			
34	38	Peas: Chancellor	1¼	454·5	1,140·5	39·9	7·30	18·19	207·4
		Oats: Gold Rain	1	686·0		60·1			
35	39	Peas: Chancellor	1¼	553·8	1,176·0	47·1	6·67	19·32	227·2
		Oats: Gold Rain	1	622·2		52·9			
36	40	Peas: Chancellor	2¼	617·9	1,298·7	47·6	6·80	20·32	263·9
		Oats: Gold Rain	1	680·8		52·4			

After harvesting and threshing, the weights of the grain from each plot were taken and where the crop consisted of mixed grains a separation was made and the weight of each fraction ascertained. From this the percentage, by weight, of the several grains as harvested, was calculated. Analysis as to moisture and protein were made of all yields as harvested and the data for "yield per plot" of protein were obtained by multiplying the percentage of protein by the total weight of the harvested grain per plot.

SINGLE GRAIN CROPS

Table No. 34 presents the data for the plots sown with one grain only.

TABLE NO. 34.—HIGH PROTEIN GRAIN MIXTURES—WHEAT: OATS: PEAS: 1929

Grain	Variety	Total weight of harvested grain	Moisture (as ground)	Protein (N. x 6·25)		
				As ground	Dry matter basis	Yield per plot
		gms.	p.c.	p.c.	p.c.	gms.
Wheat	Reward	424·0	6·83	18·66	20·03	79·3
	Hard Federation	254·8	6·66	13·88	14·87	35·4
Oats	Alaska	1,270·9	6·16	16·13	17·19	205·0
	Gold Rain	1,565·0	6·26	14·13	15·08	221·1
Peas	Lemaire	1,114·0	8·28	25·71	28·03	286·4
	Early Blue	1,248·0	7·51	25·60	27·68	319·7
	Chancellor	1,263·1	7·11	24·68	26·57	311·7

Reward with a protein content of 20·0 per cent (d.m.b.) is the richer of the two varieties of wheat, Hard Federation having only 14·87 per cent of protein.

As in the case of the wheats, there is a considerable difference in the protein content of the two varieties of oats, Alaska being the better of the two, with a protein content of 17·19 per cent (d.m.b.) that of Gold Rain being 15·08 per cent. Both figures are decidedly above the average for oats.

The spread of protein among the three varieties of peas is not great—only 1 per cent. Chancellor is the lowest of the three, while the other two varieties, Lemaire and Early Blue should be ranked as equal.

Considering the series as a whole the peas are richest in protein—Reward wheat second, the two varieties of oats next with Hard Federation wheat ranking last.

The data of the table show that, speaking generally, protein content is directly related to protein yield; the grain with the highest percentage of protein has given the highest yield.

The three varieties of peas gave the highest weight of protein per unit area, and of these Early Blue ranks first, Chancellor second and Lemaire third. The differences among them are not large, the average being 306 grams per plot.

The oats are the second highest group in the series, and as in the case of the peas, the difference between the two varieties is insignificant. The average protein yield from the two plots is 213 grams.

The oats furnish the one example in the series of a crop with a lower percentage of protein producing a higher total yield. Gold Rain oats are two per cent lower in protein content than Alaska, but by reason of a much heavier yield, produced a slightly larger amount of protein per plot.

The plots sown with wheat produced distinctly less protein than those producing either peas or oats. The average protein yield from the two plots is 57 grams.

MIXED GRAIN CROPS

WHEAT AND PEAS

Table No. 35 presents the data for the plots sown with a mixture of wheat and peas.

TABLE NO. 35.—HIGH PROTEIN GRAIN MIXTURE—WHEAT AND PEAS

Plot No.	Grain	Variety	Rate sown	Total weight of grain as harvested	Moisture	(Protein (N. x 6·25)		
						As ground	Dry matter basis	Yield per plot
			bush.	grms.	p.c.	p.c.	p.c.	grms.
2	Wheat....	Reward.....	1	740·8	7·71	23·56	25·54	174·5
	Peas.....	Lemaire.....	1¾					
3	Wheat....	Hard Federation.....	1	620·4	7·82	22·62	24·53	140·3
	Peas.....	Lemaire.....	1¾					
4	Wheat....	Reward.....	1	959·1	6·52	24·57	26·28	235·6
	Peas.....	Early Blue.....	1¾					
5	Wheat....	Hard Federation.....	1	904·6	7·26	24·03	25·90	217·4
	Peas.....	Early Blue.....	1¾					
7	Wheat....	Reward.....	1	818·03	6·81	24·18	25·95	197·8
	Peas.....	Chancellor.....	1¾					
8	Wheat....	Hard Federation.....	1	839·7	6·89	24·57	26·39	206·3
	Peas.....	Chancellor.....	1¾					
35	Wheat....	Reward.....	1	837·0	6·95	23·97	25·77	200·6
	Peas.....	Chancellor.....	1¼					
36	Wheat....	Reward.....	1	967·6	6·26	24·41	26·04	236·2
	Peas.....	Chancellor.....	1¾					
37	Wheat....	Reward.....	1	995·8	7·81	24·62	26·71	245·1
	Peas.....	Chancellor.....	2¼					

There are no marked differences in the percentages of protein among the nine samples of this group, the range being from 24·53 per cent to 26·71 per cent. The weight of grain harvested from the several plots differ considerably and these differences are reflected in the yields of protein.

The largest yield of grain, 996 grams (plot 37) is associated with the largest weight of protein produced per plot, viz., 245 grams. This plot was sown with Reward wheat and Chancellor peas at the rate of 1 bushel of the former to 2¼ bushels of the latter. This is much the highest proportion of peas in the mixtures sown and this would account very satisfactorily for the mixture giving the highest protein yield. Contrariwise the lowest yield of grain 620 grams (plot 3) gave the lowest weight of protein per plot, 140 grams.

The protein yields of plots 4 and 36—Reward and Early Blue and Reward and Chancellor—are practically equal—235·6 and 236·2 grams, respectively. It is of interest to note that the percentage of protein in the ground grain is practically the same for both plots.

The two lowest protein yields were those from Lemaire peas in combination with the wheats—plots 2 and 3.

OATS AND PEAS

Table No. 36 presents the analytical data for the plots sown with oats and peas.

TABLE No. 36.—HIGH PROTEIN GRAIN MIXTURES—OATS AND PEAS

Plot No.	Grain	Variety	Rate sown	Total weight of grain as harvested	Moisture	Protein		
						As ground	Dry matter basis	Yield per plot
			bush.	grms.	p.c.	p.c.	p.c.	grms.
9	Oats	Alaska	1	1,153·6	5·78	18·16	19·27	209·5
	Peas	Lemaire	1¾					
10	Oats	Gold Rain	1	1,263·1	5·33	14·94	15·79	188·7
	Peas	Lemaire	1¾					
12	Oats	Alaska	1	1,332·7	4·85	19·88	20·89	265·1
	Peas	Early Blue	1¾					
13	Oats	Gold Rain	1	1,307·9	6·32	16·69	17·81	218·3
	Peas	Early Blue	1¾					
14	Oats	Alaska	1	1,233·1	4·78	20·34	21·41	250·9
	Peas	Chancellor	1¾					
15	Oats	Gold Rain	1	1,313·6	5·46	18·03	19·07	236·8
	Peas	Chancellor	1¾					
38	Oats	Gold Rain	1	1,140·5	7·30	18·19	19·62	207·4
	Peas	Chancellor	1¼					
39	Oats	Gold Rain	1	1,176·0	6·67	19·32	20·70	227·2
	Peas	Chancellor	1¾					
40	Oats	Gold Rain	1	1,298·7	6·80	20·32	21·80	263·9
	Peas	Chancellor	2¼					

A study of the figures for percentages of protein will reveal the fact that there is considerable variation in the protein content among the members of this series. The protein ranges from 15·79 to 21·80 per cent—a difference of 6 per cent.

Reference to table No. 33 which gives the figures for the percentage by weight of the harvested grain will show that the yield of peas, from the various plots varied considerably, and hence, the rather large spread in the protein content—the plots yielding a low proportion of peas, producing crops with the lower protein contents.

The harvested yields of Lemaire peas are consistently low. Those of Chancellor and Early Blue, while differing on different plots, are, generally, considerably higher than those from plots sown with the dwarf variety (Lemaire).

In this series, the highest percentages of protein are associated with the highest yields and, conversely, low percentages with low yields. The lowest protein content and weight of protein are from the "Gold Rain and Lemaire" plot and if the data for the last plot in the series which was sown with a larger proportion of peas than the other plots are excluded, the highest are the "Alaska and Chancellor" and "Alaska and Early Blue". Thus, Alaska oats, in combination with either varieties of peas, has, for this first year, appeared to be a better variety for high protein production, than Gold Rain.

WHEAT, OATS AND PEAS

Table No. 37 is a summarized table of data from plots on which the three grains were sown.

As in table No. 36 the data indicate a considerable range in protein content, from 24·74 per cent to 16·61 per cent, a spread of 8·0 per cent.

Table No. 33 will show the percentage by weight of the harvested wheat in these mixtures to be so small as to be, perhaps, the least important of the three cereals in determining either percentages or total yield of protein. The proportion of peas to oats and the weight of yield are the factors which determine the results from the various plots.

TABLE No. 37—HIGH PROTEIN GRAIN MIXTURES—WHEAT, OATS AND PEAS

Plot No.	Grain	Variety	Rate sown	Total weight of grain as harvested	Moisture	Protein		
						As ground	Dry matter basis	Yield per plot
			bush.	grms.	p.c.	p.c.	p.c.	grms.
17	Wheat	Reward	½	819·3	6·04	19·97	21·25	163·6
	Oats	Alaska	½					
	Peas	Lemaire	1¾					
18	Wheat	Reward	½	872·3	5·51	15·69	16·61	136·9
	Oats	Gold Rain	½					
	Peas	Lemaire	1¾					
19	Wheat	H. Federation	½	814·9	5·58	19·87	21·05	161·9
	Oats	Alaska	½					
	Peas	Lemaire	1¾					
20	Wheat	H. Federation	½	859·3	6·42	16·25	17·36	139·6
	Oats	Gold Rain	½					
	Peas	Lemaire	1¾					
22	Wheat	Reward	½	958·0	5·89	23·10	24·55	221·5
	Oats	Alaska	½					
	Peas	Early Blue	1¾					
23	Wheat	Reward	½	908·6	6·17	20·84	22·21	189·4
	Oats	Gold Rain	½					
	Peas	Early Blue	1¾					
24	Wheat	H. Federation	½	915·2	6·08	21·88	23·30	200·2
	Oats	Alaska	½					
	Peas	Early Blue	1¾					
25	Wheat	H. Federation	½	945·8	6·27	20·50	21·88	193·9
	Oats	Gold Rain	½					
	Peas	Early Blue	1¾					
27	Wheat	Reward	½	909·6	4·85	23·53	24·74	213·7
	Oats	Alaska	½					
	Peas	Chancellor	1¾					
28	Wheat	Reward	½	899·4	3·70	21·78	22·62	195·9
	Oats	Gold Rain	½					
	Peas	Chancellor	1¾					
29	Wheat	H. Federation	½	899·1	3·78	23·00	23·90	206·8
	Oats	Alaska	½					
	Peas	Chancellor	1¾					
30	Wheat	H. Federation	½	1,059·2	6·00	21·00	22·35	222·4
	Oats	Gold Rain	½					
	Peas	Chancellor	1¾					
32	Wheat	Reward	½	1,005·5	5·84	19·35	20·55	194·5
	Oats	Gold Rain	½					
	Peas	Chancellor	1					
33	Wheat	Reward	½	938·2	5·85	20·95	22·25	196·6
	Oats	Gold Rain	½					
	Peas	Chancellor	1¾					
34	Wheat	Reward	½	974·3	6·18	21·03	22·43	204·8
	Oats	Gold Rain	½					
	Peas	Chancellor	1¾					

As in the results shown in table No. 36 percentage of protein is directly related to yield.

The four harvested crops possessing the lowest protein contents and lowest yield of protein, are those in which Lemaire was the variety of peas used.

The four plots with crops intermediate in protein value are the "Gold Rain" plots.

Four plots of the series were sown with Alaska oats, in combination with the wheats and peas used in this investigation. These four "Alaska" plots are the best in the series, both in respect to percentage and total yield of protein.

The superiority of Alaska over Gold Rain oats, was also evident in the "Oats and Peas" mixtures.

The results in general of this inquiry are summarized in table No. 38 and briefly discussed in the following paragraphs.

WHEAT AND PEAS

These are the richest mixtures in the series though they have not given the largest weight of protein per plot. That they are the richest in protein might

be predieted from the faet that wheat (with one exeeption) has a higher per-eentage of this nutrient than oats and that the proportion of peas in these mixtures is larger than in mixtures in whieh oats have replaeed wheat.

OATS AND PEAS

These mixtures though lowest in respeet to protein eontent have given the largest amount of this eonstituent per plot. This latter result must be attributed to the heavy yield of oats, whieh is deeidedly higher than that of wheat.

WHEAT, OATS AND PEAS

These mixtures are intermediate in regard to pereentage of protein, the average data showing them to be 1 per eent higher than those of oats and peas and 4 per eent lower than those of wheat and peas. They, judging by averages, are the lowest in the series in respeet to protein yield per plot. This may be due in part to the presenee of wheat with its eomparatively low yield of protein.

TABLE No. 38.—HIGH PROTEIN GRAIN MIXTURES—PROTEIN CONTENT (DRY MATTER BASIS) AND PROTEIN YIELD

Grain	Variety	Protein (Dry matter basis)	Grain	Variety	Protein yield per plot
WHEAT AND PEAS		p.c.			gms.
(SOWN, wheat 1 bushel, peas 1¾ bushels per acre)					
Maximum.....Wheat..	Hard Federation....	26·39	Wheat....	Reward.....	235·6
Peas....	Chancellor.....		Peas.....	Early Blue.....	
Wheat..	Reward.....	26·28	Wheat....	Reward.....	236·2
Peas....	Early Blue.....		Peas.....	Chancellor.....	
Minimum.....Wheat..	Hard Federation....	24·53	Wheat....	Hard Federation....	140·3
Peas....	Lemaire.....		Peas.....	Lemaire.....	
Average.....	.....	25·80	.....	.....	201·1
OATS AND PEAS					
(SOWN, oats 1 bushel, peas, 1¾ bushels per acre)					
Maximum.....Oats....	Alaska.....	21·41	Oats.....	Alaska.....	265·1
Peas....	Chancellor.....		Peas.....	Early Blue.....	
Minimum.....Oats....	Gold Rain.....	15·79	Oats.....	Gold Rain.....	188·7
Peas....	Lemaire.....		Peas.....	Lemaire.....	
Average.....	.....	20·71	.....	.....	228·1
WHEAT, OATS AND PEAS					
(SOWN, wheat ½ bushel, oats ½ bushel, peas 1¾ bushels per acre)					
Maximum.....Wheat..	Reward.....	24·55	Wheat....	Hard Federation....	222·4
Oats....	Alaska.....		Oats.....	Gold Rain.....	
Peas....	Early Blue.....		Peas.....	Chancellor.....	
			Wheat....	Reward.....	221·5
			Oats.....	Alaska.....	
			Peas.....	Early Blue.....	
Minimum.....Wheat..	Reward.....	16·61	Wheat....	Reward.....	136·9
Oats....	Gold Rain.....		Oats.....	Gold Rain.....	
Peas....	Lemaire.....		Peas.....	Lemaire.....	
Average.....	.....	21·85	.....	.....	187·9

SOYBEANS

INFLUENCE OF HEREDITY AND ENVIRONMENT ON THE PROTEIN AND OILS CONTENTS OF SOYBEANS, AS GROWN AT HARROW AND OTTAWA, CROPS OF 1928-29

The analysis of the three series of Soybeans here under eonsideration was undertaken in response to inquiries from several firms interested in the manu-

facture of soybean oil and soybean meal on a commercial scale. It was desirable to ascertain, if possible, which varieties of soybean were richest in oil and also those with the highest protein content—the percentage of protein largely determining the value of soybean meal.

Three series of samples were analysed. Series 1 and 2 were composed of the same varieties, eighteen in number, and both series were grown at the Experimental Station, Harrow, Ontario. The first representated the crop of 1928, the second that of 1929. Series 3 consisted of eight samples (of varieties different from those grown at Harrow) grown at the C.E.F., Ottawa, during the season of 1929.

Table No. 39 presents the data from the analysis of all three series. For purposes of strict comparison the fat and protein content are also recorded on a water-free basis.

TABLE NO. 39.—SOYBEAN: MOISTURE, OIL AND PROTEIN CONTENT—CROPS OF 1928 AND 1929

Lab'y. No.	Ident. No.	Variety	Weight of 100 beans	Moisture	As received		Water-free	
					Protein (N.x6·25)	OIL	Protein (N.x6·25)	OIL
			grams	p.c.	p.c.	p.c.	p.c.	p.c.
		GROWN AT HARROW, ONT. CROP OF 1928						
101568	1	Ste. Annes, 92	19·18	6·06	42·69	17·05	45·43	18·14
69	2	E. Brown	22·83	6·08	40·75	17·10	43·38	18·21
70	3	Mandarin	18·96	6·06	42·13	17·45	44·84	18·52
71	4	Yellow 210	23·77	5·92	40·32	17·99	42·85	19·13
72	5	" 17	19·94	5·90	39·50	18·68	41·92	19·86
73	6	Chin Echo	14·48	6·00	40·51	17·65	43·10	18·78
74	7	Italian	19·24	6·15	40·32	17·00	42·96	18·11
75	8	O.A.C. 211	19·99	6·07	41·69	17·23	44·38	18·34
76	9	" 81	19·77	6·08	40·75	17·43	43·38	18·56
77	10	Summerland	17·21	5·94	43·31	16·38	46·05	17·42
78	11	B. K. China	17·15	6·30	41·88	16·60	44·70	17·72
79	12	E. Korean	25·21	5·91	39·69	18·30	42·19	19·45
80	13	Green	28·25	5·74	42·82	17·45	45·41	18·50
81	14	Manchu	18·18	5·64	39·50	18·65	41·80	19·76
82	15	B. K. Eyebrow	19·18	5·64	41·76	16·78	44·25	17·78
83	16	Ito San	17·59	6·04	42·82	16·50	45·56	17·56
84	17	Golden	18·59	5·90	40·32	18·78	42·85	19·95
85	18	A.K	15·17	5·66	38·50	19·04	40·82	20·18
		GROWN AT HARROW, ONT. CROP OF 1929						
86	19	Ste. Annes, 92	22·43	5·99	45·85	16·65	48·78	17·71
87	20	E. Brown	27·25	5·65	43·50	16·25	46·12	17·22
88	21	Mandarin	21·15	6·25	45·85	16·94	48·93	18·07
89	22	Yellow 210	26·31	4·93	46·13	15·70	48·53	16·51
90	23	" 17	19·87	5·01	43·50	17·20	45·80	18·10
91	24	Chin Echo	15·32	5·13	43·75	16·25	46·13	17·13
92	25	Italian	19·32	5·36	44·75	15·80	47·29	16·69
93	26	O.A.C. 211	23·25	5·12	45·62	15·72	48·08	16·57
94	27	" 81	21·23	5·05	45·25	16·05	47·65	16·90
95	28	Summerland	17·71	6·01	46·31	14·50	49·27	15·43
96	29	Bk. China	18·23	6·12	46·13	14·25	49·14	15·18
97	30	E. Korean	25·23	5·50	43·87	16·35	46·43	17·30
98	31	Green	30·63	5·58	46·50	14·90	49·25	15·78
99	32	Manchu	18·45	5·58	43·25	16·20	45·81	17·16
600	33	Bk. Eyebrow	19·85	5·27	44·87	15·32	47·37	16·17
01	34	Ito San	17·55	5·57	46·50	14·13	49·25	14·96
02	35	Golden	17·81	5·63	42·82	16·10	45·37	17·06
03	36	A.K	14·38	5·55	41·76	17·75	44·21	18·79

GROWN AT OTTAWA, ONT. CROP OF 1929

04	37	"A" Variety	18·22	5·77	36·07	16·60	38·29	17·62
05	38	"B" "	16·77	5·58	37·44	17·55	39·66	18·58
06	39	"C" "	20·93	5·96	37·44	16·85	39·82	17·02
07	40	"D" "	18·84	5·62	37·57	17·05	39·80	18·06
08	41	"J" "	26·96	5·55	36·81	17·00	38·96	18·00
09	42	"O" "	16·28	6·06	38·94	17·70	41·41	18·84
10	43	Wis. Black	13·82	5·67	33·62	19·60	35·65	20·78
11	44	Mandarin (Ottawa)	20·84	5·33	40·56	17·42	42·85	18·40

Table No. 40 presents the maxima, minima and average data (water-free basis) for protein and oil content of the two series consisting of the same varieties and grown in the same locality, thus permitting a study of the influence of heredity and seasonal conditions.

TABLE NO. 40.—SOYBEAN: OIL AND PROTEIN, HARROW, 1928–1929

Maximum, minimum and average (water free basis)

Season of growth	Variety	Protein			Fat or Oil		
		Maximum	Minimum	Average	Maximum	Minimum	Average
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
1928							
18 varieties	Summerland	46·05				17·42	
	A.K.		40·82		20·18		
				43·66			18·67
1929							
18 varieties	Summerland	49·27				15·43	
	Ito San	49·25				14·96	
	Green	49·25				15·78	
	B.K. China	49·14				15·18	
	A. K		44·25		18·79		
				47·41			16·82

PROTEIN.—For the seasons of both 1928 and 1929 the variety "Summerland" contained the highest percentage of protein. In 1929 three other varieties, viz., Ito San, Green and Black China must be regarded as ranking equally with Summerland in this constituent. Though not quite so high in protein as "Summerland" in 1928 they are among the highest proteins of the series.

Ste. Anne's No. 92 is also a high protein variety.

Summerland, Ito San, Green and Black China for both years contain the minimum percentage of oil.

The variety designated A.K. yielded for both seasons the minimum of protein and the maximum of oil.

These results would indicate that protein and oil are reciprocals and that high protein—or high oil—is an inherited quality. This makes it possible to select those varieties most valuable for oil production.

To the differences in seasonal conditions must be attributed the fact that the average protein content for 1928 is nearly 4 per cent lower than that for 1929. Conversely, the average percentage of fat is almost 2 per cent higher in 1928 than in 1929.

Table No. 41 presents the summarized data for the third series, that of eight different varieties grown at the C.E.F., Ottawa, in 1929.

TABLE No. 41.—SOYBEAN: OIL AND PROTEIN, OTTAWA, 1929

Maximum, minimum and average (water-free basis)

Variety (8 varieties)	Protein			Fat or oil		
	Maximum	Minimum	Average	Maximum	Minimum	Average
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Mandarin	42·85	.....	.....	.....	.....	.....
Wisconsin Black	.....	35·65	.....	20·78	.....	.....
"A"	.....	.....	.....	.....	17·62	.....
	.....	.....	39·55	.....	.....	18·52

Since the varieties in this series are not the same as those in the two groups already considered it is not possible to study the consistency with which inherited qualities are sustained.

FEEDING STUFFS

The increased volume of correspondence from farmers and stockmen with respect to feeds and feeding problems and the unusually large number of feeding stuffs submitted for analysis during the past year, may be regarded as indicating a growing interest in, and appreciation of, this phase of the Division's work. Evidently farmers are realizing more and more the value of information respecting the composition and nutritive value of feeds—information which, if put into practice, should lead to a lowering in the cost of production of all animal products on the farm, milk, beef, pork, eggs, etc.

Under the Feeding Stuffs Act, administered by the Seed Branch, Department of Agriculture, the larger number of feeds must conform to "standards" or be sold under guarantee in respect to protein, fat and fibre and it is gratifying to note that millers and feed manufacturers, as a class, are placing on the Canadian market feeding stuffs that very satisfactorily conform to the "standards" or meet their guarantee. Farmers are strongly urged to note these guarantees, as printed on tag or bag—to consider them in relation to price and govern their purchases accordingly. To feed intelligently and economically this is a necessary and profitable practice, especially when the home grown feeds—oat chop, provender from mixed grain crops, etc.—require additional protein and fat in the building up of a balanced ration.

Apart from, or rather in addition to, the excellent results obtained by the administration of the Feeding Stuffs Act there is a large field for useful work —the analysis and valuation of farmers home-grown feeds and feed mixture, the examination of feeds the sale of which is governed by "standards" and which, though meeting the requirements of the Act, may differ considerably in nutritive value and feeds not coming under the Act, unclassified and, as yet, not on the general feed market, the comparison as to composition and nutritive value of cereals and coarse grains of the same type or class, the analysis of feeds made to the purchaser's formula, as more particularly in laying mashes and special mixtures in swine feeding. In undertaking this and other related work, the Division supplements the working of the Act, furnishing the farmer, by analysis and advice, with information which will enable him to use his own feeds to the best advantage and to buy his supplementary concentrates—chiefly high protein and fat feeds—intelligently and at least cost per unit of nutrient.

The feeds used in the "Advanced Swine Registry Investigation" instituted by the Animal Husbandry Division and carried out at the larger number of the Experimental Farms and Stations, have been submitted to analysis. The series includes brans, shorts, middlings, crushed or ground cereals (oats and barley), etc., in fairly large numbers and their analysis in the feeding stuffs

table is indicated by an asterisk. The presentation of these analyses practically constitute a re-survey of these staple feeds, the samples being sufficiently large and from various sources and localities. For the same reason their data have been used in the calculation of average protein, fat and fibre content, these averages being appended, together with the present standards, to the sections dealing with the several classes of feeding stuffs.

WHEAT: MILLING BY-PRODUCTS

Bran

Lab'y No. 97210.—"Pioneer," a product of the Western Canada Flour Mills. Though slightly below the standard in protein, the fat and fibre content of this sample, are very satisfactory.

Lab'y No. 98058.—"Spilmil" brand, manufactured by the Spiller's Canadian Milling Co., Calgary, Alta., satisfactorily meets its guarantee. A desirable feature of this sample is its low fibre content.

Lab'y No. 98085.—"Bell-cow," manufactured by the Quaker Oats Co., Peterborough, Ont. It is somewhat below the standard in protein but its high fat and low fibre content are very satisfactory features.

Lab'y No. 98286.—Product of Ogilvy Flour Mills Co., Ltd. This is a bran of good quality, although slightly low in protein.

Lab'y No. 98314.—Manufactured by the Maple Leaf Mlg., Co., Toronto, Ont. This sample is 1 per cent below the standard in protein but very well meets the standards in respect to fat and fibre.

Lab'y No. 98432.—"Bell-cow" from the Quaker Oats Co., Peterborough, Ont. This sample meets the standards, set for brans, in every particular—protein, fat and fibre.

Lab'y No. 98433.—Manufactured by Robin Hood Mills, meets the standards satisfactorily.

Lab'y No. 98601.—A product of Maple Leaf Mlg., Co., is 0·5 per cent too low in protein, but perfectly satisfactory in respect to fat and fibre.

Lab'y No. 98724.—"Bell-cow" from Quaker Oats Co., Peterborough, Ont., is a sample of excellent quality being high in fat, low in fibre and well meeting the standard in respect to protein.

Lab'y No. 98755.—From the Maple Leaf Mlg. Co., contains 1·5 per cent more protein, 2·5 per cent more fat and 1·5 per cent less fibre than the standards require. It is a very satisfactory product.

Lab'y No. 98852.—Also a Maple Leaf product—a fair sample, slightly low in protein and a little high in fibre.

Lab'y No. 100003.—A product of Ogilvy Flour Mills Co., Montreal. This bran is characterized by a particularly high fat content. Protein and fibre are satisfactory.

Lab'y No. 100421.—A bran manufactured by the Maple Leaf Mlg., Co., meets the requirements of the Act satisfactorily.

Lab'y No. 100687.—Manufactured by Rex Mlg. Co., Montreal. This sample satisfactorily meets the requirements in regard to protein, fat and fibre.

Lab'y No. 100937.—A mixture of equal parts of "Pioneer" and of bran milled locally (Indian Head, Sask.). The data are those of bran of fair quality, being a trifle low in protein but up to standard in fat and fibre.

Lab'y No. 101163.—" Pioneer," product of Western Canada Flour Mills Co. The data for protein and fat are well above the standards, with a fibre content within the limits.

Lab'y No. 101245.—A product of the Ogilvy Flour Mills Co., Medicine Hat, Alta., has a protein content 2·25 per cent higher than the standard for bran. It has also a high fat content and is very satisfactory in regard to fibre.

Lab'y No. 101273.—Western Canada Flour Mills Co., Experimental Station, La Ferme, P.Q. A sample of good average quality, satisfactorily meeting the standards.

Lab'y No. 102616.—"Superior," Robin Hood Mills Ltd. It fully meets the guarantee possessing 2 per cent more protein, almost 2 per cent more fat and 2·6 per cent less fibre than is required by the standards.

The following table (No. 43) presents in summarized form the main facts with respect to brans on the Canadian market, as brought out by this inquiry.

TABLE No. 43—BRAN—SUMMARY

—	Standards	Series of 19 samples		
		Maximum	Minimum	Average
	p.c.	p.c.	p.c.	p.c.
Protein	15·0	17·28	13·92	15·25
Fat	3·5	7·23	4·65	5·81
Fibre	11·5	11·85	8·90	10·42

Protein—Five of the nineteen samples were slightly below 15 per cent., the standard.
Fat—None of the samples were below the standard and the average, 5·81 per cent., clearly indicates the high fat content of present day brans.
Fibre—The larger number of the samples are well below the required limit; only one sample exceeds it.

TABLE No. 42.—ANALYSIS OF BRANS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97210*	"Pioneer" Western Can. Flour Mills Co., Winnipeg, Man., Cap Rouge, P.Q.	10·65	14·74	5·98	52·79	10·16	5·68
98058*	"Spilmil" Spillers Can. Mlg. Co., Ltd., Calgary, Alta., Ex. Sta., Lacombe, Alta.	10·50	15·27	5·92	53·95	9·73	4·63
98085*	"Bell-cow" Quaker Oats Co., Peterborough, Ont., Exper. Farm, Nappan, N.S.	11·00	14·66	6·02	53·30	9·68	5·34
98286*	Ogilvy Fl. Mills Ltd., Exp. Sta., Kapuskasing, Ont.	8·14	14·66	6·33	53·06	10·87	5·94
98314*	Maple Leaf Mlg. Co., Exp. Station, Lennoxville, Que.	11·09	13·92	5·10	52·74	10·85	6·30
98432*	"Bel-cow" Quaker Oats Co., Peterborough, Ont., Exp. Station, Scott, Sask.	12·77	15·56	5·56	49·45	10·93	5·73
98433*	Robin Hood Mills, Ltd., Exp. Station, Scott, Sask.	11·96	15·06	4·65	54·26	11·33	4·74
98601*	Maple Leaf Mlg. Co., Toronto, Experimental Station, Fredericton, N.B.	9·48	14·49	5·92	54·18	10·86	5·07
98724*	"Bel-cow" Quaker Oats Co., Peterborough, Ont., Exp. Sta., Rosthern, Sask.	8·24	15·40	6·15	56·16	9·40	4·65
98755*	Maple Leaf Mlg. Co., Experimental Farm, Brandon, Man.	10·39	16·51	6·12	51·44	9·98	5·56
98852*	" " Experimental Station, Fredericton, N.B.	9·04	14·74	5·49	53·29	11·85	5·59
100003*	Ogilvy Flour Mills Co., Montreal, Animal Husbandry Div., C.E.F.	7·92	14·81	7·23	53·17	10·92	5·95
100421*	Maple Leaf Mlg. Co., Experimental Sta., Ste. Anne de la Pocatière, Que.	8·03	14·97	5·25	54·67	10·83	6·25
100687*	Rex Mlg. Co., Montreal, Experimental Station, Kentville, N.S.	9·81	14·94	5·36	53·56	10·70	5·61
100937*	Experimental Farm, Indian Head, Sask.	6·54	14·91	5·78	56·83	10·50	5·44
101103	"Pioneer" Western Canada Flour Mills Co., Winnipeg, Man., Exp. Sta., Kapuskasing, Ont.	9·13	15·40	6·90	51·74	11·13	5·67
101245*	Ogilvy Flour Mills Co., Medicine Hat, Alta., Exper. Farm, Agassiz, B.C.	9·85	17·28	6·30	50·66	10·12	5·79
101273*	Western Canada Flour Mills Co., Experimental Station, La Ferme, Que.	9·05	15·60	5·96	53·07	10·64	5·68
102616*	"Superior" Robin Hood Mills Ltd., Experimental Station, Cap Rouge, Que.	11·16	16·90	5·30	53·29	8·90	4·45

Shorts

This series of shorts comprises twenty-one samples. Detailed comment does not appear necessary, since with the exception of two samples in which the protein and fat are somewhat below that of the standard and a third sample slightly low in protein all very satisfactorily meet the requirements of the Act. One sample (No. 98059) however, is somewhat exceptional in character if sold as shorts; its fibre content (4·94 per cent) approaches that of middlings. It is significant that this sample is nearly two per cent above the standard in protein.

The summarized data (table No. 45) show that in both protein and fat the samples average, approximateley, 0·75 per cent higher than the required standards. Further, it is worthy of note not one member of the series reaches the percentage of fibre allowed by the Act; the average of this constituent is fully one per cent below the maximum allowed—a valuable feature, especially in cases where the meal ration requires a low fibre content.

TABLE No. 45—SHORTS—SUMMARY

—	Standards	Series of 21 samples		
		Maximum	Minimum	Average
	p.c.	p.c.	p.c.	p.c.
Protein	16·0	18·85	14·10	16·70
Fat	5·0	6·69	3·60	5·77
Fibre	8·0	7·75	4·94	6·84

TABLE No. 44.—ANALYSIS OF SHORTS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97212*	St. Lawrence Fl. Mills Co., Exper. Station, Cap Rouge, P.Q.	10·52	16·00	6·33	53·60	7·25	4·30
98059*	"Spilmil" Spiller's Can. Mlg. Co., Calgary, Alta., Exp. Sta., Lacombe, Alta.	11·33	17·85	5·40	57·09	4·94	3·39
98086*	Ogilvy Flour Mills Co., Fort William, Ont., Exp. Farm, Nappan, N.S.	10·08	16·70	6·09	56·33	6·83	3·97
98288*	"Pioneer" Western Can. Flour Mills Co., Exp. Sta., Kapuskasing, Ont.	9·93	17·28	6·62	55·10	6·73	4·34
98315*	Ogilvy Fl. Mills Co., Exp. Station, Lennoxville, Que.	9·00	16·76	5·38	57·23	7·54	4·09
98603*	"Rex" Maple Leaf Mlg. Co., Toronto, Ont., Exp. Sta., Fredericton, N.B.	9·85	16·34	5·91	55·93	7·75	4·22
98725*	"Bell-cow" Quaker Oats Co., Peterborough, Ont., Exp. Sta., Rosthern, Sask.	9·73	17·16	6·54	54·89	7·65	4·05
98727*	"Superior" Robin Hood Mills Ltd., Exp. Sta., Rosthern, Sask.	11·80	15·18	3·60	60·02	6·18	3·16
98753*	Maple Leaf Mlg. Co., Experimental Farm, Brandon, Man.	10·09	16·66	5·69	57·75	6·11	3·70
99114	University of British Columbia, Vancouver, B.C.	10·68	14·10	4·71	59·95	6·55	4·01
100001*	Ogilvy Fl. Mls. Co., Montreal, Animal Husbandry Division, C.E.F.	9·27	16·25	5·99	56·46	7·55	4·48
100033*	Ogilvy Fl. Mls. Co., Montreal, Experimental Farm, Nappan, N.S.	8·36	15·91	5·78	58·19	7·68	4·08
100420*	Maple Leaf Mlg. Co., Exper. Sta., Ste. Anne de la Pocatière, Que.	10·27	16·13	5·83	56·72	6·90	4·15
100686*	Rex Mlg. Co., Montreal, Que., Exp. Station, Kentville, N.S.	9·69	16·72	5·12	58·09	6·40	3·98
100936*	Experimental Farm, Indian Head, Sask.	7·51	16·72	5·38	60·60	6·05	3·74
101085	D. W. Gunn, Ltd., Toronto, Ont.	8·81	15·22	6·69	57·39	7·24	4·65
101227*	"Rex" Maple Leaf Mlg. Co., Exp. Station, La Ferme, Que.	9·27	18·38	6·28	54·44	7·00	4·63
101240*	Ogilvy Flour Mills Co., Medicine Hat, Alta., Exp. Farm, Agassiz, B.C.	10·26	16·78	6·26	53·37	7·05	4·28
101849*	Purchased locally, Experimental Station, Swift Current, Sask.	9·72	16·99	5·04	57·37	6·98	3·90
102061*	Ogilvy Flour Mills Co., Montreal, Exper. Station, La Ferme, Que.	9·47	18·75	6·15	54·52	6·93	4·18
102615*	"Superior" Robin Hood Mls. Ltd., Exp. Station, Cap Rouge, Que.	11·46	18·85	6·35	52·64	6·45	4·25

Middlings

Lab'y No. 97706.—"Pioneer Brand" milled by Western Canada Flour Mills Co. This may be considered as a satisfactory sample of middlings. Though slightly below the standard in protein, its low fibre is a very desirable feature.

Lab'y No. 98057.—St. John Milling Co., St. John, N.B. These middlings had the appearance and colour of fine shorts This sample meets the Act in respect to fibre, is a little low in fat and over 3 per cent below the requirements for protein. Microscopical examination showed the sample to contain a considerable proportion of weed seeds.

Lab'y No. 98087.—"O'Dairy" middlings from Ogilvy Flour Mills Co. This sample does not satisfactorily meet the standards in respect to protein and fibre but in fat it is notably high.

Lab'y No. 98287.—"Pioneer Brand" Western Canada Flour Mills Co. This sample is slightly below the standards in protein. The fibre however, is 2 per cent lower than that allowed for middlings.

Lab'y No. 98316.—A product of the Maple Leaf Mlg. Co. is a sample of good quality. It very satisfactorily meets the standards for this feeding stuff.

Lab'y No. 98439.—No information was forwarded about the source of this sample. In fibre content it approaches a feed flour but it is markedly low in protein considered either as a middlings or feed flour.

Lab'y No. 98602.—"White Middlings" Maple Leaf Mlg. Co. A per cent below the standard in protein but marked with a low fibre. Typical of a "floury" middlings.

Lab'y No. 98726.—"Superior Brand" milled by Robin Hood Mills. A little below standard in protein and fat content but with a notably low percentage of fibre. A sample of "floury" middlings.

Lab'y No. 98754.—Maple Leaf Mlg. Co. A per cent and a half below the standard in protein but very satisfactory in respect to fat and fibre.

Lab'y No. 98853.—"O'Dairy Brand" Ogilvy Flour Mills Co. This sample is characterized by high protein and fat content. Its fibre is lower than that required by standards. It is a middlings of excellent quality.

Lab'y No. 100005.—No brand name—product of Maple Leaf Mlg. Co. The protein of this sample is a little below standard requirement; fat and fibre satisfactorily meet the standards.

Lab'y No. 100419.—Also the product of Maple Leaf Mlg. Co. is over 1·5 per cent low in protein, but is very low in fibre.

Lab'y No. 100681.—A further sample of Maple Leaf Mlg. Co. This is a different type of middlings from No. 100005 or 100419, in possessing higher percentages of protein, fat and fibre. Its data closely approximate the standards in respect to protein and fibre. In fat it exceeds the requirements of the Act.

Lab'y No. 100682.—No brand name—manufactured by the St. Lawrence Mlg. Co. Very satisfactory in respect to fat and fibre but half a per cent too low in protein.

Lab'y No. 100683.—A product of the Standard Milling Co. Montreal, Que., was labelled "Middlings" but the fibre content (1·87 per cent) would classify it as a feed flour, rather than as middlings.

Lab'y No. 101239.—"Spilmil" a product of Spiller's Mlg. Co., Calgary, Alta. The data for this feed are not strictly in accord with those of middlings. The protein is about 1·0 per cent low and the fibre 2 per cent low, as judged by the standard for middlings. It approaches in certain aspects a feed flour.

Lab'y No. 101259, 102058.—"Pioneer" Western Canada Flour Mills—Both these samples are slightly below the standards for middlings in protein content. Their low percentage of fibre, viz.: 2·45 and 1·85, respectively, indicate that they are of the nature of feed flour rather than middlings.

Lab'y No. 102617.—"Superior" Robin Hood Mills, Ltd. The data for this sample, are those of a middlings of excellent quality. The percentage of protein and fat are both considerably higher than the requirements set by the standards and the fibre somewhat lower—all indicating a very satisfactory product.

TABLE No. 46.—ANALYSIS OF MIDDLINGS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97706	"Pioneer" Western Can. Fl. Mills, A.A.H., Kemptville, Ont.	12·50	16·29	5·13	58·82	4·17	3·09
98057	St. John Mlg. Co., St. John, N.B., J.J.C., New Glasgow, N.S.	13·18	13·09	3·24	65·32	3·33	1·84
98087*	"O'Dairy" Ogilvy Fl. Mills, Experimental Farm, Nappan, N.S.	10·34	16·19	6·10	58·75	4·98	3·64
98287*	"Pioneer," Western Can. Flour Mills, Exper. Sta., Kapuskasing, Ont.	10·48	15·35	3·40	65·68	2·64	2·45
98316*	Maple Leaf Mlg. Co., Experimental Sta., Lennoxville, P.Q.	9·81	16·71	3·86	62·97	3·72	2·94
98439*	Purchased locally, Experimental Station, Scott, Sask.	11·47	14·70	2·64	67·32	2·26	1·61
98602*	White Middlings, Maple Leaf Mlg. Co., Exper. Sta., Fredericton, N.B.	11·81	15·45	3·82	63·01	3·45	2·46
98726*	"Superior" Robin Hood Mills Ltd., Exp. Sta., Rosthern, Sask.	10·98	15·93	2·51	66·45	2·28	1·85
98754*	Maple Leaf Mlg. Co., Experimental Farm, Brandon, Man.	10·12	15·05	4·29	64·85	3·46	2·23
98853*	"O-Dairy," Ogilvy Flour Mills, Exp. Sta., Fredericton, N.B.	10·75	17·05	4·56	60·79	3·95	2·90
100005*	Maple Leaf Mlg. Co., Toronto, An. Husb. Div., C.E.F.	10·66	15·84	3·65	62·93	3·88	3·04
100419*	" " Exp. Sta., Ste. Anne de la Pocatière, Que.	10·71	14·81	3·10	66·76	2·50	2·03
100681*	Maple Leaf Mlg. Co., Toronto, Exp. Station, Kentville, N.S.	9·56	16·53	4·58	61·45	4·65	3·23
100682*	St. Lawrence Flour Mills, Montreal, Exper. Station, Kentville, N.S.	10·30	16·00	4·62	60·33	4·45	4·30
100683*	Standard Milling Co., Exper. Station, Kentville, N.S.	9·98	15·81	3·45	67·08	1·17	1·90
101239*	"Spilmil" Spiller's Milling Co., Calgary, Alta., Exper. Farm, Agassiz, B.C.	10·09	15·53	3·43	65·49	2·49	3·51
101259*	"Pioneer" Western Canada Fl. Mills, Exp. Sta., La Ferme, Que.	10·18	15·97	3·00	66·17	2·45	2·23
102058*	"Pioneer" Western Canada Fl. Mills, Exp. Sta., La Ferme, Que.	10·36	15·47	2·98	67·76	1·85	1·58
102617*	"Superior" Robin Hood Mls. Ltd., Exper. Sta., Cap Rouge, Que.	12·08	17·87	4·80	58·14	4·18	2·93
	Feed Flour						
98731*	Union Supply Co., Experimental Station, Rosthern, Sask.	12·02	12·40	0·70	73·31	0·70	0·87

TABLE No. 47.—MIDDLINGS—SUMMARY

—	Standards	Series of 19 samples		
		Maximum	Minimum	Average
	p.c.	p.c.	p.c.	p.c.
Protein	16·5	17·87	13·09	15·72
Fat	3·5	6·10	2·51	3·85
Fibre	4·5	4·98	1·78	3·29

There would appear to be more difficulty on the part of the millers to meet the regulations in the case of middlings than in that of bran and shorts. Only four of the nineteen samples analysed reach the standard in respect to protein, though there are a number which fall between 15 and 16·5 per cent. However, with respect to fat and fibre all the larger number of the samples are quite

satisfactory; indeed the majority exceed the standard in fat and are markedly low in fibre—two excellent features for this feeding stuff, which is largely used in swine feeding.

Feed Flour

Lab'y No. 98731.—A limit of "not more than 2 per cent of fibre" is the only regulation made in respect to this feeding stuff. This sample very satisfactorily meets this requirement.

The analyses on record indicate a very considerable variation in composition of feed flours. The following range shows the limits of the samples examined by the division during the past five years:—

Protein, from 12·73 to 19·03 per cent.
Fat from 1·50 to 4·61 per cent.
Fibre from 0·39 to 4·37 per cent.

The proportion of the outer coats of the wheat berry and the presence or absence of the wheat germ are no doubt the principal factors affecting the composition of this by-product.

OATS AND OAT PRODUCTS

Oats form the principal and most important cereal crop for live stock feeding in Canada. The quality of oats depends very largely on the proportion of kernel to hull; the percentage of the latter in oats of good average quality is between 25 per cent and 30 per cent, while in light oats it may considerably exceed 40 per cent. Oat hulls are very poor feed, containing about 3 per cent protein and over 30 per cent fibre and are very indigestible. Oat hulls are frequently used as an adulterant of chop feeds. In ground oats, however, the hulls, in giving bulk to the meal, serve a useful mechanical purpose in "making the meal lighter and more easily digested."

Ground oats constitute a safe and nutritious feed, very suitable for horses, cattle and sheep. With the hulls sifted out, it is more especially useful in the feeding of young calves and pigs. Compared with barley, oats, as a rule, are richer in protein, and decidedly richer in fat or oil and in bone-forming constituents, but on the other hand they are more fibrous.

In the table of analysis the composition of 33 samples of whole and ground oats is given. The larger number of these were being used in the rations employed in the Advanced Swine Registry enquiry and represent this cereal as grown at a large number of points throughout the Dominion.

Lab'y No. 97320.—Ground oats, purchased from J. B. Renaud & Co., Quebec, Que. These oats are of fair quality, the protein being slightly low for oats of the best grade.

Lab'y No. 98061.—Oat Chop, C.W. No. 3, grown on a farm near Lacombe, Alta. This chop apparently was made from oats characterized by low protein and low fibre content.

Lab'y No. 98089.—Oats grown on Experimental Farm, Nappan, N.S. The data for protein, fat and fibre are those of oats of excellent quality.

Lab'y No. 98289.—Oats (Alaska) grown on Experimental Station, Kapuskasing, Ont., with a small admixture of hulless oats. The protein and fat of this sample are very satisfactory. The fibre is low, due no doubt to the small proportion of hulless oats contained in the sample.

Lab'y No. 98318.—Oats, purchased from the United Grain Growers, Lennoxville, Que. Though the protein is a trifle lower than that of oats of good quality, the fat and fibre are quite satisfactory.

Lab'y No. 98436.—Oat chop, from Experimental Station, Scott, Sask. This sample was labelled "Oat Chop." The data for protein and fibre are not in strict accord with those of oats in general but may be accounted for by the presence of a certain proportion of hulless oats.

Lab'y No. 98604.—Oats, Western Recleaned No. 1. The data indicate oats of excellent quality.

Lab'y No. 98730.—Oat Chop—grown near Rosthern, Sask. This sample is very satisfactory as regards fat. Its fibre content is somewhat high and is slightly below the average in protein.

Lab'y No. 98750.—Ground oats, grown on the Experimental Farm at Brandon, Man. This sample slightly exceeds the average in protein and fat and is characterized by an exceptionally low fibre content.

Lab'y No. 98751.—Ground oats sold by Maple Leaf Mlg. Co. This sample submitted from the Brandon Experimental Farm is slightly below the average in protein. It is similar to Lab'y No. 98750 in possessing an unusually low fibre content.

Lab'y No. 98854.—Oats, Western Recleaned No. 1—In composition, these oats are of good average quality. They, however, differ from No. 98604—also Western Recleaned No. 1—in lower protein and higher fibre.

Lab'y No. 99113.—Oats, purchased from McLellan and McCarter, Vancouver, B.C. Although somewhat below the average in protein and fat, these oats may be considered of good, but not the best, quality.

Lab'y No. 99425.—Oat Chop from Experimental Station, Scott, Sask. is below the average in protein, but is similarly rich in fat. In fibre it is a little high.

Lab'y No. 100002.—Oats, grown on the C.E.F., Ottawa, Ont., the data indicate oats of good average quality with a particularly high fat content.

Lab'y No. 100032.—Ground oats, submitted by Experimental Farm, Nappan, N.S. the data indicate oats of fair quality.

Lab'y No. 100424.—Oats (No. 1. Feed) grown at Experimental Station, Ste. Anne de la Pocatière, P.Q. These oats appear to be of fair quality only. The protein being about one per cent below the average.

Lab'y No. 100684.—Ground oats, from Recleaned Extra No. 1, purchased in Kingston, Ont. The most notable feature of this sample is the fibre content, almost 3·0 per cent below that usually found in oats. This may be due to the presence of a certain proportion of hulless oats.

Lab'y No. 100934.—Oats, grown on Experimental Farm, Indian Head, Sask. This sample is somewhat low in protein and decidedly high in fibre, indicating a poor quality of oats.

Lab'y No. 101166.—Oats (Alaska) grown on Experimental Station, Kapuskasing, Ont. These oats are of low grade; almost 2 per cent below the average in protein and between 1 and 2 per cent too high in fibre.

Lab'y No. 101167.—These oats were graded as "Extra No. 1" but the analysis indicates that they are of fair quality only.

Lab'y No. 101225.—Ground oats, Recleaned Extra No. 1, purchased in Kingston, Ont., this sample as shown by the analytical data is of good quality.

Lab'y No. 101244.—Oats, grown on Experimental Farm, Agassiz, B.C. A type of oats low in protein and fibre but high in fat.

Lab'y No. 101566.—Oat Chop—No. 3 C.W.—grown at Experimental Station, Lacombe, Alta. These oats are characterized by an exceptionally high fat content with low protein and high fibre.

Lab'y No. 101614-617.—All four samples of oats, were submitted for analysis by the Superintendent of Experimental Station, Lethbridge, Alta. No. 101614 and 101615 were purchased in Calgary and near Lethbridge, respectively. Nos. 101616-7 were grown at the Lethbridge Station. All are characterized by very high protein content and a satisfactory percentage of fat but contain from 1·5 to 2·0 per cent more fibre than found in oats of first quality.

Lab'y No. 101850.—Banner oats grown at Experimental Station, Swift Current, Sask. This sample is not of high quality, being somewhat low in protein and fat.

Lab'y No. 102059.—Ground oats, purchased in Kingston, Ont. A sample of good quality. It very well meets the average of the series.

Lab'y No. 102613.—Ground oats, purchased in Quebec. These are of fair quality only, being too low in protein and too high in fibre for oats of the best grade.

Lab'y Nos. 102710-711-712.—These three samples of oats, were all submitted for analysis by the Superintendent of the Experimental Station at Lethbridge, Alta. All three are characterized by high protein and one by a very low fibre content.

TABLE No. 49.—OATS—SUMMARY

(Series of 33 samples)

—	Maximum	Minimum	Average
	p.c.	p.c.	p.c.
Protein	14·03	8·78	11·19
Fat	6·80	3·49	5·24
Fibre	13·35	7·96	10·94

The most noticeable feature, from a consideration of this series, is the very wide range or "spread" in the percentage of protein, fat and fibre. It is evident that oats may and do vary widely in composition and hence in feeding value. The proportion of hull no doubt very largely determines the percentage of fibre of the oat berry but it would seem that the composition of the kernel may vary very considerably in respect to protein and fat.

Hulless Oats

From recent correspondence it may be concluded that hulless oats are attracting attention as a crop. In point of composition they are higher in protein and lower in fibre than ordinary oats and hence are a more valuable grain from the standpoint of a feed.

Lab'y No. 98437.—Oat chop (hulless) grown on Experimental Station, Scott, Sask. The protein content of this sample is distinctly lower than that of the best hulless oats. Fat and fibre are in close agreement with average data for this class of cereal.

Lab'y No. 98752.—Hulless oats, grown on the Experimental Farm, Brandon, Man. Comparing this sample, with Lab'y No. 98437, it will be seen that it is over 1 per cent higher in protein and over 2 per cent higher in fat, both desirable features, but is 1 per cent higher in fibre.

Lab'y No. 102301.—Liberty hulless oats from Upper Stewiacke, Col. Co., N.S. Apparently this may be regarded as of fair quality.

A sufficient number of samples of hulless oats have not yet been analysed to establish average data.

Oat Middlings

This feeding stuff is defined as consisting of the floury portions of the oat kernel, obtained in the milling of rolled oats from clean oats. The requirement, according to the Feeding Stuffs Act is that it should not contain more than 4·0 per cent fibre. It may be observed that this is a product not commonly found on the market.

Genuine oat middlings is a high class feed characterized by an excellent protein content, a somewhat high percentage of fat and a low percentage of fibre.

Lab'y No. 100933.—Oat Middlings—Superior Brand, manufactured by Robin Hood Mills.

This sample was sold under a guarantee of protein 16·0, fat 6·0, fibre 4·5 per cent. Although a trifle below its guarantee in protein, it fully meets the guarantee in fat and fibre.

The data are in close accord with those of oat middlings of good quality.

It is a feed characterized by an excellent protein content, a somewhat high percentage of fat and a low percentage of fibre.

Oat Feed

Feeding stuffs sold under this caption are variable in composition and hence in nutritive value. Some are of excellent quality, others are almost worthless. They, as a rule, are made up of the various by-products from the manufacture of rolled oats and other breakfast foods and may or may not contain a large proportion of ground oat hulls—an exceedingly fibrous material.

Lab'y No. 101116.—"Black Hawk Oat Feed—Reground, a product of Robin Hood Mills Ltd., Moose Jaw, Sask. The data of this feed show that it contains a large proportion of oat hulls. With a protein content of 6·56 and fibre of 23·77 per cent it must be considered a feed of poor quality.

TABLE No. 48.—ANALYSIS OF OATS AND OAT PRODUCTS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97320*	Ground oats, J. B. Renaud Co., Quebec, Exp. Sta., Cap Rouge, P.Q.	7·92	10·43	5·25	63·19	10·34	2·87
98061*	Oat Chop, C.W. 3, Farm near Lacombe, Alta.	9·71	8·78	5·93	62·45	9·85	3·28
98089*	Home grown oats, Experimental Farm, Nappan, N.S.	10·92	11·76	4·71	60·41	10 06	3 41
98289*	Home grown oats, (Alaska) Exp. Sta., Kapuskasing, Ont.	9 44	11·28	5·68	61·17	9·27	3·16
98318*	United Grain Co., Lennoxville, Que., Exper. Sta., Lennoxville, Que.	9·70	10·77	4·72	61·17	10·56	3·08
98436*	Oat Chop, Exper. Station, Scott, Sask.	11·00	12·56	3·68	61·93	8·52	2·31
98604*	Oats, Western Recleaned No. 1, Exp. Sta., Fredericton, N.B.	11·00	11·79	4·77	59·54	10·14	2·76
98730*	Oat Chop, grown locally, Exp. Station, Rosthern, Sask.	7·48	10·50	5·50	62·05	11·45	3·02
98750*	Ground oats, home grown, Experimental Farm, Brandon, Man.	10·72	11·66	5·54	59·62	8·95	3·51
98751*	Ground oats, Maple Leaf Mlg. Co., Experimental Farm, Brandon, Man.	10·77	10·11	5·83	61·60	8·98	2·71
98854*	Oats, Western recleaned No. 1, Exper. Station, Fredericton, N.B.	9·06	11·17	5·26	60·41	11·16	2·94
99113	Ground oats, McLellan and McCarter, Vancouver, B.C.	9·60	10·01	3·95	62·35	11·01	3·08
99425*	Oat Chop, Experimental Station, Scott, Sask.	9·43	10·13	6·33	59·15	11·91	3·06
100002*	Oats, homegrown, Animal Husbandry Division, C.E.F., Ottawa	8·63	10·93	6·27	60·84	10·58	2·75
100032*	Gr. Oats, Experimental Farm, Nappan, N.S.	8·41	10·59	6·00	60·87	11·12	3·01
100424*	Oats, home grown, No. 1 Feed, Exp. Sta., Ste. Anne de la Pocatière, Que.	11·38	10·19	5·01	58·93	11·34	3·15
100684*	Oats, Gr., recleaned extra No. 1, Richardson & Sons, Kingston, Ont., Exper. Station, Kentville, N.S.	9·51	11·29	4·56	63·64	7·96	3·04
100934*	Oats, home grown, Experimental Farm, Indian Head, Sask.	6·88	10·53	5·38	60·19	12·94	4·06
101166	Oats (Alaska) home grown, Exper. Station, Kapuskasing, Ont.	8·43	9·79	6·80	58·76	12·73	3·49
101167	Oats, Extra No. 1, Experimental Station, Kapuskasing, Ont.	9·62	10·69	4·47	60·65	11·51	3·06
101225*	Oats, Recleaned Extra No. 1, Richardson & Sons, Kingston, Ont., Exp. Sta., La Ferme, P.Q.	8·83	11·13	5·20	60·71	11·10	3·03
101244*	Oats, Home grown, Experimental Farm, Agassiz, B.C.	9·90	9·56	5·68	61·50	10·42	2·94
101566*	Oat Chop, No. 3, C.W., Experimental Station, Lacombe, Alta.	8·07	9·18	6·40	60·65	12·40	3·30
101614*	Oats, purchased in Calgary, Alta., Exp. Sta., Lethbridge, Alta.	6·32	13·19	5·10	58·51	13·35	3·53
10 615*	Oats, purchased locally, Experimental Station, Lethbridge, Alta.	6·36	14·00	5·35	58·69	12·45	3·15
101616*	Oats, home grown, Experimental Station, Lethbridge, Alta.	7·08	13·39	4·93	59·20	12·14	3·27
101617*	Oats, home grown, Experimental Station, Lethbridge, Alta.	6·71	14·03	4·79	58·08	13·04	3·15
101850*	Oats, Banner—home grown, Exper. Station, Swift Current, Sask.	9·26	10·59	3·84	61·81	10·85	3·66
102059*	Gr. Oats, Richardson & Son, Kingston, Ont., Exp. Station, La Forme, Que.	7·91	11·34	5·53	61·81	10·44	2·97
102613*	Gr. Oats—purchased in Quebec, Exp. Sta., Cap Rouge, Que.	11·39	10·13	5·00	58·03	12·25	3·20
102710*	Oats, Experimental Station, Lethbridge, Alta.	8·96	13·16	5·62	56·69	10·53	5·04
102711*	" "	9·89	12·95	5·70	58·74	10·02	2·67
102712*	" "	9·18	11·94	3·49	63·13	8·83	3·53
	Hulless Oats						
98437*	Hulless Oat Chop, Experimental Farm, Scott, Sask.	11·99	12·95	4·76	66·14	2·38	1·88
98752*	Hulless Oats, home grown, Experimental Farm, Brandon, Man.	10·85	14·12	7·01	62·23	3·32	2·41
102301	Hulless Oats, (Liberty), Upper Stewiacke, Col. Co., N.S.	7·33	13·72	4·95	68·55	3·05	2·40
	Oat Middlings						
100933*	Oat Middlings "Superior" Robin Hood Mills, Ltd., Experimental Farm, Indian Head, Sask.	7·09	15·43	8·90	63·60	2·15	3·37
	Oat Feed						
101116	Re-ground, oat feed, "Black Hawk", Robin Hood Mills, Moose Jaw, Sask.	5·44	6·56	3·93	55·40	23·77	4·90

BARLEY AND BARLEY PRODUCTS

Lab'y No. 98060.—Barley chop, C.W. No. 3, of fair quality, contained also about 2 per cent wild and immature oats and a small percentage of wheat. The data are in accord with those of barley of fair commercial quality.

Lab'y No. 98088.—Ground Barley, the product of Maple Leaf Milling Co., Montreal. The protein content of this sample is quite satisfactory. The fat is higher than that usually found in barley and the fibre exceeds that of good barley by about 2·0 per cent. The data would indicate the presence of a small proportion of oats.

Lab'y No. 98290.—Ground barley, grown at Experimental Station, Kapuskasing, Ont. The data are in accord with those of barley of fair quality only.

Lab'y No. 98317.—Barley meal, sold by United Grain Co., Ltd., Lennoxville, P.Q. The analysis indicates ground barley from grain of good quality.

Lab'y No. 98728.—Barley feed from barley grown near Rosthern, Sask. This sample possesses an exceptionally high protein content and a very satisfactory percentage of fat and fibre. It is a meal of excellent quality.

Lab'y No. 98729.—Ground barley, grown near Rosthern, Sask. This sample has a higher percentage of protein and of fat than is usual in barley. Its fibre is 1 per cent above that of barley of good quality. It is possible that these data may be accounted for by a small admixture of oats.

Lab'y No. 98748-749.—Two samples of barley from Experimental Farm, Brandon, Man. The difference in nutritive value between the two samples is not very great. Both are of average quality.

Lab'y No. 98864.—Barley grown at Experimental Station, Cap Rouge, P.Q. The data are those of barley of fair quality.

Lab'y No. 99112.—Ground barley. This sample is somewhat low in protein compared with average figures for Canadian grown barley. It might be considered of fair quality.

Lab'y No. 99424.—Barley, from Experimental Station, Scott, Sask. The data for protein and fat are quite satisfactory; the figures for fibre are a trifle high.

Lab'y No. 100004.—Ground barley from grain grown on C.E.F.; of good average quality.

Lab'y No. 100034.—Crushed barley, a product of Ogilvy Flour Mills Co. This sample is characterized by a very high protein and fat content. It is a barley of excellent quality.

Lab'y No. 100423.—Barley grown at Experimental Station, Ste. Anne de la Pocatière, P.Q. This sample is high in fibre which places it as inferior to the barleys of highest quality.

Lab'y No. 100685.—Barley meal purchased from Maple Leaf Milling Co., Montreal. This sample was from barley of only fair quality, the fibre being somewhat high and the protein slightly low.

Lab'y No. 100935.—Barley grown in Experimental Farm, Indian Head, Sask. The data indicate a barley of good quality; it is distinctly high in protein.

Lab'y No. 101156.—Barley, from Experimental Station, Lacombe, Alta.—a sample of good quality.

Lab'y No. 101164.—Barley O.A.C. 21, grown at Experimental Station, Kapuskasing, Ont. This sample can be considered of fair quality only. It is distinctly below the average in protein.

Lab'y No. 101168.—Ground barley sent from Experimental Station, Kapuskasing, Ont. The fibre content of this sample is much too high for that of barley. The data suggest the presence of added hulls. It is of poor quality.

Lab'y No. 101226.—"Cariboo" manufactured by the Maple Leaf Milling Co. This product has an exceptionally high protein content—12·45 per cent. Its fibre is normal for barley. It is a feed of good quality.

Lab'y No. 101243.—Barley, purchased from Brackman Ker Milling Co., Vancouver, B.C. This is a barley of good average quality.

Lab'y No. 101567.—Barley, No. 3, C.W. on analysis yielded data indicative of good quality barley.

Lab'y No. 101618-619.—Two samples of barley purchased locally and sent for analysis from Experimental Station, Lethbridge, Alta.

Lab'y No. 101618.—Is much the better barley. Its percentage of protein is exceptionally high and those of fat and fibre satisfactory. Lab'y No. 101619 is slightly below the average in its protein content.

Lab'y No. 102060.—Home grown at the Experimental Station, La Ferme, P.Q. The fibre content of this sample is satisfactory, but the protein and fat are too low for barley of the highest quality.

Lab'y No. 102612.—Barley, purchased in Quebec. The protein and fat content of this sample are fairly satisfactory but the percentage of fibre is somewhat high.

Lab'y No. 102709.—Barley, submitted for analysis by Superintendent of Experimental Station, Lethbridge, Alta. The data are in accord with those of barley of high quality.

TABLE NO. 51.—BARLEY—SUMMARY
(Series of 25 samples)

—	Maximum	Minimum	Average
	p.c.	p.c.	p.c.
Protein	13·56	9·35	11·13
Fat	4·43	1·78	2·76
Fibre	6·74	4·35	5·51

NOTE.—Lab'y. No. 98088 and 101168 have not been used in the above table.

The range of protein in this series of barleys, chiefly from the Prairie Provinces but also containing samples grown in Ontario and Quebec, is approximately 4 per cent; the fat varies 2·5 per cent and the fibre by almost 2·5 per cent. These differences may not be so much due to varietal (inherited) qualities or to environmental influences as to varying proportions of other grains, foreign matter, etc. (dockage) present in commercial grades.

TABLE NO. 50.—ANALYSIS OF BARLEY AND BARLEY PRODUCTS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
98060*	Barley chop, 3 C.W. farm near Exper. Sta., Lacombe, Alta.	10·79	10·93	2·67	68·09	5·18	2·34
98088*	Gr. Barley, Maple Leaf Mlg. Co., Montreal, Exp. Farm, Nappan, N.S.	11·09	10·72	4·10	63·64	7·67	2·78
98290*	Gr. Barley, home grown, Exp. Sta., Kapuskasing, Ont.	11·36	9·81	1·87	69·92	4·35	2·69
98317*	Barley meal, United Grain Co. Ltd., Exp. Sta., Lennoxville, P.Q.	9·04	11·28	3·12	68·23	5·77	2·56
98728*	Barley feed, grown locally, Experimental Station, Rosthern, Sask.	9·56	13·56	2·59	67·04	4·93	2·32
98729*	Gr. Barley, grown locally, Experimental Station, Rosthern, Sask.	9·06	12·79	4·24	64·35	6·73	2·83
98748*	Barley No. 1, Experimental Farm, Brandon, Man.	11·25	11·33	2·88	66·05	5·75	2·74
98749*	" No. 2 " "	10·75	10·77	3·03	67·63	5·19	2·63
98864*	Barley, home grown, Exp. Station, Cap Rouge, Que.	6·94	10·93	2·63	70·83	5·29	3·38
99112	Gr. Barley, federal grade, McLellan & McCarter Ltd., Vancouver, B.C.	11·28	9·73	2·05	69·21	5·41	2·32
99424*	Barley, Experimental Station, Scott, Sask.	11·07	11·34	3·02	66·07	5·95	2·55
100004*	" home grown, An. Husbandry, Div., C.E.F. Ottawa	8·77	11·81	2·28	68·51	5·58	3·05
100034*	Crushed barley, Ogilvy Flour Mills, Exp. Farm, Nappan, N.S.	8·53	12·28	4·43	56·27	5·40	3·09
100423*	Barley, home grown, Exp. Sta. Ste. Anne de la Pocatière, Que.	11·59	10·77	2·36	65·66	6·74	2·88
100685*	" meal, Maple Leaf Mlg. Co., Montreal, Exp. Sta., Kentville, N.S.	10·26	10·70	2·68	67·22	6·34	2·80
100935*	" home grown, Exp. Farm, Indian Head, Sask.	7·98	12·00	2·93	68·92	5·60	2·57
101156*	" Exp. Station, Lacombe, Alta.	9·44	11·13	3·08	68·22	5·65	2·48
101164	" O.A.C., 21, home grown, Exp. Sta., Kapuskasing, Ont.	11·38	9·50	2·10	68·47	5·48	3·07
101168*	" Experimental Station, Kapuskasing, Ont.	10·16	9·47	2·46	65·48	9·32	3·11
101226*	" "Caribou" Maple Leaf Mlg. Co., Exp. Sta., La Ferme, Que.	9·88	12·45	3·10	66·89	5·40	2·28
101243*	" Brackman-Ker Mlg. Co., Vancouver, B.C., Exper. Farm, Agassiz, B.C.	10·30	10·75	3·17	68·82	4·75	2·23
101567*	" No. 3, Wes. Canada, Exp. Station, Lacombe, Alta.	9·44	11·13	3·08	68·22	5·65	2·48
101618*	" purchased locally, Exp. Sta., Lethbridge, Alta.	7·79	12·22	2·05	70·98	4·63	2·33
101619*	" " " "	7·86	9·35	2·42	72·50	5·28	2·59
102060*	" home grown, Exper. Sta., La Ferme, Que.	9·57	9·69	1·78	71·01	5·47	2·48
102612*	" purchased in Quebec, Exp. Sta., Cap Rouge, Que.	11·95	10·63	3·33	65·16	6·33	3·60
102709*	" Experimental Station, Lethbridge, Alta.	9·76	11·32	2·26	69·18	4·98	2·50

CORN PRODUCTS

Lab'y No. 97446.—Corn Meal Feed (White Liver Meal) is a by-product in the manufacture of cornmeal for household use, sold by the Lake of the Woods Milling Co., Brantford, Ont. The protein of this sample is that of ground corn. In fat and fibre, however, the data are considerably higher than in whole corn.

Lab'y No. 97447.—Ground corn—This is a by-product in the manufacture of cracked corn, sold by Lake of the Woods Milling Co., Brantford, Ont. This sample is not quite so high in nutritive value as Lab'y No. 97446. While as rich in protein, it has a lower fat and higher fibre.

Lab'y Nos. 98605 and 98855.—"Royal" Corn meal-both are products of St. John Mlg. Co., St. John, N.B. The first sample, Lab'y No. 98605 is the more valuable feed, due to its higher protein and lower fibre content.

Lab'y No. 100009.—Corn meal manufactured by Lake of Woods Milling Co., Toronto, Ont. This sample is of good average quality.

TABLE No. 52.—ANALYSIS OF CORN PRODUCTS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97446	Corn meal feed, Lake of the Woods Mlg. Co., Brantford, Ont.	10·34	9·53	6·53	68·45	3·27	1·88
97447	Gr. Corn, Lake of the Woods Mlg. Co., An. Husb. Div., C.E.F., Ottawa	11·45	9·50	4·00	69·03	4·09	1·93
98605*	Corn meal—"Royal" St. John Mlg. Co., Exper. Sta., Fredericton, N.B.	10·97	9·92	4·38	71·29	1·85	1·59
98855	" "	10·83	8·91	4·73	71·74	2·14	1·65
100009*	Corn meal, Lake of the Woods Milling Co.	9·95	9·28	3·87	71·70	3·16	2·04

MEAT PRODUCTS

Lab'y No. 98292.—Digester Tankage—Swift's Canadian Co., Ltd., Guarantee: protein 60·0, fat 6·0, bone phosphate 8·0 per cent; it is somewhat lower than its guarantee in protein. The bone phosphate is 15·11 per cent.

Lab'y No. 98320.—Digester Tankage—Manufacturer not stated. Guarantee: protein 60·0, fat 6·0, bone phosphate 8·0 per cent. It fully meets its guarantee in every respect. The bone phosphate is 9·33 per cent.

Lab'y No. 98435.—"Red Ribbon Tankage"—Swift's Canadian Co. Guarantee: protein 50·0, fat 6·0, per cent, which it fails to meet by nearly 2 per cent in protein. The bone phosphate was 26·81 per cent.

Lab'y. No. 98607.—"Shur-gain," Rg. No. 1395—Gunn's Ltd., Toronto, Ont. Guarantee: Protein 60·0, fat 5·0 per cent. This sample is almost two per cent too low in protein. The bone phosphate is 23·40 per cent.

Lab'y No. 98733.—"Red Ribbon Digester Tankage"—Reg. No. 1462—Swift's Canadian Co., Winnipeg, Man., Guarantee: protein 50·0, fat 6·0 per cent. The sample exceeds its guarantee in protein by almost 11 per cent and fully meets it in fat.

The bone phosphate was 16·71 per cent.

Lab'y No. 98756.—"Gain More Tankage", Reg. No. 2135. Harris Abattoir, St. Boniface, Man. The sample meets its guarantee of protein 50·0, fat 6·0 per cent. The content of bone phosphate was 24·18 per cent.

Lab'y No. 98757.—"Red Ribbon Digester Tankage" Swift's Canadian Co., Winnipeg, Man. This product exceeds its guarantee in protein by over 7 per cent. It fully meets the guarantee in fat 6·0 per cent. The bone phosphate was 20·90 per cent.

Lab'y No. 98858.—"Shur-gain Digester Tankage." Gunn's Ltd., Toronto, Ont. Guarantee: protein 60·0 and fat 5·0 per cent. It fails to meet the guarantee in protein by over 6 per cent. The bone phosphate in this sample was 23·40 per cent.

Lab'y No. 99116.—Digester Tankage—Reg. No. 1648, Burns & Co.—This was a light, brown finely ground powder, sound and wholesome. Guarantee—protein 50·0, fat 8·0 per cent. The sample does not quite meet its guarantee in regard to protein. It would rightly be classed as a "Digester Meat and Bone Tankage" as its phosphoric acid content is over 10 per cent. The bone phosphate content is 27·37 per cent.

Lab'y No. 100008.—"50 per cent tankage"—from Swift's Canadian Co., Toronto, Ont. This is a tankage with a very high protein and low ash content, indicating a very small proportion of bone. The guarantee of 50 per cent protein is exceeded by more than 15 per cent.

The bone phosphate content is 11·14 per cent.

Lab'y No. 100418.—Tankage—City Renderers, Montreal, Que. This sample was a rather finely ground, brown meal, apparently sound and wholesome. Guarantee—protein 60·0 and fat 6·0 per cent and fully meets the guarantee.

The phosphate of bone content is 14·70 per cent.

Lab'y No. 100689.—Digester Tankage from Swift's Canadian Co. This product was sold on a guarantee of protein 60·0, fat 6·0 per cent. The sample does not meet its guarantee in respect to either protein or fat. The content of bone phosphate is 21·66 per cent.

Lab'y No. 100939.—"Gain More Tankage"—Swift's Canadian Co., Moose Jaw, Sask. Guarantee—protein 50·0, and fat 8·0 per cent. It does not meet its guarantee in regard to protein. It might better be designated as a meat and bone tankage, the phosphoric acid content exceeding 10 per cent.

The bone phosphate is 26·81 per cent.

Lab'y No. 101228.—"45 per cent Protein"—This sample was received without any information as to the manufacturer, or guarantee. It is a low-protein product and by reason of that and its high percentage of phosphoric acid (13·84 per cent) falls into the class of "Meat and Bone" products rather than that of meat meal. The bone phosphate content is 30·23 per cent.

Lab'y No. 101242.—Tankage Reg. No. 1648. Burns & Co., Vancouver, B.C. Guarantee: protein 50, fat 8·0 per cent. The protein is 1·5 per cent below guarantee. This product is characterized by an exceedingly high fat content nearly 20 per cent, endangering its keeping qualities. The content of bone phosphate is 22·92 per cent.

Lab'y No. 101275.—C.A.L. Brand Hog Feed.—The data from the analysis of this sample would indicate that it contains sufficient bone to classify it as a "Meat and bone" product. The phosphoric acid content is 11·25 per cent and 10 per cent is the limit set for a "meat" product. The percentage of bone phosphate is 24·59 per cent.

Lab'y No. 101620.—"Digester Tankage" P. Burns & Co. Guarantee: protein 50·0, fat 8·0 per cent. The product exceeds its guarantee for protein by almost 6 per cent and for fat by, approximately, the same amount. The content of bone phosphate is 19·36 per cent.

Lab'y No. 101853.—Red Ribbon Tankage—Swift's Canadian Co. Guarantee: protein 50·0, fat 6·0 per cent. The sample satisfactorily meets its guarantee in respect to both these nutrients.

The bone phosphate content is 25·28 per cent.

Lab'y No. 102064.—C.A.L. Brand Hog Feed. This sample is one of the same brand as Lab'y No. 101275 and although possessing a somewhat higher protein content should also be classed as a "Meat and Bone" product, since the phosphoric acid content (11·06) is one per cent too high for a "meat" meal.

The bone phosphate is 24·16 per cent.

Lab'y No. 102305.—Digester Tankage—Swift's Canadian Co., Edmonton, Alta. This was a dark brown, fairly fine powder, apparently sound and wholesome, odour characteristic of tankage.

Guarantee: protein 50·0, fat 6·0 per cent. It fully meets its guarantee.

The percentage of bone phosphate is 22·15 per cent.

Lab'y No. 98408-09.—Seal Meats—from Magdalen Fish and Fish Products Co., Ltd., Magdalen Islands, Canada. Lab'y No. 98408 was labelled "Seal Meat" and Lab'y No. 98409 "Seal Meat and Bones." Both were dark reddish-brown, coarsely ground meals, apparently sound and wholesome, with a fishy odour. There are no very great differences in the composition of these two samples. If palatable, both might be used in the ration to replace other protein concentrates. Both are rather high in fat.

Lab'y No. 98408 contains 8·40 per cent bone phosphate.

Lab'y No. 98409 contains 8·96 per cent bone phosphate.

A glance at the table of data reveals the wide diversity in composition of these meat products. Certain of these samples would appear to be insufficiently or perhaps wrongly, labelled. The Feeding Stuffs Act states that in meat products in which the phosphoric acid content exceeds 10 per cent, the word "bone" must appear in the designation; thus "Digester Meat and Bone Tankage" and "Meat and Bone Meal." Meat products which include meat meals and tankages have a protein range of 50 to 60 per cent, while meat and bone products will range from 40 to 55 per cent protein.

TABLE NO. 53.—ANALYSIS OF MEAT PRODUCTS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Ash	Phosphate of lime
		p.c.	p.c.	p.c.	p.c.	p.c.
98292*	"Tankage"—Swift's Canadian Co. Ltd., Exp. Sta., Kapuskasing, Ont.	6·71	57·32	9·98	20·58	15·11
98320*	Digester Tankage, Exper. Station, Lennoxville, Que.	7·81	66·51	7·27	13·07	9·33
98435*	Red Ribbon Tankage, Swift's Canadian Co., Exper. Sta. Scott, Sask.	5·79	48·21	10·04	28·12	26·81
98607*	"Shur-gain" Reg. No. 1395. Gunn's Ltd., Toronto, Exp. Sta., Fredericton, N.B.	6·57	58·15	6·17	26·89	23·40
98733*	"Red Ribbon Digester Tankage," Swift's Can. Co., Exp. Sta., Rosthern, Sask.	5·02	61·60	7·23	18·76	16·71
98756*	"Gain-more Tankage," Reg. No. 2135, Harris Abbt., St. Boniface, Man., Exp. Farm, Brandon, Man.	4·02	50·98	7·31	30·23	24·18
98757*	"Red Ribbon Tankage," Swift's Can. Co., Winnipeg, Man., Exp. Farm, Brandon, Man.	4·77	57·34	9·33	24·00	20·90
98858*	"Shur-gain" Digester Tankage, Gunns Ltd., Toronto, Exp. Sta., Fredericton	5·81	53·68	6·49	26·64	23·40
99116	"Digester Tankage," Burns & Co.	5·90	47·34	9·34	31·36	27·37
100008*	"50% Tankage," Swift's Can. Co., Toronto, An. Husb. Div., C.E.F.	7·51	65·62	8·51	14·17	11·14
100418*	"Tankage" City Rendereres, Montreal, Exp. Sta., Ste. Anne de la Pocatière, Que.	8·39	61·46	8·16	17·93	14·70
100689*	"Digester Tankage," Swift's Can. Co., Exper. Sta., Kentville, N.S.	7·38	56·95	2·85	26·05	21·66
100939*	"Gain-more Tankage," Swift's Can. Co., Moosejaw, Sask., Ex. Farm, Indian Head, Sask.	9·28	43·14	9·11	30·32	26·81
101228*	45% Protein, Experimental Station, La Ferme, Que.	6·65	45·62	10·88	34·43	30·23
101242*	"Tankage," Reg. No. 1048, Burns & Co., Vancouver, B.C., Exper. Farm, Agassiz, B.C.	6·28	48·50	19·58	26·70	22·92
101275*	C. A. L. Brand Hog Feed, Experimental Station, La Ferme, Que.	7·02	48·26	10·28	30 14	24·59
101620*	"Digester Tankage," P. Burns Co., Exp. Sta., Lethbridge, Alta.	4·55	55·90	13·57	23·35	19·36
101853*	"Red Ribbon Tankage," Swift's Can. Co., Exper. Sta., Swift Current, Sask.	5·08	52·77	5·84	29·32	25·28
102064*	C. A. L. Brand, Hog Feed Exper. Station, La Ferme, Que.	7·31	50·06	9·93	28·42	24·16
102305*	"Digester Tankage," Swift's Can. Co., Edmonton, Alta., Exp. Sta., Lacombe, Alta.	5·45	51·14	12·38	25·05	22·15
98408	Seal Meat, Magdalen Fish & Fish Co., Ltd., Magdalen Islands	21·26	45·85	17·67	11·60	8·40
98409	Seal, Meat and Bones, Magdalen Fish & Fish Products Co., Ltd., Magdalen Islands	21·94	45·13	16·61	13·77	8·96

Lab'y No. 98092.—"Fasterfat"—Fasterfat Co., Halifax, N.S. This was a brownish, coarsely ground meal, with a strong fishy odour. It was apparently sound and wholesome. It carried a guarantee of protein 70·0, fat 2·0 per cent, bone phosphate 16·0 per cent. It is somewhat below the guarantee in protein. Its bone-phosphate content is 15·34 per cent. By reason of its very fair content of these two feed constituents and its low fat content (a feature which enhances its keeping qualities) it must be considered a product of good quality.

Lab'y No. 98094.—Magdalen Fish and Fish Products Ltd., Point Basse, Magdalen Islands.—This meal is stated to be made of whole, fresh herrings, cooked, dried and ground. It was a fine brownish meal with a good clean odour. The protein content is that of good fish meal, but the fat is somewhat high—a factor which may interfere with the keeping qualities of the meal.

It contained 7·73 per cent bone phosphate.

Lab'y No. 98095.—Magdalen Fish and Fish Products Ltd., Point Basse, Magdalen Islands.—This meal was made of cod heads and bones, and corn meal in equal proportions. The resultant mixture was a yellowish, brown, granular meal with a strong fishy odour. The presence of corn meal markedly reduced the protein with fat content. It had a bone phosphate content of 4·52 per cent.

Lab'y No. 98271.—Magdalen Fish and Fish Products Ltd., Point Basse, Magdalen Islands.—A coarsely ground yellowish, brown meal with a rather rancid odour. It is made from whole herring. As in the sample of herring meal, Lab'y No. 98094, the fat content is somewhat high.

The bone phosphate is 7·78 per cent.

Lab'y No. 98272.—Magdalen Fish and Fish Products Ltd., Point Basse, Magdalen Islands.—A fish meal made from cod heads and bones. It is a yellowish, rather granular, coarsely ground meal with small particles of bone throughout.

Its outstanding feature is its content of bone phosphate of 19·99 per cent.

Lab'y No. 98273.—Magdalen Fish and Fish Products Ltd., Point Basse, Magdalen Islands.—A meal made of mackerel gibs. This is a very finely ground meal of a light brown colour, with a very strong fishy odour. The data are those of a fish meal of good quality.

Bone phosphate is 8·71 per cent.

Lab'y No. 99115.—Pilchard Meal—Lighthouse Brand—Reg. No. 1948—manufactured by Wilbur Ellis Co., Vancouver, B.C. This was a light brown, finely ground powder, with a sardine-like odour. It was sold on a guarantee of protein 62·5, fat 3·0, bone phosphate 13·0 per cent. The sample fully meets its guarantee in regard to protein and fat, but is somewhat low in bone phosphate, 11·35 per cent.

Lab'y No. 102307.—Pilchard Meal, Lighthouse Brand, Reg. No. 1948, manufactured by Wilbur Ellis Co., Vancouver, B.C. This sample, sold under the same guarantee as Lab'y No. 99115, fully meets its guarantee. It contains 14·62 per cent bone phosphate.

There are several important factors to be considered in estimating the nutritive value and suitability of a fish meal. Both moisture and fat should be kept as low as possible in order to ensure good keeping qualities—the avoidance of mould and rancidity. The best brands aim at keeping each of these constituents decidedly below 10 per cent. In selecting a fish meal it is important to learn the nature and source of the material used in its manufacture. Apart from the necessity of this being absolutely fresh, the nature of its protein—from whole fish as compared with fins, scales, heads, etc.—will largely deter-

mine its feeding value; the proteins of scales, fins, etc., are of little nutritive value; the percentage of protein of a fish meal as recorded in a table of analysis, therefore, without a knowledge of its source, is not necessarily an indication of its true feeding worth.

Fish meals as a class tend to run higher in protein and lower in phosphate of lime (bone) than meat meals, but there are exceptions to this rule.

In purchasing a fish meal the guarantee should be carefully read, bearing in mind the desirability of a comparatively low fat content, combined with high percentages of protein and bone phosphate. If practicable a sample should be obtained and examined as to freedom from rancidity.

TABLE No. 55.—FISH MEALS—SUMMARY

(Series of 7 samples)

—	Maximum	Minimum	Average
	p.c.	p.c.	p.c.
Protein	68·07	57·94	62·05
Fat	22·36	2·82	11·73
Bone phosphate	19·99	7·73	12·22

NOTE.—Lab'y. No. 98095 not included in the above.

The above data will illustrate the variability of this product, especially as regards the fat content.

TABLE No. 54.—ANALYSIS OF FISH MEALS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Ash	Phosphate of lime
		p.c.	p.c.	p.c.	p.c.	p.c.
98092*	Fasterfat Co., Halifax, N.S., "Fasterfat," Exp. Farm, Nappan, N.S.	9·07	68·07	2·82	19·66	15·34
98094	Fish Meal No. 1. Magdalen Fish &	8·49	59·60	22·36	10·00	7·73
98095	Fish Meal No. 2. Fish Pro. Ltd.	9·81	34·07	11·02	6·05	4·52
98271	Fish Meal, Point Basse	9·31	58·84	20·37	9·29	7·78
98272	" Magdalen Islands..	9·34	57·94	4·76	28·06	19·99
98273	"	9·51	62·94	14·15	12·05	8·71
99115	Pilchard Meal, Lighthouse Brand, Wilbur-Ellis Co., Vancouver, B.C.	7·16	62·69	11·89	12·15	11·35
102307	" "	6·80	64·44	5·73	15·69	14·62

EDIBLE BONE MEALS

Lab'y No. 97209.—"National Bone Phosphate." National Fertilizers Ltd., Ingersoll, Ont. Reg. No. 3130. This is a steamed bone meal from which the larger part of the fat and nitrogen has been removed. The percentage of bone phosphate is 74·09.

Lab'y No. 100690.—"Colonial Edible Bone Meal"—Colonial Fertilizers Co., Windsor, N.S. The guarantee was protein, 20·0, fat 5·0 per cent. The product meets the guarantee for protein, but not for fat, although possessing as high a fat content as is usually found in this class of meat products.

The percentage of bone phosphate is 53·21.

Lab'y No. 100940.—Swift's Special Bone Meal—Swift's Canadian Co., was sold under guarantee of protein 25·0, bone phosphate 50·0 per cent. It meets the guarantee.

The bone phosphate content was 50·49 per cent.

Lab'y No. 101230.—Poultry Bone Meal—Gunn's Ltd., Toronto, Ont. The data are those of good bone meal i.e. it possesses a protein of 25 per cent; the bone phosphate content is 57·61 per cent.

Lab'y No. 102065.—City Renderer's Ltd., Montreal, Que. This sample was not accompanied by a guarantee. The data, however, are those of a good bone meal.

The bone phosphate content is 57·16 per cent.

Lab'y No. 102611.—"National" Reg. No. 2471. This sample possesses a somewhat higher protein content than most brands of bone meal. The phosphate of lime content (55·44 per cent) and high protein content class it as a good quality meal.

TABLE No. 57.—EDIBLE BONE MEALS—SUMMARY
(Series of 6 samples)

	Maximum	Minimum	Average
	p.c.	p.c.	p.c.
Protein	27·38	21·74	24·95
Fat	2·49	0·78	1·68
Phosphate of lime (Bone phosphate)	59·61	50·49	55·18

NOTE.—Lab'y. No. 97209 has not been used in the above table.

As greater attention is now being paid to the matter of mineral requirements of live stock, it is probable that bone meals will be more extensively used in the future than in the past, more especially in the feeding of cattle, swine and poultry. Lime and phosphoric acid are the two "minerals" required to supply the most commonly occurring mineral deficiencies and these elements are best furnished to the animal in form of bone meal.

TABLE No. 56.—ANALYSIS OF EDIBLE BONE MEALS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Ash	Phosphate of lime
		p.c.	p.c.	p.c.	p.c.	p.c.
97209	"National Bone Phosphate" Reg. No. 3130, National Fertilizers Ltd., Ingersoll, Ont., Experimental Station, Cap Rouge, P.Q.	.....	5·38	.....	.....	74·09
100690*	"Colonial Edible Bone" Meal," Colonial Fertilizer Co., Windsor, N.S. Experimental Station, Kentville, N.S.	6·53	21·74	1·86	64·39	53·21
100940*	"Bone Meal," Swift's Can. Co., Experimental Farm, Indian Head, Sask.	6·53	24·82	2·42	60·97	50·49
101230*	Poultry Bone Meal, Gunn's Ltd., Toronto, Exper. Sta., La Ferme, Que.	7·59	25·32	0·78	64·64	59·61
102065*	City Renderers Ltd., Montreal, Exper. Station, La Ferme, Que.	7·35	25·50	0·84	64·69	57·16
102611*	"National," Reg. No. 2471—Exp. Sta., Cap Rouge, Que.	7·20	27·38	2·49	60·10	55·44

SPENT BONE CHAR

Bone char, bone black and bone charcoal are terms given to the residue left from burning bones out of contact with air, as in an iron retort. Spent bone char is this material after being used in the clarifying of raw sugar, and until recent years has been used in agriculture solely as a phosphatic fertilizer.

During the past five years, however, it has found a further use in agriculture: it has been employed in stock feeding as a "mineral" adjunct to the ration to furnish lime and phosphoric acid, necessary elements for bone and tissue building in the animal. It has been further suggested that bone char by reason of its porous character and the presence of charcoal may be useful in the animal economy in regulating or perhaps in preventing intestinal disturbances.

TABLE No. 58.—SPENT BONE CHAR

Lab'y Number	—	Phosphoric acid	Bone phosphate $Ca_3(PO_4)_2$
		p.c.	p.c.
79671	Spent Dust, Canada Sugar Refinery, Montreal, Div. Animal Husbandry, C.E.F.	37·15	81·12
79817	Green Dust, Canada Sugar Refinery, Montreal, Div. Animal Husbandry, C.E.F.	33·29	72·68
79818	Fine Spent Char, Canada Sugar Refinery, Montreal, Div. Animal Husbandry, C.E.F.	37·05	81·87
82733	Spent Dust, Canada Sugar Refinery, Montreal, Div. Animal Husbandry, C.E.F.	35·20	76·88
92311	Bone char (manufacturer not stated), Experimental Station, Fredericton, N.B.	36·25	79·17
95614	Bone Char, Canada Sugar Refinery, Montreal, P.Q., Division Animal Husbandry, C.E.F.	34·69	75·75
98380	Bone char, "Green Dust," Canada Sugar Refinery, Montreal, T.C.G., Sherbrooke, Que.	30·46	66·55
98606	Bone char, Canada Sugar Refinery, Montreal, Que., Experimental Station, Fredericton, N.B.	34·62	75·63
98859	Bone char, Canada Sugar Refinery, Montreal, Experimental Station, Fredericton, N.B.	34·44	75·21
99117	Spent Bone char, B.C. Sugar Refinery, Vancouver, B.C., University of British Columbia	32·91	71·86

The series comprises ten samples. The bone phsophate content ranges from 72 to 82 per cent and is from 20 to 30 per cent higher than that found in edible bone meals.

Spent Bone Char (10 samples)	Bone phosphate
Maximum	81·87 per cent
Minimum	71·86 "
Average	76·68 "

OIL CAKE MEAL

The extraction of oil from flax seed leaves a residue which, when ground, is known as oil-cake meal. Oil-cake meal, linseed meal or simply oil meal, is one of the most wholesome and highly nutritious of all the concentrates. Used judiciously and in limited quantities, it may form a most valuable ingredient in the ration for all classes of farm stock.

Two methods of extraction of the oil from the flax seed have been generally used. That employing simply pressure to the crushed seed, known as the " old process ", results in a meal with somewhat less protein, but richer in oil than that from the " new process " in which the oil is dissolved out of the crushed seed by naphtha, the excess of naphtha being subsequently driven out of the residue by steam and the mass dried and bagged.

Lab'y No. 97213.—Manufactured by Sherwin-Williams "Screwpress." This sample carries a guarantee of protein 35·0, fat 6·5, fibre 7·5 per cent. It is a little low in protein and a little high in fibre but is well over its guarantee in respect to oil.

Lab'y No. 98090.—Product of Maple Leaf Mlg. Co., Reg. No. 2347. The guarantee reads: protein 35·0, fat 5·0, fibre 9·0 per cent. Though decidedly low in protein, this sample more than meets its guarantee in respect to oil and fibre. It is unusually high in oil.

Lab'y No. 98293.—Manufactured by J. A. Livingstone, Baden, Ont. " Old process, Reg. No. 1377." The guarantee was, protein 35·0, fat 6·0, fibre 7·5 per cent. This product is a little low in protein and a trifle high in fibre. It exceeds its guarantee in oil.

Lab'y No. 98319.—Product of Sherwin-Williams Co., Montreal, P.Q. It was sold in a guaranteed analysis of protein 35·0, fat 6·5, fibre 7·5 per cent. It is somewhat low in protein; but otherwise is quite satisfactory. It is practically identical with No. 97213.

Lab'y No. 98434.—Manufactured by Alberta Linseed Oil Co., Medicine Hat, Alta. This sample was exceptionally high in moisture for this class of feed. The oil content is decidedly above the average.

Lab'y No. 98608.—Manufactured by Canada Linseed Oil Mills, Montreal, P.Q. The guaranteed analysis, reads protein 35·0, fat 5·0, fibre 7·0 per cent. This sample scarcely meets its guarantee; its protein and fat are too low and the fibre content is too high.

Lab'y No. 98732.—Manufactured by the Alberta Linseed Oil Co. Ltd., Medicine Hat, Alta. Reg. No. 1610. The analysis accompanying this sample guaranteed a protein content of 35·0, fat 6·0, fibre 7·5 per cent. The sample, although below its guarantee in protein exceeds it in oil content.

Lab'y No. 98856.—Manufactured by Canada Linseed Oil Mills, Montreal, P.Q. The protein and fat of this sample are satisfactory but the fibre is somewhat high.

Lab'y No. 100006.—This product of Maple Leaf Mlg. Co. was not accompanied by a guarantee. It is of good quality.

Lab'y No. 100422.—No information was furnished as to the manufacturer of this product. It is of fair quality only.

Lab'y No. 100688.—Manufactured by Canada Linseed Oil Mills, Montreal, P.Q., was sold under guarantee of protein 35·0, fat 5·0, fibre 9·0 per cent. The protein content of this oil cake meal was somewhat low. It is very satisfactory in respect to fat and fibre.

Lab'y No. 100938.—Manufactured by the Alberta Linseed Oil Co., Medicine Hat: "Pride of Alberta." The guarantee read: protein 35·0, fat 6·0, fibre 7·5 per cent. The guarantee is satisfactorily met.

Lab'y No. 101165.—Old Process Meal, Reg. No. 1277, manufactured by J. A. Livingstone, Baden. The guarantee is: protein 35, fat 6·0, fibre 7·5 per cent. The sample might be said to meet its guarantee.

Lab'y No. 101241.—Henderson & Co., Brandon, Man., Reg. No. 1610, sold on a guarantee of protein 35·0, fat 6·0, fibre 7·5 per cent. This sample may be said to meet its guarantee though a trifle low in protein. A very satisfactory feature of this oil cake meal is the high fat content (8·69 per cent)—a very valuable nutrient in calf feeding.

Lab'y No. 101274.—Purchased from E. J. Livingstone Co., and carrying a guarantee of protein 35·0, fat 6·0, fibre 7·5 per cent. The sample exceeds its guarantee in protein by 1·0 per cent; meets it in respect to fat content and is slightly high in its percentage of fibre.

Lab'y No. 101852.—Alberta Linseed Oil Co. Ltd., Medicine Hat, Alta. This is a very satisfactory sample of oil cake meal, possessing both protein and fat above the average for this class of feed.

Lab'y No. 102063.—H.D. Process meal, manufactured by E. J. Livingstone. The guarantee for this sample was protein 35·0, fat 6·0, fibre 7·5 per cent. In protein content it exceeds the guarantee by 1·5 per cent, is satisfactory in respect to fat, and a little high in fibre.

Lab'y No. 102306.—Dominion Linseed Oil Co. This meal is characterized by a very high protein content (40 per cent). The fat and fibre content are those of oil cake of good average quality.

Lab'y No. 102614.—Screw Press Meal—Reg. No. 279, manufactured by Sherwin-Williams Co., and sold under a guarantee of protein 35·0, fat 6·5, fibre 7·5 per cent. The sample very fully meets its guarantee, having very satisfactory protein and oil contents and in addition contains a low percentage of fibre. It is an excellent sample of oil cake meal.

TABLE No. 60.—OIL CAKE MEAL—SUMMARY

(Series of 19 samples)

—	Maximum	Minimum	Average
	p.c.	p.c.	p.c.
Protein	40·18	32·62	34·74
Fat	13·57	4·60	7·94
Fibre	8·37	6·38	7·74

The larger number of these oil cake meals well meet their guarantee, especially in respect to fat and fibre. There is a tendency to be a little low in protein, a considerable number of the samples ranging between 33 and 35 per cent.

TABLE No. 59.—ANALYSIS OF OIL CAKE MEALS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97213*	Sherwin Williams Screw press, Exp. Sta., Cap Rouge, P.Q.	6·73	33·84	8·02	38·09	7·93	5·39
98090*	Maple Leaf Mlg. Co., Reg. No. 2347, Exp. Farm, Nappan, N.S.	7·46	32·62	13·57	33·58	7·18	5·59
98293*	Old Process, Reg. No. 1377, J. A. Livingstone, Baden, Ont., Exper. Sta., Kapuskasing, Ont.	7·19	33·86	6·80	38·65	7·93	5·57
98319*	Sherwin Williams Co., Montreal, Exp. Sta., Lennoxville, Que.	7·59	33·65	7·88	37·76	7·98	5·14
98434*	Alberta Linseed Oil Co., Experimental Sta., Scott, Sask.	13·75	33·13	12·35	27·79	7·79	5·10
98608*	Canada Linseed Oil Mills, Montreal, Exper. Sta., Fredericton, N.B.	4·79	33·45	4·60	39·26	8·25	9·65
98732*	Alberta Linseed Oil Co. Ltd., Reg. No. 1610, Exp. Sta., Rosthern, Sask.	7·10	33·18	9·24	37·17	8·05	5·35
98856*	Canada Linseed Oil Mills, Montreal, Exper. Sta., Fredericton, N.B.	9·49	34·66	6·56	36·02	8·37	4·90
100006*	Maple Leaf Mlg. Co., Toronto, An. Husb. Div., C.E.F.	7·79	34·03	8·39	36·66	7·62	5·51
100422*	Exp. Station, Ste. Anne de la Pocatière, Que.	8·37	33·50	5·80	38·98	8·13	5·22
100688*	Canada Linseed Oil Meal Mills, Montreal, Exper. Sta., Kentville, N.S.	9·01	34·29	6·10	37·66	7·52	5·42
100938*	"Pride of Alberta," Alberta Linseed Oil Co., Medicine Hat, Alta., Experimental Farm, Indian Head, Sask.	8·04	34·88	8·29	36·03	7·85	4·91
101165	"Old Process" Oil Cake Meal, J. S. Livingstone, Reg. No. 1277, Exper. Station, Kapuskasing, Ont.	8·45	34·50	7·15	36·72	8·18	5·00
101241*	Reg. No. 1610, Henderson, Brandon, Exper. Farm, Agassiz, B.C.	9·15	34·76	8·69	35·35	7·15	4·90
101274*	Linseed Oil Meal, E. J. Livingstone, Exper. Sta., La Ferme, Que.	9·55	36·06	6·23	34·80	8·08	5·28
101852*	Alberta Linseed Oil Co., Ltd., Exp. Sta., Swift Current, Sask.	8·30	35·10	9·05	35·05	7·34	5·16
102063*	H. A. Process, E. J. Livingstone, Exp. Sta., La Ferme, Que.	9·37	36·56	5·98	35·01	8·13	4·95
102306	Dominion Linseed Oil Co., St. Boniface, Manitoba.	7·38	40·18	6·45	33·80	7·24	4·95
102614	Screw Press Meal, Reg. No. 279, Sherwin-Williams, Exper. Sta., Cap Rouge, Que.	8·05	37·86	9·68	35·06	6·38	4·97

DISTILLERY AND BREWERY BY-PRODUCTS

Lab'y No. 97656.—Distillers' Dried Grains (rye) Canadian Industrial Alcohol Co., Corbyville, Ont. This product was sold on a guarantee of protein not less than 20·0 per cent, fat, not less than 5·0 per cent, fibre not more than 15 per cent. It fully meets this guarantee in every respect. The fibre is exceptionally low for this class of feed, the average for 10 samples (rye grains) previously analysed in these laboratories being 15·81 per cent.

Lab'y No. 97829.—Distillers' Dried Grains (rye) Canadian Industrial Alcohol Co., Corbyville, Ont. The results for this sample are fairly close to the average from the analysis of the better grades of rye grains.

Lab'y No. 97830.—Brewers' Dried Grains—no information was furnished as to the manufacturer of these grains. The data indicate that this sample is of good quality—somewhat superior to the average of brewers' grains.

Lab'y No. 101722.—Distillers' Dried Grains (corn) the product of Distillers' Corporation, Limited, Montreal, Que. The guarantee reads—protein not less than 23·5 per cent, fat not less than 8·24 per cent, fibre not more than 14·13 per cent. The sample very well meets its guarantee. The protein content, however, is not that of pure corn grains which carry protein from 27 to 34 per cent. The data would indicate that the sample is probably a mixture of corn and rye grains, corn predominating.

TABLE No. 61.—ANALYSIS OF DISTILLERY AND BREWERY BY-PRODUCTS

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.				
97656	Distillers' dried grains (rye), Canadian Industrial Alcohol Co., Corbyville, Ont.....	5·24	22·18	6·95	52·25	10·71	2·67
97829	" " "	7·66	20·62	8·33	47·33	13·91	2·15
97830	Brewers' dried grains, J. J., Nicolet, P.Q....	7·20	22·16	8·41	49·23	10·00	3·00
101722	Distillers' dried grains (corn), Reg. No.2410, Distillers' Corp., Ltd., Montreal.....	5·37	24·88	11·03	43·96	12·56	2·20

ALFALFA AND CLOVER MEALS

The quality of these meals is dependent on the quality of the hay as cured and harvested. As found on the market or present in feed mixtures these meals are chiefly from the legumes—clover, alfalfa, etc.—a young and leafy crop, well cured, will yield a much more nutritious meal than a riper hay or one that has been partially spoiled in the curing. For this reason hay meals should always be purchased on guaranteed analysis and special attention given to the figures for fibre content, which should not greatly exceed 30 per cent.

The highest grade meals are associated with a bright green colour, those of poor quality are coarse and yellowish.

Lab'y No. 98072.—Alfalfa meal from Armstrong, B.C. This product was described as being of fair average quality from second cut alfalfa. The hay was cut and stacked during August, remaining in the stack until January when it was baled and the bale ground. No artificial heat was used in the drying process. By reason of the comparatively low protein and high fibre this product can be considered as of fair quality only.

Lab'y No. 99118.—Alfalfa ("Poultry Greens") from Vancouver, B.C. This was a bright green, finely ground product, said to be from leaves and blossoms of Yakima Valley alfalfa.

It was sold on a guarantee of "protein 18·5 per cent, fat 2·5 per cent, fibre 18·0 per cent, ash 9·5 per cent on an 8·5 per cent moisture basis." The meal satisfactorily meets the guarantee. It is an alfalfa meal of excellent quality.

Lab'y No. 101356.—Ground clover hay—from Montreal, Que. This was a sample of rather coarsely ground hay of a greenish yellow colour.

The data are in fair accord with those of clover hay of fairly good quality.

Lab'y No. 101688.—Ground hay—from l'Islet, Que. No information was furnished as to the kind of hay from which this meal had been prepared. The data, however, agree fairly well with those of red clover.

Lab'y No. 102246.—Alfalfa meal from Joliette, Que. As in the case of Lab'y No. 98072, the data of this sample are those of alfalfa meal of only fair quality. They are in accord with those of meal ground from a rather mature crop.

Lab'y No. 102296.—Ground alfalfa—from La Trappe, P.Q. The data are those of a meal of fairly good quality.

Lab'y No. 102308.—Alfalfa meal from Experimental Station, Lacombe, Alta. This was a coarsely ground sample of good green colour and said to be made " from a good quality baled alfalfa hay " grown in Southern Alberta. The data for protein and fibre indicate that this meal is from a fairly mature crop. It may be considered of good quality.

Alfalfa and clover meals are now largely used by poultry men, more particularly to supply green vegetable matter to the laying stock during the winter months. Since poultry cannot utilize highly fibrous feeds it is very important in the absence of a guarantee that the meal purchased should be of a bright green colour and comparatively free from fibrous stem fragments.

TABLE No. 62:—ANALYSIS OF ALFALFA AND CLOVER MEALS

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
98072	Alfalfa meal, J. H. Co., Ltd., Armstrong, B.C.	7·92	11·69	3·00	35·15	35·36	6·88
99118	Poultry Greens (Alfalfa), University of B.C., Vancouver, B.C.	8·22	18·73	8·02	38·88	13·86	12·29
101356	Ground clover hay, Insp. Seed Branch, Montreal, P.Q.	6·42	11·00	4·13	40·94	32·05	5·46
101688	Ground hay, J. S. C., l'Islet, P.Q.	6·54	13·62	4·33	45·48	21·21	8·82
102246	Alfalfa meal, H. E. N., Joliette, P.Q.	6·32	12·06	1·85	38·11	34·79	6·87
102296	Ground Alfalfa, J. A., D'Oka, P.Q.	7·00	12·31	2·40	45·24	26·87	6·18
102308	Alfalfa meal, Exp. Station, Lacombe, Alta.	5·43	14·00	1·98	39·97	30·24	8·38

CALF MEALS AND DAIRY FEEDS

Lab'y No. 97323.—" Royal Purple Calf Meal," Reg. No. 1600, is sold under a guarantee of protein 18·3, fat 10·3, fibre 6·5 per cent. It very satisfactorily meets its guarantee.

Microscopical examination showed the components of this meal to consist of: flax seed, oil cake, cooked corn grits, corn meal, oat middlings, wheat meal, shorts, locust beans, fenugreek and salt.

Lab'y No. 99513.—Quaker Dairy Ration, product of Quaker Oats Co., Peterborough, Ont. This feed very satisfactorily meets its guarantee of protein 18·0, fat 4·5, fibre 13·5 per cent.

Lab'y No. 101023.—" Bossie Dairy Feed," Reg. No. 2617, manufactured by the St. John Milling Co., St. John, N.B., was sold under a guarantee of protein 18, fat 4, fibre 9 per cent. It is slightly below its guarantee in protein, exceeds it in fat by 1 per cent and practically meets it in fibre.

Microscopical examination of this feed showed it to consist of cornmeal, ground wheat, malt sprouts, brewers' dried grains, ground flax screenings, corn gluten feed, oat feed, cottonseed meal, fish meal, bone meal, calcium carbonate, salt, molasses.

Lab'y No. 101024.—"Royal Milk Producer Dairy Feed," Reg. No. 2620, product of the St. John Milling Co., St. John, N.B., carried a guarantee of protein 24, fat 4, and fibre 10 per cent. This sample does not meet its guarantee by 2 per cent in protein, but is satisfactory in regard to fat and fibre.

The ingredients in this feed, as stated, are: bran, shorts, corn meal, ground oats, brewers' dried grains, oil cake, malt sprouts, flax, bone-meal, gluten feed, fish meal, cottonseed meal, cocoanut oil meal, alfalfa meal, salt, calcium carbonate, molasses.

Lab'y No. 101025.—"Mic-mac Molasses Feed"—Reg. No. 2600. Product of St. John Milling Co., St. John, N.B., has a guarantee of 14, protein; 5, fat and 12 per cent fibre. The guarantee is satisfactorily met in all three constituents. It is not in the class of the highest grade of protein concentrates.

The ingredients used in Mic-mac feed are stated to be as follows:—Ground wheat screenings, ground wheat, oat feed, flax screenings, corn meal, alfalfa meal, fish meal, cottonseed meal, oil cake meal, brewers' dried grains, calcium carbonate, salt, molasses.

Lab'y No. 101143.—"Dairy Feed" is a mixture of flax seed and cracked wheat. It was received with an enquiry as to its feeding value, compared with oil cake meal. As a protein concentrate, it is distinctly inferior to oil cake meal containing not much over one-half the protein usually found in that feeding stuff. The percentage of fat is so high that this feed would require to be used very carefully in the ration. While possessing a high nutritive value, it could not be regarded as a satisfactory substitute for oil cake meal.

Lab'y No. 101396.—Dairy Ration—No guarantee—No information concerning the components of this feed was received. It is, however, a very satisfactory product of high feeding value.

Lab'y No. 101721.—Dairy Feed—Ottawa Valley Grain Products, Renfrew, Ont. This feed was sold under a guarantee of protein 18·0, fat 3·5, fibre 8·5 per cent, which it scarcely meets.

TABLE No. 63.—ANALYSIS OF CALF MEALS AND DAIRY FEEDS

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97323	Royal Purple Calf Meal, Reg. No. 1600, Jenkins Mlg. Co., London, Ont., F. E. H., Aylesford, Ont.	7·86	19·29	11·44	51·48	5·61	4·38
99513	Quaker Dairy Ration, Quaker Oats Co., Peterborough, Ont., R.S.G., Ste. Hyacinthe P.Q.	8·75	19·35	6·00	46·88	11·74	7·28
101023	"Bossie Dairy Feed," St. John Mlg. Co., Saint John, N.B., Experimental Farm, Nappan, N.S.	9·77	17·56	5·03	50·49	9·53	7·62
101024	"Royal Milk Producer," Dairy Feed, Reg. No. 2620, St. John Mlg. Co., Saint John, N.B., Experimental Farm, Nappan, N.S.	9·07	21·81	5·28	44·68	9·75	9·41
101025	"Mic-Mac Molasses Feed," Reg. No. 2606, St. John Mlg. Co., Saint John, N.B., Experimental Farm, Nappan, N.S.	8·71	13·94	6·63	50·66	11·28	8·78
101143	Dairy Feed, F. C. P., Simcoe, Ont.	7·64	17·50	16·45	51·95	3·57	2·89
101396	Dairy Ration, Atkinson & Sons, Cornwall, Ont., G. M., Ottawa, Ont.	8·41	20·90	4·67	52·64	7·35	6·03
101721	"North Star Dairy Feed," Ottawa Valley Grain Products, Renfrew, Ont., J. R., Renfrew, Ont.	8·94	17·50	3·32	55·56	8·74	5·94

Lab'y No. 97395.—Chick Mash—a product of the Ralston Purina Co., Woodstock, Ont. It is sold under a guarantee of protein 18·0, fat 4·0, fibre 7·0 per cent. In all respects this feed most satisfactorily conforms to the guarantee.

Lab'y No. 97426.—Purina Chick Starting Feed—Reg. No. 1973. Product of the Ralston Purina Co., Woodstock, Ont. The ingredients used in this mash are stated to be as follows: Corn meal, alfalfa meal, wheat bran, wheat middlings, wheat germ, dried skim milk, linseed meal, oat middlings, meat scrap, 1 per cent cod liver oil, ½ per cent charcoal, 4 per cent bone meal.

It was sold under a guarantee of protein 17·0, fat 4·0 and fibre 6·5 per cent. It very satisfactorily meets its guarantee.

Lab'y No. 97694.—"Royal Purple Chick Starter," manufactured by W. D. Jenkins, London, Ont. The ingredients of this feed, as stated are as follows: buttermilk, oat meal, wheat meal, corn meal, flaxseed meal, bone meal and calcium carbonate.

The guarantee for this feed was protein 15·0, fat 4·7, fibre 2·3 per cent. The feed is a little low in protein, but meets its guarantee in respect to fibre and fat.

Lab'y No. 98313.—"Purina Chick Startena," a product of Ralston Purina Company, Woodstock, Ont. The guarantee for the feed was protein 17·0, fat 4·0, fibre 6·5 per cent. The guarantee is very full met in respect to all three nutrients.

Lab'y No. 99089-090.—Chick Growing Mash No. 1 and No. 2 were compounded by the same dealer. Analysis and microscopical examination showed there to be no essential difference between the two samples although No. 2, is stated to contain 4 per cent of grit which is reflected in the higher ash content. No. 1, contains only 1·5 per cent grit. Both are feeds of fairly satisfactory composition.

Lab'y No. 101397.—Laying Mash—No information was submitted as to the ingredients contained in this mash. It is characterized by a very high protein content.

Lab'y No. 101512.—Laying Mash—a feed stated to be compounded of ground yellow corn, ground wheat, fish meal, oat meal, bone meal, tankage, alfalfa, cod liver oil and salt and a small proportion of barley. The protein is not as high as in many feeds of this class. The fibre is very satisfactory.

A part of the wheat of this feed had been previously damaged and dried; this might account for the alleged unpalatability of the feed.

Lab'y No. 102295.—Laying Mash—This mash was compounded as follows: Oil cake meal, 10 pounds; shorts, 30 pounds; barley meal, 30 pounds; meat meal, 30 pounds; cod liver meal, 15 pounds; bone meal, 12 pounds; clover meal, 20 pounds; ground oats, 15 pounds; feed flour, 15 pounds; middlings, 15 pounds; bran, 25 pounds; corn meal, 30 pounds; buttermilk, 7 per cent, salt 0·75 per cent, calcium carbonate 10 per cent, charcoal 1 per cent.

The feed belongs to the better class of laying mashes by reason of its high protein and satisfactory fibre content. It is, however, somewhat high in fat and decidedly high in ash for continuous feeding. The ash content might profitably be reduced by decreasing the proportion of calcium carbonate in the mixture.

Lab'y No. 102297.—Laying Mash—This was a home mixed feed consisting of: wheat bran, 100 pounds; wheat shorts, 100 pounds; ground oats, 100 pounds; corn meal, 100 pounds; gluten meal, 100 pounds; meat meal (60 per cent) 100 pounds; salt, 6 pounds.

These data are in very fair accord with those from several of the well known brands of laying mash on the market. It would appear to be very satisfactory from the standpoint of protein and fibre and may be considered a typical high class laying mash.

Lab'y No. 102365.—Developing Mash—No information was forwarded regarding the ingredients of this mash. The data are those of a fair sample of this class of feed. It is a meal of good quality.

Lab'y No. 102366.—"Full-of-Pep" Quaker Oats Co., Peterborough, Ont. This feed is sold under a guarantee of protein 16·0, fat 6·0, fibre 5·0 per cent which may be said it meets satisfactorily.

TABLE NO. 65.—POULTRY FEEDS SUMMARY

(Series of 12 Samples)

—	Maximum	Minimum	Average
	p.c.	p.c.	p.c.
Protein	22·44	13·56	17·64
Fat	7·89	5·14	6·23
Fibre	7·29	2·23	5·29

This series includes both special chick feeds and laying mashes. The former tend to have a lower protein and fibre than the latter but the range in all three nutrients is wide in both classes of feed. It would apparently be useful to poultry keepers if limits in respect to protein, fat and fibre could be established.

TABLE NO. 64.—ANALYSIS OF POULTRY FEEDS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97395	Chick Mash "Chow," Ralston Purina, Woodstock, Ont., F. W. P., Freelton, Ont.	8·80	19·97	7·89	47·94	4·96	10·44
97426	Purina Chick Starting Feed, Ralston Purina Co., Woodstock, Ont.	8·71	17·84	6·24	53·92	5·16	8·13
97694	Chick Mash, "Royal Purple Chick Starter", W. A. Jonkins Mfg. Co., London, Ont.	8·91	13·56	5·14	58·29	2·23	11·8
98313	Chick Feed, "Purina Chick Startena", Ralston Purina Co., Woodstock, Ont.	9·22	18·44	7·44	50·47	5·18	9·25
99089	Chick Growing Mash No. 1, Barnard, Spencerville, Ont.	11·29	14·37	5·38	59·29	3·43	6·24
99090	" " "	10·72	14·00	5·23	58·95	3·37	7·73
101397	Laying Mash, Atkinson & Sons, Cornwall, Ont.	7·62	22·41	6·20	46·40	7·29	10·08
101512	" E.S., Ailsa Craig, Ont.	6·53	16·56	5·28	60·01	5·80	5·82
102295	" Institute Agricole d'Oka, P.Q.	5·99	19·59	6·92	45·93	7·12	14·45
102297	" H. A. G., Colton, Ont.	7·38	22·44	5·18	51·02	6·50	7·48
102365	Developing Mash, Atkinson & Sons, Cornwall, Ont.	7·58	16·72	6·55	55·34	6·73	7·08
102366	Chick Feed, "Full-O-pep," Quaker Oats Co., Peterborough, Ont.	6·28	15·75	7·30	58·03	5·74	6·90

POULTRY GRITS

Table No. 66 contains the analyses of a number of shell products submitted for a report as to their suitability for poultry grits.

These "grits" may serve a dual purpose; as attrition materials to assist in the grinding of the food in the gizzard of the fowl and in furnishing the hen with carbonate of lime useful in egg shell formation.

TABLE No. 66.—ANALYSIS OF POULTRY GRITS

(Oyster Shell, Scallop Shell, Clam Shell, Egg Shell)

Lab'y. No.	Source	Mineral matter insoluble in acid	Oxide of iron and alumina (Fe_2O_3+ Al_2O_3)	Carbonate of lime ($CaCO_3$)	Carbonate of magnesia ($MgCO_3$)
		p.c.	p.c.	p.c.	p.c.
88440	Oyster shell, Shediac, N.B.	2·14	0·52	92·50	0·91
89394	Scallop Shell, Annapolis Royal, N.S.	0·34	0·32	98·50	0·61
93155	Crushed Oyster Shell, Nelson, B.C.	0·92	0·76	93·50	trace
97167	Crushed Clam Shell, Annapolis Royal, N.S.	1·96	0·24	94·75	0·00
97868	Dried Ground Egg Shell, Belleville, Ont.	0·14	.....	89·62	1·97

Lab'y No. 88440.—Oyster shells (whole) from Shediac, N.B. These shells, if suitably crushed would make a very satisfactory poultry grit.

Lab'y No. 89394.—Scallop shells (whole) from a canning factory at Annapolis Royal, N.S.

The carbonate of lime content of these shells is very high: if crushed into suitable size and shape they should prove an excellent poultry grit.

Lab'y No. 93155.—Crushed oyster shell sent from Nelson, B.C., and thought to be imported from Seattle.

The composition of this material compares well with the usual brands of oyster shell placed on the market for poultry use.

Lab'y No. 97167.—Crushed clam shells from a canning factory, Annapolis Royal, N.S.

As a supplier of lime in poultry feeding these shells should prove quite satisfactory. The Poultry Division reports as follows on the suitability of this material for poultry: "This is a very nice clean sample of crushed clam shells but for adult poultry it is crushed too fine. Fed in this size it would result in too great waste."

Lab'y No. 97868—Dried crushed egg shells from a cold storage and egg breaking plant, Belleville, Ont.

The value of this material in poultry management would be in furnishing material for egg shell formation—it contains 6·81 per cent of protein which enhances its value for this purpose.

FOX FOODS

Lab'y No. 97691.—"Swift's Silver Fur Food"—This was a canned product stated to contain meat by-products, cereals, dry skim milk, mineral salts and vegetables. It may be pointed out that this product has a water content of 60·50 per cent. It contains, approximately, ·5 per cent common salt and 3·73 per cent bone phosphate of lime.

Lab'y No. 102431-32.—Two samples of fox biscuits manufactured by Robinson's Mill and Bakery Co., Ltd., Summerside, P.E.I. No. 102431 labelled "Gold Tip" and Lab'y No. 102432 labelled "White Tip".

"Gold Tip" is stated to contain bran, white flour, rolled oats, cornmeal, shorts, soda, bone meal, salt and shortening. "White Tip" is made from white flour, shortening, salt, soda and bran meal. Both appear sound and wholesome but compared with a number of brands containing meat by-products previously analyzed in these laboratories, are much lower in protein. Their nutritive value is decidedly lower than that of the greater number of brands on the market.

There is no great difference in feeding value between these two brands.

TABLE No. 67.—ANALYSIS OF FOX FOODS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97691	"Swift's Silver Fur Food," Swift & Co., Chicago, L. M., Archambault, Que.	60·50	15·65	7·62	.....	.....	5·63
102431	Fox Biscuit, "Gold Tip," Robinson's Mill & Bakery Ltd., Summerside, P.E.I.	7·78	12·06	4·83	70·42	1·88	3·03
102432	Fox Biscuit, "White Tip," Robinson's Mill & Bakery Ltd., Summerside, P.E.I.	7·75	12·26	2·27	75·64	0·45	1·63

MISCELLANEOUS FEEDS

Lab'y No. 97700.—Feed from Edmundston, N.B. This is not a purchased meal; it is a mixture made on the farm and stated to contain oats, barley and buckwheat—a species of chop or provender. It is a chop of good feeding value. The letter accompanying this sample contained an inquiry concerning its suitability as a feed for young pigs. The fibre content is somewhat high for very young stock but is quite suitable for animals over two months old, though somewhat low in protein if skim milk is not used.

Lab'y No. 97828.—Schumacher Feed, Quaker Oats Co. This is not a high class feed; it is low in protein and high in fibre. The guarantee for this feed is as follows: protein 10·5, fat 4·0, fibre 12·0 per cent. This sample hardly meets the guarantee in respect to protein.

Lab'y No. 98274.—Clams' necks (dried) from Experimental Station, Sidney, B.C. This sample a by, or waste, product from the canning of clams was, as received, a dry, reddish brown, coarsely granular powder. The data indicate a distinct food value, provided it is sweet and palatable. Twenty per cent of protein places it in the class of fairly high concentrates and suggests the possibility of using it in the ration in place of tankage and fish meal. Its suitability for this, however, could only be determined by feeding trials. It has an exceptionally high ash content but of this only 3·0 per cent is phosphate of lime.

Lab'y No. 99099.—Ground Wheat Screenings, from North Hatley, P.Q., consisted of wheat, weed seeds, traces of flax, corn and chaff. This sample affords an illustration of the necessity for both chemical and microscopical analysis of screenings. Although the chemical data indicate a feed of very fair nutritive value, the injurious weed seed (1·5 per cent) and ergot content are in excess of the maximum amount (1·0 per cent) permitted in screenings by the Feeding Stuffs Act. This feed had been found unpalatable and was refused by stock. This sample does not meet the requirements for Government Standard Recleaned Screenings.

Lab'y No. 99514.—Quaker Sugared Schumacher Feed, manufactured by the Quaker Oats Co., Peterborough, Ont. This feed is said to contain hominy feed, barley meal, oil cake meal, oat feed, cottonseed meal, standard recleaned screenings, bone meal, calcium carbonate, molasses and salt.

The guarantee for this feed is as follows: protein 10·5, fat 4·0, fibre 12·0 per cent. The sample barely meets the guarantee in respect to fibre but is very satisfactory as to protein and fat. Feeds of this type cannot be considered of high feeding quality.

Lab'y No. 99998.—Feed, Ground Roughage, from Animal Husbandry Division, C.E.F., Ottawa. This was a coarsely ground, yellowish, fibrous (strawy) feed, loose and light with no true fine floury meal—having the general appearance of broken straw and crushed oat kernel. This feed is said to consist of ripe oat sheaves, with possibly a little peas and barley, all ground together.

Though a somewhat better feed than oat straw, it is poor material with a very low nutritive value.

Lab'y No. 100208.—Mink meal, manufactured by Ross-Miller Biscuit Co. Ltd., Napanee, Ont. This sample, excepting for its low fat content, compares favourably with some of the better class of fox biscuits on the market at present. It would seem probable that this meal is made from a feed flour with a certain admixture of a meat product.

Lab'y No. 101162.—Clover Hay, Experimental Station, Kapuskasing, Ont. This hay is, approximately, 50 per cent alsike clover, with a little red clover, tufted vetch and alfalfa. The grasses, say 25 per cent, were timothy and a couple of species of *Poa*. There was a fair proportion of weeds and a considerable amount of sand.

The clover, first cutting, was in full bloom. The protein is not so high as that of pure clover hay, due to the proportion of non-legumes. This sample does not quite reach the standards for the best quality clover hay.

Lab'y No. 101365.—Chop Feed, from Bradwell, Sask., said to be a mixture of ground barley and ground sweet clover hay. The data would indicate that the sample is essentially barley.

Lab'y No. 101649.—Red clover screenings (ground), Hagersville, Ont. The data from this sample indicate that it is almost entirely ground red clover seed. If palatable, the feed would have a very considerable nutritive value and could be profitably used in the meal ration, as for instance mixed with chop, say, in the proportion of from one-tenth to one-fifth of the total meal mixture.

Trial for germination showed no viable sprouting seeds.

Lab'y No. 101651.—"Ground Flax Seed and Straw" from St. Hyacinthe, P.Q. The crop from which this feed was made, was cut when the seed was approaching ripening and allowed to dry in the field for three or four days. The grain and straw were then ground together. This sample was submitted for analysis, in the hope that it would prove a suitable substitute for oil cake meal but it is in no way comparable to this class of feed, being almost 25·0 per cent lower in protein, 7·0 per cent higher in fat and 25 per cent higher in fibre than an average sample of oil cake meal. It possesses, however, feeding value more especially for its fat content and might find a place in the ration of dairy cows. However, on account of the harsh nature of flax straw we could not recommend this practice; the resulting meal is low in protein and too fibrous.

Lab'y No. 101757.—Meal, ground from the cleaning of seed peas (Chancellor), from Kemptville, Ont. This feed consisted almost entirely of broken peas and in consequence, possessed a high nutritive value. Its high protein content places it among the better class of concentrates.

Lab'y No. 101868.—Skim-milk powder sold by Producers Dairy, Ottawa, submitted by Poultry Division, C.E.F., Ottawa. This powder appeared to be sound, sweet and wholesome. The figures are in accord with those for good quality samples of skim milk powder. This valuable feeding stuff is characterized by its high percentages of protein and sugar.

Lab'y No. 102176.—Mill Screenings, product of the Lake of the Woods Milling Co., sent in for analysis from Corbyville, Ont. The protein content of this sample is among the highest found in this class of feed. The fibre meets the standard (8·0 per cent) for screenings. If palatable this is a good feeding stuff—well proportioned as to nutrients.

Lab'y No. 102277.—Buckwheat Feed, Sutton Junction, P.Q. This feed was described as "buckwheat with the flour taken out." Compared with ground buckwheat, this feed is higher in protein and fat, but unfortunately, also higher in fibre—a feature which considerably reduces its digestibility. It would appear to be a mixture of, say, slightly less than one half buckwheat middlings

and slightly more than one half buckwheat hulls. Authorities who have used this feed consider it to be worth, approximately, 25 per cent less than wheat bran.

Lab'y No. 102309-10.—Wheat with straw and barley with straw from Ancienne Lorette, Que. These two samples were prepared by grinding the grains with their straw. The enquiry was as to their nutritive value in comparison with bran. Both samples contain a small percentage of protein, only about 8·0 per cent associated with a high fibre (23 per cent). They are not to be classed with bran which contains twice the protein and only half the fibre of these two samples. They must be regarded as low quality feeds.

Lab'y No. 102537.—Feed, from St. Hyacinthe, P.Q. This was a feed compounded for use as a dairy ration. From its appearance it was thought to consist of bran, distillers' grains and corn. It has notable percentages of protein and fat with a low fibre.

The data show it to be a very satisfactory feed for milch cows.

Lab'y No. 102596.—Milk Albumen from Quinte Milk Products, Ltd. Wellington, Ont. This milk by-product was prepared by separating the albumen from whey. The acidulated whey is packed through a filter press and the resulting albumen dried.

The sample, as received, was in rather large fragments and coarse powder. The whole sample was dry, hard and of a dark brown colour. The protein content was much higher than that, say, of a milk powder (nearly 58 per cent) and would render this product valuable in the preparation of a laying mash.

FEEDS USED IN ADVANCED SWINE REGISTRY INVESTIGATION

Lab'y Nos. 97318, 97749, 97873, 98285, 98498, 98600, 98721, 98722, 98723, and *98857* are all meal mixtures compounded at several of the Experimental Farms and Stations, for use in the Advanced Swine Registry Investigation.

The ration suggested by the Animal Husbandry Division for the initial feeding period for 60 days subsequent to weaning, i.e. for animals practically from two to four months old, was as follows:—

Middlings	200	pounds
Ground oats	100	"
Ground barley	50	"
Shorts	50	"
Bran	25	"
Linseed oil meal	14	"
Tankage 45 per cent protein	14	"
Bone char	4½	"
Salt	2¼	"
Buttermilk-hand fed.		

Four samples—Nos. 97749, 98285, 98600 and 98721 belong to this initial period. Their protein, fat and fibre percentages are as follows:—

—	Protein %	Fat %	Fibre %
Lab'y. No. 97749	15·58	5·39	5·69
" 98285	16·47	4·92	6·69
" 98600	14·83	4·73	7·30
" 98721	14·59	4·68	6·35
Maximum	16·47	5·39	7·30
Minimim	14·59	4·68	5·69
Average	15·37	4·93	6·51

It is probable that the variations in composition here shown are not larger than might be expected. They would be due to one or both of the following causes: differences in composition in the same class of feed and incomplete mixing of the compounded feed. There is ample evidence to support the probability of the first cause and the difficulty of obtaining a homogeneous mixture by ordinary farm methods has been shown to be great.

Sample No. 97318 from the Experimental Station at La Ferme, P.Q. from feed used in this first period, was compounded as follows: ground oats 2 parts, middlings 2 parts, shorts 1 part, bran 1 part. Its analysis shows that it differs from the suggested ration in its higher fibre content, viz. 8·60 per cent and its somewhat lower percentage of protein.

The ration suggested by the Animal Husbandry Division for the second feeding period, 60 to 90 days—for swine, approximately, 4 to 5 months old—was as follows:—

Middlings	100	pounds
Ground oats	150	"
Ground barley	100	"
Shorts	50	"
Bran	25	"
Linseed oil meal	14	"
Tankage, 45 per cent protein	14	"
Bone char	4½	"
Salt	2¼	"

Buttermilk hand fed.

Three samples—Lab'y Nos. 98498, 98722, and 98857—are from feeds used in this second period. Their chief data are as follows:

—	Protein	Fat	Fibre
	p.c.	p.c.	p.c.
Lab'y. No. 98498	15·38	5·45	6·87
" 98722	15·44	4·69	6·59
" 98857	16·15	5·40	5·22
Maximum	16·15	5·45	6·87
Minimum	15·38	4·69	5·22
Average	15·66	5·18	6·23

The "spread" is not so great as in the series of the first feeding period. Considering the average of the two series the only difference of significance is in the slightly higher protein of the second series.

The suggested ration for the third feeding period—90 days to finish—for swine from 5 months old to finish, was as follows:—

Ground oats	150	pounds
Ground barley	200	"
or		
Ground corn	200	"
Shorts	100	"
Linseed oil meal	14	"
Tankage, 14 per cent protein	14	"
Bone char	4½	"
Salt	2¼	

Buttermilk hand fed.

The analyses of the one sample (No. 98723) submitted in this series and in which barley, not corn, was used, gave the following:—

Protein	15·79	per cent
Fat	4·59	"
Fibre	6·52	"

Sample No. 97873, from the Experimental Station, Ste. Anne de la Pocatière, from feed used in this third period, was compounded as follows: barley 2 parts, oats 1 part, corn gluten feed 2 parts, bran 2 parts, salt and bone char each 1 per cent. Its analysis showed:

Protein	15·74 per cent
Fat	4·62 "
Fibre	7·47 "

Except that it is slightly higher in fibre this feed very closely approximates that made from the suggested formula.

Lab'y No. 94613-614.—Two samples of "fish food" prepared in England. These analyses were made at the request of the Deputy Minister of Fisheries.

The notable feature of these analyses is the high protein—56·85 and 57·29 per cent—and phosphate of lime—21·51 and 23·61 per cent. There is no notable difference in this respect between the two samples. They approach in composition many of the meat and bone products on the market and are possibly of fish origin. Apparently, both are in a sound and wholesome condition.

Lab'y No. 96407.—"Cod Liver Residue." This is described as the "residue of cod livers after the expression of a part of the oil in the crude presses used by fishermen." The inquiry was as to its value in poultry feeding.

As received, the sample was of a light brown colour, of semi-pasty consistency with a slight but not offensive fishy odour. This material has an appreciable nutritive value by reason of its high percentages of protein and oil. In all probability the vitamin content of the oil would not be affected by the method of expression, and employed judiciously this "residue," further dried, might be advantageously used in poultry feeding.

Lab'y No. 98311-312.—These are canned ling and ling liver made by The Canadian Canners Ltd., Picton, Ont., with the view of putting the products on the market for silver fox feeding.

The percentage of water in this sample of canned ling is considerably higher than in the fresh fish, no doubt, due to water added in the canning process. This seriously reduces the protein content, possibly by 6 or 8 per cent. The fat content 0·68 per cent, is also much below the average of that usually present in fish.

The analysis of the canned ling liver, shows it to possess a very low protein content (4·81 per cent) and a percentage of fat undesirably high (42·46 per cent) for good keeping qualities or for use in a balanced ration. There is a probability that the oil of this fish liver might contain valuable vitamins.

Lab'y No. 88223.—"Canned Clams" from Shediac, New Brunswick. This sample contains a very high percentage of water (92·58 per cent), and in consequence the food value of the sample is very low. Authorities give the water content of the canned clam as 83·0 per cent and protein 10·5 per cent. The commercial value of this product would depend more upon its flavour and palatability than upon its nutrient content.

Lab'y No. 92965-966.—Canned Lobster, a product of the Portland Packing Co., Neufrage, P.E.I., and "Canned Crab" (Japanese). The data from the analysis of these two samples are in all essential particulars, so close, that it may be said that in respect to nutritive value there is practically no difference between these two products. The figures agree fairly well with those for lobster and crab recorded in works on human nutrition.

TABLE No. 68.—MISCELLANEOUS FEEDS

Lab'y. No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97700	Feed—G. M., Edmonston, N.B.	9·07	12·56	4·58	63·50	7·21	3·08
97828	Schumacher Feed: Quaker Oats Co., J. J., Nicolet, P.Q.	9·84	10·00	3·84	59·66	11·34	5·32
98274	Clam necks (dried) Experimental Station, Sidney, B.C.	6·28	20·31	0·89	.....	.....	31·99
99099	Wheat screenings: J. B. R., North Hatley, Que.	11·51	12·72	4·90	62·25	5·90	2·72
99514	Quaker Sugared Schumacher Feed, Reg. No. 2180, Quaker Oats Co., Peterborough	8·47	10·93	4·93	57·53	12·42	5·72
99993	Feed: Ground roughage, An. Husbandry Division, C.E.F., Ottawa	9·49	9·00	3·80	47·62	24·02	6·07
100208	Mink Meal: Ross-Miller Biscuit Co., Napanee, Ont.	9·18	16·78	1·37	69·22	0·92	2·53
101162	Clover hay, Experimental Station, Kapuskasing, Ont.	6·77	9·53	2·34	41·19	31·29	8·88
101365	Chop feed, C.C.T.R., Bradwell, Sask.	9·95	10·00	1·98	69·48	6·25	2·34
101649	Red clover screenings (ground), E. C., Hagersville, Ont.	5·95	37·82	10·69	27·30	13·91	4·33
101651	Ground Flax Seed and Straw, Sr. G., St. Hyacinthe, Que.	6·37	10·38	14·40	31·11	33·79	3·95
101757	Meal from the cleaning of peas, A. A. H., Kemptville, Ont.	11·69	20·48	1·73	57·01	6·15	2·94
101868	Skim-milk powder, Poultry Division, C.E.F., Ottawa	3·90	32·98	1·07	53·97	.....	8·08
102176	Ground mill screenings, E. F. B., Corbyville, Ont.	9 01	16·78	5·38	58·20	7·78	2·85
102277	Buckwheat feed, N. G. M., Sutton Junction, Que.	10·44	14·69	4·25	41·02	25·98	3·62
102309	Wheat with straw: C. J. G., Ancienne Lorette, Que.	10·22	7·72	1·65	51·16	23·07	6·18
102310	Barley with straw, C. J. G., Ancienne Lorette, Que.	10·85	7·94	2·23	50·58	22·90	5·50
102537	Compounded feed, L. P., St. Hyacinthe, Que.	7·48	20·41	5·30	54·85	8·58	3·38
102596	Milk Albumen, Quinte Milk Products, Ltd., Wellington, Ont.	6·04	57·60	1·73	.....	.....	21·33
97318*	Feed—Experimental Station, La Ferme, Que.	8·39	14·56	5·53	58·86	8·60	4·06
97749*	Meal—Experimental Farm, Agassiz, B.C.	9·65	15·58	5·39	58·59	5·69	5·10
97873*	Meal—Experimental Station, Ste. Anne de la Pocatière, Que.	8·28	15·74	4·62	57·25	7·47	6·64
98285*	Feed—Experimental Station, La Ferme, Que.	10·38	16·47	4·92	53·39	6·69	8·15
98498*	Feed—Experimental Farm, Agassiz, B.C.	9·46	15·38	5·45	57·23	6·87	5·61
98600*	"—Experimental Station, Fredericton, N.B.	9·41	14·83	4·73	58·62	7·30	5·11
98721*	" No. 1, Experimental Station, Rosthern, Sask.	8·38	14·59	4·68	63·10	6·35	2·90
98722*	" No. 2, " "	9·33	15·44	4·69	59·44	6·59	4·51
98723*	" No. 3, " "	8·06	15·79	4·59	61·13	6·52	3·91
98857*	Feed, Experimental Station, Fredericton, N.B.	10·86	16·15	5·40	56·98	5·22	5·39
94613	"Fish Food," Liverine Ltd., Grimsby, England, (No. 1)	11·90	56·85	3·75	.....	.....	24·89
94614	"Fish Food," Liverine Ltd., Grimsby, England (No. 2)	11·25	57·29	3·28	.....	.....	27·54
96407	"Cod Liver Residue," J. W. E., St. John, N.B.	53·94	22·13	18·25	.....	.....	1·08
98311	"Canned Lake Ontario Ling," A. P. H., Picton, Ont.	83·72	11·80	0·68	.....	.....	0·26
98312	"Canned Ling Liver," A. P. H., Picton, Ont.	34·06	4·81	42·46	.....	.....	0·68
88223	"Canned Clams," D. J. D., Shediac, N.B.	92·58	3·88	0·17	.....	.....	1·16
92965	"Canned Lobster," Portland Packing Co., Newfrage, P.E.I.	78·79	17·81	0·52	.....	.....	1·26
92966	"Canned Crab" (Japanese)	77·18	17·69	0·52	.....	.....	2·07

SUGAR BEETS FOR FACTORY PURPOSES

The tables included in this chapter present the data for 1929 from the sugar beet investigation carried on by this Division since 1902 and the chief objects of which are to determine the areas in the Dominion suitable for the growing of high quality beets and the most desirable varieties for that purpose.

Seed of the following varieties was used in this investigation during the past season: Dippe, Rabbethge and Giesecke and Fredericksen. The seed of the first two varieties came from Germany while that of Fredericksen was from Denmark. A number of other varieties, chiefly of Russian origin have been grown at the Central Farm and a few of the Stations.

The beets were grown on twenty-four Farms, Stations and Substations of the Experimental Farms System as follows: Prince Edward Island, Charlottetown; Nova Scotia, Kentville and Nappan; New Brunswick, Fredericton; Quebec, Lennoxville, Cap Rouge, Ste. Anne de la Pocatière and La Ferme; Ontario, Ottawa, Harrow and Kapuskasing; Manitoba, Brandon and Morden;

Saskatchewan, Rosthern, Scott, Indian Head and Swift Current; Alberta, Fort Vermilion, Lacombe, Lethbridge and Beaverlodge; British Columbia, Agassiz, Sidney, Summerland and Windermere. The data are presented in table No. 70.

Co-operative experiments were carried on at Armstrong, B.C., using the varieties Rabbethge and Giesecke and Fredericksen. At Kamsack, Sask., four growers carried on a small experiment with these roots.

For convenience of reference the cultural particulars and the chief meteorological data of spring, summer and autumn months at the several Farms and Stations, are presented in tabular form. This table has been constructed from information furnished by the Superintendents.

TABLE No. 69.—SUGAR BEETS GROWN ON THE DOMINION EXPERIMENTAL FARMS AND STATIONS, 1929

Station or farm	Sowing	Pulling	Character and depth of soil		Manuring previous season	Manuring present season	Crop of previous season	Character of season		
			Surface	Subsoil				Spring	Summer	Autumn
					per acre	per acre				
Charlottetown, P.E.I.	June 15	Nov. 21	Sandy loam	Gravelly clay	8 tons manure	12 tons manure	Barley	May 48·79° June 59·96	Mean temperature: July 66·00° Aug. 65·34 Sept. 59·38	Oct. 48·05°
								May 5·62 in. June 1·65 "	Precipitation: July 3·32 in. Aug. 2·22 " Sept. 3·97 "	Oct. 4·61 in.
Kentville, N.S.	May 28	Oct. 9	Fairly heavy sandy loam.	Gravelly	None	16 tons manure and 1,000 lbs. 5-8-5- fertilizer	Oats, seeded to clover and timothy.	May 51·68° June 60·25	Mean temperature: July 64·94° Aug. 63·58 Sept. 59·58	Oct. 47·19°
								May 6·52 in. June 2·30	Precipitation: July 1·60 in. Aug. 2·32 Sept. 4·46	Oct. 2·40 in.
Nappan, N.S.	June 7	Oct. 23	Clay loam	Heavy clay	None	30 tons manure	Wheat	May 49·18° June 58·15	Mean temperature: July 64·60° Aug. 63·06 Sept. 56·50	Oct. 56·16°
								May 3·79 in. June 1·00	Precipitation: July 2·59 in. Aug. 1·12 Sept. 3·90	Oct. 2·61 in.
Fredericton, N.B.	May 29	Oct. 2	Medium loam	Medium loam	None	15 tons manure and 1,200 lbs. 2-12-5 fertilizer	Buckwheat	May 51·16° June 61·25	Mean temperature: July 66·03° Aug. 62·94 Sept. 57·73	Oct. 44·06
								May 5·03 in. June 2·52	Precipitation: July 3·87 in. Aug. 2·15 Sept. 1·91	Oct. 3·48 in.
Lennoxville, P.Q.								May 51·92° June 62·28	Mean temperature: July 64·49° Aug. 60·83 Sept. 57·84	Oct. 45·15°
								May 4·27 in. June 3·59	Precipitation: July 2·44 in. Aug. 3·78 Sept. 2·32	Oct. 2·94 in.

Cap Rouge, Que.	May 27	Oct. 19	Sandy loam	Shale	None	20 tons rotted manure in autumn of 1928.	Oats	May....49·42° June....60·54 May.... 4·26 in. June.... 3·86	Mean temperature: July....63·37° Aug....61·59 Sept....56·63 Precipitation: July.... 5·33 in. Aug.... 5·12 Sept.... 2·67	Oct....41·1° Oct.... 3·7 in.
Ste. Anne de la Pocatiere, Que.	May 23	Oct. 23	Hard clay	Blue clay	None	20 tons manure. applied in fall.	Peas	May....48·31° June....57·38 May.... 3·29 in. June.... 3·19	Mean temperature: July....63·61° Aug....60·80 Sept....52·98 Precipitation: July.... 5·08 in. Aug.... 3·11 Sept.... 2·45	Oct....41·75° Oct.... 3·61 in.
La Ferme, Que.	June 21	Oct. 4	Muck and clay	Compact clay	None	16 tons of manure and 562 lb. of superphosphate.	Clover and timothy hay.	May....44·12° June....57·14 May.... 4·44 in. June .... 4·49	Mean temperature: July....61·43° Aug....58·14 Sept....50·91 Precipitation: July.... 2·97 in. Aug.... 2·75 Sept.... 5·50	Oct....38·92° Oct.... 3·93 in.
Ottawa, Ont.								May....52·70° June....62·70 May.... 3·61 in. June.... 2·65	Mean temperature: July....66·80° Aug....62·80 Sept....59·80 Precipitation: July.... 1·81 in. Aug.... 3·25 Sept.... 1·96	Oct....44·40° Oct.... 1·88 in.
Kapuskasing, Ont.	June 14	Oct. 15	Fairly heavy clay.	Heavy clay	None	16 tons	Hay	May....44·30° June....56·10 May.... 3·50 in. June.... 2·31	Mean temperature: July....63·80° Aug....59·00 Sept....49·90 Precipitation: July.... 1·74 in. Aug.... 3·75 Sept.... 5·16	Oct....38·70° Oct.... 4·69 in.
Harrow, Ont.	May 17	Oct. 28	Black sandy clay.	Sand	None	500 lb. of 4-8-6	3rd crop of alfalfa plowed under.	Late, wet and cool	Very dry and moderately hot.	Early part very dry and quite cold.
Brandon, Man.	May 16	Sept. 19	Black sandy loam.	Clay	None	None	Sweet clover	May....46·00° June....58·70 May.... 1·86 in. June.... 1·69	Mean temperature. July....66·10° Aug....64·10° Sept....48·80 Precipitation: July.... 1·15 in. Aug.... 0·51 Sept.... 2·40	Oct....44·10° Oct.... 1·74 in.

TABLE No. 69.—SUGAR BEETS GROWN ON THE DOMINION EXPERIMENTAL FARMS AND STATIONS, 1929—*Concluded*

Station or Farm	Sowing	Pulling	Character and depth of soil		Manuring previous season	Manuring present season	Crop of previous season	Character of season		
			Surface	Subsoil				Spring	Summer	Autumn
					per acre	per acre				
Morden, Man.	May 11	Sept. 19	Dark, medium sand loam.	Brownish clay.	None.	None.	Peas.	May.....53·00° June.....61·13 May..... 0·87 in. June..... 0·44	Mean temperature: July.....68·79° Aug.....65·56 Sept.....52·02 Precipitation: July..... 1·25 in. Aug..... 0·81 Sept..... 2·59	Oct....45·85° Oct.... 1·85 in.
Rosthern, Sask.	May 23	Sept. 25	Sandy loam.	Clay hard pan.	12 tons.	None.	Fallow.	May.....47·00° June.....60·10 May..... 1·13 in. June..... 3·05	Mean temperature. July.....65·50° Aug..... 63·60 Sept.....48·90 Precipitation: July..... 0·72 in. Aug..... 0·81 Sept..... 1·44	Oct....43·10° Oct.... 0·00 in.
Scott, Sask.	May 30	Sept. 27	Brown loam.	Clay loam.	None.	None.	Fallow.	May.....45·20° June.....57·58 May..... 0·63 in. June..... 2·57	Mean temperature July ....63·44° Aug.....63·06 Sept.....47·20 Precipitation: July..... 0·67 in. Aug..... 0·35 Sept..... 1·32	Oct....37·45° Oct.... 0·22 in.
Indian Head, Sask.	May 16	Sept. 14	Heavy dark clay loam.	Chocolate-coloured clay.	None.	None.	Fallow.	May.....45·26° June.....59·34 May..... 2·16 in. June..... 1·18	Mean temperature: July ....66·93° Aug.....65·86 Sept.....48·03 Precipitation: July..... 0·73 in. Aug..... 0·18 Sept..... 1·72	Oct....43·14° Oct.... 2·49 in
Swift Current, Sask.	April 9	.....	Sandy clay loam.	Clay.	Manure, 20 tons.	None.	Fallow.	May.....45·50° June.....58·60 May..... 1·81 in. June..... 2·59	Mean temperature: July..... 66·10° Aug..... 64·90 Sept..... 48·80 Precipitation: July..... 1·30 in. Aug..... 0·44 Sept..... 1·33	Oct....44·20° Oct.... 0·29 in.

Fort Vermilion, Alta.	May 7	Sept. 24	Dark loam	Bluish clay	20 wagon-loads manure.	None	Fallow	Temperature above normal. Precipitation above average.	Temperature above normal. Precipitation about average.	Temperature mod'ly warm. Precipitation just above normal.
Beaverlodge, Alta.	June 8	Oct. 15	Silt loam	Clay	None	None	Fallow	Windy, slightly above average precipitation.	Windy, precipitati on above average.	Precipitation heavy.
Lacombe, Alta.	May 8	Sept. 30	Black loam	Clay loam	None	None	Fallow	May.....48·00° June.....55·95 May..... 1·42 in. June..... 1·32	Mean temperature: July.....61·13° Aug.....61·16 Sept.....46·77 Precipitation: July..... 0·63 in. Aug..... 1·52 Sept..... 0·63	Oct....44·42° Oct.... 0·21 in.
Lethbridge, Alta. (Irrigated)	June 5	.....	Sandy clay loam.	Sandy clay	Applied in fall of 1928, 15 tons.	None	Field beans	May.....48·50° June.....58·10	Mean temperature: July.....64·00° Aug.....65·70 Sept.....48·90	Oct....46·60°
Lethbridge, Alta. (Non-irrigated).	May 2	Oct. 19	Sandy clay loam.	Sandy clay	None	None	Fallow	May..... 2·63 in. June..... 3·72	Precipitation: July..... 0·52 in. Aug..... 0·59 Sept..... 2·05	Oct.... 2·20 in.
Agassiz, B.C.	May 22	Oct. 23	Sandy loam	Gravelly and sandy loam.	None	15 tons and fertilizer 700 lbs.	Millets	May.....56·29° June.....60·27 May..... 4·29 in. June..... 3·03	Mean temperature: July.....64·14 Aug.....63·88 Sept.....62·23 Precipitation: July..... 0·51 in. Aug..... 0·95 Sept..... 1·47	Oct....54·08° Oct.... 4·03 in.
Sidney, B.C.	May 14	Oct. 22	Peaty loam	Sandy	None	None	1000 head kale	May.....52·60° June.....58·10° May..... 0·77 in June..... 1·31	Mean temperature: July.....63·50° Aug.....62·70 Sept.....58·50 Precipitation: July..... 0·24 in. Aug..... 0·38 Sept..... 0·71	Oct....51·60° Oct.... 1·08 in.
Summerland, B.C.	June 10	Oct. 28	Sandy loam	Sandy loam over lying coarse gravel.	None	8 tons	Cantaloupes	May.....58·20° June.....63·10 May..... 0·16 in. June..... 1·02	Mean temperature: July.....70·14° Aug.....71·16 Sept.....58·93 Precipitation: July..... 0·02 in. Aug..... 0·64 Sept..... 0·23	Oct....50·50° Oct.... 0·81 in.

Charlottetown, P.E.I.—Roots were uniform as to shape, sound and of medium size. A number of beets had green tops, from being out of the ground: this green part of the beet is low in sugar and purity and was cut off as waste before making the analysis.

The data, in respect to both sugar and purity, were satisfactory.

Kentville, N.S.—These results were very satisfactory, both as to sugar content and purity. The beets would be considered quite suitable, from the standpoint of quality and size, for sugar extraction.

Nappan, N.S.—The results were quite satisfactory; the sugar content was a good average and the purity decidedly high. These beets would be considered of excellent quality for sugar extraction.

Fredericton, N.B.—The data for sugar content were satisfactory, but not as high as have been obtained from beets grown at this Station. The figures for purity were very good and the weight per root satisfactory. In general the results were somewhat below those of 1928.

Lennoxville, P.Q.—The data for both sugar and purity were higher than in 1928 and may be regarded as indicative of beets suitable for sugar extraction. In weight and size the roots were fair. The records show that beets of good average quality have been grown at this Station for a number of years past.

Cap Rouge, P.Q.—The sugar data were decidedly high but these must, in a large measure, be attributed to the very small size of the beet, which latter would make the acreage yield too light for profitable culture. The purity figures were good.

Ste. Anne de la Pocatière, P.Q.—The sugar content of these beets was among the highest in the series. The data also for purity and weight were quite satisfactory. The results generally indicated excellent quality for sugar extraction.

La Ferme, P.Q.—Though these results showed a high sugar content, it must be pointed out that as received the beets were seriously wilted—which would raise the percentage of sugar in the juice. Further, the beets were exceedingly small—an additional factor towards high sugar content—and this means a very light yield per acre—too small for profitable culture. Quality, as indicated by coefficient of purity, was also poor.

Ottawa, Ont.—The data for both sugar and purity were higher than in the previous three years. The average purity was the highest of any beets received. In weight and size they were fair. In general, the results indicate excellent roots for sugar extraction.

Kapuskasing, Ont.—Though the sugar content and purity were quite fair, the very small size of root precludes the favourable consideration of the profitable growing of the crop for factory purposes; the yield would be too light.

Harrow, Ont.—The results were quite good both as to sugar content and coefficient of purity. In weight and size the roots were fair. The average sugar content was a little higher than in the previous two years but the coefficient of purity was a little lower. These beets would be considered of good quality for factory use.

Brandon, Man.—The figures for sugar content were decidedly low—much lower than those for 1928. In respect to purity these beets were only fair.

Results as to richness and purity from this Farm have not on the whole been satisfactory, though yields have been good.

Morden, Man.—These beets were decidedly below the average in sugar content, though of fair purity. Though of good weight indicating a fair yield per acre, the results generally were not favourable to the possibilities of beet culture for sugar extraction at this point.

Rosthern, Sask.—The sugar content was quite good, as was the case in 1928; in 1927 the results were decidedly low. In purity also the beets were quite fair.

Though of good shape and sound, the beets were very small; the yield per acre would be too low to make the growing of beets for factory purposes a paying venture.

Scott, Sask.—These results, in respect to sugar content, were fair, being slightly better than those of 1928, but they were decidedly lower as to purity. Low purity distinctly reduces the value of the beets for sugar extraction, so that these results did not indicate a satisfactory root for factory purposes. Further, the beets were very small, which must have meant a very light yield per acre. With few exceptions the beets from this Station have been of poor quality.

Indian Head, Sask.—These results were fairly satisfactory as to sugar content, though rather low in respect to purity—more especially the Horning variety.

The weight of root was decidedly light, indicating a low tonnage per acre.

All the roots were sound, uniform in size and shape but too small for a profitable yield.

Compared with the beets grown in 1928, the results for the present season (1929) showed about 2 per cent less sugar; they were however much superior to the 1927 results.

Swift Current, Sask.—The sugar data were below average, with a decidedly low coefficient of purity. The results generally were not unlike those of 1928, but markedly poorer than those of 1927.

In size and shape of root, the beets were very fairly satisfactory.

Fort Vermilion, Alta.—These data indicate an excellent quality of beet, both as to sugar content and purity. The weight of root is a little light, which presumably means a low yield per acre—an unfavourable feature if commercial culture for factory purposes were under consideration.

Beaverlodge, Alta.—The sugar beets—all three varieties—were very poor, in both sugar content and purity. They would not be considered as at all suitable for sugar extraction. Evidently they had not ripened properly.

Lacombe, Alta.—The percentage of sugar in juice was good but the coefficient of purity was very poor. Further, the beets were very small, which would mean a yield altogether too light for profitable culture. Results from this Station have not indicated favourable possibilities for the growing of beets for factory purposes.

Lethbridge, Alta.—The roots from the dry land plots were much higher in sugar content than those from the irrigated area, with a decidedly high coefficient of purity. Further, the weight per root of the dry land roots was higher than that of irrigated beets. Both in weight and sugar these dry land beets were very good and surpassed those irrigated.

These results being of such an unusual character, further information was sought respecting the experiment. In reply to our enquiry the Superintendent writes: "The beets on dry land were a failure as a crop owing to the severe drought. A mistake was made in the seeding of the irrigated area which necessitated a second and much later planting. This may perhaps explain the very poor results obtained, especially as to size."

Agassiz, B.C.—The sugar content of these beets was very similar to that of the preceding year—decidedly lower than that obtained in the earlier years of this investigation at this Farm. The purity was fairly high, which in part compensates—from the factory standpoint—for the somewhat low percentage of sugar. The beets were very large—over 3 pounds—and this will, in some measure, account for the percentages of sugar not being higher than here recorded. The yield should have been very satisfactory.

Sidney, B.C.—The data for both sugar and purity were very fair—very similar to those of 1927 and 1928—and indicative of roots, both as to richness and size, suitable for factory purposes.

Summerland, B.C.—These data are very satisfactory, both as to sugar content and purity; they indicate a good quality of beet for sugar extraction.

TABLE No. 70.—SUGAR BEETS GROWN ON THE DOMINION EXPERIMENTAL FARMS, 1929

Variety	Locality where grown	Percentage of sugar in juice	Coefficient of purity	Average weight of one root		Yield per acre	
			p.c.	lb.	oz.	tons	lb.
Fredericksen..	Charlottetown, P.E.I.	19·06	86·38	1	14	9	1,140
	Kentville, N.S.	18·10	87·62	1	7	12	1,344
	Nappan, N.S.	18·66	93·07	1	3	10	667
	Fredericton, N.B.	17·76	85·90	1	11	13	1,463
	Lennoxville, P.Q.	19·68	89·73	1	5	.....	
	Cap Rouge, Que.	19·97	83·56	..	12	7	1,563
	Ste. Anne de la Pocatière, Que.	21·63	85·31	1	10	11	1,304
	La Ferme, Que.	19,84	80·63	..	4	2	70
	Ottawa, Ont.	19·37	91·32	1	11	.....	
	Kapuskasing, Ont.	17·68	81·34	..	11	.....	
	Harrow, Ont.	19·56	84·45	..	14	11	1,846
	Brandon, Man.	15·09	79·69	1	14	12	905
	Morden, Man.	15·90	82·41	1	4	13	200
	Rosthern, Sask.	18·23	79·34	1	13	7	1,444
	Scott, Sask.	18·30	76·88	..	9	2	1,400
	Indian Head, Sask.	18·97	82·12	..	13	5	960
	Swift Current, Sask.	16·59	79·09	1	5	11	1,200
	Fort Vermilion, Alta.	19·17	82·99	1	1	9	.....
	Beaverlodge, Alta.	13·32	73·77	1	8	5	1,880
	Lacombe, Alta.	19·15	77·85	..	10	4	385
	Lethbridge, Alta. (irrigated)	17·10	78·45	..	13	.....	
	" " (non-irrigated)	20·59	87·02	1	5	.....	
	Agassiz, B.C.	16·48	85·84	3	5	14	1,100
	Sidney, B.C.	17·66	88·31	1	14	11	1,540
	Summerland, B.C.	19·32	81·55	1	13	10	312
Horning.....	Charlottetown, P.E.I.	18·49	85·72	2	..	10	1,780
	Kentville, N.S.	17·96	88·61	1	2	12	288
	Nappan, N.S.	17·94	88·53	1	4	10	800
	Fredericton, N.B.	17·16	84·67	1	12	13	1,273
	Lennoxville, Que.	18·79	88·09	1	8	.....	
	Cap Rouge, Que.	20·33	85·82	..	13	7	956
	Ste. Anne de la Pocatière, Que.	22·00	86·06	1	7	.....	
	La Ferme, Que.	18·62	78·00	..	5	2	50
	Ottawa, Ont.	19·18	92·36	1	9	.....	
	Kapuskasing, Ont.	17·22	80·71	..	11	.....	
	Harrow, Ont.	19·38	85·49	1	8	16	435
	Brandon, Man.	15·45	81·79	1	11	12	1,309
	Morden, Man.	15·30	81·87	1	7	11	1,000
	Rosthern, Sask.	16·93	78·39	1	5	7	586
	Scott, Sask.	18·48	76·67	..	10	2	1,850
	Indian Head, Sask.	17·73	78·91	1	..	7	80
	Swift Current, Sask.	14·64	75·97	1	7	14	1,500
	Fort Vermilion, Alta.	18·80	84·31	1	4	10	1,600
	Beaverlodge, Alta.	13·16	73·67	2	4	8	1,710
	Lacombe, Alta.	18·01	76·14	..	15	4	1,100
	Lethbridge, Alta. (irrigated)	16·81	79·03	..	14	.....	
	" " (non-irrigated)	20·81	87·94	1	6	.....	
	Agassiz, B.C.	15·88	82·83	3	11	15	720
	Sidney, B.C.	17·53	93·09	2	10	13	1,280
	Summerland, B.C.	19·61	84·89	2	1	14	1,494
	Charlottetown, P.E.I.	18·24	85·78	1	10	12	420

TABLE No. 70.—SUGAR BEETS GROWN ON THE DOMINION EXPERIMENTAL FARMS, 1929—*Concluded*

Variety	Locality where grown	Percentage of sugar in juice	Coefficient of purity	Average weight of one root		Yield per acre	
			p. c.	lb.	oz.	tons	lb.
Rabbethge and Giesecke.	Kentville, N.S.	19·41	89·62	1	2	9	1,536
	Nappan, N.S.	16·77	84·43	1	4	12	167
	Fredericton, N.B.	18·70	90·35	1	8	8	1,841
	Lennoxville, Que.	19·43	88·72	1	7	.....	
	Cap Rouge, Que.	20·50	87·26	..	11	7	559
	Ste. Anne de la Pocatière, Que.	22·43	85·05	1	10	.....	
	La Ferme, Que.	20·48	79·71	..	4	1	50
	Ottawa, Ont.	19·34	91·11	1	6	.....	
	Kapuskasing, Ont.	18·17	81·94	..	10	.....	
	Harrow, Ont.	19·95	86·52	1	2	15	263
	Brandon, Man.	15·29	80·76	2	..	11	1,595
	Morden, Man.	16·05	83·22	1	7	13	200
	Rosthern, Sask.	19·13	80·48	..	13	7	190
	Scott, Sask.	17·84	74·96	..	10	2	500
	Indian Head, Sask.	18·90	81·12	..	13	6	1,080
	Swift Current, Sask.	15·63	77·38	1	9	7	1,950
	Fort Vermilion, Alta.	18·99	84·37	1	3	10	880
	Beaverlodge, Alta.	12·47	71·39	1	13	7	850
	Lacombe, Alta.	17·72	75·11	..	13	4	710
	Lethbridge, Alta. (irrigated)	19·12	83·64	..	12	.....	
	" " (non-irrigated)	20·14	86·60	1	5	.....	
	Agassiz, B.C.	15·25	81·70	2	15	18	1,800
	Sidney, B.C.	17·50	86·08	1	15	14	380
	Summerland, B.C.	20·32	85·76	2	6	14	1,494

Averages for "Sugar in Juice" and "Coefficient" of "Purity" of the three varieties, Fredericksen, Horning and Rabbethge and Giesecke, as grown on the 25 Experimental Farms and Stations in this investigation in 1929, are as follows (table 71):—

TABLE No. 71.—SUGAR BEETS: SUGAR IN JUICE AND COEFFICIENT OF PURITY: AVERAGES FROM THE SEVERAL VARIETIES GROWN ON TWENTY-FIVE EXPERIMENTAL FARMS AND STATIONS THROUGHOUT THE DOMINION, 1929

Variety	Sugar in juice	Coefficient of purity
	p.c.	p.c.
Fredericksen	18·28	83·76
Horning	18·25	83·18
Rabbethge and Giesecke	18·31	83·33

The averages for sugar are in very close accord with those for the previous season; the data for coefficient of purity are somewhat higher. The results indicate that the varieties sown are of high factory quality. It is perhaps significant that the beets from all three sources of seed were practically of equal quality.

The results in the following table (No. 72) present the average percentage of sugar in juice from beets grown from 1920 to 1929 inclusive at the several Farms and Stations of the Experimental Farm System. They permit a comparison of the quality of the beets as grown at a large number of points in the Dominion and indicate the variation which may take place from year to year at these points, due largely to changing seasonal conditions.

TABLE No. 72.—AVERAGE PERCENTAGE OF SUGAR IN JUICE IN SUGAR BEETS GROWN ON DOMINION EXPERIMENTAL FARMS, 1920-1929

Locality	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Charlottetown, P.E.I.	16·44	16·40	.....	18·67	19·23	19·30	17·80	17·91	18·82	18·59
Kentville, N.S.	18·36	18·06	18·72	20·43	24·71	18·08	20·33	18·66	19·39	18·39
Nappan, N.S.	18·01	18·08	18·45	17·61	16·08	19·49	18·41	.....	19·79	17·70
Fredericton, N.B.	18·34	18·09	16·61	15·60	21·42	19·19	15·48	17·86	19·62	17·87
Lennoxville, P.Q.	14·55	16·01	15·12	15·99	17·51	17·29	17·15	18·49	17·20	19·30
Cap Rouge, Que.	16·09	17·04	21·27	18·61	.....	20·17	19·11	22·80	18·77	20·27
Ste. Anne de la Pocatiere, Que.	13·24	17·31	17·69	15·30	19·72	19·80	18·18	20·01	21·19	22·02
La Ferme, Que.	.....	.....	.....	.....	.....	.....	.....	16·65	.....	19·95
Ottawa, Ont.	15·04	15·61	16·44	16·16	16·36	15·57	16·92	17·08	18·98	19·29
Kapuskasing, Ont.	.....	.....	.....	.....	.....	.....	15·73	16·52	16·82	17·69
Harrow, Ont.	.....	.....	.....	.....	.....	.....	.....	18·99	18·71	19·63
Brandon, Man.	15·24	16·82	14·14	12·19	13·36	.....	13·16	14·51	18·49	15·28
Morden, Man.	.....	.....	.....	.....	.....	.....	9·44	14·17	19·42	15·75
Rosthern, Sask.	14·15	13·56	17·27	13·13	14·19	14·27	17·95	14·37	17·72	18·09
Scott, Sask.	15·74	15·79	17·25	19·21	15·71	14·18	12·58	12·92	17·34	18·20
Indian Head, Sask.	20·24	.....	19·70	20·12	17·10	16·52	15·73	12·54	21·18	18·53
Swift Current, Sask.	.....	.....	.....	.....	.....	.....	16·05	18·06	16·10	15·62
Fort Vermilion, Alta.	.....	14·47	16·00	14·32	13·01	16·11	12·28	19·74	20·80	18·95
Beaverlodge, Alta.	.....	15·77	.....	19·16	.....	.....	13·45	13·70	.....	12·98
Lacombe, Alta.	12·86	13·84	15·77	.....	.....	12·25	9·26	15·13	14·88	18·29
Lethbridge, Alta. (irrigated)	18·34	17·99	17·04	17·21	18·85	17·28	15·34	17·86	17·78	17·68
Lethbridge, Alta. (non-irrigated)	19·35	16·63	17·57	15·92	.....	15·04	15·23	20·50	17·10	20·18
Agassiz, B.C.	16·46	15·78	16·67	17·62	16·75	.....	14·94	15·44	16·50	15·87
Sidney, B.C.	14·29	.....	.....	16·67	14·90	18·74	16·38	17·22	16·82	17·58
Windermere, B.C.	19·26	15·78	17·56	20·02	17·44	21·96	15·84	.....	22·91	.....
Summerland, B.C.	16·85	20·03	17·36	16·92	20·08	21·33	14·96	20·49	19·16	19·42

The results in the following table (No. 73) from beets grown at Ottawa, Rosthern, Fort Vermilion, Lethbridge, Agassiz and Sidney are chiefly from seed obtained from the Amtorg Trading Co., New York. These, we understand are representative Russian varieties, the seed being produced in Russia and largely used in that country for sugar extraction. The results indicate that they are high quality varieties, furnishing data very similar to those from the seed obtained from the Dominion Sugar Co., Chatham, Ont.

TABLE No. 73.—SUGAR BEETS: ADDITIONAL VARIETIES—DOMINION EXPERIMENTAL FARMS AND STATIONS, 1929

Locality where grown	Variety	Percentage of sugar in juice	Coefficient of purity	Average weight of one root	
			p.c.	lb.	oz.
Ottawa, Ont.	Bielotzerkov	19·78	92·14	1	2
	Ivanosk	19·09	91·10	1	6
	Kalnik	20·26	93·05	..	15
	Ramon	19·24	91·65	1	5
	Uladovka	18·82	90·53	1	6
	Vierchniateka	19·89	92·58	1	4
Rosthern, Sask.	Amtorg X 8	20·35	83·08	..	13
	" N 3	18·54	78·72	..	12
	" E 4	18·78	81·10	..	13
	" E 10	18·58	78·81	..	14
	Buszczynski	18·78	81·21	..	14
	Dippe	18·59	80·71	..	14
	Kalnik	18·84	80·32	..	13
Fort Vermilion, Alta.	Dippe	18·64	82·83	1	0
	Vilmorin's Improved	17·71	83·16	1	2
	Schreiber & Sons	20·04	86·40	1	3
Lethbridge, Alta.	Dippe (non-irrigated)	21·60	87·58	1	7
	Raymond Seed Co. (irrigated)	18·31	81·83	1	9
	Schreiber & Sons (irrigated)	17·56	79·95	..	14
Agassiz, B.C.	Klein Wanzleben	16·43	81·28	3	11
Sidney, B.C.	"	16·77	88·12	3	..

An experiment was instituted at the Experimental Station, Lethbridge, Alta. to ascertain the influence of early and late seeding on the sugar percentage and purity. Beets from the several plots were forwarded for analysis and the results

are presented in the following table (No. 74). Particulars as to the period between the several seedings are not available, but it is doubtful if that information would satisfactorily explain the results which, for one reason or another, would go to show that the beets of the 2nd, 4th and 6th seedings are richer, by about 2 per cent, than those of the 1st, 3rd and 5th. Further work must be done in this inquiry before drawing conclusions.

TABLE No. 74.—INFLUENCE OF EARLY AND LATE SEEDING ON SUGAR CONTENT OF BEETS, EXPERIMENTAL STATION, LETHBRIDGE, ALTA., 1929—(IRRIGATED)

Seeding	Percentage of sugar in juice	Coefficient of purity	Average weight of one root
	p.c.	p.c.	lb. oz.
1st date of seeding	16·06	76·10	3 8
2nd " "	18·03	82·94	3 9
3rd " "	16·30	77·16	3 14
4th " "	18·01	79·77	2 3
5th " "	16·44	77·21	2 5
6th " "	18·68	78·07	1 5

SUGAR BEETS FROM KAMSACK, SASK.

The Kamsack Board of Trade being interested in the possibility of establishing the beet sugar industry in that district obtained seed from the Canadian Sugar Factories, Limited, Raymond, Alta. in the spring of 1929. This seed was distributed among farmers and from the resultant beets four samples were submitted for analysis. Unfortunately particulars as to cultural methods, seasonal conditions etc. were not obtainable.

TABLE No. 75.—SUGAR BEETS—KAMSACK, SASK., 1929

Grower	Sugar in juice	Coefficient of purity	Average weight of one root
	p.c.	p.c.	lb. oz.
R.D.	16·97	74·15	1 13
C. J. K.	20·65	84·14	.. 11
M. G.	16·13	78·50	2 4
P. K.	16·92	78·86	.. 12

The results from the beets grown by C. J. K. are quite satisfactory—both as to sugar content and purity. These beets, however, were quite small which in some measure would account for the comparatively high percentage of sugar. The small weight of root would undoubtedly mean a low acreage yield.

The remaining three samples are fair only as to sugar content and decidedly poor as to purity.

The somewhat poor condition in which these beets were received may in some degree have affected these results, but certainly the present data—though admittedly inadequate for a decision in the matter—are not encouraging.

SUGAR BEETS FROM THE NORTHERN OKANAGAN, GRANDE PRAIRIE AND KAMLOOPS DISTRICTS, B.C.

This series of 34 samples consisted of beets of the varieties "Fredericksen" and "Rabbethge and Giesecke", grown at a number of points throughout the Okanagan districts. The seed was supplied by the Experimental Farm System at the request of the provincial department of Agriculture, British Columbia,

which undertook to distribute the seed, supervise the culture of the beets and collect and ship samples of the harvested crop for analysis. Mr. Donald Graham, President of the Board of Trade, Armstrong, B.C., was instrumental in instituting this enquiry and enlisting the co-operation of all those necessary to its successful prosecution.

TABLE No. 76.—SUGAR BEETS—NORTHERN OKANAGAN, GRANDE PRAIRIE, KAMLOOPS DISTRICTS, 1929

Grower	Locality	Variety	Sugar in juice	Coefficient of purity	Average weight of one root	
			p.c.	p.c.	lb.	oz.
J. P. L.	.....	Rabbethge & Giesecke	15·59	81·64	2	4
P. C.	Lumby	" "	17·95	82·30	1	7
G. F. I.	Salmon Arm	" "	17·54	82·31	1	13
J. B.	Kelowna	Fredericksen	17·39	83·99	2	11
H. E.	North Kamloops	Rabbethge & Giesecke	19·23	88·57	1	9
J. B.	Grand Prairie	" "	18·91	86·10	1	7
C. J. B.	Kelowna	Unnamed	19·65	87·84	1	4
J. B.	Grand Prairie	Fredericksen	20·13	87·16	1	7
F. P.	Armstrong	Rabbethge & Giesecke	17·68	84·59	2	2
W. H.	"	Fredericksen	17·56	83·62	1	1
C. W. B.	Lansdowne	"	17·13	81·98	1	10
T. W.	Kelowna	"	17·64	86·04	1	14
J. D. C.	"	Rabbethge & Giesecke	17·18	81·83	2	13
C. K.	Falkland	" "	20·99	89·84	1	7
A. C. B.	Winfield	" "	20·18	88·14	1	14
C. P.	Falkland	Fredericksen	20·10	87·78	..	8
T. G.	Mara	"	18·78	84·68	1	5
W. R. P.	Winfield	"	19·47	87·84	1	13
G. F.	Lansdowne	Rabbethge & Giesecke	18·57	87·32	1	8
J. C. H.	Armstrong	Fredericksen	17·39	82·92	1	14
A. L. B.	"	"	19·73	89·02	3	7
E. K.	"	Rabbethge & Giesecke	9·86	71·17	1	9
E. K.	"	Fredericksen	15·36	80·42	1	10
R. G. H.	Grandview Flats	Rabbethge & Giesecke	18·08	82·64	1	14
G. H. H.	North Kamloops	" "	19·18	84·48	1	11
E. E.	"	Fredericksen	20·45	87·76	1	8
J. P. L.	.....	"	19·83	89·04	2	2
H.	Grindrod	"	20·30	88·84	1	8
G. F. I.	Salmon Arm	"	19·32	88·26	2	4
P. C.	Lumby	"	18·33	85·29	1	10
R. H.	.....	"	18·34	83·01	1	4
G. H. H.	North Kamloops	"	18·45	86·60	1	7
C. W. B.	Lansdowne	Rabbethge & Giesecke	16·85	80·61	1	10
J. C.	.....	Fredericksen	18·06	85·61	2	5

With a few exceptions, these beets were of excellent quality, i.e., they contained a percentage of sugar sufficiently high for profitable extraction with a very satisfactory coefficient of purity.

There were a few beets somewhat small i.e. light in weight, but the majority in respect to size appeared to be satisfactory. There were no data as to yields.

Considering shape, forkiness, etc., the series as a whole may be regarded as well grown and suitable for factory purposes.

INSECTICIDES AND FUNGICIDES

Investigations under this heading—the preparation of spray mixtures, the chemical and physical examination of liquid and dust insecticidal and fungicidal preparations in every day use and the testing of these on experimental plots, are conducted partly in the laboratory of the Division of Chemistry at Ottawa and partly in co-operation with the Entomological Branch of the Department of Agriculture, through the many branch Stations.

ROSIN OIL SPRAYS

In co-operation with the entomologist in charge at Vineland Station, various experiments were conducted toward the preparation of rosin-oil varnish sprays. The oils experimented with comprised vegetable oils, drying, semi-drying and non-drying; animal and petroleum oils with rosin. These oil varnishes when added to water in the presence of a suitable emulsifying agent, give a spray which on drying, leaves a film on the surface of the leaf or wood, thus tending to seal up insect eggs.

It is as yet too early to make any definite statement as to the relative effectiveness of these sprays, but results so far obtained are quite promising.

CO-OPERATIVE WORK AT ANNAPOLIS ROYAL, N.S.

At the entomological laboratory at Annapolis Royal, N.S., experiments covered a wide and varied field. The investigations comprised a study of arsenicals in different sprays, an examination of the many preparations used on the experimental plots and observation of these applied preparations throughout the season.

PYRETHRUM

Extracts were prepared and tested from home-grown pyrethrum (*Chrysanthemum cinerariaefolium*) harvested at three stages of growth, unopened bud, semi-opened bud and open flower. The stems, attached to the bud at these stages were also analysed with interesting results. The data found will be confirmed next season.

A brief review of some of the more important preparations examined follows:—

ARSENATE OF LIME

Lab'y Nos. 98826, 99333.—The samples analysed all meet their guarantee for total arsenic (As) and are well below the water soluble arsenic tolerance permitted. The relative density, or the volume occupied by a pound of the powder, shows some variation, indicating that orchardists should weigh the required amount of the arsenate for each spray tank rather than measure it.

TABLE No. 77.—ANALYSIS OF ARSENATE OF LIME, 1929–1930

Lab'y No.	Source of sample (manufacturer)	Vendor or submitter	Relative density	Arsenic, as metallic As		Moisture
				Total	Water soluble	
			Cu. in. per lb.	p.c.	p.c.	p.c.
97726	Deloro Chemical Co., Deloro, Ont.	Associate Dominion Entomologist, Ottawa.	83	27·22	0·07	2·36
97779	Niagara Dust Co., Kentville, N.S.	Entomologist in charge, Annapolis Royal, N.S.	84	27·17	0·03	1·26
97782	Deloro Chemical Co., Deloro, Ont.	Entomologist in charge, Vineland Station, Ont.	63	27·32	0·29	2·65
99333	Deloro Chemical Co., Deloro, Ont.	Associate Dominion Entomologist, Ottawa.	75	26·60	0·27	.....

Sample No. 97782 was received with the remarks that foliage injury resulted from a delayed dormant spray application of the poison when used in combination with Bordeaux mixture. An analysis of the arsenate by our revised method showed it to be a stable preparation, yielding no soluble arsenic when subjected to air aspiration in the presence of Bordeaux mixture. The density of the poison is such that more, i.e., a greater weight, may have been used in each spray tank than actually stated.

ARSENATE OF LEAD

Lab'y No. 97778.—The sample analysed fully meets its guarantee; the water soluble arsenic, while below the tolerance permitted, is, however, somewhat high for lead arsenate powders: This sample submitted by the Entomologist in charge at Annapolis Royal, N.S., is the product of the Niagara Dust Co., Kentville, N.S.

Analysis

Moisture	0·21 p.c.
Total Arsenic (As)	21·71 "
Water soluble arsenic (As)	0·44 "
Lead oxide (PbO)	64·38 "
Density (cubic inches per pound)	84

SULPHUR PREPARATIONS

Lab'y No. 102603.—Lime sulphur solution, submitted by La Société Co-operative des Fruitièrs de St. Hilaire, P.Q.

Analysis

Total sulphur	21·44 p.c.
Sulphide sulphur	19·80 "
Baumé at 20°C	30°

The total sulphur and sulphide sulphur found are low for products of this nature. A good grade product contains from 24 to 26 per cent total sulphur.

SULPHUR LIME POWDER

Lab'y No. 99499.—Dry lime sulphur submitted by the Entomologist-in-charge, Vineland Station, Ont., and prepared by Jos. Tweedle, Stoney Creek, Ont.

Analysis

Sulphur (free)	34·50 p.c.
Solubility of preparation	19·52 "
Total soluble sulphur	5·39 "
Ash, essentially lime	65·43 "

A light yellow powder, quite coarsely ground and only fairly soluble in water; settles quite rapidly on cessation of agitation.

It cannot be regarded in respect to composition as a high grade "dry lime sulphur" and its physical condition is too coarse for satisfactory use as a dusting compound.

NICOTINE PREPARATIONS

Lab'y Nos. 101121, 102696.—Solutions of nicotine sulphate imported from Europe and submitted respectively by the Entomologist-in-charge, Annapolis Royal, N.S., and W. J. Tawse, Co-operative Fedérée de Quebec, Montreal.

	Lab'y No. 101121	Lab'y No. 102696
	p.c.	p.c.
Nicotine (as alkaloid)	41·97	42·71
Specific gravity, at 20°C	1·165	1·166

Both samples were light-brown, clear solutions without sediment. The evidence would indicate that these samples are one and the same preparation.

When used as a spray against certain insects, such as the currant worm and rose leaf hopper, this preparation appears to be as satisfactory and effective as the standard spray material, nicotine sulphate (Black Leaf 40), but further experimental work is necessary before any statement can be made regarding its general usefulness as compared with the recognized nicotine preparations on the market.

TOBACCO EXTRACTS

Lab'y Nos. 102585-589.—Samples submitted by S. J. Richey, St. John, N.B., and some of them were apparently of home preparation. Samples Nos. 102585 and 102589 fermented quite rapidly.

Lab'y No.	Brand	Nicotine as alkaloid	Reaction
		p.c.	
102585.....No. 1 W.....	Nicoteen	0·119	alkaline
102586.....No. 2 W.....	"	10·56	acid
102587.....No. 3 S.....	"	0·127	alkaline
102588.....No. 4 S.....	"	40·30	acid
102589.....No. 5 P.....	"	0·304	alkaline

For the control of aphis, the extracts registered under sample numbers 102585 and 102587 may be used direct, while dilution with water of the extract under number 102589 will be necessary. Samples number 102588 appears to be a standard preparation of nicotine sulphate, while sample number 102586 is probably "standard" which has been "cut" by the addition of water.

NICOTINE DUSTS

Lab'y Nos. 98279, 98908.—Nicotine dusts submitted for a report as to strength and efficacy and sent in, respectively, by Thos. Hurtley, North Kingston, N.S., and R. W. Thompson, Department of Entomology, Guelph, Ont.

Analysis

	Lab'y. No. 98379	Lab'y. No. 98908
Nicotine (as alkaloid).....	1·12 per cent	5·25 per cent

Sample No. 98379 was below strength for a 2 per cent dust; sample No. 98908, stated to be a 4 per cent dust, contained nicotine in excess of this figure.

OILS

Lab'y Nos. 102349-50.—Oils to be used in the preparation of summer sprays, submitted by the Imperial Oil Company, Ottawa, Ont.

Analysis

	Lab'y. No. 102349	Lab'y. No. 102350
Viscosity, seconds Seybolt (100°F.).....	46	138
Percentage of oil unsulphonated.....	89·5	98

These oils will be put under practical test and their relative effectiveness reported later.

BOILER COMPOUND

Lab'y No. 102076.—Submitted by the Entomologist-in-charge, Vineland Station, Ont., and a product of the Brooks Co., Hamilton, Ont.

Analysis

Silica (SiO_2).....	27·50 per cent
Sodium oxide (Na_2O).....	13·72 "

A magenta coloured, strongly alkaline solution of sodium silicate: approximately a 35 per cent solution. The use of solutions of this nature, diluted to the proper strength in sprays, may be of value in sealing up insect eggs, thus preventing hatching, but no definite information on this point is yet available.

COPPER DUSTING MIXTURE

Lab'y No. 100650.—Manufactured by Niagara Sprayer Co., Middleport, N.Y., and submitted by G. C. Chamberlain, Plant Pathologist, Dominion Laboratory of Plant Pathology, St. Catharines, Ont.

Analysis

Copper, as metallic Cu	7·45 per cent
Total arsenic, as metallic As	0·20 "

The sample was a blue-coloured, finely ground powder, a mixture of copper sulphate and lime. The arsenic found is probably accidental, due to contamination from the mixer. This preparation is a straight copper-lime dust, in other words, a dry Bordeaux.

KING BUG KILLER

Lab'y No. 99773.—Manufactured by King Calcium Products, Campbellville, Ontario, and submitted by Mason and Dale, Bowmanville, Ont., and stated to be a " quick, sure death " insecticide.

Analysis

Total arsenic, as metallic As	1·52 per cent
Water-soluble arsenic, as metallic As	0·18 "
Copper, as metallic Cu	0·32 "

A grey coloured, finely ground powder, a mixture of calcium arsenate and copper sulphate, with lime (heavily carbonated) as a filler.

The small amount of copper present removes this preparation from the rank of strong fungicides. It is probably intended as an insecticide for control of the potato beetle; and may also possess weak fungicidal properties.

WELL WATERS FROM FARM HOMESTEADS

Dirty water—water offensive to sight, taste or smell—carries its own condemnation; it needs no analysis to pronounce it an unusable supply. But there are many farm well waters clear, bright and odourless which are far from being safe and wholesome. The presence of excretal matter—soakage from sources of contamination in the more or less immediate surroundings of the well—may not —does not always—reveal itself without the aid of chemistry and bacteriology. Herein lies the danger of concluding that a water without a " bad taste " or " offensive smell " is necessarily a good water. If there is the slightest reason to suspect the purity of a supply, there should be no delay in having it tested. This examination of farm well waters is made free of charge provided the directions for collection and shipment of the sample (obtainable on application to this division) are carefully carried out and the express charges on the sample prepaid. No sample should be forwarded without first consulting these instructions—dirty bottles, old corks, etc., render the analysis valueless.

During the past year 120 samples have been sent in, examined and reported. This number is somewhat less than in the past and possibly may indicate a falling off in interest in this important matter. An ample supply is generally recognized as one of the farm's most valuable assets; a pure supply is of equal importance, since polluted water endangers the health of the family and may seriously affect the thrift of the live stock. A classification of these waters, according to accepted standards, is as follows:—

	per cent
Pure and wholesome	34
Seriously polluted	25
Suspicious and probably polluted	27
Saline	14

There are no grounds for concluding that the above classification represents the condition generally throughout the Dominion of farm well waters, but it is somewhat significant that only one third of the samples examined have been found to be of first class drinking quality—especially when it may be affirmed that our natural waters of lake, stream and springs are of the purest.

Attention may be directed to a leaflet entitled "The Farm Well" which discusses the proper location of the well and the protective measures which may be taken to safeguard the purity of the supply. This leaflet is obtainable on application.

RED-WATER CATTLE DISEASE AS OCCURRING IN CERTAIN DISTRICTS OF BRITISH COLUMBIA

At a meeting held in May, 1929, of the officials of the Health of Animals and Experimental Farm Branches of the Department of Agriculture, called for the purpose of considering the problems in connection with the redwater cattle disease in British Columbia it was considered desirable to reopen this investigation and as a first step to make a survey of conditions in the districts of the province in which this disease might be more or less prevalent.

This survey was entrusted to Mr. C. H. Robinson of the Division of Chemistry and Dr. E. A. Bruce, Pathologist, Health of Animals' Branch, who during the month of June visited the areas in the Fraser River valley in which the disease occurred. More than thirty typical farms were carefully inspected, notes made on the conditions found and samples of soil, herbage, well water, blood from diseased cattle, urine, etc., for further examination in the laboratories, collected.

Although good progress has been made in this investigation there is still much to do. Until the present avenues of this enquiry have been further explored it has been thought well to defer publication of the detailed data, which already are voluminous. A brief interim report on the results obtained to date will, however, be of interest.

HERBAGE

Two representative samples of hay were secured; one from the Matsqui prairie district, in which, according to accounts, the disease is not known, the other, a ferny hay collected on a "red-water" farm near Langley. The following botanical analysis of these two hays was made by Mr. H. Groh of the Division of Botany:—

"The hay from 'non-redwater' area consisted of 6 pounds of grasses, mostly timothy, but including also rye grass, a *Poa*, Yorkshire fog and red top; 3 ounces of red and alsike clover; 2 ounces of horsetail and 5 ounces of other weeds, namely, common plantain, dandelion, yarrow, mouse-ear chickweed and Canada thistle.

"The sample from a 'redwater' area was separated into 4¾ pound grasses; one pound clover, red and alsike; one pound bracken and several ounces of other weeds, mostly yarrow and brambles. Another 3½ pounds of crushed mixture and seeds of Yorkshire fog was made up of probably about the same proportions as the above weights. The grasses, which could not have been separated readily, contained somewhat similar proportions of rye grass, red top and Yorkshire fog, with timothy, *Poa* and orchard grass as unimportant constituents. The weeds included, besides yarrow, and bramble some sheep sorrel, ox-eye daisy, mouse-ear chickweed, self heal, daisy fleabane, and least hop clover (*Trifolium dubium*).

"The results of this analysis are therefore pretty largely negative as regards known injurious species, unless bracken can be shown to have any bearing on the matter."

The mineral content of the two hays was determined. The following are the data:—

TABLE NO. 78.—MINERAL CONTENT OF HAYS

(Water-free basis)

—	CaO	P_2O_5	K_2O	SiO_2	P_2O_5 : CaO
	p.c.	p.c.	p.c.	p.c.	
Hay from "Redwater" area	0·81	0·43	1·95	1·92	1 : 1·88
Hay from area free from redwater	0·64	0·42	1·40	2·72	1 : 1·52

The differences in mineral content of these two hays lie chiefly in their percentages of lime and potash; the " redwater " hay contains the larger amount in each case—evidently due to the fact that it is the hay with the larger proportion of legumes—red and alsike clovers. The percentages of calcium (lime) though not as high as those in " mixed " hays from well manured land are considerably above the average of hays from soils distinctly deficient in this element. The phosphoric acid content (practically the same for both hays) is decidedly low, probably about one half that which might be expected in hays from well cultivated soils.

The amounts of lime, phosphoric acid and potash in these hays, expressed as percentages of the amount found in hay from well cultivated land, are as follows:—

—	CaO/100	P_2O_5/100	K_2O/100
From Redwater area	81	58	61
From Area free from Redwater	64	57	44

The usual feeding stuffs analysis of these hays afforded the following data:—

TABLE No. 79.—ANALYSIS OF HAYS

—	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
From Redwater area	7·37	7·25	2·10	49·75	28·15	5·38
From area free from Redwater	7·69	5·44	3·03	49·81	28·38	6·65

The hay from the " redwater " farm contains the higher percentage of crude protein, due undoubtedly to its containing a larger proportion of legumes.

URINE

Forty samples of urine were collected and examined while fresh for reaction by means of the quinhydrone electrode. Thirty of these were from cows or herds affected to a greater or less degree with redwater disease. Ten samples were taken for the purposes of comparison from the herd of the Experimental Farm at Agassiz, B.C.

TABLE No. 80.—REACTION OF URINE

The hydrogen-ion concentration was determined electrometrically using the quinhydrone electrode

Locality of herd	Red water cattle	Disease free cattle	Locality of herd	Red water cattle	Disease free cattle
	pH	pH		pH	pH
Langley Prairie	8·13	.....	Aldergrove	.....	7·87
Milner, Langley	7·90	.....	"	.....	8·58
"	8·25	.....	"	.....	8·12
Mt. Lehmann	7·90	.....	"	.....	7·94
Deroche	.....	8·03	"	8·17	.....
"	.....	8·03	Deroche	.....	7·77
"	7·15	.....	"	.....	7·81
"	.....	8·08	"	.....	7·62
"	.....	8·26	Coghland	8·40	.....
"	.....	7·96	"	.....	8·57
"	.....	7·15	Agassiz	.....	8·55
"	.....	7·32	"	.....	7·23
Aldergrove	.....	7·77	"	.....	8·57
"	.....	7·99	"	.....	8·59
"	8·2 (?)	.....	"	.....	8·17
"	.....	8·19	"	.....	8·10
"	.....	8·12	"	.....	8·14
"	.....	8·17	"	.....	7·91
"	8·10	.....	"	.....	7·96
"	.....	8·64			

It will be observed that no sample of urine from diseased cattle had an acid reaction. The suggestion, therefore, that acidity of the urine, results in irritation of the bladder walls with the subsequent appearance of blood in the urine, receives no support from the data of this enquiry.

BLOOD

Since "mineral deficiency" was considered as possibly having some bearing on the cause or causes of this disease, samples of blood sera from diseased and unaffected animals were collected and examined as to calcium and phosphorus (inorganic and total) content.

TABLE No. 81.—CALCIUM AND PHOSPHORUS CONTENT OF THE BLOOD SERA

(Milligrams per 100 cc. Serum)

Locality of herd	Calcium		Phosphorus			
			Inorganic		Total	
	Red water cattle	Disease free cattle	Red water cattle	Disease free cattle	Red water cattle	Disease free cattle
Sperling, B.C.	11·1	.....	4·7	.....	11·1	.....
"	10·9	.....	7·2	.....	12·7	.....
"	11·4	.....	5·1	.....	10·5	.....
"	10·3	.....	5·6	.....	11·6	.....
Medd R. Langley	.....	11·5	.....	4·9	.....	9·7
"	.....	11·9	.....	5·2	.....	10·1
"	.....	12·2	.....	5·6	.....	11·5
Langley	12·0	.....	6·0	.....	12·2	.....
"	.....	11·7	.....	5·5	.....	11·6
"	10·9	.....	5·7	.....	12·0	.....
"	11·5	.....	4·9	.....	10·1	.....
"	.....	12·1	.....	5·3	.....	10·6
"	12·2	.....	5·6	.....	11·5	.....
"	.....	11·3	.....	5·5	.....	10·9
"	10·8	.....	4·8	.....	9·7	.....
"	11·2	.....	5·1	.....	10·4	.....
"	11·8	.....	5·2	.....	10·5	.....
"	.....	10·8	.....	5·4	.....	11·6
"	11·5	.....	7·0	.....	12·0	.....
"	12·1	.....	4·6	.....	9·9	.....
"	12·5	.....	5·4	.....	10·5	.....
Ottawa	.....	11·0	.....	5·2	.....	10·9
"	.....	10·8	.....	5·0	.....	8·5
"	.....	11·1	.....	4·8	.....	9·5
"	.....	10·9	.....	5·0	.....	9·0
"	.....	11·3	.....	5·0	.....	12·7

The results of the calcium determinations illustrate the remarkable constancy of this element in the blood; comparing the data of the blood from diseased and disease-free cattle it may be stated that there is no significant difference in the content of this element.

The phosphorus data are not so constant as those for calcium but the variation is neither direct nor pronounced, permitting no differentiation between diseased and disease-free animals. The figures, however, are far higher than those obtained by Green and Du Toit in South Africa from the blood of animals suffering from phosphorus deficiency. These authors found the inorganic phosphorus content of whole blood to range from 1 to 1·5 milligrams per 100 cc. whole blood of animals suffering from phosphorus deficiency. The present data therefore would seem to show that there is no lack of phosphorus in the blood stream of animals suffering from redwater disease.

SOIL

To learn if the examination of soils from disease affected areas might throw any light upon the prevalent idea that mineral deficiency, including soil acidity, is associated with the occurrence of this disease, samples of soil from affected and disease-free areas were collected and analysed.

REACTION OF SOIL

The hydrogen-ion concentration was determined electrometrically using the quinhydrone electrode.

TABLE No. 82.—REACTION OF SOIL

Locality	Red water area	Disease free area	Locality	Red water area	Disease free area
	pH	pH		pH	pH
Matsqui prairie	.....	5·54	Fairfield	5·96	.....
" (subsoil)	.....	5·76	Cowichan	5·88	.....
	5·54	.....	Langley (bench)	5·56	.....
	5·88	.....	" (bench), (subsoil)	5·12	.....
	5·15	.....	" (lowland)	.....	5·37
Mt. Lehmann	5·62	.....	" (lowland) (subsoil)	.....	5·63
Abbotsford	5·46	.....	Mt. Lehmann	5·93	.....
Chilliwack	5·83	.....	Coghlan	5·17	.....

All these soils, it will be observed, have an acid reaction and there is no pronounced difference in this regard between the soils of affected and disease-free areas.

From the soils collected four surface samples were selected for detailed analysis; two from red-water areas and two from disease-free areas. The results of the analysis are as follows:—

TABLE No. 83.—ANALYSIS OF SOILS
(Water-free Basis)

Locality	Nitrogen	Lime (CaO)	Magnesia (MgO)	Phosphoric acid (P_2O_5)	Available		Lime requirements, pounds $CaCO_3$ per acre
					Lime (CaO)	Phosphoric acid (P_2O_5)	
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	lbs.
Disease-free Area—							
Matsqui prairie	0·303	1·13	2·17	0·243	0·362	0·115	6,356
Langley-lowland	0·512	0·75	2·05	0·362	0·245	0·069	14,568
Red Water Area—							
Abbotsford	0·197	0·60	1·02	0·246	0·121	0·120	7,352
Langley-bench	0·232	0·96	1·98	0·466	0·163	0·214	8,020

Judged by the tentative standards suggested from the analysis of many Canadian soils, none of these soils are noticeably deficient in the essential elements of plant food, considered either as total or available. There is no indication from these results that there is any relation between the mineral plant food content of the soil and the occurrence of this disease.

WATER

A further avenue of research which might give useful information in this investigation suggested itself in the determination of the iodine and "mineral" content of the waters of a district in which the disease was more or less prevalent.

To this end three samples of water from the Langley Prairie district were obtained, the collection being made by the Superintendent of the Experimental Farm, Agassiz, who writes as follows:—

"No. 1 is from a well 16 feet deep which apparently never goes dry, situated on high land.

"No. 2 from an artesian well 1½ miles west of well No. 1.

"No. 3 from a small running creek about 300 yards south of the artesian well (No. 2). This creek is apparently fed by several springs.

"All the waters furnished came from sources that are used for watering cattle. There are no red water cattle on the 'shallow well' farm (No. 1), but there are cases in the vicinity. There have, however, been a few occurrences on the farms from which the other two waters were collected.

"Apparently red water disease in dairy cattle has been quite common in the district in which these samples were collected."

IODINE CONTENT OF WATERS	Iodine parts per billion (10^9)
No. 1 Shallow well, highland	1·55
No. 2 Artesian well	37·40
No. 3 Running Creek	9·10

Authorities who have worked specially on the iodine content of waters in relation to the occurrence of goitre have stated that in districts of the Western United States in which the iodine content of the water is below 0·5 parts per billion goitre is likely to be quite prevalent.

Judged by this standard water No. 1, though not deficient in iodine, must be regarded as comparatively low in this element.

Investigations carried on in recent years in the United States have shown that the iodine content of water supplies of Minnesota, Mississippi and Illinois is below 1·0 part per billion whereas in a more easterly location e.g. Massachusetts the iodine content is between 2 and 3 parts per billion.

The iodine content of No. 2 (Artesian) is very high, approaching the amount found in the sea (Adriatic sea=51 parts per billion).

Water No. 3 (Creek) is well supplied with iodine.

The data of this inquiry afford no indication that there is iodine deficiency in the water supply of areas in which this disease occurs.

TABLE No. 84.—MINERAL CONTENT
(parts per million)

—	No. 1, shallow well	No. 2, artesian well	No. 3, creek
Total solids at 130° C.	124·0	605·0	77·0
Lime (CaO)	18·3	17·7	12·6
Magnesia (MgO)	5·7	4·6	10·9
Soda (Na_2O)	24·1	280·8	21·3
Potash (K_2O)	6·2	13·8	5·5
Silica (SiO_2)	19·0	25·4	13·5
Phosphoric acid (P_2O_5)	0·7	2·5	0·7
Chlorine (Cl)	7·8	200·0	4·0
Sulphuric acid (SO_3)	7·6	43·6	10·2

Water No. 1. Shallow well. Though not to be classed with "soft" waters, it is not highly mineralized. Of the mineral content, soda rather than lime predominates. Chlorides and sulphates are present only in small amounts. The analysis does not reveal any compound or property which would render this water an unsuitable supply for farm use.

Water No. 2. Artesian well. This might be classed as a moderately saline water, the chief mineral constituent being common salt (23 grains per gallon). Lime and magnesia compounds are small in amount and sulphates are not high. The saline content of this water, though high, is below the recognized limit set for potable waters.

Water No. 3. Creek. This is a distinctly soft water. Its low mineral content consists of soda rather than lime compounds. Chlorides are low and the soda is probably present chiefly as sulphate and silicate. From the chemical standpoint, this water, according to recognized standards would be considered a safe and desirable supply for cattle use.

FERMENTATION IN CANADIAN HONEY

The Canadian honey industry has suffered considerable losses through the spoilage of honey on storage by fermentation. This fermentation is caused by sugar tolerant yeasts, several types of which have been isolated and studied by the Division of Bacteriology of the Central Experimental Farm*. Infection by these organisms may be due in part to careless handling and in part to the transportation by the bee of yeasts from the flowers to the comb. In so far as the infection is due to careless handling it can be avoided; in so far, however, as it is due to the bees themselves it cannot be avoided, and, therefore, some control measure is necessary in order that the activity of the yeasts may be kept at a minimum.

In order to obtain an insight into the conditions most favourable to the growth of yeasts in honey the following investigation was undertaken by the Division of Chemistry in co-operation with the Divisions of Apiculture and Bacteriology. Two hundred samples of honey, collected from all parts of Canada, were sent to the Division of Apiculture. There, each sample was divided into two parts, one was placed in an hermetically sealed receptacle and stored at room temperature, and the other was sent to the Divisions of Bacteriology and Chemistry for bacteriological and chemical examination.

The Division of Chemistry made the following determinations upon the samples: moisture, ash, hydrogen ion concentration, titrateable acidity, nitrogen, invert sugar, sucrose, levulose, dextrose. The moisture was determined by the refractometer method. The hydrogen ion concentration was measured electrometrically with a quinhydrone electrode using a dilution of one part of honey to two parts of water approximately. The nitrogen was estimated upon, approximately, a ten gram sample by the Kjeldahl method.

The samples which were stored at room temperature at the Division of Apiculture will be left there until fermentation takes place. An attempt will then be made to correlate the chemical analysis with the rates of fermentation. At the same time, as a corollary, valuable data will be obtained as to the general composition of Canadian honey throughout the Dominion, as to the variation in composition with geographical location, and as to the variation in composition with floral origin.

At the present time 122 samples of the series have been analyzed. The results are summarized in tables 85 to 93 inclusive.

TABLE No. 85.—MOISTURE CONTENT OF CANADIAN HONEY—SUMMARY

Moisture per cent	Number of Samples	Percentage of Samples
From 15 to 15·9	1	1·0
" 16 " 16·9	19	15·0
" 17 " 17·9	35	28·5
" 18 " 18·9	50	41·0
" 19 " 19·9	14	11·0
" 20 " 20·9	2	1·5
" 21 " 22	1	1·0

*Bulletin No. 116, New Series, Department of Agriculture.

TABLE No. 86.—ASH CONTENT OF CANADIAN HONEY—SUMMARY

Ash per cent	Number of Samples	Percentage of Samples
From 0·02 to 0·039	19	16
" 0·04 " 0·059	52	43
" 0·06 " 0·079	20	16
" 0·08 " 0·099	12	10
" 0·10 " 0·139	6	5
" 0·14 " 0·199	5	4
" 0·20 " 0·299	5	4
0·331	1	1

TABLE No. 87.—TITRATEABLE ACIDITY OF CANADIAN HONEY—SUMMARY

Titrateable acidity c.c's. of IN Na OH per 100 gms honey	Number of Samples	Percentage of Samples
From 10 to 14·9	40	33·0
" 15 " 19·9	47	38·5
" 20 " 24·9	23	19·0
" 25 " 29·9	4	3·0
" 30 " 36	8	6·5

TABLE No. 88—HYDROGEN ION CONCENTRATION OF CANADIAN HONEY—SUMMARY

Gram ions per liter x 10^{-5}	Number of Samples	Percentage of Samples
39·8	2	2·0
From 32 to 16	38	31·0
" 16 " 8	50	40·5
" 8 " 4	25	20·0
" 4 " 2	7	5·5
" 0 " 2	1	1·0

TABLE No. 89.—NITROGEN CONTENT OF CANADIAN HONEY—SUMMARY

Nitrogen per cent	Number of Samples	Percentage of Samples
0·019	1	1·0
From 0·020 to 0·024	9	8·5
" 0·025 " 0·049	88	83·5
" 0·050 " 0·074	2	2·0
" 0·075 " 0·099	2	2·0
" 0·100 " 0·125	2	2·0
0·156	1	1·0

TABLE No. 90—INVERT SUGAR PERCENTAGE IN CANADIAN HONEY.—SUMMARY

Invert sugar	Number of samples	Percentage of Samples
p.c.		
From 70 to 71·9	4	3
" 72 to 73·9	21	17
" 74 to 75·9	49	40
" 76 to 77·9	40	33
" 78 to 79·0	8	7

TABLE No. 91.—SUCROSE CONTENT IN CANADIAN HONEY.—SUMMARY

Sucrose	Number of samples	Percentage of Samples
p.c.		
0·0	15	12
From 0·1 to 0·9	16	13
" 1·0 to 1·9	36	30
" 2·0 to 2·9	22	18
" 3·0 to 3·9	14	11
" 4·0 to 4·9	10	8
" 5·0 to 5·9	5	4
" 6·0 to 6·9	1	1
" 7·0 to 7·9	2	2
" 8·0 to 8·9	1	1

TABLE No. 92.—LEVULOSE CONTENT OF CANADIAN HONEY.—SUMMARY

Levulose	Number of samples	Percentage of Samples
p.c.		
From 37 to 38·9	7	6
" 39 to 40·9	48	39
" 41 to 42·9	52	42
" 43 to 44·9	13	11
" 45 to 47	2	2

TABLE No. 93.—RATIO OF LEVULOSE TO DEXTROSE.—SUMMARY

Ratio	Number of samples	Percentage of Samples
From 0·95 to 0·99	1	1
1·00	3	3
From 1·01 to 1·09	25	24
" 1·10 to 1·19	41	40
" 1·20 to 1·29	22	21
" 1·20 to 1·39	9	9
" 1·40 to 1·49	1	1
1·72	1	1

Up to the present time six samples have fermented, and in three others fermentation is suspected. The analyses of the fermented samples are given in table 94, and the analyses of the three doubtful samples are given in table 95.

TABLE No. 94.—ANALYSES OF SAMPLES OF HONEY WHICH HAVE FERMENTED WHEN STORED AT ROOM TEMPERATURE

Lab. No.	Moisture	Invert sugar	Sucrose	Levulose	Dextrose	Ash	Nitrogen	Titrateable acidity	pH.
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	No. of c.c's of I N NaOH per 100 gms. honey	
100200	19·3	76·0	1·0	38·6	38·5	0·253	0·097	31·5	4·5
100201	20·2	74·3	1·8	40·9	34·8	0·044	0·034	15·0	3·9
100256	22·4	70·3	1·0	39·1	32·6	0·058	0·036	20·8	4·1
100257	21·6	70·3	0·0	38·4	33·2	0·075	0·086	35·4	4·1
100272	19·5	76·8	0·0	40·9	36·2	0·072	0·040	22·4	3·6
100326	19·9	76·5	1·2	40·2	36·7	0·195	0·042	22·7	3·7

TABLE No. 95.—ANALYSES OF SAMPLES OF HONEY IN WHICH FERMENTATION IS SUSPECTED

Lab. No.	Moisture	Invert sugar	Sucrose	Levulose	Dextrose	Ash	Nitrogen	Titrateable acidity	pH
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	No. of c.c's of I N NaOH per 100 gms. honey	
100313	18·9	72·4	1·7	43·8	30·3	0·166	0·046	17·7	3·8
100314	19·3	76·2	0·0	42·0	35·6	0·039	0·048	18·8	3·0
100327	19·9	76·1	0·3	43·4	34·5	0·048	0·034	14·5	3·7

By comparing the analyses given in tables 94 and 95 with the summary of the analyses of Canadian honeys given in the preceding tables it will be seen that the average moisture of the fermented samples is definitely higher than the average moisture of Canadian honeys. This substantiates the conclusion of a previous investigation, viz., that a high moisture content in honey is favourable to fermentation. In the case of some of the other constituents as for example, nitrogen, titrateable acidity, and ash there is sufficient variation from the general average to suggest that they too might play a part in determining the optimum conditions for fermentation. Until the investigation is completed, however, it would be dangerous to draw any definite conclusions other than those just intimated.

The final results of the investigation, together with the complete data on the chemical composition of Canadian honey, will be presented in the annual report for the year ending March 31, 1931.

ANALYTICAL AND EXAMINATIONAL WORK ON SAMPLES SUBMITTED BY THE HEALTH OF ANIMALS BRANCH, THE FRUIT BRANCH AND THE DAIRY AND COLD STORAGE BRANCH OF THE DEPARTMENT OF AGRICULTURE

During the year 1,838 samples were examined. This report gives a brief summary of the results of our examination for each class of product.

The following is a classified list of the samples examined during the year 1929-30.

HEALTH OF ANIMALS BRANCH

Inks	15
Salts and preservatives	33
Spices and condiments	126
Denaturing oils	67
Lards, lard compounds, edible oils and fats	135
Mincemeats	36
Sausages, meat products and fish and meat pastes	262
Pickled pork, bacon and pickling solutions	59
Miscellaneous	68
	801

FRUIT BRANCH

Evaporated apples	323
Glace and Maraschino cherries	60
Colours	21
Jams, marmalades, jellies and preserves	169
Tomato products	27
Miscellaneous	47
Special jam investigation	84
	731

DAIRY AND COLD STORAGE BRANCH

Condensed milks	72
Evaporated milks	80
Milk powders	124
Miscellaneous	30
	306

HEALTH OF ANIMALS BRANCH

Inks

Fifteen samples were examined. All were free from arsenic.

Salts and Preservatives

Thirty-three samples were examined, including several special curing and flavouring compounds such as "Neverfail," "Prague," "Griffith," etc.

Spices and Condiments

Sixty-two samples of liquid spice and sixty-four samples of dry spices were examined. Five samples were found to be adulterated with foreign starch. One sample which was labelled "mixed spices" contained 94 per cent sodium chloride.

Denaturing Oils

Thirty-two samples were examined for all tests. Thirty-five samples were examined for taste test only. A summary of results is given in table 96.

TABLE No. 96.—NUMBER AND PERCENTAGE NUMBER OF DENATURING OILS WHICH SATISFY THE VARIOUS STANDARD TESTS

Tests	Number examined	Standards required	Satisfy requirements	
			Number	Per cent
All	32		16	50
Flash point	32	Not below 75°C. (167°F.)	32	100
Boiling point	32	Not below 205°C. (401°F.)	25	78
Specific Gravity	32	Not below 0·819	32	100
Taste	67	Easily recognized when present in the proportion of 1 part oil to 1,000 parts fat	24	36

Lards, Lard Compounds and Edible Oils and Fats

One hundred and thirty-five samples were examined. All were free from adulteration.

Mincemeats

Thirty-six samples were examined for glucose and preservatives. Twenty-seven contained benzoates, one sample only containing more than 1 part per 1,000, the maximum amount allowed by the regulations. Four samples contained glucose.

Sausages, Meat Products and Fish and Meat Pastes

Two hundred and sixty-two samples were examined under this heading. Summaries of results of analyses of nineteen samples of pork sausage and twenty-two samples of bologna are given in tables 97 and 98.

TABLE No. 97.—SUMMARY OF RESULTS OF ANALYSES OF SAUSAGES AND BOLOGNA

—		Water p.c.	Protein (N x 6·25) p.c.	Water protein ratio.	Cereal starch p.c.
Pork sausages	Ave.	54·5	11·5	4·8	2·7
	Max.	61·3	13·4	6·2	7·2
	Min.	41·5	9·8	4·2	Free
Bologna	Ave.	60·2	13·4	4·5	3·4
	Max.	67·4	16·4	5·6	5·4
	Min.	52·5	9·4	4·0	0·3

TABLE No. 98.—NUMBER AND PERCENTAGE OF PORK SAUSAGE AND BOLOGNA WHICH CONTAIN WATER AND STARCH IN EXCESS OF MAXIMUM AMOUNTS ALLOWED BY THE REGULATIONS AND SUMMARY OF WATER: PROTEIN RATIOS

—		Samples containing more than 60 per cent water	Samples containing more than 5 per cent starch	Samples having water: protein ratios				
				Above 5	Above 4·5	Above 4	Above 3·6	Below 3·6
Pork sausages	Number	2	2	4	9	14	14	0
	Per cent.	10	10	28	64	100	100	0
Bologna	Number	13	3	1	6	13	15	0
	Per cent.	59	14	6	40	87	100	0

Forty-nine samples of imported fish pastes were examined. All were free from preservatives, one sample of anchovy paste was coloured with iron oxide pigment.

Fifty-nine samples of imported meat pastes were examined, one sample only of ham and tongue paste contained preservatives, borates. All were free from added colour.

The average, maximum and minimum percentages of cereal starch in forty samples of fish pastes were 3·0, 5·9 and nil, respectively.

The average, maximum and minimum percentages of cereal starch in fifty-eight samples of meat pastes were 3·3, 6·0 and 1·3 respectively.

One sample of imported lunch loaf contained 7·6 per cent of cereal starch.

One hundred and twelve samples of meat products were examined. All were free from preservatives and artificial colouring.

Pickled Pork, Bacon and Pickling Solutions

Thirty-five samples of pickled pork and bacon were examined for nitrite content. Eleven samples, thirty-one per cent, contained more than the maximum allowed by the regulations (200 parts per million as sodium nitrite). The largest amount found in any sample was 750 parts per million.

Twenty-four samples of pickling solutions were examined for nitrite content. The maximum amount found in any sample was 1,250 parts per million as sodium nitrite.

Miscellaneous

Sixty-eight samples were examined under this heading, including a large variety of products such as flours, sugars, pickles, gelatines, vinegars, oils, sausage casings, essences, purifiers, sugars and milk powders.

FRUIT BRANCH

Evaporated Apples

Three hundred and twenty-three samples were examined for water content. Table 99 gives a comparison of results for the past five years.

TABLE No. 99.—WATER CONTENT OF EVAPORATED APPLES

Year	Number of samples	Water per cent			Number of samples containing water in excess of standard (25 p.c.)	Per cent containing water in excess of standard
		Average	Maximum	Minimum		
1925–26	561	21·7	34·4	3·9	72	13
1926–27	204	22·2	27·7	4·2	38	14
1927–28	196	21·9	29·8	13·2	27	14
1928–29	150	21·1	31·2	4·8	17	11
1929–30	323	20·5	27·5	6·2	17	5

Glace and Maraschino Cherries

Fifty-four samples of glace cherries were examined. All were free from sulphites and non-permissible colours.

The average, maximum and minimum percentages of glucose were 49·8, 65·0 and 28·0 respectively.

Six samples of Maraschino cherries were examined. One sample contained benzoates in excess of the maximum (1 part per 1,000) allowed by the regulations. All contained permissible coal tar colours.

Colours

Twenty-one samples were examined. Four samples contained a non-permissible coal tar colour mixed with ponceau 3 R (S & J 56). One sample of "special egg colour" consisted of a mixture of orange 1 (S & J 85) and tartrazine (S & J 94) with a large amount of common salt. The ash was found to be 85·6 per cent.

Three samples of imported colours for peas were examined. One sample was naphthol green B (S & J 398), a non-permissible coal tar dye. The other two samples contained natural colouring matter. One of these samples—a dark green liquid—contained 0·25 per cent of copper.

Jams, Marmalades, Jellies and Preserves

One hundred and sixty-nine samples were examined for glucose, preservatives and added colours. One hundred and thirty-nine of these were imported products.

Two samples of imported jams contained non-permissible coal tar colours and two contained preservatives (benzoates). Three samples of imported preserves contained small amounts of glucose.

Three samples of jams prepared in Canada contained preservatives (benzoates).

Tomato Products

Twenty-two samples of tomato catsups and sauces, and five samples of tomato pastes were examined.

Eight samples of catsup contained ponceau 3R (S & J. 56), a permissible coal tar colour.

Fourteen samples of tomato catsup contained benzoates, in four of these the amounts were in excess of that allowed by the regulations. One sample contained an excessive amount of salicylates.

Miscellaneous

Forty-seven samples were examined under this heading, including evaporated and dehydrated fruits, fruit pulps, canned fruits, "aplets," "croettes," "emrelettes," "rubyettes," pectin preparations, pickles, lemon curds and mayonnaise.

One sample of canned blueberries which was said to have a peculiar odour and taste, was found to contain 240 parts per million of tin.

Special Jam Investigation

With a view to the establishment of new standards for jams, several samples of strawberry, raspberry and cherry jams, and the syrups used in their preparation were examined.

The average, maximum and minimum percentages of water soluble solids determined by difference in forty-five samples of strawberry jams were 71·1, 80·3 and 64·8 respectively.

The average, maximum and minimum water soluble solids determined by difference in ten samples of raspberry jam were 71·9, 76·3 and 65·8 respectively.

The average, maximum and minimum water soluble solids determined by difference in eight samples of cherry jams were 73·1, 77·2 and 69·8 respectively.

A summary of results of analyses of seventeen samples of syrups used in the preparation of these jams is given in table 100.

TABLE No. 100.—SUMMARY OF RESULTS OF ANALYSES OF SYRUPS USED IN THE PREPARATION OF JAMS

—	Total sugars p.c.	Sucrose p.c.	Invert sugar p.c.
Average	67·1	51·1	16·0
Maximum	68·0	54·9	25·9
Minimum	66·5	40·7	12·7

Four samples of strawberries used in the preparation of strawberry jams were analysed. The results of analyses are given in table 101.

TABLE No. 101.—RESULTS OF ANALYSES OF STRAWBERRIES USED IN THE PREPARATION OF STRAWBERRY JAMS

Lab'y. Number	Variety	Total solids	Water insoluble solids	Total sugars (as invert)	Pectin (as calcium pectate)	Ash	Acidity (as citric acid)
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
97802	.....	9·34	2·27	3·64	1·20	0·64	1·53
97823	Aroma.....	9·86	1·62	3·92	0·98	0·72	0·89
97924	Aroma.....	10·26	2·31	4·34	1·34	0·62	1·08
98329	.....	9·41	2·42	3·53	0·72	0·81	1·14

Condensed Milks

Seventy-two samples were examined under this heading, including fifty-nine samples of condensed milk and thirteen samples of skimmed condensed milk.

A summary of results of analyses is given in table 102.

TABLE NO. 102.—SUMMARY OF RESULTS OF ANALYSES OF CONDENSED MILK

—	Net weight	Total solids	Fat	Lactose	Sucrose	Ash	Protein (N x 6·38)
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Whole condensed milk—							
Average	13·94 oz.	73·64	8·09	11·76	44·21	1·92	8·01
Maximum	14·18 oz.	75·90	8·36	12·50	46·44	2·35	8·99
Minimum	13·67 oz.	71·88	7·89	10·41	41·25	1·72	6·96
Skimmed condensed milk—							
Average	.....	71·51	0·34	14·35	43·56	2·44	9·77
Maximum	.....	73·60	0·75	15·04	44·74	2·77	10·35
Minimum	.....	68·03	0·13	13·84	42·10	2·11	8·78

Fifteen per cent of the samples of condensed milk for home consumption contained less than the minimum standard for fat (8 per cent). 44 per cent of the samples of condensed milk for export contained less than the minimum standard for fat (9 per cent).

Four samples of condensed milk and three samples of skimmed condensed milk were found to have " sugar down," that is, a deposit of sugar at the bottom of the can.

One sample of condensed milk was badly discoloured, had a manurial odour, a metallic taste and mould development. It was unfit for human consumption.

Evaporated Milks

Eighty samples were examined. A summary of results of analyses is given in table 103.

TABLE NO. 103.—SUMMARY OF RESULTS OF ANALYSES OF EVAPORATED MILK

Net Weight			Total Solids			Fat		
Number of samples	Net weight in ounces	Per cent under weight	Number of samples	Total solids	Per cent below standard (25·5 p.c.)	Number of samples	Fat	Per cent below standard (7·8 p.c.)
				p.c.			p.c.	
50	Ave.. 6·02 oz.	26	77	Ave...26·33	Nil	77	Ave....7·83	16
	Max. 6·19 oz.	.....	.....	Max...28·35	.....	.....	Max....8·05	.....
	Min.. 5·70 oz.	.....	.....	Min....25·50	.....	.....	Min.....7·64	.....
29	Ave..16·01 oz.	24	3	Ave...31·62	.....	3	Ave....9·23	.....
	Max. 16·09 oz.	.....	.....	.....	.....	.....	.....	.....
	Min. 15·52 oz.	.....	.....	.....	.....	.....	.....	.....

Skim-milk and Whole Milk Powders

One hundred and twenty-four samples were examined. A summary of results is given in table 104.

TABLE No. 104.—SUMMARY OF RESULTS OF ANALYSES OF MILK POWDERS

Moisture			Ash	Fat	
Number of samples	Moisture	Number above standard (5 p.c.)	Ash	Fat	Number below standard (26 p.c.)
	p.c.	No.	p.c.	p.c.	No.
87	Skimmed Milk Powder—				
	Average....2·82	1	Average....8·29		
	Maximum....5·33		Maximum....9·29		
	Minimum....1·23		Minimum....7·44		
37	Whole Milk Powder—				1
	Average....1·86	Nil	Average....5·93	Average....27·61	
	Maximum....4·84		Maximum....6·81	Maximum....28·47	
	Minimum....0·74		Minimum....5·44	Minimum....24·65	

All samples of milk powders were free from borates and carbonates.

Miscellaneous

Thirty-samples were examined under this heading, including dried buttermilk, malted milks, condensed coffee, Allenbury's Milk Food, Ice-cream mix, casein, cream powders, modified milk powder, condensed whey, Lemon powder and "St. Ivel" cream.

PRESERVATION OF EGGS WITH "DRY ICE"

It has been shown that one factor in the deterioration of eggs on storage is the loss of carbon dioxide. It therefore seemed probable that eggs would keep better if this loss of carbon dioxide was prevented by keeping the eggs in an atmosphere containing a small percentage of carbon dioxide.

In co-operation with the Poultry Division of the Livestock Branch a preliminary investigation was carried out in these laboratories to determine whether or not the storage of eggs in an atmosphere of carbon dioxide by enclosing them in sealed boxes containing "dry ice" (solid carbon dioxide) would assist in their preservation, and to ascertain how much "dry ice" would furnish the best results for keeping eggs during the summer for from ten to fifteen days. The results seemed to show that even quite small percentages of carbon dioxide influenced the keeping qualities. It was found that 30 dozen eggs, which were kept in a vaseline sealed metal container for twelve days showed very little visible deterioration at the end of this period. The percentages of carbon dioxide in the container at the beginning and end of the period were determined and found to be 0·05 and 0·28 per cent by volume respectively.

EXAMINATION OF IMPORTED EGGS FOR PRESERVATION BY THE OIL IMMERSION PROCESS

Samples from four shipments of imported eggs were examined at the instance of the Poultry Division of the Live Stock Branch.

Two of these samples gave positive tests for oil indicating that the eggs had been preserved by the oil immersion process.

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