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, 1927

Printed by authority of the Hon. W. R. Motherwell, Minister of Agriculture,
Ottawa, 1928

CONTENTS

DIVISION OF CHEMISTRY

REPORT OF THE DOMINION CHEMIST

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

The work of the year, as in the past, has covered a wide and varied field. One of the aims of the division is to help, with information, advice and analysis, as far as may be practicable, individual farmers, agricultural representatives and farmers' organizations who may apply for chemical assistance. This phase of the division's activities is of course carried on in addition to the main work of inaugurating investigations towards the solution of special problems in the several branches or phases of Canadian agriculture.

It is satisfactory to record that the endeavour to help the farmer through correspondence and as occasion may dictate, by analysis, continues to meet with an appreciative response. It is felt that this service is disseminating knowledge which put into practice must result in better and more profitable farming throughout the Dominion.

In this summary report it will only be possible to give a brief account of the more important phases of work which have been undertaken during the past twelve months, but sufficient explanatory text accompanies the data to give the reader a clear idea of the object and plan of the enquiry or investigation and of the results obtained. It may be added here that certain special matters which have engaged our attention and which are more or less of particular and wide interest are published in bulletin form.

SAMPLES RECEIVED FOR ANALYSIS

The following table presents a classified record of the samples examined in the chemical laboratories during the past year. These samples total 4,828 and vary greatly as to their nature. Their sources also are numerous; in addition to those which may be considered as specially belonging to the division's investigations, the number includes many sent in by farmers and agricultural or district representatives and those submitted by the Meat and Canned Foods Division of the Health of Animals Branch (Department of Agriculture).

TABLE 1—SAMPLES RECEIVED FOR EXAMINATION AND REPORT FOR TWELVE MONTHS ENDING MARCH 31, 1927

—	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	Total
Soils	103	248	64	.....	196	98	23	71	66	869
Manures and fertilizers	16	.....	1	.....	40	35	12	4	1	107
Forage plants, fodders and feeding stuffs	17	106	36	6	329	50	23	4	2	573
Waters	5	2	4	.....	62	22	6	5	4	110
Samples from Meat and Canned Foods Division	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,400
Miscellaneous, including dairy products, insecticides and fungicides	47	54	46	33	282	109	55	101	42	769
										4,828

SOILS

The samples of soil sent in by farmers for examination and report, have increased very considerably in number during the past year. In dealing with samples of this nature, a partial examination is made and sufficient data obtained to advise the farmer with respect to the economic treatment of the land represented. Since the information given in respect to these soils is, as a rule, applicable only to the conditions of the individual farmer, no attempt will be made to publish the data resulting from this analytical work.

The division has within the past year examined two series of soils, a study of the data of which is of an investigational nature and of more or less widespread interest.

(1) A series of 24 samples—surface and subsoil—collected from a clay area in connection with a fertilizer experiment to be inaugurated on the Experimental Station at Kapuskasing, Ont. The publication of the data from this series is being held until the results of a second series from a similar area are available. The data already obtained show that these soils are exceptionally well supplied with lime, magnesia and potash. The percentages of organic matter, nitrogen and phosphoric acid are slightly below the average of good clay loams, the data indicating that a profitable response might be expected from the application of nitrogenous and phosphatic fertilizers.

(2) A series of 50 samples—surface and subsoil—collected in connection with the work conducted by the Division of Illustration Stations in Prince Edward Island. The data of this series have been reported in a special bulletin, but a brief reference may be made in this report to the outstanding features of the investigation.

The soils were collected from cultivated areas at seventeen points well distributed throughout the island. The periods of cultivation were from 50 to more than 100 years, and in the majority of instances the land had been seeded down to hay with a grain crop, chiefly oats, with long intervals of pasture. Consequently, high fertility as the result of liberal manuring and the adoption of a rational rotation (e.g., one including a legume) could scarcely be expected.

In respect to texture, colour and physical characters generally, the soils of this series are very similar; they are soils for the most part which have been derived from the soft red sandstones and other representatives of the Triassic formation. According to accepted classifications practically all these soils would be classed as "sandy" or "fine sandy loams" only two or three contain sufficient silt and clay to class them as "loams". The physical data would show that the lighter soils are to be found in the southeastern portions of Kings and Queens counties and that the heavier loams, i.e., those with the larger proportion of silt and clay occur in the central and western parts of the province.

From their physical make-up they may be adjudged as suitable for a large number of farm crops and with judicial management, including the upkeep of humus-forming material they may be expected to prove excellent soils, with good aeration, warm and with a fair absorptive capacity for moisture. They are such as would readily respond to applications of plant food. They are readily worked and being capable of good tilth would permit of easy root extension. They are underlaid by sub-soils containing more or less gravel, an aid to their natural drainage.

From the standpoint of fertility as measured by chemical analysis, the larger number of these soils are below rather than above the average of productive sandy loams, though only a few could be stated as distinctly poor.

The results in general from this investigation would suggest for the maintenance and increase of the fertility of these soils: (1) the addition of humus-forming material as furnished by the application of farm manures, the turning

under of green crops, e.g., buckwheat, rye and clover and the adoption of comparatively short rotations in which clover or other legume is a member; (2) for crops other than potatoes, the application of ground limestone or other lime-bearing material to correct acidity and furnish lime for crop use, (3) the supplementing of the plant food constituents furnished by the manure and in the crop residues, by the rational use of fertilizers. In the majority of cases a complete fertilizer should undoubtedly be used, the formula to be adjusted from a consideration of the past manuring and cropping of the soil and the special requirements of the crop to be grown.

INVESTIGATIONAL WORK WITH FERTILIZERS

Experiments with fertilizers as in the past have been carried on at several of the branch farms and stations, with a view to obtaining data which will aid in advising the farmer with respect to the economical use of these materials. In addition to this more or less general work, a number of experiments are in progress to determine the fertilizing value of several new fertilizers which have recently made their appearance on the market.

FERTILIZERS FOR POTATOES

The growing of potatoes has become highly specialized in many parts of the Dominion but more particularly in the Maritime Provinces; in New Brunswick and Prince Edward Island the production of certified seed potatoes has assumed large proportions within the last few years and may be considered as one of the most important of the agricultural products of many sections of those provinces. Since the potato growers depend to a large extent on the employment of commercial fertilizers to give them profitable returns, much attention is given by this Division to experimental work with these materials for the potato crop.

It has been found that complete fertilizer mixtures containing the three elements nitrogen, phosphoric acid and potash given best returns for the potato crop. From the standpoint of crop yields and the economic maintenance of soil fertility the fertilizer should preferably be used either in conjunction with a moderate dressing of well rotted manure, applied in the fall or early spring, or on a ploughed down clover sod. The previous treatment of the land will determine to a large extent the fertilizer formula and rate of application.

Experimental data show that as a source of nitrogen for the potato crop a combination of nitrate of soda and sulphate of ammonia is usually superior to either of these materials used alone. Superphosphate and muriate or sulphate of potash are generally the most satisfactory forms of phosphoric acid and potash.

MANURE AND FERTILIZERS FOR THE POTATO CROP

CHARLOTTETOWN, P.E.I.

An experiment with manure and fertilizers conducted at the Experimental Station, Charlottetown, P.E.I., over a four year period on four separate areas gave the following yields of potatoes and grain grown in a four year rotation of potatoes, oats, hay, hay.

Manure and Fertilizer applied for potato crop, per acre	Potatoes — Average yield per acre for 4 years 1923–26	Oats — Average yield per acre for 3 years 1924–26
	bush.	bush.
Manure—20 tons	193	56·3
Fertilizer—equivalent to 1,000 lb. of 4–8–8	164	54·4
Manure—10 tons with fertilizer equivalent to 500 lb. of 4–8–8	209	61·2
No manure or fertilizers	68	40·1

The largest yields of potatoes resulted from the treatment with manure and fertilizers; the yields of oats are in the same order as those of potatoes and show a marked response of the crop to the fertilizer treatment of the previous year.

FERTILIZER FORMULÆ FOR THE POTATO CROP

CHARLOTTETOWN, P.E.I., NAPPAN, N.S., AND FREDERICTON, N.B.

An experiment to obtain information with respect to the most profitable formulæ and rate of application of fertilizers for the potato crop in a rotation of potatoes, grain and hay (chiefly clover) was commenced in 1922 at the branch Farm at Nappan and the Experimental Stations at Charlottetown and Fredericton. Ten formulæ, each applied at 1,000, 1,500 and 2,000 pounds per acre were employed. Nitrogen was supplied in equivalent amounts by nitrate of soda and sulphate of ammonia; phosphoric acid by superphosphate and potash by muriate of potash. There was no application of manure made in the rotation. The profits resulting from the various treatments as given in tables 2, 3 and 4 were computed by using the following fertilizer and crop values: Potatoes, 60 cents per bushel; nitrate of soda, $70 per ton; sulphate of ammonia, $70 per ton; superphosphate, $25 per ton; muriate of potash, $45 per ton.

At Charlottetown, P.E.I.—On a light sandy loam the average results for two years—1922 and 1926—showed that all the formulæ experimented with gave very profitable results. The mixtures having the formulæ 3-8-6, 4-8-8 and 4-8-10 proved especially effective in increasing crop yields.

The profits obtained when the cost of the fertilizer was deducted from the value of the increase in yields are as follows:—

TABLE 2—FERTILIZER FORMULÆ FOR POTATOES, CHARLOTTETOWN, P.E.I.

Formulæ	Profits per Acre (Average of two years)		
	at 1,000 lb. per acre	at 1,500 lb. per acre	at 2,000 lb. per acre
	$ cts.	$ cts.	$ cts.
6–6–6	41 60	50 05	52 25
5–6–6	43 80	45 60	71 05
4–6–6	34 41	45 79	48 97
3–6–6	44 02	65 20	61 79
5–8–6	31 72	44 26	66 70
4–8–6	43 05	47 95	68 45
3–8–6	56 26	52 06	81 07
4–8–10	54 95	54 05	97 15
4–8–8	56 75	67 70	78 35
4–8–4	32 15	38 70	52 25

Generally speaking, the profits per acre increased with the rate of application of the fertilizer. For nine of the ten formulæ employed the largest profit was obtained when the fertilizer was applied at the rate of one ton per acre.

At Nappan, N.S., on a medium clay loam, the following data were obtained (table 3):—

TABLE 3—FERTILIZER FORMULÆ FOR POTATOES, NAPPAN, N.S.

Formulæ	Profits per Acre (Average of four years)		
	at 1,000 lb. per acre	at 1,500 lb. per acre	at 2,000 lb. per acre
	$ cts.	$ cts.	$ cts.
6-6-6	17 89	12 51	10 97
5-6-6	18 16	22 65	17 60
4-6-6	24 05	31 82	36 33
3-6-6	29 28	25 55	35 12
5-8-6	23 35	20 82	23 19
4-8-6	26 95	27 15	23 28
3-8-6	29 83	27 12	37 04
4-8-10	29 75	37 30	32 80
4-8-8	29 63	35 26	29 42
4-8-4	20 60	25 02	23 22

At this Farm no one formulæ stands out as markedly superior to the others. The 4-8-10, 3-8-6, 4-8-8, 3-6-6, and 4-6-6 mixtures have given the larger profits. Five of the ten formulæ under consideration have given the largest profit when applied at the rate of 1,500 pounds per acre; three formulæ show the largest profit when applied at the rate of 2,000 pounds per acre and two at the rate of 1,000 pounds per acre. It would appear that for the potato crop on the average clay loam as occurring in the neighbourhood of Nappan, an application of 60 pounds of nitrogen, 120 pounds of phosphoric acid and 120 pounds of potash per acre would probably prove to be very satisfactory. These amounts of plant food would be furnished by 1,500 pounds of 4-8-8.

At Fredericton, N.B., the yields of potatoes for two years—1922 and 1926—are available. The soil of this experimental area is a clay loam and the year previous to the commencement of the experiment it had received manure at the rate of 10 tons per acre for a potato crop. The data as presented in table 4 were obtained.

TABLE 4—FERTILIZER FORMULÆ FOR POTATOES, FREDERICTON, N.B

Formulæ	Profits per Acre (Average of two years)		
	at 1,000 lb. per acre	at 1,500 lb. per acre	at 2,000 lb. per acre
	$ cts.	$ cts.	$ cts.
6-6-6	24 75	20 40	22 80
5-6-6	32 04	23 61	20 16
4-6-6	11 85	24 12	19 93
3-6-6	18 34	30 17	30 85
5-8-6	24 60	26 46	25 46
4-8-6	17 97	33 76	35 51
3-8-6	25 14	27 50	31 57
4-8-10	21 91	24 10	27 55
4-8-8	25 77	23 11	25 98
4-8-4	27 00	22 32	8 11

Three of the ten formulæ gave the largest profit when applied at the rate of 1,000 pounds per acre, two formulæ when at the rate of 1,500 pounds and five at the rate of 2,000 pounds per acre.

From these results generally it may be concluded that for the potato crop an application of 60-80 pounds, nitrogen, 120-160 pounds phosphoric acid (P_2O_5) and 90-120 pounds potash (K_2O), equivalent to 1,500 to 2,000 pounds per acre of a 4-8-6 fertilizer, would be satisfactory and profitable.

SOURCES OF NITROGEN FOR THE POTATO CROP

Experiments to obtain data with respect to the value of Urea and Cyanamide as sources of nitrogen for the potato crop, were commenced in 1926 at the Experimental Stations at Kentville, N.S., and Fredericton, N.B.

At Kentville, N.S., these materials were compared with nitrate of soda and sulphate of ammonia, each of the nitrogenous fertilizers being applied in conjunction with superphosphate and muriate of potash. The complete mixtures were prepared to equal approximately a 4-8-6 fertilizer and were applied at two rates per acre, viz., 1,000 and 2,000 pounds. Additional treatments in which phosphoric acid and potash only were applied are included. The cyanamide was applied separately about ten days previous to planting the " sets."

The yields per acre—average of quadruplicate plots of $\frac{1}{320}$ acre—are given in table 5.

TABLE 5—SOURCES OF NITROGEN FOR THE POTATO CROP, KENTVILLE, N.S., 1926

Plot No.	Sources of Nitrogen	Equivalent formula and rate of application, per acre	Yield of potatoes, per acre	Increase due to nitrogen	Increase due to phosphoric acid and potash
			bush.	bush.	bush.
1	Nitrate of soda	2,000 lb. of 4-8-6	224·2	13·6	
2	Sulphate of ammonia	2,000 lb. of 4-8-6	260·3	49·7	
3	Cyanamide	2,000 lb. of 4-8-6	244·7	34·1	
4	Urea	2,000 lb. of 4-8-6	248·9	38·3	
5	No nitrogen	2,000 lb. of 0-8-6	210·6	.....	93·4
6	Nitrate of soda	1,000 lb. of 4-8-6	184·4	− 7·1	
7	Sulphate of ammonia	1,000 lb. of 4-8-6	171·6	−19·9	
8	Cyanamide	1,000 lb. of 4-8-6	194·9	3·4	
9	Urea	1,000 lb. of 4-8-6	183·6	− 7·9	
10	No nitrogen	1,000 lb. of 0-8-6	191·5	.....	74·3
	Average of check plots receiving no fertilizer	.....	117·2		

These results at Kentville are somewhat irregular and inconsistent. Further work will be necessary before any definite pronouncement as to the relative values of the various sources of nitrogen at this Station can be made, but in so far as the present work will allow a statement, it would appear that there is no very great difference in the effectiveness of the several forms of nitrogen employed.

Apparently, from the yields of plots 5 and 10, the soil of this area called for applications of phosphoric acid and potash to a much greater degree than for an application of nitrogen.

At Fredericton, N.B.—Urea and cyanamide were compared with a mixture of nitrate of soda and sulphate of ammonia applied in conjunction with superphosphate and muriate of potash. The quantities were such as to equal a 4-8-6 fertilizer at 1,000 and 2,000 pounds per acre. The cyanamide was applied by two

methods (1) separately, about a week before planting the sets and (2) mixed with the superphosphate and muriate of potash and applied at planting time. The fertilizer was applied before planting and covered with soil.

The yields per acre—average, of quadruplicate plots of 1/320 acre—are given in table 6.

TABLE 6—SOURCES OF NITROGEN FOR THE POTATO CROP, FREDERICTON, 1926

Plot No.	Sources of Nitrogen	Equivalent formula and rate of application, per acre	Yield of potatoes, per acre	Increase over check plots per acre
			bush.	bush.
1	Nitrate of soda and sulphate of ammonia	2,000 lb. of 4-8-6	412·0	167·7
2	Cyanamide (applied a week before planting)	2,000 lb. of 4-8-6	374·7	130·4
3	Cyanamide (applied at planting time)	2,000 lb. of 4-8-6	360·0	115·7
4	Urea	2,000 lb. of 4-8-6	408·7	164·4
5	Nitrate of soda and sulphate of ammonia	1,000 lb. of 4-8-6	370·7	126·4
6	Cyanamide (applied a week before planting)	1,000 lb. of 4-8-6	345·3	101·0
7	Cyanamide (applied at planting time)	1,000 lb. of 4-8-6	329·3	85·0
8	Urea	1,000 lb. of 4-8-6	341·3	97·0
	Average of check plots receiving no fertilizer		244·3	

At the higher rate of application, urea gave a yield practically equal to that from a mixture of nitrate of soda and sulphate of ammonia; the yields from the cyanamide plots, more especially when the fertilizer was applied at planting time, were appreciably lower.

At the lower rate of application, except in plot 7, no very marked differences in yield from the various treatments were obtained. The yield of plot 7 on which cyanamide was applied at planting time was the lowest of all the treated plots.

Judging from these results, urea compares very favourably with a mixture of nitrate of soda and sulphate of ammonia as a source of nitrogen for the potato crop. Cyanamide has also proved fairly satisfactory, the data lending strong support to the claim that for best results this fertilizer should be applied some little time previous to planting the sets; applied at the time of seeding or planting a certain amount of injury to the germinating seed or sprouting sets may result.

AMMO-PHOS AS A SOURCE OF NITROGEN AND PHOSPHORIC ACID

Experimental work with ammo-phos was conducted during the past year at Charlottetown, P.E.I., Fredericton, N.B., and Kentville, N.S. This nitrogenous phosphatic fertilizer is manufactured in two grades, viz. a "13-48" grade containing 13 per cent of ammonia (equivalent to 10.7 per cent of nitrogen) and 48 per cent of phosphoric acid, and a "20-20" grade containing 20 per cent ammonia (equivalent to 16.45 per cent of nitrogen) and 20 per cent of phosphoric acid. By using both of these two grades, mixtures containing various percentages of nitrogen and phosphoric acid may be obtained.

At Charlottetown and Fredericton two fertilizer mixtures each having the formula 4-8-6 were prepared by using (1) both grades of ammo-phos to furnish the nitrogen and phosphoric acid and muriate of potash to furnish the potash, (2) nitrate of soda and sulphate of ammonia, superphosphate and muriate of potash. These two mixtures were applied at the rate of 1,000 and 2,000 pounds per acre for the potato crop. The experiment was conducted on 1/320 acre plots in quadruplicate on a light sandy loam soil at Charlottetown and on a clay loam soil at Fredericton.

The yields obtained were as follows (table 7):—

Table 7.—Ammo-phos for Potato Crop, Charlottetown, P.E.I. and Fredericton, N.B., 1926

Plot No.	Fertilizer applied in pounds per acre	Plant food supplied, pounds per acre			Average yield of potatoes per acre	
		Nitrogen (N)	Phosphoric acid (P_2O_5)	Potash (K_2O)	Charlotte-town	Frederic-ton
					bush.	bush.
1	Ammo-phos (13-48) 180+ammo-phos (20-20) 370+muriate of potash 240	80	160	120	198·0	388·0
2	Nitrate of soda 260+sulphate of amm. 190 +super. 1000+muriate of potash 240	80	160	120	182·0	412·0
3	Ammo-phos (13-48) 90+ammo-phos (20-20) 185+muriate of potash 240	40	80	60	162·0	369·3
4	Nitrate of soda 130+sulphate of amm. 95+super. 500+muriate of potash 240	40	80	60	157·3	370·7
5	Check—no treatment				144·0	244·3

The data for both Charlottetown and Fredericton show that ammo-phos has proved to be a very satisfactory source of nitrogen and phosphoric acid for the potato crop.

At Kentville both grades of ammo-phos were employed separately for the turnip crop and compared with a mixture of nitrate of soda and superphosphate and also with a mixture of sulphate of ammonia and superphosphate. Certain of the plots received in addition muriate of potash. The plan was carried out in quadruplicate on a gravelly loam soil. The treatments and yields per acre are presented in table 8.

Table 8.—Ammo-phos as a Source of Nitrogen and Phosphoric Acid for the Turnip Crop, Kentville, N.S., 1926

Plot No.	Fertilizer applied—pounds per acre	Plant food supplied pounds per acre			Average yield of turnips per acre
		Nitrogen (N)	Phos-phoric acid (P_2O_5)	Potash (K_2O)	
	Section "A"—using "13-48" grade of Ammo-phos				bush.
1	Ammo-phos—500	53·0	240	.....	561·6
2	Sulphate of ammonia 255+superphosphate 1500	53·0	240	.....	697·6
8	Nitrate of soda 355+superphosphate 1500	53·0	240	.....	654·4
9	Sulphate of ammonia 255+Sydney basic slag 1715	53·0	240	.....	587·2
10	Nitrate of soda 355+Sydney basic slag 1715	53·0	240	.....	556·8
3	Ammo-phos 500+muriate of potash 120	53·0	240	60	582·4
4	Sulphate of ammonia 255+superphosphate 1500+muriate of potash 120	53·0	240	60	596·8
5	Ammo-phos 250	26·5	120	.....	556·8
6	Ammo-phos 250+muriate of potash 120	26·5	120	60	545·6
7	Sulphate of ammonia 255+superphosphate 750+muriate of potash 120	26·5	120	60	545·6
	Average of checks	.....	.....	.....	294·8
	Section "B"—using the "20-20" grade of Ammo-phos				
11	Ammo-phos 500	82·0	100	.....	614·4
12	Sulphate of ammonia 390+superphosphate 625	82·0	100	.....	681·6
15	Nitrate of soda 550+superphosphate 625	82·0	100	.....	673·6
16	Sulphate of ammonia 390+Sydney basic slag 715	82·0	100	.....	510·4
17	Nitrate of soda 550+Sydney basic slag 715	82·0	100	.....	553·6
13	Ammo-phos 500+muriate of potash 120	82·0	100	60	654·4
14	Sulphate of ammonia 390+superphosphate 625+muriate of potash 120	82·0	100	60	728·0
	Average of checks	.....	.....	.....	294·8
	Section "C"—using a mixture of the two grades of Ammo-phos				
18	Ammo-phos (13-48) 125+Ammo-phos (20-20) 200+muriate of potash 120	46·0	100	60	534·4
19	Sulphate of ammonia 220+superphosphate 625+muriate of potash 120	46·0	100	60	507·2
	Average of checks	.....	.....	.....	294·8

The irregularities in this series make it exceedingly difficult to differentiate between the various sources of nitrogen and phosphoric acid, as suppliers of plant food for the turnip crop. There is, however, evidence of a satisfactory character to show that the plant food in ammo-phos is practically as available as that in nitrate of soda and sulphate of ammonia and superphosphate. Attention may be directed to the marked increase in yields of all the fertilized plots over those of the check plots.

The plan of experiment also included the comparison of (1) nitrogen as nitrate of soda and as sulphate of ammonia, and phosphoric acid as superphosphate, (2) nitrogen as nitrate of soda and as sulphate of ammonia and phosphoric acid in Sydney (fortified) basic slag.

The results of plots 2 and 8, and 12 and 15 permit the comparison of the two forms of nitrogen each with superphosphate. The yields are such as to indicate that the nitrate and sulphate nitrogen have been of practically equal value.

The comparison of the data of plots 9 and 10, and 16 and 17, in which Sydney slag is used to furnish phosphoric acid, shows similar results in respect to the two forms of nitrogen but the yields are distinctly lower than from the superphosphate plots indicating that this latter form of phosphoric acid is more effective for the turnip crop than Sydney slag.

DISTRIBUTION OF FERTILIZER IN THE ROTATION—EXPERIMENT E-21—KENTVILLE, N.S.

This experiment commenced in 1921 at Kentville, N.S., includes several features in regard to fertilizing and manuring and these may best be considered under separate sections. The work is being conducted in duplicate on plots one-twentieth acre in area and the plan embraces a total of 140 plots. A three-year crop rotation of hoed crop, grain and clover hay is followed.

Section I.—This section deals with the effect of applying the nitrogenous fertilizer at different times during the rotation and contains ten series of treatments of three plots (A, B and C) each. The A, B and C plots of each series receive the same amounts of plant food during the rotation, the phosphoric acid and potash being applied the first year while the nitrogen is distributed over the three years of the rotation as follows: Plot A receiving all the nitrogen the first year, plot B receiving two-thirds of the nitrogen the first year and one-third the second year, and plot C one-third of the nitrogen each year of the rotation.

The results for a period of two-crop rotations—1st rotation: potatoes, oats, hay; 2nd rotation: corn, oats and hay—are given in table 10. These results may be summarized as follows:—

—	Application	Average value of crops produced during six years
		$ cts.
Average of "A" plots	All nitrogen applied the first year	315 15
Average of "B" plots	Nitrogen distributed over two years	315 52
Average of "C" plots	Nitrogen distributed over three years	304 40
Average of check plots		256 39

Very little difference in the value of the crops produced under the three methods of application of the nitrogen has resulted. When the nitrogen is all applied the first year for the hoed crops almost identical results were obtained as when one-third of this constituent of the fertilizers is reserved for the grain crop of the second year. Returns, but very slightly lower, were obtained when the nitrogen is distributed equally over the three years.

Four plots of this section permit of a comparison between nitrate of soda and sulphate of ammonia as sources of nitrogen. Nitrate of soda gives slightly better returns than sulphate of ammonia but the differences may be considered as well within the limit of experimental error. The following values of yields for these plots were obtained (table 9):—

TABLE 9.—RELATIVE VALUE OF NITROGEN IN NITRATE OF SODA AND SULPHATE OF AMMONIA

Group	Nitrogenous fertilizer	Plant food supplied			Average value of crops for six years		
		Nitrogen (N)	Phosphoric acid (P_2O_5)	Potash (K_2O)	"A" plots	"B" plots	"C" plots
					$ cts.	$ cts.	$ cts.
1	Nitrate of soda (with superphosphate of muriate of potash)	62	80	60	317 55	321 63	300 39
6	Sulphate of ammonia (with superphosphate and muriate of potash)	62	80	60	314 30	312 57	292 95
7	Nitrate of soda (with slag and muriate of potash)	62	80	60	324 67	316 23	296 61
8	Sulphate of ammonia (with slag and muriate of potash)	62	80	60	322 25	300 05	299 73

Comparing the returns from plots 1 and 6 with those from plots 7 and 8 it will be noted that superphosphate and basic slag gave practically equal results as sources of phosphoric acid.

Section II.—In this section (Series 11 to 21) various sources of phosphoric acid, viz., superphosphate, basic slag, tankage and bone meal are compared at two rates per acre. The "A" plots of each series received 30 pounds of nitrogen, 80 pounds of phosphoric acid and 60 pounds of potash per acre; the "B" plots received one-half these amounts. In two series, 13 and 14, dried blood is compared with nitrate of soda as a source of nitrogen and in series 18 and 19 manure at the rate of 10 tons per acre was applied in conjunction with the commercial fertilizers.

The various sources of phosphoric acid employed in the section gave about equal returns. Nitrate of soda proved slightly more effective than dried blood in increasing crop yields but the differences are not large. The largest yields of this section were obtained from the plots which received manure in addition to the application of commercial fertilizers.

The heavier rate of application of the fertilizer (A plots), viz., 30 pounds nitrogen, 80 pounds phosphoric acid and 60 pounds of potash per acre, gave the larger net profit, i.e., value of increased yield less cost of fertilizer.

Section III.—In this section ten plots (22 to 31) received the same amount of plant food during the 3-year rotation as the ten series of Section I (see table 9), but one-half the total fertilizer was applied the first year and the remaining half divided over the second and third years. The value of crops produced during the six years are given in table 10.

It has already been shown that there was little difference in the value of the crops produced, employing the methods of application of the fertilizer as described under "A" and "B" of Section I. The results from Section III are comparable with the foregoing, the plots of both sections receiving the same amounts of plant food; the only point of difference is in the time of application. The data of these sections furnish evidence to the effect that there is no object in splitting the fertilizer application over the rotation, save perhaps in the case of nitrogen —a portion of which may be reserved for the grain crop of the rotation. This means that in ordinary farm practice the fertilizer may be advantageously used as one application, viz., for the hoed crop (1st year) of the rotation.

TABLE 10.—SECTIONS I AND III—EXPERIMENT E-21, KENTVILLE, N.S.

VALUE OF CROPS PRODUCED 1921-1926

Section I								Section III	
Plot group	Fertilizers applied during 3 year rotation pounds per acre	Plant food supplied pounds per acre			Total value of crops produced during 6 years 1921-1926*			Plot No.	Total value of crops produced during 6 years 1921-26* (One half total fertilizer 1st year, remainder divided equally over 2nd and 3rd year)
		Nitrogen (N)	Phosphoric acid (P_2O_5)	Potash (K_2O)	"A" plots (all the nitrogen in the 1st year)	"B" plots (nitrogen in 1st and 2nd year	"C" plots (nitrogen in 1st 2nd and third year)		
					$ cts.	$ cts.	$ cts.		$ cts
1	Nitrate of soda 400 Superphosphate 500 Muriate of potash 120	62	80	60	317 55	321 63	300 39	22	289 48
2	Nitrate of soda 200 Superphosphate 500 Muriate of potash 120	31	80	60	315 31	318 73	320 62	23	267 30
3	Nitrate of soda 400 Superphosphate 250 Muriate of potash 120	62	40	60	293 90	304 12	335 23	24	259 39
4	Nitrate of soda 200 Superphosphate 250 Muriate of potash 120	31	40	60	302 34	322 50	300 57	25	243 61
5	Nitrate of soda 400 Superphosphate 500 Muriate of potash 60	62	80	30	310 23	330 19	299 01	26	286 49
6	Sulphate of ammonia 300 Superphosphate 500 Muriate of potash 120	62	80	60	314 30	312 57	292 95	27	258 02
7	Nitrate of soda 400 Basic slag 714 Muriate of potash 120	62	80	60	324 67	316 23	296 61	28	268 57
8	Sulphate of ammonia 300 Basic slag 714 Muriate of potash 120	62	80	60	322 25	300 05	299 73	29	276 64
9	Manure 10 tons Nitrate of soda 200 Superphosphate 500 Muriate of potash 120	31	80	60	324 93	310 03	299 09	30	317 27
10	Manure—10 tons Nitrate of soda 200 Superphosphate 250 Muriate of potash 120	31	40	60	326 06	319 12	299 84	31	299 37
	Average of check plots	256·39						238·31	

*The following values were used in making calculations: Potatoes, 60c. per bushel; corn, $3.00 per ton; oats, 60c. per bushel; straw, $6.00 per ton; hay, $10.00 per ton.

ASBESTOS WASTE: AN INQUIRY AS TO ITS VALUE FOR THE CORRECTION OF SOIL ACIDITY

During the season of 1926, the division was asked to examine certain claims made respecting the agricultural value of tailings (asbestos waste) from the asbestos mills, Thetford Mines, P.Q. It was urged that this material might have a value in the correction of soil acidiy and the present investigation was conducted with that point in view.

This asbestos waste is coarsely ground serpentine rock from which the fibrous material (asbestos) has been removed as far as possible by milling processes. This rock is essentially hydrated magnesium silicate. The accumulation of tailings has reached large proportions and is more or less in the way at the mines. If it is found that this waste material possesses any appreciable value in the correction of soil acidity it might prove a cheap source of supply of soil amendment for acid soils.

The asbestos waste is available in three forms or grades viz., British Canadian gravel, Kings Floats and Beaver sand. Analysis of representative samples of each grade submitted by the Asbestos Corporation at Thetford Mines, P.Q., are as follows:—

ANALYSIS OF ASBESTOS WASTE

—	Lab'y No. 85501 "British Canadian Gravel"	Lab'y No. 85502 "Kings Floats"	Lab. No. 85503 "Beaver Sand"
Fineness	Crushed rock screened to size ⅛"-½" (approx.)	Finely ground flour-like, containing a large proportion of short fibre.	Ground to size of coarse sand.
Moisture (at 103° C.)	0·59	1·51	0·45
Loss on ignition (water of constitution)	12·51	12·43	10·99
*Mineral matter soluble in acid	45·88	44·51	44·64
Mineral matter insoluble in acid	41·02	41·55	43·92
*Containing—			
Calcium oxide (CaO)	Nil	Nil	Nil
Magnesium oxide (MgO)	38·18	34·57	34·68
Oxide of iron and alumina ($Fe_2O_3+Al_2O_3$)	8·07	10·18	11·12
Phosphoric acid (P_2O_5)	trace	trace	trace
Potash (K_2O)	"	"	"

PLAN OF EXPERIMENT

To ascertain the value of the asbestos waste in correcting soil acidity, the ground material was mixed at various rates with an acid soil, the mixtures placed in 10-inch pots and kept at room temperatures for a period of six months without cropping. A constant moisture content of 15 per cent was maintained throughout. For comparative purposes, mixtures of ground limestone and soil and of basic slag and soil were maintained under similar conditions. At intervals of one, three and six months the soil of each pot was sampled and a representative portion examined for lime requirement, pH value and gram-ions of Ca absorbed per gram of soil.

Soil.—The soil was a reddish sandy loam obtained from one of the fields on the Experimental Station at Kentville, N.S. A mechanical analysis gave 67·23 per cent of total sand of which more than half was very fine, 20·95 per cent of silt and 11·82 per cent of clay. The soil was prepared by passing it through a sieve containing 100 meshes to the square inch, the portion which failed to pass through being discarded.

The lime-requirement (Jones method) and pH value of the soil thus prepared are as follows:—

Lime-requirement { 2,319 lb. quickline, per acre. or 4,136 lb. carbonate of lime, per acre.

pH value=5·40

Asbestos Waste.—The material specially supplied by the Asbestos Corporation, Limited for this experiment was that designated as "Beaver Sand" but which for this purpose had been reground to fairly fine powder. Analysis of this product gave the following data:—

MECHANICAL ANALYSIS

Passing	10	mesh sieve	99·98 per cent.
"	20	"	99·92 "
"	60	"	74·60 "
"	80	"	60·88 "
"	100	"	43·40 "

CHEMICAL ANALYSIS

Moisture (at 103° C)	0·66
Loss on ignition (water of constitution)	11·34
Mineral matter soluble in acid (HCl=Sp. Gr. 1·115) * (by difference)	44·46
Mineral matter insoluble in acid	43·54
*Containing—	
Calcium oxide (CaO)	1·05
Magnesium oxide (MgO)	34·86
Iron and alumina oxides (Fe_2O_3 and Al_2O_3)	10·06
Phosphoric acid (P_2O_5)	trace
Potash (K_2O)	0·14

Ground Limestone.—The ground limestone used, contained 92 per cent of carbonate of lime, the remainder being largely insoluble silica. A mechanical analysis gave the following:—

Passing 10 mesh sieve		99·70	per cent
" 20	"	99·32	"
" 60	"	71·40	"
" 80	"	60·34	"
" 100	"	51·54	"

Basic Slag.—A Bessemer slag containing 16·63 per cent of total phosphoric acid was employed; 80 per cent passed a 100-mesh sieve.

DETAILS AND METHODS OF ANALYSIS

The series comprised 24 pots of soil; 8 were treated with asbestos waste, 8 with ground limestone, 2 with basic slag, and 2 were used as checks. Each pot contained 10½ pounds of soil to which at the outset of the experiment 1 pound of water was added. The pots were weighed at short intervals and the weight maintained by the addition of water.

The technique of the methods used for the several determinations may be briefly outlined as follows:—

Lime requirement.—The Jones method was used. In this method 5·6 grams of soil and ·5 grams calcium acetate are gently triturated in a mortar with a little water and then washed into a 200 cc. flask with about 150 cc. water. This is shaken occasionally for 15 minutes made up to volume and filtered. 100 cc. of the clear filtrate are titrated with tenth-normal alkali using phenolphthalein as the indicator. A correction is used for the sodium acetate. A simple calculation then gives the lime requirement.

Hydrogen-ion Concentration.—The pH values were determined electrometrically using the quinhydrone electrode with a saturated calomel cell. One part of the air-dry soil was shaken for one-half hour with five parts of water, the difference of potential was measured on the soil-water mixture.

Gram-ions of Calcium adsorbed per Gram of Soil.—Five grams of soil from each sample were shaken with 200 cc. of 0·1 N. calcium acetate solution in a horizontal shaker for one hour. The extract was filtered. 100 cc. of the filtrate were titrated with 0·01 N. potassium hydroxide solution, using phenolphthalein as an indicator. On the assumption (not necessarily true) that the titrateable acid represents, equivalently, the amount of calcium absorbed or adsorbed by the soil, this latter quantity was calculated and expressed as gram-ions of calcium adsorbed per gram of soil.

The results obtained are set forth in table 11.

TABLE 11—INFLUENCE OF ASBESTOS WASTE, GROUND LIMESTONE AND BASIC SLAG ON SOIL FERTILITY

Pot No.	Treatment		Lime requirements in pounds quick lime per acre			pH values			Gram-ions of Ca adsorbsd per gram of soil		
	Grams per pot	Equivalent to pounds per Acre	After one month	After three months	After six months	After one month	After three months	After six months	After one month	After three months	After six months
	Asbestos Waste										
15	4·5359	2,000	2,173	2,045	2,173	5·70	5·64	5·63	$16·56 \times 10^{-6}$	$16·56 \times 10^{-6}$	$15·74 \times 10^{-6}$
16	.....	.....	2,173	2,173	2,173	5·60	5·62	5·58	16·98	.....	15·74
17	9·0718	4,000	2,173	1,917	1,663	5·63	5·70	5·70	16·76	15·84	14·80
18	.....	.....	2,173	2,173	1,663	5·64	5·67	5·65	16·76	.....	15·54
19	18·1436	8,000	2,173	1,789	1,663	5·75	5·68	5·67	16·16	15·84	15·02
20	.....	.....	2,173	2,045	1,917	5·75	5·70	5·81	16·16	.....	15·02
21	36·2872	16,000	2,045	1,663	1,663	5·82	5·70	5·85	16·16	15·02	14·40
22	.....	.....	1,917	1,789	1,789	5·62	5·70	5·76	16·56	.....	13·84
	Ground Limestone										
1	4·5359	2,000	1,789	1,663	1,534	5·77	5·74	5·78	14·3	14·3	11·82
2	.....	.....	1,789	1,662	1,534	5·85	5·74	5·84	14·08	.....	12·34
3	9·0718	4,000	1,534	1,278	1,150	5·96	5·85	6·12	12·12	12·20	9·96
4	.....	.....	1,406	1,278	1,278	5·99	5·95	6·11	12·34	.....	9·76
5	18·1436	8,000	1,022	893	767	6·41	6·35	6·68	8·84	8·72	6·66
6	.....	.....	893	767	767	6·53	6·47	6·70	8·10	.....	6·34
7	36·2872	16,000	383	256	128	6·90	6·93	7·17	4·8	4·18	2·52
8	.....	.....	383	256	128	6·80	6·95	7·21	4·8	.....	2·74
	Basic Slag										
9	1·1340	500	1,789	2,045	1,854	5·60	5·65	5·58	15·3	16·04	14·54
10	.....	.....	1,917	2,045	2,109	5·62	5·63	5·68	15·62	.....	14·88
11	2·2680	1,000	2,045	2,045	1,854	5·82	5·62	5·63	15·32	15·64	14·08
12	.....	.....	2,045	1,917	1,929	5·76	5·63	5·80	14·50	.....	14·30
13	4·5359	2,000	1,917	1,917	1,789	5·60	5·58	5·74	15·12	15·02	13·88
14	.....	.....	1,789	1,917	1,663	5·60	5·58	5·78	14·70	.....	13·16
	Check										
23	.....	.....	2,428	2,173	2,173	5·60	5·60	5·65	17·18	16·66	15·94
24	.....	.....	2,319	2,173	2,173	5·60	5·62	5·60	17·18	.....	15·94

DISCUSSION OF RESULTS

Asbestos Waste.—The application of the asbestos waste even at the rate of 8 tons per acre and after a period of six months, had not materially reduced the lime-requirement of the soil. This conclusion from the lime-requirement data is supported by the pH values which clearly show that there has been no decrease in acidity. The results for the adsorption of lime from the asbestos waste show little or no adsorption, as might have been expected from a knowledge of the composition of the material. The data of this investigation have proved conclusively that this asbestos waste has no value in the correction of soil acidity.

Ground Limestone.—The influence of ground limestone has been most marked in its neutralizing action. The reduction in acidity, as measured by the " lime-requirement ", is in direct ratio to the rate of application of the limestone. Although the action was most marked in the first month it continued throughout the period (six months) of the investigation. Thus, the application of 1 ton of ground limestone to soil having a lime-requirement of 2,319 pounds lime, reduced this figure in one month to 1,789 pounds, in three months to 1,662 pounds and in six months to 1534 pounds. Similarly, the application of 8 tons reduced the lime-requirement in one month to 383 pounds, in three months to 256 pounds and in six months to 128 pounds, per acre.

The pH values and the results for calcium adsorption very satisfactorily confirm the conclusions drawn from the lime-requirement data.

Basic Slag.—A review of the data obtained with this phosphatic fertilizer shows clearly that under the conditions of this experiment this slag has not reduced acidity. It is evident that as a corrective of soil acidity, the value of this slag is negligible.

LIMESTONE

As the demand throughout Eastern Canada for ground limestone increases, it becomes more and more desirable to establish crushers at a larger number of points. The support for this is in the fact that transportation charges constitute an important and frequently a preponderating part of the cost of the crushed limestone to the purchaser. It becomes desirable therefore, in districts in which there is a demand for crushed limestone, to search for limestone deposits of good quality which may be readily quarried. Before exploiting any deposit it is of primary importance to ascertain its quality and in this matter the Division has offered its services for a number of years past. As a result of this work the reports of the Division contain the analysis of limestones from many and widely distant points. These data have served to indicate deposits suitable for the manufacture of crushed limestone and have been the means of preventing loss by the working of rock of poor quality.

From the data of several years the following tentative classification of limestones for agricultural purposes has been drawn up:—

GRADES OF LIMESTONE

1st Grade: containing 95 per cent and over of carbonates.
2nd " : " between 80 and 95 per cent of carbonates.
3rd " : " " 60 and 80 " " "
4th " : " " 50 and 60 " " "

It is seldom that limestones containing less than 50 per cent of carbonates will be found profitable to work, since quarrying, crushing and transportation costs will, as a rule, exceed the value of their lime content.

Particulars respecting locality of occurrence, analytical data and report as to quality of nine samples submitted during the year, are presented in the following table (12):—

TABLE 12—ANALYSES OF LIMESTONES, 1926-27

Lab'y. No.	Locality of occurrence	Mineral matter insoluble in acid	Oxide of iron and alumina (Fe_2O_3 Al_2O_3)	Carbonate of lime ($CaCo_3$)	Carbonate of magnesia ($MgCO_3$)	Reports
		p.c.	p.c.	p.c.	p.c.	
	Ontario					
84250	Lanark	1·09	0·40	91·25	6·57	Highest grade, of excellent quality.
88439	Peterboro Co., Tp. of Galway	1·92	0·26	91·50	6·23	Highest grade, of excellent quality.
	Quebec					
84219	Elgin Co., Huntingdon	17·27	1·36	46·50	34·69	Dolomitic limestone, of fair quality (2nd grade).
85029	Huntingdon	24·49	2·22	42·03	30·09	Dolomitic limestone, of fair quality (3rd grade).
87504	Huntingdon	10·69	9·56	47·75	23·29	Dolomitic limestone, of very fair quality (3rd grade).
87509	Huntingdon	10·80	2·82	48·25	36·97	Dolomitic limestone, of very fair quality (2nd grade).
87510	Huntingdon	11·84	2·96	48·25	36·59	Dolimitic limestone, of very fair quality (2nd grade).
	Nova Scotia					
85880	St. Andrews	2·76	1·00	86·00	6·80	Calcitic limestone of good quality (2nd grade).
	British Columbia					
85197	Millstream	2·84	0·52	94·80	.....	Calcitic limestones of excellent quality (1st grade).

CRUSHED OR GROUND LIMESTONE

As the testing of soils in Eastern Canada for acidity (sourness) proceeds, more areas are added to the list of those requiring lime, in some form, if maximum crop yields are to be expected. During the year a large number of soils have been sent in by farmers and agricultural representatives for examination in this connection and the results show in the majority of cases a pronounced " lime requirement"—the equivalent say, of from 2 to 4 tons, per acre of crushed limestone of good quality.

Of all forms of lime offered for sale for soil treatment crushed or ground limestone has proved, as a rule, the most suitable and the most economical to use*.

The quality of a crushed limestone and its suitability for employment will depend on its chemical composition and its degree of fineness. A good quality limestone will contain at least 80 per cent of carbonate of lime—or of mixed carbonates of lime and magnesia, as occurring in dolomitic limestones—while those of highest grade will contain 90 per cent and over.

The degree of fineness will determine to a great extent the rate of solution of the ground limestone in the soil and hence the rapidity with which it will correct acidity and furnish lime for plant growth. The finer the limestone the more rapid will be its solution and hence its effectiveness. Generally speaking, if a quick prompt action is desired a material 60 to 75 per cent of which passes a sieve 80 meshes to the linear inch will be found fairly satisfactory. If an immediate action is not of first importance a coarser ground limestone, say, 50 to 75 per cent passing a 60-mesh sieve can be successfully used. In any case all should pass a 10-mesh sieve.

In the accompanying table (13) data are presented of a number of samples examined since the issue of the last annual report. It is satisfactory to note in respect to composition and fineness so many were found of excellent quality.

* In districts in which deposits of marl (essentially carbonate of lime) occur, there should be no necessity to purchase ground limestone. No better form of lime for soils exists than that in this naturally-occurring carbonate of lime.

TABLE 13—ANALYSES OF CRUSHED OR GROUND LIMESTONES, 1926–1927

Lab'y No.	Manufacturer or Source	Chemical Analysis				Mechanical Analysis				Report
		Mineral matter insoluble in acid	Oxide of iron and alumina (Fe_2O_3+ Al_2O_3)	Carbonate of lime ($CaCO_3$)	Carbonate of magnesia ($MgCO_3$)	Passing 10-mesh sieve	Passing 20-mesh sieve	Passing 60-mesh sieve	Passing 80-mesh sieve	
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	
	Ontario									
85358	Dundas	1·71	1·36	54·25	41·62	100·0	87·0	49·6	40·4	Dolomitic (magnesian) limestone of excellent quality and finely ground.
86667	Longford Quarries	6·62	1·42	88·50	1·74	66·2	42·2	14·8	10·0	Calcitic limestone, of good quality, rather coarsely ground.
86697	Trenton	4·00	0·98	91·50	1·20	.....	.....	.....	.....	Calcitic limestone, of good quality, rather coarsely ground.
87977	Kemptville	16·76	2·40	48·75	31·85	59·6	35·2	18·8	16·0	Dolomitic limestone, of fair quality, rather coarsely ground.
	Quebec									
85345	Hull	2·20	0·94	92·50	trace	95·9	78·4	44·7	33·0	Calcitic limestone, of excellent quality, finely ground.
88437	"	4·30	1·10	92·50	2·72	100·0	100·0	99·2	96·4	Calcitic limestone, of excellent quality, extremely finely ground.
88438	"	5·28	1·38	91·00	1·98	64·0	40·2	13·4	8·8	Calcitic limestone, of excellent quality, rather coarsely ground.
	New Brunswick									
88174	Cail's Mills	2·30	0·46	95·75	0·76	.....	.....	.....	.....	Calcitic limestone, of excellent quality, finely ground.
88175	"	7·44	0·86	86·25	4·84	.....	.....	.....	.....	Calcitic limestone of good quality, finely ground.
	British Columbia									
87006	Courtenay	0·42	0·24	97·25	1·59	85·6	63·2	45·4	40·8	Calcitic limestone, of excellent quality, ground moderately fine.

MARL

It is significant and gratifying that the attention of farmers and agricultural organizations is increasingly being directed to our deposits of marl as a source of lime for land treatment. Past reports of this division have fully described the nature and use of this naturally-occurring amendment but it may be well to again emphasize the fact that there is no more suitable—and in many districts no cheaper—form of lime for the correction of soil acidity (sourness), than marl; there is no more desirable material for increasing the supply of lime in soils naturally deficient in that element.

The cost of digging, air-drying and crushing will be found as a rule much lower than that of the manufacture of ground limestone and full advantage should be taken of this cheap and satisfactory source of lime, especially where deposits occur in the neighbourhood of the farm.

Samples of marl have been received for analysis and report from Ontario, Quebec, Nova Scotia and British Columbia. The data, presented in the accompanying table (14), show that with few exceptions the deposits were of excellent quality.

TABLE 14—ANALYSES OF MARLS (AIR-DRIED) 1926-1927

Lab'y No.	Locality of Occurrence	Mineral Matter insoluble in acid	Oxide of Iron and Alumina (Fe_2O_3 +Al_2O_3)	Carbonate of Lime ($CaCO_3$)	Carbonate of Magnesia ($MgCO_3$)	Moisture Organic Matter etc. (Undetermined)	Report
	Ontario	p.c.	p.c.	p.c.	p.c.	p.c.	
84344	Tp. Osgoode	4·17	0·84	86·25	3·48	5·26	Of good quality.
84912	Paris	1·82	0·26	93·50	.....	4·42	Of excellent quality.
88009	Near Mitchell's Bay, Kent Co.	6·52	2·30	82·00	2·57	6·61	Of good quality.
88173	Williamsford	5·22	1·02	89·75	2·82	1·19	Of excellent quality.
	Quebec						
85092	St. Leon le Grand	6·72	0·94	84·63	4·54	3·17	Of good quality.
85363	Tp. of Low	5·24	0·76	88·75	.....	5·25	Of good quality.
85364	Tp. of Low	3·42	0·36	92·00	.....	4·22	Of good quality.
87310	Mercier de Caplan	3·14	9·14	82·50	.....	5·22	Of fair quality.
	Nova Scotia						
87203	Williams Point, Antigonish Co.	14·08	3·22	77·75	trace	4·95	Of fair quality.
	British Columbia						
84121	Salmon Arm	11·24	1·15	81·50	0·98	5·13	Of good quality.
84483	W. Kootenay	41·97	3·36	41·25	8·88	4·54	A very low grade marl.
84484	W. Kootenay	81·68	8·58	5·00	2·67	2·07	Carbonate of lime content too low: of no value.
84582	Lower Nicola	1·40	0·16	92·50	.....	5·94	Of good quality.
86181	Enderby	50·02	3·20	40·50	.....	6·28	A low grade marl.
87867	Wardner	51·36	5·24	33·88	7·64	1·88	A low grade marl.
87868	Wardner	0·28	0·28	92·75	0·91	5·78	Of excellent quality: very pure.

SUGAR BEETS FOR FACTORY PURPOSES

The two main objects of this inquiry are: (1) to ascertain the suitability of various districts in the Dominion, in respect to soil and season, for the growing of beets for sugar extraction, and (2) to determine the relative value for factory purposes of the several special strains or varieties of sugar beets bred for high sugar content, chiefly in France, Russia and Germany. Since 1918 there has been added to the above, the study of the comparative value of beets from foreign and Canadian-grown seed.

The growing of the beets has been carried out during the past year on twenty-three Farms, Stations and Substations of the Experimental Farm System, as follows: Prince Edward Island: Charlottetown; Nova Scotia: Kentville and Nappan; New Brunswick: Fredericton; Quebec: Lennoxville, Cap Rouge and Ste. Anne de la Pocatière; Ontario: Ottawa 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, Invermere and Summerland.

In addition to the foregoing beets have been analyzed from experimental plots on certain of the Illustration Stations of Prince Edward Island and from farmers' plots grown under the direction of the Prince Albert, Sask., Board of Trade.

Unfortunately Canadian-grown beet seed was not obtainable; the Dominion Sugar Company informed us that none was grown in the Dominion last year. The seed used in this investigation the past season was obtained from the Dominion Sugar Company, Chatham, Ont., the particulars being as follows: varieties, Dippe, Horning and Schreiber, all being imported from Germany. The Russian-grown seed of the varieties Ivanosk R.M., Ivanosk S., Kalnik, Vadovosk, Sacharotrest, Buszczynski and Uladovka was supplied by the Amtorg Trading Company, 165 Broadway, New York.

The data for the season of 1926 from the analysis of beets grown on the Dominion Experimental Farms, the weight per root and yield per acre are given in table 15. Notes on the soil and season conditions obtaining at the several Farms and Stations, together with a brief report on the quality of the beets, adduced from the analytical data, are as follows:—

Charlottetown, P.E.I.—Soil: sandy loam, 6-10 inches, overlying a gravelly brick clay. Manured in the fall of 1925 with 10 tons of stable manure per acre. Manured in the spring of 1926 with 10 tons of stable manure per acre. Previous crop: wheat, barley. Sown June 12, pulled November 16. Spring, very late; summer, fine and warm with precipitation below average, but well distributed. The autumn was wet which made the harvesting late and difficult.

The results are not quite equal to those of 1924 and 1925 but are very good. The beets grown at this Station are usually excellent, both as to richness and purity.

Kentville, N.S.—Soil: sandy loam 9 to 12 inches; overlying a gravelly subsoil. Commercial fertilizers had been applied the previous season; in the spring of the present season 20 tons of manure per acre. Previous crop, hemp. Sown, May 21, pulled October 15. May, June and first part of July cool and wet; latter part of July and all of August very dry; September and October, dry and cool.

The data indicate beets of superior quality, very rich in sugar and of high purity. The yields also appear to be very good. The beets from this Station are almost invariably of very high quality.

Nappan, N.S.—Soil: clay loam of from 12 to 18 inches overlying a medium to heavy clay. No manuring the previous season but 20 tons applied the present season. Previous crop: hay. Sown, June 5; pulled, October 28. The mean temperatures for May, June and July were, respectively, 46·81°, 58·02°, 63·82°; the precipitation for these months was 3·18, 1·58 and 2·28 inches. For August, September and October the mean temperatures were 60·97°, 52·82° and 46·60°, and the precipitation 2·09, 1·15 and 4·85 inches.

These results indicate an excellent quality of beets, both as to sugar content and purity. Seasonal conditions were evidently favourable to good growth and the proper ripening of the crop. Past records have shown that almost invariably a high quality of beet is grown on this Farm.

Fredericton, N.B.—Soil: light clay loam for 18 inches; subsoil: of the same texture except that it has more sand. At a depth of four feet there is a hard pan. No manure or fertilizer in season of 1925; 15 tons of barnyard manure and 800 pounds 4-8-6 home-mixed fertilizer were applied in the spring of the present season. Previous crop: clover. Sown, May 28; pulled, October 7. The mean temperature and the rainfall data were as follows:—

—	Mean Temperature	Rainfall
	°	in.
April	34·5	1·48
May	48·2	1·87
June	59·2	2·06
July	65·45	3·43
August	62·09	6·05
September	55·18	3·01

Though good growth was made, the beets being medium to large in size and well formed, the data indicate poor quality. In neither sugar content nor purity were the beets satisfactory. Usually, beets of very much higher quality have been grown at this Station.

Lennoxville, P.Q.—Soil: sandy loam of from 4 to 6 inches, overlying gravel. No manuring the previous season; barnyard manure at the rate of 12½ tons per acre was applied in the spring of the present season. Previous crop, grain. Sown, May 28; pulled, October 14. Spring was cool and dry; summer cool and dry, autumn cool and wet.

The data indicate an excellent beet, both as to sugar and purity. With the exception of Horning all the varieties have given beets sufficiently rich and pure for satisfactory, profitable sugar extraction.

Cap Rouge, P.Q.—Soil: naturally drained sandy loam of from 15 to 20 inches overlying shale. No manuring or fertilizing previous or present season. Previous crop, cereals. Sown, May 31; pulled, October 13. Spring, cold, dry and dull. Summer, July, cold and wet; August, more favourable with rain and sunshine; September, cool, wet and dull.

In respect to quality these beets are quite satisfactory, but they are too small. The tonnage per acre would be altogether too low to make the culture for factory purposes profitable.

Ste. Anne de la Pocatière, P.Q.—Soil: hard clay of 8 inches, overlying blue clay. Manuring: previous season, barnyard manure, 20 tons per acre; present season, none. Crop of previous season: peas. Sown, June 8, pulled October 14. The spring was very late and very dry; the seed was in the ground for a month before it began to grow on account of dry weather. The summer was also very dry and very cool. Roots grew very slowly until the latter part of August, when plentiful rains brought on the crop faster. October was favourable for roots; rain and fine weather greatly improved their quality and yield.

The results are satisfactory though not ranking with the highest; they would be considered suitable for factory purposes.

Ottawa, Ont.—Soil: medium to light sandy loam, in excellent state of fertility. Subsoil: sand. The precipitation for the spring months of March, April, and May was 7·88 inches; for June, July, and August it was 10·17 inches. September had a precipitation of 2·96 inches. The mean temperature of July was 66°, of August 65° and of September 56°.

As in the past the Ottawa-grown beets are of medium quality they are not equal to the best in the series, nor could they be classed with the poorest. The beets were well grown and of a suitable size for factory purposes.

Kapuskasing Ont.—Soil: fairly heavy clay of from 6 to 8 inches overlying a heavy stratified clay. No manuring the previous season; present season 16 tons of barnyard manure per acre. Previous crop: hay. Sown, June 4; pulled, October 4. The precipitation for March, April and May was 3·76 inches; for June, July and August it was 4·63 inches and in September 2·85 inches. The mean temperature of June 53·40°, of July 62·05°, August 61·00° and September 48·40°.

These beets were of fair quality only, and of small size. Possibly the results may be considered promising as from such a northern latitude—but they do not compare very favourably with those from the larger number of the points under examination.

Brandon, Man.—Soil: heavy clay loam to the depth of 12 inches overlying a clayey subsoil. No manure applied previous or present season. Previous crop, peas. Pulled, October 5. The spring, dry and windy, summer, medium dry and cool and the autumn very wet.

These beets are very low in both sugar and purity; they must be classed as of inferior quality. The roots were large and the yields good. It is only occasionally that beets of high quality have been grown at this Farm. The present poor results may be largely accounted for by the very wet autumn.

Morden, Man.—Soil: black loam about 8 inches deep overlying a black clay. No manures applied previous or present season. Summer-fallowed in 1925. Sown, May 14, pulled, September 25. Spring dry and mild with average temperatures; summer rather cool with good precipitation; autumn cooler than usual and much wetter (September 4·13 inches).

These results from the standpoint of richness and purity are very poor—practically the poorest in the series. The roots were large and the yields excellent but the beets are of such an inferior quality that they would not be at all satisfactory for factory purposes i.e., sugar extraction. Possibly the wet cool autumn was largely responsible for the poor results.

Rosthern Sask.—Soil: sandy loam of 6 inches, overlying a very hard clay. No manure applied previous or present season. Corn grown in 1925: Sown, May 12, pulled, September 29. Character of season: a mild open winter with the spring opening up fairly early; an abundance of rain during April and May with a somewhat lower than average temperature; the summer was very dry with moderate temperatures. During the three summer months only about one inch of rain fell. In the autumn the weather was cooler and the soil was dryer than is usual in autumn. No beneficial rain fell before the roots were harvested.

The percentages of sugar are fair to good but the results for the coefficient of purity are far from satisfactory. Data in previous years of this examination have as a rule indicated beets of inferior quality—too poor for profitable sugar extraction.

Scott, Sask.—Soil: brown sandy loam of 6 inches overlying a grayish loam with a considerable proportion of clay. The plots had been manured once every four years between 1912 and 1920 at the rate of 8 tons per acre. No manuring the previous season. Summer-fallowed in 1925. Sown May 31, pulled September 21. The spring cool and backward with plenty of moisture (May 2·97, June 1·39 inches); summer warm but very dry (July ·75, August 2·52 inches); autumn cloudy and cool (September ·74 inches).

These results indicate a beet of poor quality; the percentages of sugar and the coefficient of purity are among the lowest in the series. The records of

this investigation show that with but few exceptions the beets from the Northern Station have been of poor or at best medium quality.

Indian Head, Sask.—Soil: black clay loam of 10 inches overlying dark chocolate clay. No manure applied previous or present season. Summer-fallowed 1925. Sown, May; pulled, October 7. Season: Spring cool with moderate supply of moisture; summer warmer than average with a large number of small showers but total precipitation below average. Autumn cool and wet. There was 5 inches of snow on the 23rd and 24th of September which was followed by a low temperature of 8° above zero on the 25th.

These beets are poorer than those from this Farm for the previous three years. The cool and wet autumn prevented the proper ripening of the crop. Several of the beets, as received for analysis, showed sprouting or second growth. Though not the poorest in the series these beets would scarcely be considered suitable for sugar extraction.

Swift Current, Sask.—Soil: clay loam of 7 inches overlying clay. No manure previous or present season. Previous crop, wheat. Sown, May 19; pulled, September 28. Season: April and May, precipitation 2·76 inches; temperature, maximum 60°, minimum 38°, very high winds; June, July and August, precipitation 7·26 inches; temperature, June moderate, July hot, August warm; September, precipitation, ·48 inches; temperature, maximum 54·2°; minimum 32°, September 24, 23° of frost.

Sugar content of beets is fair but purity very low. Roots are exceedingly small. The Superintendent writes, " practically the whole season was unfavourable for the production of root crops of any kind; the rainfall was below the average and wind velocity above the average ".

Fort Vermilion, Alta.—Soil: dark loam to a depth of four feet over a blue clay. No manure applied previous or present season. Previous cropping potatoes in 1924 and corn in 1925. Sown, May 26; pulled, September 10. The spring was cool with a light precipitation and the summer warm with very light rainfall. Autumn cold with plenty of rain and snow.

The results throughout the series are decidedly low and the beets must be considered of inferior quality. The roots were of good size but too low in sugar for profitable factory use.

Beaverlodge, Alta.—Soil: black brown silt of from 5 to 6 inches overlying a chocolate clay subsoil. No manure applied previous or present season. Summer-fallowed in 1925 after Eureka beardless-hulless barley following three years in sod. Sown, May 14; pulled, November 1. Spring: wet, with heavy snow fall in June, ten inches of soft snow lying on the ground at one time. Wireworms damaged the crop and severe frosts in September checked growth. Soil a little too clayey and compact.

These results are very low, both as to sugar and purity. The beets are of inferior quality and would not be considered satisfactory for factory purposes.

Lacombe, Alta.—Soil: black loam overlying clay loam. Manured in 1925 with 20 tons per acre of rotted barnyard manure. The crop of the previous season was alfalfa. Sown, May 22; pulled, September 22. Spring, dry and warm; summer moderately warm and autumn cold and wet.

These are very poor beets; they are low both in sugar and purity. They are among the poorest in the series. It would seem that the cold and wet autumn prevented the proper ripening of the crop.

Lethbridge, Alta.—Soil: sandy clay loam of 1 foot in depth over clay loam. Sown, May 18; pulled, October 25. Spring: moderately warm with strong high winds drying out surface soil. Precipitation scanty, no late frosts. Summer, moderately warm with very little wind and no very low temperatures: heavy rains in June, fair amount of rain in July and good rains in August. Weather was very wet throughout September with a little snow on the 20th-23rd. Weather warm during day with light frosts at night and 23° frost on September 23rd October weather was mild with little frost and rain and no snow.

Dry land: Summer-fallowed in 1925. Irrigated land: previous crop, peas.

These beets, in all three varieties, on both irrigated and non-irrigated plots, have given results which are exceptionally low for this Station. They are distinctly inferior, in respect to both sugar content and purity. Hitherto, beets from this Station have almost invariably been of high quality.

Agassiz, B.C.—Soil: sandy loam to a depth of about 8 inches; subsoil sandy and gravelly. Manuring of present season: 12 tons, per acre, of barnyard manure and 500 pounds, per acre, of commercial fertilizer. The crop of the previous season was oats. Sown, May 12: pulled, October 17.

—	Temperatures		Precipitation
	Maximum	Minimum	
	°	°	inches
Spring	90	35	10·16
Summer	95	43	4·26
Autumn	84	37	9·44

The results for sugar content are decidedly lower than usually recorded for this Farm, probably due to the exceedingly wet and cool autumn preventing the proper ripening of the beet.

Sidney, B.C.—Soil: gravelly loam 14 inches, overlying sand and gravel. No manure in 1925; fertilized the present season at the rate of 600 pounds per acre. Summer-fallowed in 1925. Sown May 17; pulled November 17. The spring was early and mild with a precipitation for the spring months (March, April and May) of 3·38 inches. June and July were very dry, August 1·09 inches, September dry, October precipitation 3·91 inches.

The results indicate a beet of very fair quality; they are not among the best, nor could they be classed with the poorest. Evidently the seed was sown too late for best results and October was too cool and wet for maximum sugar production. The superintendent writes: "The beets did not get their growth until Autumn—a time when they should have been ripening".

Invermere, B.C.—Soil: fine silty loam 12 inches deep on similar soil of a lighter colour, which is underlaid with gravel. No manure applied previous or present season. Summer-fallowed in 1925. Sown, May 28; pulled, October 8. Irrigated, May 21, June 30 and August 6.

Precipitation—	inches
March, April and May	0·99
June, July and August	2·79
September	3·01
Mean Temperature—	°
March, April and May	44·58
June, July and August	61·09
September	44·63

"Growth was hindered in the early stages by the presence of couch grass, reducing the yields."

The results indicate a beet of fair quality only; they are much lower, in both sugar and purity than those from this Station for many years. The superintendent writes: "Sowing was a little late, the season was unusually hot and dry and irrigation water was rather scarce."

Summerland, B.C.—Soil: gravelly loam overlying the same. Manured 10 tons per acre in present season; no manure in 1925. Crop of previous season: grass and legume plots. Sown, May 27; pulled, October 1.

The character of the season was as follows: Very early spring after the mildest winter on record. Spring precipitation slightly above the average for the previous 10 years. No damaging spring frosts. On April 28 temperature reached 84°.

Summer very hot and dry. June "usually our wettest summer month" precipitation below average for previous 10 years. July very much below average. August slightly higher. Autumn continues dry. Exceptionally cold about September 24, 7° of frost being recorded on that date.

Irrigation applied: April 14, May 7, June 6 and July 7; total, 34 acre-inches.

With the exception of the results for the variety Horning the data for both sugar and purity are decidedly low. In the past excellent results have been obtained from this Station. The beets were very large, due probably in part to heavy irrigations; low sugar content might also be ascribed in part to very cool weather in September.

TABLE 15.—SUGAR BEETS GROWN ON THE DOMINION EXPERIMENTAL FARMS, 1926

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.
Dippe	Charlottetown, P.E.I., 1st planting	18·81	88·74	1	3	9	1,600
	Charlottetown, P.E.I. (Country test)	19·24	91·47	1	9	11	300
	Charlottetown, P.E.I. 2nd planting	18·09	87·08	1	6		
	Charlottetown, P.E.I. 2nd (Country test)	17·65	86·26	1	5		
	Kentville, N.S.	20·73	91·83	1	2	14	564
	Nappan, N.S.	18·27	84·68	1	6	10	1,600
	Fredericton, N.B.	15·18	76·14	1	14	18	1,703
	Lennoxville, Que.	17·47	82·00	1	11	17	340
	Cap Rouge, Que.	19·18	85·88	..	8	4	858
	Ste. Anne de la Pocatière, Que.	18·64	85·17	1	–	9	1,664
	Ottawa, Ont.	16·96	82·88	1	8		
	Kapuskasing, Ont.	15·61	81·00	1	..	4	1,307
	Brandon, Man.	13·06	77·25	3	1	12	1,940
	Morden, Man.	9·80	58·87	1	15	26	136
	Rosthern, Sask.	18·88	79·97	..	14	10	180
	Scott, Sask.	12·19	68·76	1	5	4	114
	Indian Head, Sask.	16·22	81·36	1	10	3	221
	Swift Current, Sask.	16·89	79·39	..	6	2	1,352
	Fort Vermilion, Alta.	12·47	78·61	1	11		
	Beaverlodge, Alta.	13·06	73·86	..	14	4	1,400
	Lacombe, Alta.	9·33	59·54	1	..	7	1,925
	Lethbridge, Alta. (Irrigated)	14·68	76·83	2	11		
	Lethbridge, Alta. (Non-irrigated)	16·10	79·05	1	0		
	Agassiz, B.C.	15·49	84·63	1	10	8	1,620
	Sidney, B.C.	17·28	86·88	1	6	6	980
	Invermere, B.C.	16·15	79·56	1	4	8	60
	Summerland, B.C.	14·73	69·84	2	9	10	460
Horning	Charlottetown, P.E.I., 1st planting	17·97	86·48	1	4	11	1,400
	Charlottetown, P.E.I. 2nd planting	16·71	86·46	1	7		
	Kentville, N.S.	19·45	92·17	1	2	13	294
	Nappan, N.S.	18·21	86·84	1	8	11	300
	Fredericton, N.B.	14·53	77·69	1	13	18	1,515
	Lennoxville, Que.	15·94	80·09	2	3	15	440

TABLE 15.—SUGAR BEETS GROWN ON THE DOMINION EXPERIMENTAL FARMS, 1926—*Continued*

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.
Horning	Cap Rouge, Que	18·92	86·32	..	9	4	1,192
	Ste. Anne de la Pocatière, Que	17·96	83·60	1	2	15	1,507
	Ottawa, Ont	17·12	86·88	1	9		
	Kapuskasing, Ont	15·38	80·67	..	13	4	1,307
	Brandon, Man	13·75	76·81	2	14	12	800
	Morden, Man	8·47	53·46	2	8	21	912
	Rosthern, Sask	17·36	78·14	1	2	10	1,000
	Scott, Sask	12·76	71·93	1	1	3	85
	Indian Head, Sask	14·44	79·68	1	9	3	46
	Swift Current, Sask	16·51	75·46	..	8	3	1,080
	Fort Vermilion, Alta	12·34	76·76	2	4		
	Fort Vermilion, Alta., "late sown"	12·27	79·52	..	13		
	Beaverlodge, Alta	13·76	74·42	..	14	5	1,700
	Lacombe, Alta	8·87	57·44	..	13	7	560
	Lethbridge, Alta. (Irrigated)	16·38	79·98	2	6		
	Lethbridge, Alta. (Non-irrigated)	14·34	76·70	1	4		
	Agassiz, B.C	14·49	83·73	1	13	11	161
	Sidney, B.C	16·21	84·89	1	1	7	1,400
	Invermere, B.C	15·19	78·70	1	4	12	800
	Summerland, B.C	17·44	82·50	2	7	9	1,580
Schreiber & Sons	Charlotteton, P.E.I., 1st planting	14·95	84·45	1	4	12	1,300
	Charlottetown, P.E.I., 2nd planting	19·00	91·03	1	5		
	Kentville, N.S	20·83	89·45	1	2	12	24
	Nappan, N.S	18·75	89·39	1	8	7	1,300
	Fredericton, N.B	16·75	86·66	1	13	17	292
	Lennoxville, Que	18·04	86·34	1	14	15	1,200
	Cap Rouge, Que	19·23	86·14	..	8	4	588
	Ste. Anne de la Pocatière, Que	17·95	85·76	1	3	10	1,282
	Ottawa, Ont	16·69	86·50	1	14		
	Kapuskasing, Ont	16·20	85·72	..	14	5	1,413
	Brandon, Man	12·67	71·99	2	..	11	1,600
	Morden, Man	10·06	57·65	2	14	23	50
	Rosthern, Sask	17·62	78·59	..	14	10	760
	Scott, Sask	12·80	67·50	1	..	3	192
	Indian Head, Sask	16·55	83·14	1	6	3	148
	Swift Current, Sask	16·14	80·48	..	4	2	1,832
	Fort Vermilion, Alta	12·07	78·02	1	5		
	Beaverlodge, Alta	13·53	75·61	..	13	5	700
	Lacombe., Alta	9·57	62·82	..	13	5	1,440
	Lethbridge, Alta. (Irrigated)	14·97	76·81	2	12		
	Lethbridge, Alta. (Non-irrigated)	15·25	77·41	..	..		
	Agassiz, B.C	14·84	83·85	1	9	12	564
	Sidney, B.C	15·67	85·35	1	5	6	1,640
	Invermere, B.C	16·20	81·41	..	15	9	300
	Summerland, B.C	12·71	70·20	3	6	12	640
Ivanosk R. M. (Russian)	Charlottetown, P.E.I. (1st planting)	18·34	89·33	1	7	12	1,100
	Charlottetown, P.E.I. (2nd planting)	17·86	83·73	1	12		
	Kentville, N.S	20·31	91·45	1	2	10	592
	Nappan, N.S	18·79	87·82	1	13	14	500
	Ste. Anne de la Pocatière, Que	17·07	80·24	..	15	10	1,282
	Ottawa, Ont	16·72	84·20	1	9		
	Brandon, Man	13·59	77·66	2	11	10	1,860
	Rosthern, Sask	19·37	79·38	..	14	10	240
	Agassiz, B.C	13·83	83·77	1	10	11	1,229
Ivanosk S (Russian)	Charlottetown, P.E.I. (1st planting)	17·47	83·73	1	8	14	
	Charlottetown, P.E.I. (2nd planting)	18·41	87·76	1	4		
	Kentville, N.S	20·17	91·58	1	..	11	440
	Nappan, N.S	18·79	88·63	1	10	11	200
	Ste. Anne de la Pocatière, Que	18·06	85·63	1	..	10	772
	Brandon, Man	14·34	78·56	2	3	10	940
	Rosthern, Sask	18·46	80·23	..	14	10	240
	Agassiz, B.C	15·39	85·96	1	10	13	1,434
Kalnik (Russian)	Charlottetown, P.E.I. (1st planting)	18·19	89·74	1	3	12	500
	Charlottetown, P.E.I. (2nd planting)	18·64	87·18	1	..		
	Kentville, N.S	20·29	88·72	1	5	13	188
	Nappan, N.S	18·75	83·41	1	12	9	400
	Lennoxville, Que	18·34	83·75	1	9	15	800
	Ste. Anne de la Pocatière, Que	17·74	82·52	..	14	10	473
	Brandon, Man	14·06	77·75	2	5		

TABLE 15.—SUGAR BEETS GROWN ON THE DOMINION EXPERIMENTAL FARMS, 1926—*Concluded*

Variety	Locality where grown	Percentage of sugar in juice	Co-efficient of purity	Average weight of one root		Yield per acre	
			p.c.	lb.	oz.	tons	lb.
Vladovosk (Russian).	Charlottetown, P.E.I. (1st planting)	17·93	89·04	1	8	14	1,700
	Charlottetown, P.E.I. (2nd planting)	13·92	81·37	1	6		
	Kentville, N.S.	19·32	87·70	1	2	10	1,964
	Nappan, N.S.	17·98	85·63	1	12	11	800
	Ste. Anne de la Pocatière, Que.	18·49	84·47	1	0	10	1,780
	Ottawa, Ont.	16·04	83·32	1	3		
	Brandon, Man.	13·57	78·41	3	..	11	1,860
	Rosthern, Sask.	17·69	77·67	..	15	13	540
	Agassiz, B.C.	14·65	80·07	1	3	12	564
Fredericksen.	Charlottetown, P.E.I. (1st planting)	15·45	84·14	1	13	10	1,900
	Charlottetown, P.E.I. (2nd planting)	19·15	88·86	1	7		
	Lennoxville, Que.	17·30	82·75	2	3	17	140
Kuhm & Co.	Charlottetown, P.E.I. (1st planting)	18·33	88·55	1	4	13	1,700
	" " (2nd planting)	18·11	86·94	1	8		
Buszczynski.	" " (1st planting)	17·40	85·57	1	7	9	1,700
	" " (2nd planting)	16·65	89·99	1	5		
	Nappan, N.S.	19·16	88·00	..	15	4	800
Sachrotrest I.	Charlottetown, P.E.I. (1st planting)	18·07	89·33	1	5	14	200
	Charlottetown, P.E.I. (2nd planting)	17·84	89·64	1	3		
" Ivanosk	Nappan, N.S.	18·99	88·04	1	9	11	1,600
" II.	Charlottetown, P.E.I. (1st planting)	18·17	88·80	1	5	11	1,500
	Charlottetown, P.E.I. (2nd planting)	17·71	90·05	1	4		
" Ivanosk P.M.	Nappan, N.S.	19·14	89·34	1	2	11	1,200
" III.	Charlottetown, P.E.I. (1st planting)	17·46	85·98	1	1	12	1,400
	Charlottetown, P.E.I. (2nd planting)	18·42	86·38	1	6		
" Uladovsk Y. S.	Nappan, N.S.	19·17	88·76	1	5	8	1,500
Ideal.	Nappan, N.S.	19·34	87·10	1	7	11	1,400
Rabbethge & Giesecke.	Nappan, N.S.	19·34	88·82	1	7	11	500
	Lennoxville, Que.	19·33	85·55	1	11	17	100
Kalnik.	Nappan, N.S.	18·75	86·66	1	10	9	400
Klein Wanzleben.	Fort Vermilion, Alta.	13·07	78·47	2	10		
Waterloo.	" "	13·94	79·93	2	8		
Vilmorin's.	" "	13·59	80·65	2	8		
Kitchener.	" "	13·29	79·87	2	7		
Henning & Harving.	" "	12·46	77·56	2	7		

Averages of "sugar in juice" and "co-efficient of purity" of the three varieties —Dippe, Horning and Schreiber & Sons—as grown on the twenty-three Farms and Stations in this investigation in 1926 are presented in table 16.

TABLE 16.—SUGAR BEETS: SUGAR IN JUICE AND CO-EFFICIENT OF PURITY: AVERAGES FROM THE SEVERAL VARIETIES GROWN ON 23 EXPERIMENTAL FARMS AND STATIONS THROUGHOUT THE DOMINION, 1926.

Variety	Sugar in Juice	Co-efficient of Purity
	p.c.	p.c.
"Dippe"	16·00	79·90
"Horning"	15·26	79·13
"Schreiber & Sons"	15·56	80·09

These averages are lower than those obtained for a number of years past. It would seem that the season of 1926—and more particularly the autumn months—has not been favourable, at a very considerable number of points, for sugar production. Reference to the superintendents' notes previously recorded, will make it clear that cold and wet weather prevailed at many of the Stations during the late summer months—a condition detrimental to the proper ripening of the beet. It may be remarked that a few very low results—as from Morden, Man. and Lacombe, Alta.—have markedly pulled down these averages; table 15 shows that at quite a number of the points medium to good results were obtained.

This inquiry into the quality of sugar beets as grown at a number of points throughout the Dominion, was instituted in 1902 and the results have been published annually in the reports of this division. In table 17 averages for the percentage of sugar in juice from beets grown from 1919 to 1926, inclusive, are given, the results permitting a comparison and indicating the variation in quality which may take place from year to year, due chiefly to seasonal conditions.

TABLE 17.—AVERAGE PERCENTAGE OF SUGAR IN JUICE IN SUGAR BEETS GROWN ON DOMINION EXPERIMENTAL FARMS 1919-1926

Locality	1919	1920	1921	1922	1923	1924	1925	1926
Charlottetown, P.E.I.	18·33	16·44	16·40	.....	18·67	19·23	19·30	17·80
Kentville, N.S.	19·25	18·36	18·06	18·72	20·43	24·71	18·08	20·33
Nappan, N.S.	17·83	18·01	18·08	18·45	17·61	16·98	19·49	18·41
Fredericton, N.B.	20·94	18·34	18·09	16·61	15·60	21·42	19·19	15·48
Lennoxville, P.Q.	15·91	14·55	16·01	15·12	15·99	17·51	17·29	17·15
Cap Rough, P.Q.	16·88	16·69	17·04	21·27	18·61	.....	20·17	19·11
St. Anne de la Pocatière, P.Q.	18·89	13·24	17·31	17·69	15·30	19·72	19·80	18·18
La Ferme, P.Q.	16·05	.....	.....	.....	.....	.....	.....	.....
Ottawa, Ont.	17·79	15·09	15·61	16·44	16·16	16·36	15·57	16·92
Kapuskasing, Ont.	.....	.....	.....	.....	.....	.....	.....	15·73
Brandon, Man.	.....	15·24	16·82	14·14	12·19	13·36	.....	13·16
Morden, Man.	.....	.....	.....	.....	.....	.....	.....	9·44
Rosthern, Sask.	.....	14·15	13·56	17·27	13·13	14·19	14·27	17·95
Scott, Sask.	14·39	15·74	15·79	17·25	19·21	15·71	14·18	12·58
Indian Head, Sask.	15·68	20·24	.....	19·70	20·12	17·10	16·52	15·73
Swift Current, Sask.	.....	.....	.....	.....	.....	.....	.....	16·05
Fort Vermilion, Alta.	17·35	.....	14·47	16·00	14·32	13·01	16·11	12·28
Beaverlodge, Alta.	.....	.....	15·77	.....	19·16	.....	.....	13·45
Lacombe, Alta.	.....	12·86	13·84	15·77	.....	.....	12·25	9·26
Lethbridge, Alta. (irrigated)	14·31	18·34	17·99	17·04	17·21	18·85	17·28	15·34
Lethbridge, Alta. (non-irrigated)	.....	19·35	16·63	17·57	15·92	.....	15·04	15·23
Agassiz, B.C.	17·02	16·46	15·78	16·67	17·62	16·75	.....	14·94
Sidney, B.C.	17·98	14·29	.....	.....	16·67	14·90	18·74	16·38
Invermere, B.C.	14·72	19·26	15·78	17·56	20·02	17·44	21·96	15·84
Summerland, B.C.	.....	16·85	20·03	17·36	16·92	20·08	21·33	14·96

CO-OPERATIVE WORK WITH SUGAR BEETS

PRINCE EDWARD ISLAND, 1926

Sugar beets of the variety Dippe have been grown on six of the Illustration Stations of this province, under the direction of the Superintendent, Experimental Station, Charlottetown. The seed was from the same stock as that used on the Experimental Farms and Stations. The results are presented in table 18.

TABLE 18.—SUGAR BEETS GROWN IN CO-OPERATION WITH ILLUSTRATION STATIONS, P.E.I., 1926—VARIETY DIPPE

Lab'y. No.	Grower	Locality	Sugar in juice	Coefficient of purity	Average weight of one root
			p.c.	p.c.	lb. oz.
87385	John Clark	Rustico	18·35	87·52	.. 14
87386	Clifford McEwen	St. Peters	18·11	88·92	.. 11
87387	J. E. Daly	Iona	17·50	84·96	2 2
87388	C. Grigg	West Devon	17·15	87·04	.. 11
87389	M. McKenzie	Rose Valley	17·87	88·35	.. 14
87390	Thos. Noonan	Richmond	14·96	81·82	1 4

Summarizing particulars of growth, soil, etc., it may be said that the date of sowing was very late—middle of June or later, and the roots harvested during the last half of October. The soil generally was sandy loam, with manure or fertilizer, or both on the larger number of the Stations. The Spring was late and cool, the summer with precipitation below average was fairly well distributed and the autumn cool and wet—conditions not favourable to high yields or high quality.

With the exception of sample No. 87390 (for which there is not satisfactory explanation) the results for these beets do not differ materially from those of the beets grown on the Experimental Station, Charlottetown. They indicate beets of good quality, but are somewhat small from the point of profitable yields. Considering that the season was somewhat exceptionally unfavourable, the results may be regarded as quite satisfactory.

PRINCE ALBERT DISTRICT, SASKATCHEWAN, 1926

During the autumn of 1925 the Board of Trade of Prince Albert, Sask., requested the analysis of a number of samples of sugar beets grown by farmers from seed supplied by the Board in the spring. The seed was stated to be the variety Detitzscher. These beets, as received, were unfortunately in a very bad condition, the larger number of them evidently had been frozen either before shipment or on route and then thawed, leaving the beet in a soft and sticky condition. The results of this examination, though far from satisfactory, were published in the Annual Report of this Division for year ending March 31, 1926.

In the spring of 1926 this Board of Trade again asked for our assistance in this matter of testing out the Prince Albert district in respect to its suitability for sugar beet growing. In response to this request sufficient seed for twenty co-operators of the variety Dippe was sent, together with directions for the proper culture of the crop. The field work was supervised by Mr. O. A. Cooke and the collection and shipment of the samples undertaken by Mr. Georges Michaud, both of the provincial Department of Agriculture. The analytical data are presented in table 19.

These results are not encouraging. The roots grew to a good size and no doubt the tonnage per acre would be satisfactory, but taking the series as a whole the sugar content and purity are too low for profitable sugar extraction. In a few instances the beets possessed a fair percentage of sugar but in the majority of cases, the results would not be considered satisfactory for sugar manufacture.

From the limited data available no final decision should be reached but the results so far obtained indicate that this district is too far north for the growth of a rich, pure root; the season probably is too short to allow a proper ripening of the beet.

TABLE 19.—SUGAR BEETS GROWN IN CO-OPERATION WITH THE PRINCE ALBERT BOARD OF TRADE—VARIETY DIPPE 1926

Lab'y. No.	Variety	Sender	Locality	Sugar in juice	Co-efficient of purity	Average weight of one root	
				p.c.		lb.	oz.
86883	Klein Wanzleben	J. G. Dennis	Royal	14·35	75·91	2	9
84	Vilmorin's Improved	J. C. English	Red Deer Hill	13·48	75·50	1	1
85	Dippe	"	"	15·02	79·47	1	2
86	Alexander Janasz	J. H. Brownlee	Prince Albert	13·50	75·60	2	3
87	Dippe	R. Halcro	Davis	12·58	73·14	1	4
88	"	Jno. Arnold	Clouston	13·52	77·34	1	13
89	Alexander Janasz	"	"	13·45	77·03	1	12
90	Dippe	A. D. Clarke	Lily Plain	16·38	85·90	..	9
91	Alexander Janasz	Cecil Young	Paddockville	15·89	83·20	..	10
92	Dippe	Sam Sorensen	"	16·13	83·87	..	7
93	Seed from Raymond Sugar Factory	A. Pellerin	Albertville	14·04	77·62	1	..
94	Dippe	J. P. Baker	Henryburg	12·72	77·94	1	14
95	"	O. E. Engelbrecken	Spruce Home	15·59	79·97	..	6
96	"	A. D. Clark	"	14·04	77·41	..	14
97	"	P. A. Forsythe	P. A. Jail Farm	13·77	78·68	3	1
98	Vilmorin's Improved	"	"	13·06	77·39	2	11
99	Unknown	"	"	11·85	74·22	5	4
900	Dippe	E. H. Delporte	Albertville	13·32	76·17	1	7
901	"	W. H. S. Gange	Red Deer Hill	14·69	74·57	2	14
902	Klein Wanzleben	"	"	16·09	78·98	2	1

FARM OR FIELD ROOTS

MANGELS

An interesting series of mangels grown by the Division of Forage Plants on the Central Farm, Ottawa, has been submitted to analysis. These roots were representative of fifteen varieties and were grouped as to type. The classification as to type is based on the length-width ratio of the root and the object of the inquiry, now in its second year, is to ascertain what relation, if any, exists between type (as thus defined) and nutritive value as measured by dry matter and sugar content.

The detailed data are presented in table 20.

TABLE 20.—ANALYSIS OF MANGELS, C.E.F., OTTAWA, ONT., 1926

Type	Variety	Dry matter	Sugar in juice	Average weight of one root
		p.c.	p.c.	lb. oz.
Long	Long Yellow	13·52	5·56	2 9
"	Perfection Mammoth Long Red	11·93	5·29	3 2
"	Elvethan Long Red	11·67	3·96	3 15
Half Long	Giant Sugar	13·11	7·78	3 7
"	Jumbo	12·98	7·01	3 2
"	Half Sugar Green Top	11·28	6·74	3 13
Intermediate	Giant Yellow Half Long Intermediate	10·28	5·40	3 9
"	Red Intermediate	9·33	4·61	4 2
Tankard	Yellow Eckendorffer	10·20	4·60	4 3
"	Eckendorffer Red	9·24	4·61	4 10
Ovoid	Non-such	11·32	3·06	3 11
Globe	Red Globe	11·25	6·31	2 9
"	Yellow Intermediate	11·15	2·23	3 9
"	Red Globe	10·86	5·82	3 2
	New Combination	10·75	5·32	3 10

A considerable range or "spread" in dry matter and sugar is to be observed. This is in agreement with the results of previous years' work with this class of roots. In dry matter the range is from 13·52 to 9·24 per cent, and in sugar from 7·78 to 2·23 per cent. In a general way, as noted in previous years, there is a relation between dry matter and sugar; they rise and fall together fairly regularly.

The maxima, minima and averages of the several groups or types are presented in table 21. From these results it will be seen that the types "Long" and "Half long" furnished the richest roots. This is in agreement with the findings of the previous year.

TABLE NO. 21.—MANGELS: DRY MATTER AND SUGAR IN JUICE

(Averages, Maxima and Minima)

Type	Dry matter			Sugar in juice		
	Average	Maximum	Minimum	Average	Maximum	Minimum
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Long	12·37	13·52	11·67	4·93	5·56	3·96
Half-long	12·46	13·11	11·28	7·18	7·78	6·74
Intermediate	10·30	10·28	9·33	5·00	5·40	4·61
Tankard	9·72	10·20	9·24	4·60	4·61	4·60
Ovoid	11·32	.....	.....	3·06	.....	.....
Globe	11·09	11·25	10·86	4·79	6·31	2·23

An investigation conducted by this Division for many consecutive years, to trace the influence of heredity on dry matter and sugar content, furnished evidence of the most satisfactory character as to the superiority of the Mammoth Long Red (Long Type) over the Giant Yellow Globe (Globe Type) in respect to both dry matter and sugar. Shape or "type" is evidently an inherited factor; there is little doubt but that this factor is more or less associated or linked with nutritive value, i.e., dry matter and sugar content.

The averages obtained from the analysis of mangels for the past twenty-two years (1904-1926) are presented in table 22; the averages 11·07 dry matter and 5·47 sugar in juice may be accepted for mangels as a class.

TABLE 22.—MANGELS—DRY MATTER AND SUGAR IN JUICE, 1904-1926

Year	Number of Varieties analysed	Average weight of one root	Dry matter	Sugar in juice
		lb. oz.	p.c.	p.c.
1904	10	2 11	11·69	6·62
1905	17	3 9	10·04	4·67
1906	16	2 7	11·63	5·93
1907	10	2 11	12·64	7·46
1908	12	2 2	11·87	5·33
1909	14	3 5	11·21	6·21
1910	8	5 10	10·04	4·46
1912	23	2 9	9·51	6·43
1913	13	2 14	10·51	5·63
1914	24	2 1	12·79	7·75
1915	36	3 9	9·25	4·27
1916	26	2 ..	8·86	2·66
1917	31	1 15	12·64	6·72
1918	13	2 4	11·78	6·13
1919	80	.. 14	12·58	6·26
1920	42	3 8	9·18	4·07
1921	41	3 ..	9·73	4·00
1922	50	2 13	12·81	5·93
1923	129	2 10	12·37	5·27
1924	141	2 12	10·42	4·49
1925	20	2 14	10·64	5·03
1926	15	3 8	11·26	5·22
Average for 22 years			11·07	5·47

INFLUENCE OF LIMING ON THE YIELD AND QUALITY OF MANGELS

An experiment was carried out during the past season (1926) on the Experimental Station, Kentville, N.S., to ascertain the effect of liming on the yield and quality of mangels. The variety used was Giant White Sugar. The plan consisted in sowing six plots on a limed range and similarly six on an unlimed range, harvesting and weighing the crop from each plot separately and therefrom forwarding representative roots to Ottawa for analysis. The data are presented in table 23.

TABLE 23.—ANALYSIS OF MANGELS, EXPERIMENTAL STATION, KENTVILLE, N.S.

Variety—Giant White Sugar Mangel

—	Yield per plot	Sugar in juice	Dry matter	Average weight of one root
	lb.	p.c.	p.c.	lb. oz.
Limed Range B—				
1	1,345	8·35	16·18	1 7
2	795	5·55	13·74	.. 13
3	1,105	9·19	14·08	1 4
4	1,160	6·55	14·97	1 10
5	921	7·81	13·58	1 8
6	237	11·76	19·36	.. 6
Unlimed Range A—				
1	907	11·04	17·36	1 12
2	470	10·47	17·70	1 5
3	765	10·11	14·63	1 7
4	1,195	11·94	18·59	1 4
5	415	9·00	16·24	.. 15

The data for both dry matter and sugar are decidedly, indeed exceptionally high. This is undoubtedly due to the very small size (weight) of root—from one-half to one-third that of well-grown mangels.

Comparing the figures for the two ranges it will be observed that the yields from the limed plots far exceed those from the unlimed but that the percentages of dry matter and sugar are much higher in the unlimed mangels. In "weight of root" there is little difference between the mangels of the two ranges. These results are more clearly brought out in the following table of averages:—

AVERAGES FROM LIMED AND UNLIMED PLOTS

—	Limed	Unlimed
Yield	927 lb.	750 lb.
Dry matter	15·32 per cent	16·90 per cent
Sugar in juice	8·20 "	10·51 "
Weight of one root	1 lb. 3 oz.	1 lb. 5 oz.

CARROTS

Five varieties grown by the Division of Forage Plants on the Central Farm, Ottawa, have been submitted to analysis. The seed in all instances was obtained from Canadian sources. The data, presented in table 24 show a spread from 10·85 to 8·17 per cent in dry matter and from 2·67 to 1·04 per cent in sugar in juice. The averages from the data of nineteen years—from roots grown on the Central Farm—are dry matter 10·92 per cent and sugar 2·75 per cent.

TABLE 24.—ANALYSIS OF CARROTS, C.E.F., OTTAWA, ONT., 1926

Variety	Dry matter	Sugar in juice	Average weight of one root
	p.c.	p.c.	lb. oz.
Long Orange Belgian	10·85	2·47	.. 12
Improved Danver's Half Long	10·58	2·67	.. 7
Champion	8·97	1·04	1 11
Danish Champion	8·52	2·58	1 5
White Belgian	8·17	1·14	1 8

TURNIPS

The series of swede turnips submitted by the Division of Forage Plants and grown on the Central Farm, Ottawa, comprised six varieties. Of these the seed for "Bangholm Pajbjerg" was obtained from Copenhagen, Denmark, and that for "Bangholm" from the University of British Columbia, Vancouver, B.C.

The results of the examination given in table 25 show that the roots are somewhat undersized but that in dry matter and sugar they are of good average quality. The average data for the past eighteen years for this class of farm roots are, dry matter 10·07 per cent, sugar 1·15 per cent.

TABLE 25.—ANALYSIS OF SWEDE TURNIPS, C.E.F., OTTAWA, ONT., 1926

Variety	Average weight of one root		Dry matter	Sugar in juice
	lb.	oz.	p.c.	p.c.
Bangholm "Pajbjerg"	3	9	11·69	0·92
Hall's Westbury	3	..	11·56	0·51
Derby	2	15	11·40	1·03
Kangaroo	3	3	11·08	0·82
Bangholm	3	1	10·79	0·82
Garton's Superlative	3	7	10·08	0·92

WHEAT AND FLOUR

Wheat from Pollockville, Alta. Lab'y No. 83901.—This wheat was submitted April, 1926, from a correspondent at Pollockville, Alta., through the Cereal Division, Ottawa. It had been developed from special heads selected from the crop of 1914 and information was desired as to its protein content.

ANALYSIS	Per cent
Moisture	5·02
Protein (N. x 5·7)	15·71
Ash	1·85
Weight of 1,000 kernels in grams	30·09

The percentage of protein is decidedly high and the indications are that this wheat would yield a flour of excellent bread making quality. This wheat has a kernel of very fair size, of good colour and moderately hard.

Marquis and Garnet Wheat. Lab'y No. 87594-5.—These two wheats were grown by the School of Agriculture, Olds, Alta., in 1925 and submitted by the Cereal Division as members of the variety test conducted by that division. Their relative position in respect to protein content was desired.

ANALYSIS

—	Marquis	Garnet
	Per cent	Per cent
Moisture	10·32	10·43
Protein (N. x 5·7)	14·29	14·05
Ash	1·67	1·23
Weight of 1,000 kernels, in grams	31·46	29·74

Marquis is slightly superior to Garnet in protein content; it also possesses a somewhat higher percentage of ash (mineral constituents) and a heavier kernel. The differences between these two wheats, however, are not very significant or pronounced.

Jireh Flour. Lab'y No. 84679.—This flour is manufactured by the Jirch Food Company, Brockville, Ont. The analysis was made at the request of the Kingston General Hospital. In appearance this flour slightly resembles Graham flour, showing fine flecks of bran-like particles.

Analysis	Per cent
Moisture	10·78
Protein (N. x 5·7)	11·93
Fat	1·81
Carbohydrates	73·88
Fibre	0·61
Ash	0·99
	100·00

These results would indicate that this flour approximates in composition a whole-wheat flour rather than the "patents" grade of the millers.

"Vermilion" Wheat and Flour.—At the request of the Dominion Cerealist this Division undertook the examination of a number of wheats and their flours to gain some information, from the chemical standpoint, on the comparative value of a new variety of wheat known as Vermilion, which was creating considerable interest among farmers in the Prairie Provinces, and especially in Alberta.

This series consists of eight samples of wheat grown at four points in Alberta and their respective flours. The varieties include Vermilion (four samples), Marquis (three samples), and Red Fife (one sample), and for the purpose of this inquiry each of the four points or localities is represented by a sample of Vermilion and one of Marquis or Red Fife. The series therefore falls into four groups of two samples each, thus allowing a strict comparison between Vermilion and the other varieties, grown under the same environmental conditions.

WHEAT

The examination of the wheats has afforded the data recorded in the following table (26):—

Table 26.—Wheats: Vermilion, Marquis and Red Fife, Crop of 1926

Lab'y No.	Milling No.	Variety	Grower	Locality	Weight of 1,000 kernels	Moisture	On water-free basis		
							Nitrogen	Protein (Nx 5·7)	Ash
					gms.	p.c.	p.c.	p.c.	p.c.
88182	1669	Vermilion	J. Nairn	Minburn, Alta.	30·80	8·93	2·55	14·52	1·30
88183	70	Red Fife	"	"	32·31	10·38	2·61	14·94	1·69
88184	71	Vermilion	M. Benson	Sibbald, Alta.	25·37	10·01	3·20	18·24	1·44
88185	72	Marquis	"	"	28·81	9·62	2·88	16·48	1·40
88186	73	Vermilion	Al. Allance	Manville, Alta.	35·47	10·52	2·31	13·19	1·40
88187	74	Marquis	"	"	28·74	9·85	2·44	13·94	1·63
88188	75	Vermilion	W. Salmandich	Vegreville, Alta.	28·00	10·07	2·60	14·90	1·48
88189	76	Marquis	.....	"	30·11	9·30	2·88	16·39	1·28

Weight of Kernel.—In three of the pairs the weight of the Vermilion kernel is less than that of its companion variety (Marquis or Red Fife). This might indicate a higher percentage of bran, or stated otherwise, a lower percentage of straight flour, from Vermilion than from Marquis or Red Fife.

Protein.—These results are strictly comparable, being calculated to a water-free basis.

Except in the case of the samples from Sibbald, the percentage of protein in Vermilion was found to be less than that in the other member of the pair. In some degree perhaps the higher percentage in the Vermilion sample from Sibbald may be accounted for by the somewhat poorly developed character of the grain, indicating a condition just short of full maturity.*

Apart from the question of the relative qualities of the wheats under consideration, this series offers several excellent examples of the influence of environmental conditions (locality) on the protein content of the berry. The two wheats from Minburn fall between 14 and 15 per cent the two from Sibbald—the highest in the series—between 16 and 18 per cent, the two from Mannville—the lowest in the series—between 13 and 14 per cent and the two from Vegreville, between 14 and 16 per cent. Thus it appears that this series furnishes further evidence to support the finding from previous investigatory work that the protein content of wheat may be markedly affected by evironmental factors—precipitation—temperature, soils, etc., etc.

FLOURS

Flours milled by the Cereal Division from the foregoing wheats were submitted to analysis and the data in the following table (27) obtained.

* Previous work in these laboratories has shown that immature wheat has a higher protein content than the same wheat at full maturity.

TABLE 27—FLOURS: VERMILION, MARQUIS, AND RED FIFE CROP OF 1926

Lab'y No.	Milling No.	Variety	Grower	Locality	Moisture	On Water-free Basis			Gluten			Quality
						Nitrogen	Protein (Nx5·7)	Ash	Wet	Dry	Ratio W/D	
					p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	
88229	1669	Vermilion	J. Nairn	Minburn, Alta	9·64	2·32	13·22	0·42	36·13	11·83	3·05	Inclined to be firm.
88230	1670	Red Fife	"	"	9·43	2·42	13·77	0·52	36·89	12·44	2·96	Firm and resilient.
88231	1671	Vermilion	M. Benson	Sibbald, Alta	9·36	2·95	16·72	0·47	43·49	14·93	2·91	Soft and weak.
88232	1672	Marquis	"	"	9·29	2·72	15·54	0·48	41·86	14·35	2·91	Moderately firm.
88233	1673	Vermilion	A. Allance	Manville, Alta	9·30	2·16	12·30	0·48	37·40	11·74	3·18	Very soft and weak.
88234	1674	Marquis	"	"	9·15	2·25	12·88	0·56	36·83	12·92	2·85	Firm and resilient.
88235	1675	Vermilion	W. Salmandich	Vegreville, Alta	11·55	2·38	13·54	0·46	35·75	11·89	3·00	Soft and weak.
88236	1676	Marquis	"	"	12·30	2·73	14·34	0·40	36·52	12·58	2·90	Moderately firm.

Moisture.—All the four samples, with the exception of those from the wheats from Vegreville, are within half a per cent of one another—and might be considered as rather dry.

The samples from Vermilion and Marquis grown at Vegreville show a somewhat higher moisture content—but quite within the limits recognized as safe for commercial flours.

Protein.—As in the case of the corresponding wheats, the protein content of the Vermilion flours is lower than that of the Marquis or Red Fife from the same farm, excepting in the samples from Sibbald.

Speaking generally, however, the differences between Vermilion and Marquis in protein content are not such as to justify any statement respecting marked superiority of the Marquis—based purely on the percentage of protein.

As might be expected the flours follow the wheats in showing the influence of environment on the protein content.

Maximum, minimum and average data for the protein content of the series may be given as follows:—

—	Vermilion protein	Marquis protein	Red Fife protein
	p.c.	p.c.	p.c.
Maximum	16·72	15·54	.....
Minimum	12·30	12·88	.....
Average	13·94	14·25	13·77
Number of samples	4	3	1

Wet and Dry Gluten.—As between Vermilion and Marquis and Vermilion and Red Fife from the same locality, differences in the *percentage* of gluten, both wet and dry, are not significant. It is evident therefore in this inquiry that these data cannot be regarded as a discriminating factor.

The results, however, as to *quality* of gluten are pronouncedly unfavourable to Vermilion; in every instance the gluten of this variety was found inferior to that of Marquis or Red Fife—The gluten of Vermilion may be stated as soft, sticky, weak and non-resilient, while that of the Marquis and Red Fife was firm and resilient.

Marquis and Garnet Flours.—The flours reported in this chapter were milled by the Cereal Division from Marquis and Garnet wheats of common stock—grown at eleven widely distant points in Manitoba, Saskatchewan, and Alberta. The data permit a comparison of the two flours in respect to protein, ash and diastatic value. This inquiry was undertaken at the instance of the Dominion Cerealist, who wished to obtain chemical data which might assist in the valuation of the two flours and which might also serve to contribute to our knowledge of the influence of environment on the protein content of wheat. The data are presented in table 28.

TABLE 28—FLOURS: CO-OPERATOR'S SAMPLES, CROP 1925, CEREAL DIVISION, C.E.F., OTTAWA

Lab'y No.	Milling No.	Variety	Locality of Growth	Moisture	Water-free Basis			pH	Diastatic value
					Nitrogen	Protein (Nx5·7)	Ash		
				p.c.	p.c.	p.c.	p.c.		
86566	1591	Garnet, 0·652	Dropmore, N.W. Manitoba, Tp. 23, R. 29	13·27	2·08	11·89	0·78	6·30	118·8
67	1592	Marquis, 0·15	" " " "	11·67	2·39	13·61	0·80	6·33	122·0
68	1593	Garnet, 0·652	Teulon, N.E. Manitoba, Tp. 16, R. 2	12·80	1·55	8·83	0·60	6·40	230·0
69	1594	Marquis, 0·15	" " " "	11·73	1·62	9·23	0·67	6·37	109·2
70	1595	Garnet, 0·652	Macdonald, Central Manitoba, Tp. 12, R. 8	12·28	2·50	14·22	0·66	6·35	130·0
71	1596	Marquis, 0·15	" " " "	11·86	2·48	14·17	0·64	6·27	74·4
72	1597	Garnet, 0·652	Miami, North Manitoba, Tp. 5, R. 6	12·76	1·75	10·00	0·72	6·37	163·2
73	1598	Marquis, 0·15	" " " "	12·67	1·72	9·86	0·73	6·40	115·6
74	1599	Garnet, 0·652	Lashburn, N.W. Sask., Tp. 48, R. 25	11·90	2·62	14·95	0·65	6·34	133·6
75	1600	Marquis, 0·15	" " " "	11·03	2·77	15·82	0·69	6·30	93·2
76	1601	Garnet, 0·652	Valparaiso, N.E. Sask., Tp. 45, R. 16	12·01	2·22	12·63	0·64	6·30	144·4
77	1602	Marquis, 0·15	" " " "	11·94	2·43	13·86	0·66	6·37	82·8
78	1603	Garnet, 0·652	Glamis, Central Sask., Tp. 28, R. 13	11·84	2·68	15·25	0·65	6·28	160·0
79	1604	Marquis, 0·15	" " " "	12·24	2·69	15·32	0·63	6·11	94·8
80	1605	Garnet, 0·652	Clyde, N.W. Alberta, Tp. 59, R. 25	11·93	2·56	14·44	0·70	6·21	156·8
81	1606	Marquis, 0·15	" " " "	12·46	2·34	13·36	0·77	6·40	94·4
82	1607	Garnet, 0·652	Linfield, N.W. Alberta, Tp. 59, R. 5	11·11	2·62	14·94	0·78	6·19	320·8
83	1608	Marquis, 0·15	" " " "	11·47	2·71	15·45	0·81	6·19	126·0
84	1609	Garnet, 0·652	Manville, N.E. Alberta, Tp. 50, R. 9	12·10	2·96	16·86	0·57	6·20	202·8
85	1610	Marquis, 0·15	" " " "	11·69	3·20	18·28	0·60	6·29	54·0
86	1611	Marquis, 0·15	Gravelbourg, S. Saskatchewan	13·02	2·59	14·73	0·63	6·15	79·2
87	.....	Garnet Crop 1925	Scott, not bleached	12·46	2·63	14·97	0·56	6·03	210·8
88	.....	" Crop 1925	" bleached	12·09	2·62	14·95	0·59	5·96	286·8
89	.....	Marquis Crop 1925	Scott, not bleached	11·69	2·62	14·95	0·60	6·10	191·6
90	.....	" Crop 1925	" bleached	11·86	2·56	14·62	0·59	6·09	199·6
91	.....	.....	Monarch, Ontario Winter wheat	13·75	1·77	10·11	0·52	6·10	133·2

A review of these data shows that in the majority of cases the Marquis flour is slightly superior to that of Garnet in point of protein content. The maximum, minimum and average data for the two flours from wheats grown at eleven points in the three provinces are as follows:—

PROTEIN CONTENT OF MARQUIS AND GARNET FLOURS (Nx 5·7)

—	Marquis	Garnet
	p.c.	p.c.
Maximum	18·28	16·86
Minimum	9·23	8·83
Average	14·05	13·66

Since but one stock of Marquis seed was used in this inquiry and similarly one stock for Garnet, the great difference between maximum and minimum data for both wheats can only be explained by the influence of environment—soil, season, etc. In support of this contention it is significant to note that the maximum protein content of both Marquis and Garnet was from wheat grown at Manville, N.E. Alberta and that similarly the lowest for these two varieties was from wheat produced at Teulon, N.E. Manitoba.

The hydrogen ion (pH) data (which give a measure of active acidity) show but slight differences between the two flours; in respect to this quality or property both flours closely approximate the normal.

The diastatic value may be considered as a measure of enzymatic action—the maltose producing power—of the flour. In the larger number of instances Garnet Flour has the higher value. This may result in a crust of more pleasing appearance and there is some evidence that it otherwise favourably affects bread-making value.

FLAX SEED

The work recorded in this chapter is a continuation of the inquiry first undertaken in 1922, which had for its object the determination of the oil and protein content of Canadian-grown flaxseed. The series here reported comprised four varieties—Argentine, Novelty, Crown, and Linota, the samples including seed grown on the Experimental Farm, Brandon, Man., 1926. The purpose of this experiment was to note the influence, if any, on oil, and protein content, of conditions prevailing at Brandon. The seed was from parent stocks, grown in 1925, at a number of points. The particulars are as follows:—

Lab'y. No.	Variety	Locality of growth	Year of growth	History of seed
84596	Argentine	Deloraine, Man.	1925	North Dakota and Saskatchewan.
86836	"	Brandon, Man.	1926	
84597	Novelty	C.E.F., Ottawa	1925	Experimental Farm, Ottawa.
86837	"	Brandon, Man.	1926	
84598	Crown	Saskatoon, Sask.	1925	University of Saskatchewan.
86838	"	Brandon, Man.	1926	
84594	Linota	Minnesota	1925	University of Minnesota.
86839	"	Brandon, Man.	1926	

The analytical data of the series (eight samples) are presented in table 29.

Considering the original stock or parent seed (1925) the variety Crown is the richest in oil, with Linota the last in the series. The range in oil is from 35·39 to 38·83 per cent; in protein, 23·76 to 27·13 per cent. As a rule, the oil content is in inverse ratio to the protein; varieties with a high percentage of oil are generally low in protein and vice versa. In weight of seed Argentine ranks first and Linota last.

A study of the data of the Brandon grown (1926) seed and a comparison of the results generally with those of the parent seed, shows that in respect to oil content "Crown" stands first, closely followed by "Novelty," in both years. Similarly, Linota is the lowest. In protein content the varieties in 1926 do not show differences quite as large as in 1925—the several members of the series with the exception of Crown are practically equal in this respect. In weight of seed, as in the 1925 samples, Argentine furnished the heaviest and Linota the lightest seed.

TABLE No. 29.—FLAX SEED FROM BRANDON—ORIGINAL SEED AND CROP OF 1926

—	Argentine		Novelty		Crown		Linota	
	Parent seed	Crop of 1926 (Brandon)	Parent seed	Crop of 1926 (Brandon)	Parent seed	Crop of 1926 (Brandon)	Parent seed	Crop of 1926 (Brandon
Lab'y. No.	84596	86836	84597	86837	84598	86838	84599	86839
Moisture	6·29	6·57	6·17	5·77	6·16	6·16	7·06	6·09
Protein	27·13	25·86	24·25	26·04	23·76	24·54	25·01	25·44
Fat	37·47	36·91	37·18	38·33	38·82	38·37	35·39	33·64
Carbohydrates	17·46	20·80	20·32	20·47	21·26	21·16	22·91	23·81
Fibre	7·87	6·54	7·90	6·20	6·35	6·43	5·96	7·26
Ash	3·78	3·32	4·18	3·19	3·65	3·34	3·67	3·76
	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
Weight of 1,000 seeds, in grams	6·92	6·64	6·06	5·18	5·59	5·42	4·09	3·98

SILAGE: ALFALFA; SWEET CLOVER; OAT, PEA AND VETCH; AND CORN

This investigation was planned and carried out by the Division of Field Husbandry with the assistance of the Division of Chemistry. Its chief object was to determine the effect on the composition of the silage of certain factors—stage of growth, moisture content of material as ensiled, length of ensiling period and type of silo, e.g. glass jars as compared with small stave silos for experimental ensiling. This division has contributed to this inquiry by the analysis of the various ensiled materials—alfalfa, sweet clover, oats, peas and vetch, and corn.

ALFALFA SILAGE

This series comprised twenty samples, the details of which are as follows:—

(1) Ten samples all cut at the 1/10 bloom stage and immediately ensiled and differing from each other in the type of silo used and in the period of ensiling.

(2) Six samples, cut at the 1/10 bloom stage, three of which were wilted for five hours before ensiling and three wilted two days with water added at the time of ensiling. In each case the three types of silo were used and all were examined at the end of six months.

(3) Four samples, cut at the full bloom stage; three were immediately ensiled, using the three types of silo, and one was wilted for 5 hours and preserved in the stave silo. All were examined at the end of the six months' period.

Two samples, one from the first group and one from the third, were discarded on account of severe moulding and not analysed. Both had been ensiled in glass, one in a screw top the other in a "Perfect Seal" jar—the latter it was found had a badly adjusted cover.

The analytical data for this series (on silage, as received and on the water-free basis), together with the more essential particulars of ensiling and of character or condition of the resultant silage are presented in table 30.

TABLE 30.—ALFALFA SILAGE—

Lab'y No.	Ident. No.	Date of Receipt	Stage of Growth	Wilted or Watered	Ensiling Period	Type or Silo
75203	656	15-10-24	1-10 bloom.....	Not wilted.....	3 months storage...	Stave silo.....
75204	657	15-10-24	"	"	" ...	Screw top jar.....
75205	658	15-10-24	"	"	" ...	Perfect seal jar.
77413	668	14- 1-25	"	"	6 months storage...	Stave silo, 1 foot from top..
77414	669	14- 1-25	"	"	" ...	Screw top jar.
77415	670	14- 1-25	"	"	" ...	Perfect seal jar.....
77416	671	14- 1-25	"	Wilted 5 hours.....	" ...	Stave silo , 1 foot from top..
77417	672	14- 1-25	"	"	" ...	Screw top jar.....
77418	673	14- 1-25	"	"	" ...	Perfect seal jar.....
77532	674	20- 1-25	"	Wilted 2 days, water added.	" ...	Stave silo, 1 foot from top..
77744	675	27- 1-25	"	" "	" ...	Screw top jar.....
77435	676	27- 1-25	"	" "	" ...	Perfect seal jar.....
77803	680	2- 2-25	Full bloom.....	Not wilted.....	6 months storage...	Stave silo, 1 foot from top..
77805	682	2- 2-25	"	"	" ...	Perfect seal jar.....
77867	683	10- 2-25	"	Wilted 5 hours.....	" ...	Stave silo, 2 feet from bottom
78572	703	10- 3-25	1-10 bloom..... 2nd cutting.	Not wilted.....	" ...	Stave silo, 2 feet from top..
78574	705	10- 3-25	1-10 bloom.....	"	.....	Screw top jar.....
79461	716	2- 5-25	"	"	9 months storage...	Stave silo; from bottom....

No. 77804, Ident. No. 681.—Sample rejected as unfit for analysis (Screw top jar).
No. 78573, Ident. No. 704.—Sample rejected as unfit for analysis (Perfect seal jar).

As Received							Water-free					Particulars
Moisture	Protein	Fat	Carbohydrates	Fibre	Ash	Acidity	Protein	Fat	Carbohydrates	Fibre	Ash	
p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	
83·12	2·08	0·85	4·93	7·24	1·78	1·37	12·32	5·06	29·20	42·87	10·55	Brown, no mould, rather dry at top of jar, signs of breakdown at bottom of jar but not acrid.
82·95	2·62	0·81	6·30	5·42	1·90	1·70	15·37	4·77	37·00	31·77	11·09	Greenish brown, closely packed; moist; no breakdown; but top badly moulded; sour odour.
85·81	2·39	0·56	4·73	4·92	1·59	1·26	16·87	3·97	33·38	34·69	11·09	Greenish brown; closely packed, moist, no breakdown, smell resembling that of olives.
81·87	2·23	1·21	4·39	8·38	1·92	1·17	12·32	6·65	24·22	46·22	10·59	Dark greenish brown; moist; signs of breakdown; acrid odour; top half moulded; large proportion of stem.
80·35	3·29	1·43	6·92	6·00	2·01	1·37	16·78	7·28	35·22	30·52	10·20	Dark greenish brown, moist, odour very pungent and sour; no mould nor breakdown; some timothy noticed in the silage.
82·83	3·15	1·52	5·15	5·65	1·70	1·28	18·36	8·83	29·99	32·93	9·90	Dark green, very moist, large proportion of flower heads, very pungent odour; silage appears sound.
72·52	4·66	1·82	8·23	9·75	3·02	0·64	16·95	6·62	29·96	35·49	10·99	Very light coloured; greenish yellow silage; rather dry; no mould nor breakdown; almost odourless.
76·38	4·65	1·64	7·28	7·05	3·00	0·32	19·69	6·92	30·82	29·85	12·70	Top half of contents of jar was discarded owing to mould; bottom half was kept but it was not in good condition; also moulded; greenish brown; odour masked by that of mould.
72·94	5·18	2·40	7·86	8·40	3·22	1·96	19·14	8·85	29·07	31·06	11·88	Light green, finely cut, sound and wholesome, odour slightly pungent.
69·99	5·47	1·09	8·87	11·45	3·13	1·51	18·22	3·64	29·55	38·18	10·41	Greenish brown, finely cut, sour odour; sound and wholesome.
69·04	5·89	2·08	8·58	10·93	3·48	1·30	19·02	6·73	27·70	35·32	11·24	Pale yellowish or olive green; faint aromatic and pleasant odour; quite finely cut.
71·68	6·88	1·82	8·11	9·37	3·14	1·58	20·74	6·43	28·65	33·09	11·09	
81·35	2·80	0·91	4·59	8·47	1·88	1·07	15·08	4·86	24·60	45·40	10·06	Dark olive green; strong, very sour pungent odour; cut to medium fineness with a large proportion of stem present.
76·90	4·33	2·09	5·94	8·00	2·74	1·32	18·74	9·03	25·78	34·61	11·84	Dark olive green, strong sour pungent odour; coarsely cut; large proportion of stem.
66·29	6·55	2·62	10·57	10·74	3·23	1·19	19·66	7·89	30·53	32·22	9·70	Olive green; finely cut; faint aromatic odour; larger proportion of leaf than usual.
82·68	2·97	0·66	5·22	6·19	2·28	0·75	17·17	3·84	30·08	35·74	13·17	Dark olive green or brownish green; strong disagreeable odour with marked odour of butyric acid; cut to medium fineness; leaves and softer parts of silage very slimy.
81·36	3·64	1·07	5·15	6·66	2·12	1·17	19·55	5·76	27·57	35·76	11·36	Pale olive green; no odour of butyric acid; sweet and in good condition; cut to medium fineness; large proportions of stem; some liquid separate from the mass.
77·53	2·30	1·86	6·05	10·02	2·24	1·22	10·25	8·27	26·89	44·63	9·96	Dark olive green; cut to medium fineness; large proportion of stem; strong sour and rather disagreeable odour with some odour of butyric acid noticeable.

Commenting on group (1) in which the crop was cut at 1/10 bloom stage and immediately ensiled, silage of the same age, i.e., of the same ensiling period, from the stave silo possessed the lowest protein content, calculated to the water-free basis. Of the two forms of glass jar silos there is some evidence that the "Perfect Seal" glass jar produced a silage with a slightly higher percentage of protein.

As between the two ensiling periods, three and six months, the silage from the stave silo remains practically unaltered in respect to its protein content. In the case of the glass jar silos, the protein content (dry matter basis) of the six months' material was higher than the corresponding sample of three months.

Group (2) permits the comparison of silage from wilted material with that of wilted and watered, the only other varying factor being the type of silo. The average percentage of protein in the silage from unwilted material recorded on the water-free basis, was 18·59, while that of the silage from material wilted two days and watered as ensiled, was 19·33. It is interesting to note that the water content of the latter silage was lower than that from the wilted but not watered material; there appears to be a more or less direct relation between the protein data of the silage and the moisture content of the material as placed in the silo.

As before, the lowest percentage of protein (dry matter basis) was found in the silage from the stave silo.

In groups (1) and (2) the stage of growth, type of silo and ensiling period were the constant factors and consequently the data permit a study of the effect of wilting on the composition of the resultant silage. In every instance the silage from the wilted material possessed a higher protein content than the silage from the corresponding unwilted material. The average for the wilted material is 18·96 per cent, that for the unwilted 15·33 per cent.

The data of group (3) permits the comparison of the silage from unwilted material cut at full bloom stage, as preserved in two types of silo—stave and Perfect Seal. The sample in the screw top jar was badly moulded and therefore rejected as unfit for analysis.

As in group (1) the silage from the stave silo possessed a lower protein content than that from the Perfect seal glass jar.

Comparing the silage from the wilted and unwilted material, cut at full bloom stage and preserved in stave silos, there is a difference of 4·5 per cent in protein content (water-free basis) in favour of the silage from the wilted crop. This, again, is in accord with the findings from groups (1) and (2).

Group (3), in conjunction with groups (1) and (2) furnishes data for a comparison between silages from full bloom and 1/10 bloom material, wilted and unwilted, as preserved in a stave silo. The figures are as follows (table 31):—

TABLE 31—ALFALFA SILAGE

Stage of growth	Wilted or or unwilted	Type of silo	Period of ensiling	Protein (Water-free basis)
				p.c.
Full bloom	Wilted 5 hours	Stave	6 months	19·66
One tenth (1-10) bloom	"	"	"	16·95
Full bloom	Unwilted	"	"	15·08
One-tenth (1-10) bloom	"	"	"	12·32

Fair deductions from these data appear to be that wilted material gives a silage with a higher protein content than unwilted and that the crop cut at full bloom stage yields a silage richer in protein than that ensiled when at the 1/10 bloom stage.

Reviewing the notes on the condition of the silage samples as collected for analysis, the outstanding features may be enumerated as follows:—

1. Of the experimental silos used, the glass jar known as Perfect Seal gave the best preserved silage, i.e. silage showing least "break-down" and mould.

2. The larger proportion of samples showing mould or signs of "break-down" from unwilted material.

3. There are indications that alfalfa cut at full bloom stage will more frequently yield a better preserved silage than that from 1/10 bloom crop.

SWEET CLOVER SILAGE

This series comprised eighteen samples, as follows:—

(1) Nine samples all cut at the "bud" stage and immediately ensiled and differing from each other in the type of silo used and in the period of ensiling.

(2) Three samples cut at the bud stage—wilted 5 hours and ensiled in the three types of silo; all examined at the end of six months.

(3) Six samples cut at the full bloom stage, three ensiled immediately and three wilted 5 hours. Three types of silos were used and all were examined at the end of six months.

The data are presented in table 32.

TABLE 32—SWEET CLOVER SILAGE,

Lab'y No.	Ident. No.	Date of Rsceipt	Stage of Growth	Wilted or Watered	Ensiling Period	Type of Silo
75053	651	4-10-24	Bud stage.....	Not wilted.....	3 months.....	Stave silo.....
75054	652	4-10-24	"	"	3 "	Screw top jar.....
75055	653	4-10-24	"	"	3 "	Perfect seal jar.....
77201	662	29-12-24	"	"	6 "	Stave silo.....
77202	663	29-12-24	"	"	6 "	Screw top jar.....
77203	664	29-12-24	"	"	6 "	Perfect seal jar.....
77216	665	5- 1-25	"	Wilted 5 hrs.....	6 "	Stave silo.....
77217	666	5- 1-25	"	"	6 "	Screw top jar.....
77218	667	5- 1-25	"	"	6 "	Perfect seal jar.....
77746	677	27- 1-25	Full bloom.....	Not wilted.....	6 "	Stave silo.....
77747	678	27- 1-25	"	"	6 "	Screw top jar.....
77748	679	27- 1-25	"	"	6 "	Perfect seal jar.....
78241	686	14- 2-25	"	Wilted 5 hrs.....	6 "	Stave silo.....
78242	687	14- 2-25	"	"	6 "	Screw top jar.....
78243	688	14- 2-25	"	"	6 "	Perfect seal jar.....
78771	710	28- 3-25	Bud stage.....	Not wilted.....	9 "	Stave silo.....
78772	711	28- 3-25	"	"	9 "	Perfect seal jar.....
78773	712	28- 3-25	"	"	9 "	Screw top jar.....

In this series the outstanding feature is that the dry matter of the silage from the crop cut at the "bud" stage is richer in protein than that of the crop ensiled at a later stage. Thus the average protein content of twelve silages from crop cut at the bud stage was on the water-free basis 21·40 per cent, while that of six from full bloom crop was 19·00 per cent, the range for the former being 24·14 to 20·12 per cent and for the latter 20·57 to 17·67 per cent.

From the standpoint of protein content, as calculated on the water-free basis, the data of this series do not give any indication of marked influence on the composition of the silage of any of the other factors—type of silo, ensiling period and wilting.

From the notes made on the samples as received at the laboratory the larger proportion of silage of good, satisfactory quality was from crops cut at the full bloom stage. Further, from the notes it would appear that the Perfect seal jar proved the most satisfactory of the experimental silos used. Silages from these jars were all free from mould and in excellent condition.

As Received						Water-free						Particulars
Moisture	Protein	Fat	Carbohydrates	Fibre	Ash	Acidity	Protein	Fat	Carbohydrates	Fibre	Ash	
p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	
77·41	4·71	1·11	8·56	6·12	2·09	2·00	20·86	4·89	37·89	27·11	9·25	Dark brown, finely cut, free from mould, characteristic odour of sweet clover.
76·21	4·84	1·93	8·32	6·19	2·51	0·85	20·34	8·12	34·93	26·04	10·57	Badly moulded half way down jar; strong odour of coumarin.
75·00	5·18	1·97	8·48	6·73	2·64	1·40	20·75	7·87	33·85	26·95	10·58	Light greenish brown; no break down nor mould; sour odour.
76·96	4·64	1·18	8·70	6·08	2·44	2·00	20·12	5·13	37·76	26·37	10·61	Dark brown, no appearance of breakdown; large proportion of leaf; slightly sour odour.
77·98	4·95	1·89	7·69	5·06	2·43	2·16	22·49	8·57	34·91	22·97	11·61	Half of sample badly moulded; bottom half dark brown; very moist; stems soft and showing signs of breakdown; large proportion of leaf; odour of mould and decay.
74·83	5·14	2·80	8·50	6·23	2·50	1·68	20·43	11·11	33·75	24·77	9·94	Dark greenish brown; free from mould; dry, no sign of breakdown, slightly acrid odour.
68·73	6·58	1·37	8·47	11·94	2·91	0·97	21·05	4·37	27·07	38·18	9·33	Brown, woody, distinct odour of sweet clover, sound.
64·09	8·67	3·97	13·16	6·79	3·32	1·37	24·14	11·06	36·64	18·90	9·26	Dark greenish brown, large preponderance of leaf, wholesome in appearance and colour.
68·25	7·04	2·85	11·46	7·62	2·78	1·29	22·16	8·97	36·08	24·02	8·77	Greenish yellow; large proportion of stems, sound and wholesome; sour odour.
78·56	3·79	0·83	6·22	8·32	2·28	neutral	17·67	3·85	29·03	38·80	10·65	Dark greenish brown, very soft, disagreeable odour, though no odour of butyric acid, finely cut; leaf and stem in equal proportions.
75·52	4·81	2·16	7·75	7·68	2·08	1·85	19·66	8·80	31·70	31·35	8·49	Dark olive green; pungent aromatic but not unpleasant odour; quite finely cut with some large piecse of stem.
74·95	5·16	2·87	7·19	7·61	2·22	1·74	20·57	11·44	28·80	30·33	8·86	Pale olive green; sweet and not unpleasant odour, pungent; moderately finely cut some large pieces of stem.
75·57	4·49	1·79	8·16	7·93	2·06	1·35	18·39	7·34	33·39	32·47	8·41	Pale olive green; pungent aromatic but not very strong odour; large proportion of stem; modsrately finely cut.
76·68	4·39	2·37	6·00	8·42	2·14	1·36	18·81	10·14	25·78	36·11	9·16	Pale olive green; large proportion of stem; cut to medium fineness; aromatic pungent odour.
74·67	4·79	2·70	7·85	8·13	1·86	1·40	18·92	10·65	31·10	32·09	7·34	Pale yellowish green; large proportion of coarsely cut stem; leaves and soft part of plant more finely cut than stem; faint sweetish odour.
75·84	5·12	1·54	9·15	5·91	2·44	1·22	21·17	6·36	27·87	24·48	10·12	
76·39	4·89	1·50	7·81	6·50	2·91	neutral	20·70	6·36	33·06	27·56	12·32	
74·97	5·52	2·77	7·93	6·13	2·68	1·19	22·04	11·08	31·70	24·49	10·69	

OATS, PEAS AND VETCH SILAGE

The crops used for these silages were from a mixture composed of 2 bushels Banner oats, ¾ bushel Arthur peas and ¼ bushel common vetch. The stage of maturity recorded for this series is that of the oat crop.

This series may be considered under the following groupings.

(1) Six samples from crop cut at "milk" stage, three ensiled immediately and three wilted 5 hours. Three types of silo were used and all were examined at the end of six months.

(2) Eight samples from crop cut at "dough" stage, immediately ensiled; samples examined at 3, 6 and 9 month periods. Three types of silo were used.

(3) Two samples from crop cut at "dough" stage, wilted 5 hours, examined at 6 months period; one sample from stave silo, the other from screw top jar.

The data are presented in table 33.

TABLE 33.—OATS, PEAS AND VETCH SILAGE,

Lab'y. No.	Ident. No.	Date of receipt	Stage of growth	Wilted or watered	Ensiling period	Type of silo
75632	661	30-10-24	Oats in dough stage.	Not wilted.....	3 months.....	Stave silo.....
75630	659	30-10-24	" "	"	3 "	Screw top jar.....
75631	660	30-10-24	" "	"	3 "	Perfect seal jar.....
78289	692	20- 2-25	Oats in milk stage.	"	6 "	Stave silo.....
78290	693	20- 2-25	" "	"	6 "	Screw top jar.....
78291	694	20- 2-25	" "	"	6 "	Perfect seal jar.....
78292	695	20- 2-25	" ".	Wilted 5 hrs.....	6 "	Stave silo.....
78293	696	20- 2-25	" "	"	6 "	Screw top jar.....
78294	697	20- 2-25	" "	"	6 "	Perfect seal jar.....
78552	699	7- 3-25	Oats in dough stage.	Not wilted.....	6 "	Stave silo.....
78533	700	7- 3-25	" "	"	6 "	Perfect seal jar.....
78554	701	7- 3-25	" "	Wilted 5 hrs—.....	6 "	Stave silo.....
78555	702	7- 3-25	" "	"	6 "	Screw top jar.....
78853	714	9- 4-25	" "	Not wilted.....	9 "	Stave silo.....
78854	715	9- 4-25	" "	Not wilted.....	9 "	Screw top jar.....
78855	716	9- 4-25	" "	"	9 "	Perfect seal jar.....

The data of group (1) do not disclose any marked differences in composition between silages from wilted and unwilted crops.

Comparing the data of groups (1) and (2) there is apparently but little difference between the silage from the "milk" stage crop and that from the crop cut later, viz. "dough" stage.

Group (2) does not reveal any differences of note between silages of 3, 6 and 9 months periods nor between the silages from the several types of silo under experiment.

No significant differences in composition are to be observed between the samples of group (3), nor between the members of groups (1) and (3) i.e. between silage from wilted crop of "milk" stage and similar crop but cut at "dough" stage.

C.E.F., Ottawa, Crop of 1924

As received							Water-free					—
Moisture	Protein	Fat	Carbohydrates	Fibre	Ash	Acidity	Protein	Fat	Carbohydrates	Fibre	Ash	
p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	
75·74	3·27	2·26	9·40	7·29	2·04	1·12	13·51	9·34	38·67	30·06	8·42	Brown, rather dry, finely cut, moulded but not broken down; odour mouldy.
73·94	3·09	2·04	11·15	7·73	2·06	1·62	11·85	7·82	42·80	29·64	7·90	Greenish, finely cut, badly moulded but no breakdown.
72·52	3·20	2·05	11·78	8·30	2·45	1·27	11·67	6·83	43·52	30·11	7·87	Greenish, dry, finely cut, odour pungent, no mould.
73·74	3·34	1·67	11·27	8·47	1·82	1·41	12·57	6·30	42·41	31·88	6·84	Olive green, stems rather coarsely cut, characteristic sour odour of butyric acid.
74·02	3·18	1·32	12·15	7·39	1·94	.....	12·24	5·07	46·80	28·44	7·45	Yellowish green, lighter in colour than usual and stronger odour; but no odour of butyric acid noticeable; finely cut.
74·48	3·28	1·98	10·30	8·07	1·89	2·04	12·84	7·76	40·40	31·61	7·39	Yellow green, sour aromatic but not strong or unpleasant odour.
69·90	3·95	1·22	13·26	9·34	2·33	1·42	13·12	4·04	44·80	31·01	7·75	Dark olive green; characteristic odour but no odour of butyric acid; sweet and in good condition; moderately finely cut.
71·35	3·50	1·69	12·14	9·11	2·21	2·28	12·25	5·91	42·37	31·80	7·71	Olive green; silage at top of jar was badly moulded; sour disagreeable smell but no odour of butyric acid; cut to medium size.
70·42	3·61	2·05	12·42	9·29	2·21	1·87	12·19	6·93	42·01	31·42	7·45	Yellow green; sour aromatic odour; sweet and in good condition; cut to medium fineness.
72·54	3·46	2·19	11·22	8·66	1·93	1·82	12·60	7·96	40·84	31·56	7·04	Olive green; pungent; aromatic, rather strong odour; no trace of mould; rather coarsely cut with some large uncut pieces of stem.
73·36	3·07	2·83	10·90	8·20	1·64	1·98	11·53	10·62	40·94	30·76	6·15	Pale olive green; slight but sour odour; cut to medium fineness with some large uncut pieces of stem throughout.
66·81	4·09	1·73	15·98	8·90	2·49	2·21	12·32	5·22	48·15	26·80	7·51	Olive green, faint odour, sweet and in good condition; cut to medium fineness.
67·02	3·89	1·50	16·33	8·71	2·56	1·77	11·80	4·53	49·52	26·40	7·75	Top of material badly moulded; the remainder pale olive green had a slightly disagreeable odour; medium fineness although some large pieces of stem had been cut.
72·91	3·22	2·82	11·85	7·63	1·57	1·49	11·89	10·40	43·74	28·17	5·80	Pale olive green; sweet and wholesome; rather coarsely cut and large proportion of stem; silage seemed very dry.
75·00	3·08	2·16	9·94	7·95	1·87	1·63	12·33	8·62	39·75	31·81	7·49	Yellowish green; odour characteristic of silage in good condition; rather finely cut; large proportion of leaf.
76·05	2·88	2·98	9·21	7·04	1·84	1·07	12·03	12·43	38·46	29·41	7·66	Pale yellowish green; characteristic but wholesome odour; cut to medium fineness; large proportion of leaf.

A close scrutiny of the data for this series, on the water-free basis reveals very little of significance from the standpoint of comparison; as a whole the series is remarkably uniform in composition. It may, however, be noted that the silages from the crop cut at the "dough" stage show a slightly lower protein content, with no concomitant rise in fibre, than those from the crop ensiled at the "milk" stage.

CORN SILAGE

In this series of six samples type of silo was the only varying factor. The variety employed was Wisconsin No. 7, which was ensiled at the "milk" stage; examination was made between the fifth and sixth month of ensiling. The data are tabulated in table 34.

TABLE 34.—CORN SILAGE—

Laby. No.	Ident. No.	Date of Receipt	Stage of Growth	Ensiling Period	Type of Silo	As		
						Moisture	Protein	Fat
						p.c.	p.c.	p.c.
78286	689	20-2-25	Milk.....	5 months...	Screw top jar.....	79·50	1·70	1·28
78287	690	20-2-25	"	5 " ...	Perfect seal jar.....	81·03	1·72	1·06
78768	707	28-3-25	"	6 " ...	Stave—top.....	79·09	1·62	1·35
78769	708	28-3-25	"	6 " ...	" —centre.....	80·30	1·64	1·56
78770	709	28-3-25	"	6 " ...	" —bottom.....	79·20	1·73	2·46
78774	706	28-3-25	"	6 " ...	Large cement silo.....	78·75	1·66	0·95

It may first be noted that all the samples show a very high percentage of water for corn silage. The data for the series are as follows:—

	Water p.c.
Maximum	81·03
Minimum	78·75
Average	79·65

An average percentage of water from eleven samples of corn silage analysed in recent years in these laboratories, was 76·89 per cent. This means that the silages now discussed were decidedly poorer—nearly 3 per cent—in dry matter than good average corn silage.

The only further comment that appears to be safe is the somewhat low protein content that may be marked throughout the series. Compared with silage of average quality the silages of this series are approximately ·5 per cent lower, which on the dry matter basis amounts to a full one per cent.

At the date of examination the silage from the Perfect seal jar and that collected from the top of the stave (experimental) silo were badly moulded.

Reviewing, briefly, the results of the several series of silage in this enquiry, the more important deductions from the alfalfa samples were the higher protein content of the silage from the wilted material and of the crop cut at the later stage, i.e. full bloom.

With respect to the Sweet Clover silages the outstanding result appears to be the greater richness in protein of material in the bud stage, as compared with that in full bloom.

The differences in composition between the several samples of Oats, Peas and Vetch Silage are small, but there are indications that the silage from the earlier cut crop was slightly the richer.

The following table (35) giving the maximum, minimum and average of protein, fibre and ash for the four classes of silage will be found of interest and may prove useful for reference.

C.E.F., Ottawa—Crop, 1924

Received				Water-free					—
Carbo-hydrates	Fibre	Ash	Acid-ity	Pro-tein	Fat	Carbo-hydrates	Fibre	Ash	
p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	
10·89	5·46	1·17	1·78	8·29	6·22	53·13	26·65	5·71	Pale olive green; characteristic sour pungent odour but not disagreeable or strong; cut to medium fineness; large proportion of stem and leaf; good condition no large pieces of cob.
10·57	4·64	0·98	1·27	9·17	5·68	55·11	24·82	5·22	Large development of pale green mould; remainder of silage after removal of mould pale olive green; sour slightly musty odour.
10·30	6·36	1·30	0·72	7·76	6·44	49·18	30·43	6·20	One third of silage at the top of jar was badly moulded and slight traces noticeable throughout mass; greenish yellow in colour; small proportion of cob; silage finely cut.
9·56	5·84	1·10	1·35	8·33	7·98	48·44	29·66	5·59	Greenish yellow: sample in good condtion; finely cut; pungent odour;
9·65	5·79	1·16	1·40	8·32	11·84	46·38	27·84	5·59	Greenish yellow; sample in good condition; finely cut; pungent odour, large proportion of stalk.
10·15	6·33	2·16	2·24	7·82	4·47	47·78	29·80	10·10	

Table 35.—Summarized Data of Silage

(Dry Matter Basis)

Silage	No. of samples	—	Protein (N.x 6·25)	Fibre	Ash
			p.c.	p.c.	p.c.
Alfalfa	18	Maximum	20·74	46·22	13·17
		Minimum	10·25	29·85	9·70
		Average	17·01	36·14	10·99
Sweet Clover	18	Maximum	24·14	38·80	12·32
		Minimum	17·67	18·90	7·34
		Average	21·68	28·56	9·78
Oats, peas and vetch	16	Maximum	13·51	31·88	8·42
		Minimum	11·53	26·40	5·80
		Average	12·29	30·05	7·51
Corn	6	Maximum	9·17	30·43	6·20
		Minimum	7·76	24·82	5·22
		Average	8·28	28·20	5·62

THE SUGAR JACK PROCESS

This process, it is claimed, is a "scientific system" for the conversion of roughages, as hay, stalks, vines, straw and clover threshings, etc., into a succulent, easily digestible feed. The inventor claims that "roughage considered valueless can now be converted into palatable feed, which surpasses ensilage and selected expensive hay."

The equipment required is a stave tank or small silo open at both ends, so placed in the barn that about one fourth of its length projects above the mow floor; the clearance or distance between the bottom, or lower end of the silo and the feeding floor is from 3 to 4 feet, allowing ample room for handling and removing the Sugar Jack. The roughage while being processed is held in the press by means of two stout bars of wood held across the lower end by hangers. There is also necessary a converter or dipping tank, in which the roughage is moistened with the solution of Sugar Jack Converter before being put in the silo or press.

The "Converter" was shown to have the following approximate composition:—

	Per cent
Common salt	75
Slaked lime (hydrated dolomitic lime)	23
Vegetable matter (barley, chaff, etc.)	2

This process was given a thorough trial by the Animal Husbandry Division, comparing the processed material (Sugar Jack) in the feeding of dairy cattle with corn silage. Analyses of the roughages employed, the finished processed material and of the corn silage used for comparison, were made by this division.

A complete and detailed account of this investigation giving milk yields, data of composition of material before and after processing used in the feeding trials, etc., with conclusions therefrom, will be presented in bulletin form. It may suffice here to say that although by the Sugar Jack process a hard, coarse roughage may be presented to the animal in a moist, soft and warm condition, with its palatability somewhat enhanced by a slight saltiness, the analytical data clearly show that in passing through the press there has been nothing of food value added to the original unprocessed material. On the other hand, as might be expected, the fermentation in the press results in a certain destruction of the nutrients—starch, sugar, protein, etc.—losses comparable to those which take place in the ordinary silo.

FORAGE CROPS

ALFALFA HAY

Lab'y. Nos. 88705-6-7

These three samples of alfalfa hay were submitted by the Superintendent, Experimental Substation, Grande Prairie District, Beaverlodge, Alta. They represent three varieties, Yellow Flowered Siberian (Boyd), Cossack (Boyd), and Grimm (Brooks), "from crop seeded in 1923 and cut very nearly in full bloom" in the season of 1926.

Analysis of Alfalfa Hays

(Calculated to a 12 per cent moisture basis)

Laboratory Number	88705	88706	88707
Variety	Yellow-flowering Siberian (Boyd)	Cossack (Boyd)	Grimm (Brooks)
Moisture	12·0	12·0	12·0
Protein*	15·67	16·12	16·03
Ether Extract	3·90	4·13	4·23
Carbohydrates	36·45	37·58	38·06
Fibre	25·08	22·61	21·22
Ash	6·90	7·56	8·46
	100·0	100·0	100·0
*Albuminoids	13·32	14·82	13·53
Non-albuminoids	2·35	1·30	2·50

No marked difference between these hays is to be observed—though certain of the results would indicate that the yellow-flowered Siberian is somewhat the riper and slightly less nutritive than the other two varieties. For practical purposes, however, they may be considered, in respect to composition, of equal feeding value.

These data, as a whcle, are in fair accord with those of alfalfa hay of good quality.

WILD SUNFLOWER

Lab'y Nos. 86465-6

These two samples of wild sunflower, grown on the Experimental Station, Swift Current, Sask., were submitted by the Division of Forage Plants, for a report as to probable feeding value. This plant appears to be a native of the prairies and may be found growing wild practically all over the inhabited parts of Saskatchewan and Alberta. It resembles ordinary sunflowers in appearance but is very much smaller and is more branching in its habit of growth. Cattle eat it readily in the green state. The seeds were just forming when the samples for analysis were collected.

Each sample represents one complete average plant, cut a few inches above the soil. Description: height 36 inches and 38 inches, cut August 6, 1926. Green weight No. 1, 17·75 ounces, No. 2, 22·75 ounces.

These samples were received in the air-dried condition. They were of good green colour and consisted of stem, leaf and flower head. Stalk, slight, pithy and crisp but not harsh. Leaf, apparently in fair proportion to that of stalk. Flower head, from 1¼ to 1¾ inches in diameter, seeds just forming. There was possibly a larger proportion of leaf than in ordinary sunflower.

ANALYSIS OF WILD SUNFLOWERS

	Fresh Material		Dry Matter	
	No. 1	No. 2	No. 1	No. 2
Moisture	81·30	81·30	.....	.....
Crude proteins*	2·92	2·88	15·63	15·38
Crude fat	0·77	0·75	4·11	3·99
Carbohydrates	9·09	8·83	48·61	47·25
Fibre	3·47	3·85	18·54	20·58
Ash	2·45	2·39	13·11	12·80
	100·0	100·0	100·0	100·0
*Albuminoids	2·16	2·12	12·13	12·01
Non-albuminoids	0·76	0·76	3·50	3·37

The two plants, designated Nos. 1 and 2 are practically identical in composition.

The percentage of dry matter compares very favourably with that of cultivated sunflowers grown under dry land conditions.

The protein content is higher than that usually found in the sunflower crop as cut for the silo. This may be due in part to the apparently larger proportions of leaf to stalk than in the cultivated sunflower.

The percentage of fibre is distinctly lower than that of cultivated sunflower, again, probably following the larger proportion of leaf.

Provided that this plant is found satisfactory from the stand-point of palatability and yield it would appear from the present analyses that the wild sunflower might develop into a useful forage crop in semi-arid areas.

ARTICHOKES

Lab'y. Nos. 85797 and 86499

This examination undertaken at the instance of a correspondent at Castlegar, Kootenay W., B.C., consisted of the analysis of the "stalk and leaf" and the tubers of the artichoke (*Helianthus tuberosis*). The name of the variety was Improved Giant White French artichoke. Since the leaves of the plant were

found palatable to stock it was thought that a suitable silage might be prepared from the tops (stalks and leaves) and the tubers might be used more particularly in swine feeding.

The sample of "stalks and leaves" collected for analysis was gathered in the first week of August, the statement being made that the plant would grow for at least two months from that date. The tubers were dug October 9, it being stated that ordinarily there is tuber development until November.*

The sample of "stalks and leaves" when received for analysis was slightly wilted; stalks about ¾-inch in diameter and somewhat woody. There were no signs of flower heads. The tubers were sound and firm.

ANALYSIS OF ARTICHOKES

—	Stalks and Leaves		Tubers	
	Fresh material	Dry matter	Fresh material	Dry matter
	p.c.	p.c.	p.c.	p.c.
Water	74·26	.....	73·23	.....
Crude protein**	2·61	10·12	2·33	8·71
Crude fat	0·65	2·56	0·13	0·47
Carbohydrates	13·19	51·26	21·46	80·17
Fibre	5·70	22·13	1·23	4·61
Ash	3·59	13·93	1·62	6·04
	100·0	100·0	100·0	100·0
**Albuminoids	1·33	5·18		
Non-albuminoids	1·28	4·94		

*Data for yields per acre have not been obtainable but the Superintendent of the Experimental Station, Saanichton, B.C., reports that 46 plants yielded 595 pounds of stalks and leaves and 325 pounds of tubers.

Stalks and Leaves.—The composition of "Stalk and Leaf" is quite similar to that of the sunflower plant, cut at an early stage of growth; it would appear that these two forages are fairly comparable as to palatability and feeding value. A German authority states that the tubers and leaves and stems of artichokes may be fed to sheep, goats and dairy cows with good results.

It will be observed, as in the case of the sunflower, that the ash content is very high. This would indicate that the artichoke would prove a more or less exhaustive crop in respect to the mineral elements (and particularly potash) withdrawn from the soil. The introduction of the artichoke as a forage crop would make it necessary to well consider means for the up-keep of the soil's store of available mineral plant food. It has been found in the case of the sunflower, with a 15 ton per acre yield, that there is a withdrawal of potash of approximately 250 pounds per acre.

Tubers.—In point of composition the artichoke tuber is very similar to the potato, some authorities giving these two a practically equal nutritive value.

Recent experiments carried on at Cambridge, England, with artichokes have shown that they did not prove profitable as a field crop. It is stated that artichoke tubers may in reasonable quantities be fed with profit to sheep and pigs but that given in excess they cause scouring. The same authority claims that artichoke tubers may result in an inferior quality in pork.

In the potato the carbohydrates consist entirely, or practically so, of starch—the feeding value of which is well known. In the artichoke tuber about 2 per cent of the carbohydrates is inulin and while this can be utilized by the animal its nutritive value has never been definitely determined. There is no starch present, water and certain gummy carbohydrates filling its place.

Opinion is divided as to the value of artichokes (tubers) as a field crop and it is significant that it has never taken a rank among the successful succulent forages. With this divergence of statement as to the practical profitable growing and feeding of artichokes it is impossible at the present time to regard the matter of artichoke growing other than as an experiment.

THE CURING OF HAY WITH SALT

This division has been for some years investigating the value of the natural deposits of salt occurring at Malagash, N.S., as a fertilizer and soil amendment. The experiments have been in progress at the Experimental Farm, Nappan, N.S., the Experimental Stations at Kentville, N.S., and Charlottetown, P.E.I.

It had been suggested that a further use for this salt might be found in the curing of hay. It was hoped that the preservative action of salt would permit of damp hay being stored without moulding and that the presence of the salt would ensure against spontaneous combustion of the hay. It would therefore be found effective and valuable in the making of hay in wet seasons. It was further contended that the quality of the hay would be improved, being greener, more succulent and more palatable.

In order to test the value of Malagash salt in hay curing, a series of experiments was carried out at the Experimental Farm, Nappan, N.S., during the summer of 1926. The hay, "a mixture of clover and timothy," was made into sixteen stacks. These were divided into four groups of four stacks each as follows: (1) Hay stacked on the third day after cutting, it being tedded on the second day and drawn on the third. (2) Hay drawn on the second day it being tedded and put in the windrow on the same day. (3) Hay drawn on the fourth day, it being tedded on the second, raked on the third and drawn on the fourth. (4) Hay that had received rain and partly dried. The four stacks of each group had been salted as follows: (1) No salt. (2) Ten pounds of salt to the ton. (3) Twenty pounds of salt to the ton. (4) Thirty pounds of salt to the ton. Samples of hay from the top, middle and bottom of each stack were forwarded to the Chemical laboratory for analysis in the hope that the nutritive value of these samples representative of the hay as stacked and as fed could be determined and from this the effects of the salt in hay curing be ascertained.

The chemical data from this experiment are inconclusive. They do not reveal any outstanding chemical characteristics in the salted hays but the appearance of the hays and the results of feeding trials furnish some evidence in favour of salting. The superintendent at the Experimental Farm, Nappan, under whom the feeding trials were conducted reported as follows: "the salted hay was a better colour than the non-salted and had a higher percentage of leaves attached than the other, was less dusty and had a much better aroma. The thirty-pound lot was very loosening on the steers—while they did not scour badly yet they were very soft and I would be almost inclined to believe they were a little too much that way for good feeding but the ten and twenty pound lots were quite alright and the cattle undoubtedly relished it and cleaned it all up in good style —much more so than the unsalted."

This experiment is being continued in 1927.

FEEDING STUFFS

In this chapter the detailed analyses of the various feeding stuffs submitted during the year are presented in tabular form (table 36). The several types or classes of feeds have been grouped and information as to source, etc., given. Brief notes furnishing further information as to purity, quality, etc., are appended.

BRAN

Lab'y. No. 85472

This a " clean " bran of good quality; practically no foreign matter present. It satisfactorily meets the requirements of the Feeding Stuffs Act in respect to fat and fibre and barely the authorized standard in regard to protein.

MIDDLINGS

Lab'y. No. 86294

This is a " clean " sample, fairly mealy in character. It, however, fails to meet the requirements of the Act in respect to protein and fibre.

Lab'y. No. 88534

These middlings are of excellent quality, genuine and fully meet the requirements of the Feeding Stuffs Act.

OAT PRODUCTS

Lab'y. No. 85473

Ground oats, stated to be from western-grown oats. Though below the average for the best grade in protein, this sample is decidedly rich in fat and low in fibre.

Lab'y No. 87876

Oat chop. This is a very poor sample; about 2·5 per cent too low in protein and about 3·0 per cent too high in fibre. It may be from a very poor grade of oats or it may contain added oat hulls.

Lab'y. No. 87927

Canada western feed oats.

Lab'y. No. 87928

No. 3 Canadian western oats.

These two samples of oats, submitted by the Dominion Cerealist, differ but little in their protein content, but No. 87927 has much higher percentage of fibre and in consequence is the poorer sample of the two. Both samples are a little low in fat and high in fibre when compared with oats of good average quality.

Lab'y. No. 88334

Oat feed. This feed is of extremely poor quality; it evidently contains a large percentage of oat hulls.

SCREENINGS

Lab'y. No. 86592

Ground elevator screenings. Though somewhat above the average for re-cleaned screenings in fibre, this feed, otherwise, is of good quality. No information was furnished respecting its palatability.

This sample was examined by the microscopist of the Seed Branch, who reported as follows: " It contains ground wild buckwheat and other weed seeds, oats and chaff with a trace of corn and flax. Weed seeds designated injurious—0·5 per cent; vital weed seeds, 6 per ounce, chaff, 10 per cent. It also contains smut and rust spores but not in sufficient quantity to give it a disagreeable odour or taste."

Lab'y. No. 87118

Elevator screenings. A separation of the components of this sample afforded the following data:—

	Per cent.
Wheat (some of which is badly smutted)	28·6
Flax and oats	2·0
Weed seeds, not designated as injurious:—	
Black bindweed	16·2
Small black seeds (chiefly Lambs' Quarters)	17·7
Weed seeds designated as injurious	3·5
Chaff	32·0
	100·0

These screenings are of decidedly inferior quality; the proportion of wheat is much below that of chaff and weed seeds decidedly above that found in screenings of fair quality.

Lab'y. No. 87330

Ground mill screenings. Though satisfactory as to protein and fat, the fibre is too high for use of this feed in swine feeding. No information was furnished respecting palatability.

DISTILLERS' DRIED GRAINS

Lab'y. No. 87946

Distillers' dried grains from rye, according to analyses made in these laboratories, have an average protein content of 20·17 per cent. This sample contains 20·67 per cent and in consequence may be considered of good average quality.

The averages for fat and fibre, from ten samples of rye grains, were 6·43 and 15·81 per cent, respectively. This sample, with 7·13 and 14·67 per cent is therefore quite satisfactory in this respect.

Lab'y. Nos. 88122 and 88538

These are distillers' dried grains from corn, rye and barley malt, the percentage of protein being much higher in No. 88122, in consequence of the larger proportion of corn used in the mash.

In "grains" from cereals, including corn, the protein content may vary, roughly, from 25 to 34 per cent, the higher percentage following the higher proportion of corn used. The percentage of fat in "grains" from mixtures containing corn is from 5 to 8 per cent higher than in rye grains.

CALF MEALS

Lab'y. No. 85205

Judging from analytical data, this should prove a satisfactory feed for calves; its percentage of protein and fat give it a high nutritive value and its comparatively low fibre content is a further favourable feature.

Lab'y. No. 87991

This calf meal, the brand name of which could not be obtained (the correspondent stating that it was being sold from bulk) is apparently a sound and wholesome feed with desirable proportions of protein, fat and fibre.

DAIRY CATTLE FEEDS

Under this caption there is recorded the results of examination of a number of feeds advertised as specially useful in the feeding of dairy cattle.

Lab'y. Nos. 85151 and 87623

These feeds are sold under the brand name of "Purina Cow Chow," which is stated to be compounded of gluten feed, hominy feed, oil cake meal, cotton seed meal, alfalfa meal, molasses and salt, and is sold with a guarantee of protein 24, fat 4·3 and fibre 12 per cent.

While sample No. 85151 fairly satisfactorily meets its guarantee, the other sample, No. 87623 is distinctly inferior; it is below its guarantee in protein and fat and contains an excess of fibre. This indicates carelessness in manufacture rather than intentional fraud. High-grade concentrates of this character necessarily command a high price and it is therefore particularly desirable that they should fully and satisfactorily meet their guarantee.

Lab'y. Nos. 87506 and 88391

These are two samples of Quaker Dairy Ration, sold under a guarantee of protein 18·0, fat 5·0 and fibre 12·0 per cent. This feed is stated to be made from oil cake meal, cotton seed meal, steamed bone meal, hominy feed, gluten feed, oat feed, standard recleaned screenings, barley meal, salt and calcium carbonate. Both samples satisfactorily meet their guarantee.

Lab'y. Nos. 87507 and 88392

These feeds intended for dairy cattle were compounded by the Animal Husbandry Division, C.E.F., as follows:—

—	No. 87507	No. 88392
	lb.	lb.
Bran	300	200
Brewers' dried grains	300	400
Ground oats	200	200
Oil cake meal	100	100
Cotton seed meal	100	100
Gluten meal	100	
Salt (iodized)	11	11
Bone char	22	22
Ground limestone	11	11

From the analyses, as well as from the formulae, both feeds would be classed as high-grade concentrates. It will be observed that the substitution of 100 pounds of bran by 100 of Brewers' dried grains and the omission of 100 pounds of gluten feed have reduced the protein by 1·0 per cent and the fat by 2·0 per cent, while raising the fibre 1·5 per cent.

Lab'y. No. 86997

No guarantee was furnished with this sample. It appears to be decidedly inferior to the brand known as Quaker Dairy Ration, made by the same milling firm, from which it differs in containing nearly 2·5 per cent less protein and 2·0 per cent more fibre.

Lab'y No. 86998

The components of this "Jersey Feed" are stated to be as follows: gluten feed, distillers' corn grains, bran, oil cake meal, cottonseed meal, malt sprouts, brewers' dried grains, corn meal, salt and carbonate of lime.

This meal falls into the class of high-grade concentrates, by reason of its excellent percentages of protein and fat and its comparatively low fibre content.

HORSE FEEDS

The three samples considered under this heading were submitted as feeds suitable for horses and the inquiry was as to their relative nutritive value.

Lab'y. No. 87204

The components of this feed are stated to be oil cake meal, alfalfa meal, cracked corn, crushed oats, salt and molasses. Its guarantee was protein, 9·7

per cent, fat, 3·2 per cent and fibre, 8·0 per cent. Though a little higher in fibre it may, by reason of its high protein and fat, be said to fully meet its guarantee.

Lab'y. Nos. 87205 and 87871

Both of these are compounded feeds, corn and oats predominating. They contained molasses. Their analyses indicates a marked similarity in composition and nutritive value. They are decidedly lower in protein than No. 87204 and must be considered slightly poorer than this feed.

HOG FEED

Lab'y. No. 85152

This feed is stated to be composed of corn meal, gluten feed, tankage, oil cake meal, alfalfa meal, feed flour, ground barley, charcoal, molasses and salt. It carries a guarantee of protein 15·0 per cent, fat 2·5 per cent and fibre 7·0 per cent.

Its analysis would show that it has a higher feeding value than its guarantee would indicate. The amounts and proportions of the nutrients, including mineral matter present, are such as to make this a desirable meal for use in pig feeding.

POULTRY FEEDS

Lab'y. No. 85372

This compounded feed, containing bran, shorts, corn, barley, oats, oil cake, meat meal and charcoal, appears to be of excellent quality; the protein and fat are in good proportions and the percentage of fibre is not too high.

Lab'y. No. 86493

The components of the "Poultry Mash" are given as follows: Bran, shorts, oats, corn meal, fish meal, beef scrap, alfalfa meal, linseed meal, charcoal, salt and grit.

The results of this analysis indicate a mash of high feeding value. The fibre may be a little high but the percentages of protein and fat are those of compounded feeds which have proved useful for egg production.

MEAT AND BONE BY-PRODUCTS

Lab'y. No. 84551

This product carries a guarantee of 50 per cent protein. It is in the form of a coarse, light brown powder showing small particles of brown; apparently sound and wholesome. It fully meets its guarantee with respect to protein and contains approximately 20 per cent of bone phosphate.

Lab'y. No. 85452

A light brown powder showing a considerable proportion of bone fragments; apparently sound and wholesome. It bears a guarantee of 60 per cent protein which it fails to meet by almost 10 per cent. Its bone phosphate content is 21·73 per cent.

Lab'y. No. 85338

The "Digester Tankage" carries a guarantee of protein 60 per cent, fat 6·0 per cent. A dry, brown finely ground product; apparently sound and wholesome. It contains 21·67 per cent of bone phosphate but does not meet its guarantee in protein by 4·5 per cent.

Lab'y. No. 85759

A dry, grey, powdery product, showing a considerable proportion of bone particles. It has an extremely high bone phosphate content, viz 35·08 per cent.

Lab'y. No. 86650

Submitted by the Poultry Division, C.E.F. Guarantee: protein 60·0 per cent, fat 5·0. Finely ground powder of a yellowish brown colour; apparently sound and wholesome. It fully meets its guarantee and contains 12·92 per cent bone phosphate.

Lab'y. No. 86651

Submitted by Poultry Division, C.E.F. Guarantee: protein 60 per cent, fat 10·0 per cent. Very similar in appearance to No. 86650; apparently sound and wholesome. It meets its guarantee. Its bone phosphate content is 17·17 per cent.

FISH PRODUCTS

Fish meal is a feeding stuff product obtained by the utilization of surplus fish and fish offal, the process of manufacture comprising the reduction of the fish or offal by steam cooking, the separation by skimming and pressure of the larger proportion of the oil and the drying and grinding of the residue. The fish and fish wastes employed must be fresh and sound and the several operations carefully and thoroughly carried out, if a wholesome, palatable meal with good keeping qualities is to result. Unsound fish or waste will result in unwholesome and rancid products, unpalatable to stock, likely to produce scouring and other digestive troubles, and apt to cause tainted meats, milk and eggs. The two essential factors in the manufacture of edible fish meals are fresh clean fish as raw material and the reduction to safe limits of the moisture and oil content. High-grade meals with good keeping qualities are invariably characterized by small percentages of moisture and fat.

Lab'y. No. 84539

Foro Fish Meal manufactured by Foro Products Company, Sidney, B.C. Submitted by the Superintendent, Experimental Farm, Agassiz, B.C. Guarantee: protein 70 per cent, fat 8 per cent. Yellowish-brown powder showing small particles of bone; apparently sound and wholesome. It is a little lower than its guarantee in protein, but is otherwise quite satisfactory. Its percentage of bone phosphate is 8·85.

Lab'y. No. 84540

"Royal Standard Edible Fish Meal" (name of manufacturing firm not stated). Submitted by Superintendent, Experimental Farm, Agassiz, B.C. Guarantee: protein 60·0 per cent, fat 5·0 per cent. Light, yellowish-brown powder, showing small fragments of bone; apparently sound and wholesome. It does not meet its guarantee in protein by 3·5 per cent but exceeds it in fat by over 10 per cent. Bone phosphate present 18·93 per cent, which is very high for a fish meal..

Lab'y. No. 84541

"Hiuskookum No. 1. Edible Fish Meal". Stated to be made from the whole dogfish at Rendezvous Island, B.C. Submitted by Superintendent, Experimental Farm, Agassiz, B.C. Guarantee: protein 70 per cent, fat 11·0 per cent, bone phosphate 9 per cent. The percentage of bone phosphate present is 7·58: a fine ground yellowish brown powder; apparently sound and wholesome. It meets its guarantee as to protein and fat.

Lab'y. No. 85206

Salmon meal: in the form of a coarse light yellowish-brown powder, showing small fragments of bone; apparently sound and wholesome. Its chief data are protein 61·76 per cent, fat 13·62, bone phosphate 14·52 per cent.

Lab'y. No. 85207

Grey fish meal: well ground yellowish-brown powder inclined to pack, probably owing to its rather high fat content; apparently sound and wholesome. Its analysis showed protein 64·42 per cent; fat 16·86 per cent and bone phosphate 10·22 per cent.

Lab'y. No. 87408

Sardine Factory Waste. This sample contains too high a percentage of moisture; it would quickly spoil on storage. Dried to 10 per cent moisture basis it would contain approximately 47 per cent protein, 14 per cent fat and 21 per cent bone phosphate.

Lab'y. No. 87415

Pilchard Meal. Manufactured at Kildonan, Vancouver Island, B.C. A well-dried coarsely granular meal, showing fragments of bone. Its analysis showed protein 68·68 per cent, fat 7·39 per cent, and bone phosphate 13·35 per cent.

Lab'y. No. 87731

Grey fish meal made at Sooke, Vancouver Island, B.C., and by the same firm which furnished samples Nos. 85206 and 85207. The analytical data are protein 60·88 per cent, fat 17·81 per cent, and bone phosphate 8·56 per cent. This and its companion sample (No. 85207) from grey fish possess too high a fat content to ensure good keeping qualities.

Lab'y. No. 87968-69

Fish Meals. These are prepared in Gaspé, P.Q., from fish scraps resulting from the canning of cod, haddock and halibut; liver and entrails are not used and consequently little fatty matter is included.

They are characterized by high protein content (No. 87969 being exceptionally high) and a very low percentage of fat. Their percentages of bone phosphate, 22·50 and 18·46 per cent, are decidedly above the average for fish meals.

Lab'y. No. 88286

Struven Fish Meal. Made from fresh whole Menhaden fish. Guarantee: protein 55·0 per cent, fat 4·0 per cent. It is a dark brown meal, finely ground; apparently sound and wholesome. It exceeds its guarantee in protein by nearly 5 per cent. Its claim by guarantee to be a low fat meal is not supported by our analysis. Bone phosphate is present to the amount of 16·29 per cent.

MISCELLANEOUS

Lab'y. No. 83967

Rye Shorts. Forwarded by a correspondent in St. Sebastien d'Iberville, P.Q., who had purchased a carload for use in feeding dairy cows. The analysis indicates that the sample is genuine and of good quality. As a rule rye products are not palatable to stock and fed alone or in large quantities they are apt to cause digestive disorders. Mixed with other meals rye shorts should give good results.

Lab'y. No. 84800

Ground Broken Peas from threshing machine. This is a valuable product, ranking with the high class protein concentrates. It would be found particularly serviceable in rations for swine.

Lab'y. No. 86609

Hominy feed. The data correspond closely to those of genuine hominy feed, though not of the highest grades. Its percentages of fibre is slightly higher than that in the best samples and this somewhat reduces its feeding value.

Hominy feed is a palatable and wholesome feeding stuff, moderately rich in protein and fat.

Lab'y. No. 85685

Flax screenings. These screenings were forwarded by a farmer at Grande Prairie, Alta., who stated he had 400 bushels. He wished to know "the best use to which they could be put but had no sheep".

The botanical examination yielded the following figures:—

Weed seeds not designated as injurious	1·95
Weed Seeds designated as injurious*	68·55
Chaff	5·45
Wheat and barley	3 47
Flax	20·58
	100·00

*Chiefly false flax, one of the weed seeds designated in the Feeding Stuffs Act as injurious to live stock.

Although these screenings contain high percentages of protein and fat and their percentage of fibre is not excessive, it is doubtful if this material can be safely fed, owing to the very large proportion of "false flax" seed present. According to such information as is available this weed seed is injurious to live stock.

Lab'y. No. 85471

Oil cake meal manufactured by J. & J. Livingston, Baden, Ont. There is a fairly wide range in the protein and fat content of oil cake meals; the present sample compared with an average struck from the analysis of ten samples, is rather low in protein and high in oil. It is a genuine sample and free from impurities.

Lab'y. No. 87329

Fox biscuits manufactured by P.E.I. Fox Biscuit Company, Charlottetown, P.E.I. They are stated to contain, in addition to flour, pork cracklings and dripping, bone meal and cod liver oil. Description: moderately hard, light brown, with interior lighter in colour, porous, showing a few small pieces of crackling or similar material throughout the biscuit.

Six samples, representing six brands of Canadian manufactured fox biscuits, previously analyzed in these laboratories, afforded the following data:—

—	Protein	Fat	Fibre
	p.c.	p.c.	p.c.
Maximum	23·75	7·06	2·94
Minimum	17·36	1·37	0·90
Average	19·91	4·68	1·49

Lab'y. No. 87730

Provender or chop, compounded from oats and barley, with a small proportion of wheat and peas. This sample is somewhat superior to the general run of oat chops, the higher protein resulting from the presence of peas. It is also somewhat higher in fat and lower in fibre than average samples.

Lab'y. No. 87914

Provender or chop, composed of buckwheat 33 per cent, oats and barley (with a small proportion of wheat and peas) 66 per cent. This is somewhat inferior to sample No. 87730, being slightly lower in protein and fat and higher in fibre.

Lab'y. No. 88160

Cod liver meal, manufactured or prepared by W. A. Munn, St. John's, Newfoundland, and submitted by the Poultry Division, C.E.F. A finely ground meal of a bright yellowish brown colour, with a slight fishy odour.

The results here recorded are from the first analysis made in these laboratories of this product—now advertised for use in poultry feeding. The oil presumably is the chief constituent of value, by reason of its high Vitamin A content. It has in addition a considerable feeding value from its large percentage of protein. Its carbohydrate content, by difference 12·29 per cent is presumably glycogen, otherwise known as liver sugar.

Lab'y. No. 88335

Peanut Hearts. This sample was submitted for analysis and report as to its value in poultry feeding, from St. Timothée College, Beauharnois, P.Q. This by-product is characterized by high percentages of protein and fat and a low fibre content. The data of this sample are in accord with those previously obtained in these laboratories for this material.

By reason of its very high fat content the quantity fed in the ration should be limited, especially for poultry and swine.

Lab'y. No. 86621

Garbage feed from hotel waste. This sample, from Peterborough was submitted in two parts: one jar of solids and another of liquids. These resulted from the cooking by live steam of the vegetable and animal waste collected from several hotels, the fat being skimmed from the cooked mass and otherwise used. Oat chop and middlings were added to the cooked and skimmed waste and the resultant mash used in swine feeding.

The "jar of solids" contained potato peelings (in a large proportion), apple cores, tea leaves, pieces of carrot, turnips, cauliflower, cabbage, celery, etc., and two large pieces of meat, cigar stubs and cardboard covers of milk bottles were also noticed.

The material was free from mould, decomposition or fermentation. It was practically odourless and remained so after being kept for several days in the laboratory.

The "jar of liquid" contained a sediment occupying about one-fourth of the container, with a supernatant fluid of greenish grey colour. It held several floating pieces of solid fat. The material was sound and almost odourless.

To prepare a sample for analysis which would be thoroughly representative of the whole, the contents of the two jars were mixed and the semi-fluid mass dried down to a water-free condition and ground. The ground material was exposed to the air for several days, to take up such moisture as it would, and the sample then considered as air-dried.

ANALYSIS OF GARBAGE

—	Fresh, mixed Material	Air-dried Material
Water	90·00	12·46
Protein	2·25	19·69
Fat	3·17	27·74
Carbohydrates	2·51	22·00
Fibre	1·36	11·90
Ash	0·71	6·21
	100·00	100·00

It is evident from these results that this garbage has a distinct feeding value. It is not, however, very well balanced as regards its chief nutrients. It must be considered as too rich in fat, as compared with its protein content, as a feed for swine—especially for young and growing pigs. It would be desirable therefore, in its use, to mix it with grain or meal feeds low in fat. Provided this cooked garbage can be obtained in requisite quantities there should be no occasion to enrich the ration with tankage or meat meal.

In the foregoing we have been obliged to assume that the sample was representative; it must, however, be recognized that this garbage is a material more or less subject to daily change.

A suggestion for the improvement of the cooked garbage as a feed for swine would be to skim it more closely as to fat.

Lab'y. No. 86403

Tomato pulp waste, from Port Dover Canning Company. As received, this sample was a wet, compact mass of tomato skins and seeds, with a very small proportion of stems and leaves. The material when received was in a state of fermentation.

This material, if fresh, is probably wholesome. The analysis might seem to indicate a fairly nutritious forage, somewhat akin to farm roots. However, it cannot be regarded as possessing any appreciable feeding value from the fact that it contains a large proportion of skins with a very high fibre content and secondly the seeds of which there is a large amount, have such a hard integument or seed coat that a great proportion of them would pass through the animal undigested. If by grinding, the seeds could be broken down, the nutritive value would be much enhanced. Whether it would pay to dry and grind is doubtful.

TABLE 36.—ANALYSIS OF FEEDING STUFFS

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
	Bran						
85472	Lake of the Woods Mlg. Co., Montreal, Que.....	13·04	15·01	6·16	49·92	10·24	5·63
	Middlings						
86294	E. B. Noelville, Ont.....	10·92	14·49	5·64	61·60	5·34	2·01
88534	W. B., Hemmingford, Que., Mfg. by Maple Leaf Mlg. Co.....	12·06	17·20	4·53	59·27	4·41	2·53
	Oat Products						
85473	Ground Oats: Maple Leaf Mlg. Co., Montreal, Que.....	12·86	10·60	6·09	58·59	9·04	2·82
87876	Oat Chop: Ogilvy Mlg. Co., Medicine Hat, Alta.	8·98	9·26	4·83	58·98	14·33	3·62
87927	Regular Run Oat Scalps: (Canada Western Feed Oats).....	6·62	11·70	3·72	60·29	14·11	3·56
87928	No. 3, Canadian Western Oats.....	6·81	11·32	3·92	62·48	12·22	3·19
88334	Oat Feed: J. R., Cochrane, Ont. Mfg. by Ogilvy Mlg. Co.....	6·55	5·18	2·18	26·70	53·64	5·75
	Screenings						
86592	Ground Elevator Screenings: Vancouver Mlg. & Grain Co., Vancouver, B.C.....	9·53	15·92	4·42	56·17	10·24	3·72
87118	Screenings: H. B. Monte, Creek, B.C. From Govt. Elevator, Vancouver, B.C.....	9·98	14·28	4·01	51·06	13·01	7·66
87330	Mill Screenings: Quaker Oats Co., Peterboro, Ont.....	9·40	13·61	5·66	54·18	13·55	3·60
	Distillery Products						
87946	Distillers' Dry Grains (Rye) Can. Industrial Alcohol Co.....	5·96	20·67	7·13	49·10	14·67	2·47
88122	Dried Grains (corn, rye and barley malt) Melcher's Gin and Spirits Distillery Co., Ltd., Berthierville, Que.....	5·50	29·41	15·40	32·32	15·80	1·57
88538	Distillers' Dried Grains, Melcher's Gin & Spirits Dist. Co., Ltd., Berthierville, Que.....	8·55	25·06	12·60	39·63	12·78	1·38
	Calf Meals						
85205	Feed, International Growfast Calf Meal, No. 820	10·38	22·43	7·83	47·78	5·83	5·75
87991	Calf Meal. C.R. Elmdale, Ont.....	14·23	21·98	8·67	43·09	6·72	5·31

TABLE 36.—ANALYSIS OF FEEDING STUFFS—*Concluded*

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
	Dairy Cattle Feeds						
85151	Purina Cow Chow, Chisholm Milling Co., Toronto, Ont.	12·11	23·72	6·57	44·06	7·87	5·67
87506	Quaker Dairy Ration: Quaker Oats Co., Peterboro, Ont.	7·94	19·34	4·70	51·90	10·53	5·59
88507	Dairy Cattle Ration, C.E.F., Ottawa, Ont.	8·91	20·01	5·14	47·89	10·55	7·50
88391	Quaker Dairy Ration, Quaker Oats Co., Peterboro, Ont.	8·41	19·49	5·62	49·63	10·51	6·34
88392	Dairy Cattle Ration, C.E.F., Ottawa, Ont.	7·93	19·05	3·14	50·54	12·17	7·17
86997	Dairy Cattle Feed, Quaker Oats Co., Peterboro, Ont.	9·13	17·01	4·59	50·99	12·52	5·76
86998	Jersey Feed: J. B. Renaud, Quebec, Que.	10·02	25·83	6·30	41·89	10·77	5·19
87623	Purina Cow Chow, Chisholm Mlg. Co., Toronto, Ont. (Ralston Purina Co.)	11·49	21·94	4·65	46·07	9·16	6·69
	Horse Feed						
87204	Purina O Molene Chisholm Mlg. Co. Ralston Purina Co.)	8·13	11·81	3·97	61·83	9·69	4·57
87205	Horse Feed: Aimé Guertin Co., Montreal, Que.	11·96	10·07	2·67	60·52	10·30	4·48
87871	Horse Feed: Aimé Guertin Co., Montreal, Que.	9·66	9·76	3·01	62·22	10·23	5·12
	Hog Feed						
85152	Purina Pig Chow: Chrisholm Mlg. Co., Toronto Ont. (Ralston Purina Co.)	12·46	18·98	7·47	49·16	4·73	7·20
	Poultry Feeds						
85372	Egg Mash: Le Moulin à Farine, Plessisville, Que.	11·33	22·51	7·36	44·80	7·11	6·89
86493	Poultry Mash: Brackman-Ker Mlg. Co., Vancouver, B.C.	11·65	19·92	6·37	46·78	9·65	6·63
	Meat Products						
85451	"Laymore" Meat Scrap: Swifts	6·86	53·54	12·72	.....	.....	22·92
85452	Meat Scrap: City Renderers Ltd., Montreal, Que.	6·73	50·62	16·12	.....	.....	25·17
85338	Digester Tankage: Gordon, Ironsides & Fares, Winnipeg, Man.	7·38	55·52	7·79	.....	.....	23·31
85759	Tankage: P. Burns Co., Prince Albert, Sask.	7·48	44·72	7·44	.....	.....	38·02
86650	Meat Meal: Reg. No. 1613:-City Renderers Ltd., Montreal, Que.	10·31	60·12	10·65	.....	.....	14·80
86651	Hasab Meat Meal: Reg. No. 313: Ontario Fertilizers Ltd., Toronto, Ont.	6·88	59·64	11·39	.....	.....	17·48
	Fish Products						
84539	Foro Fish Meal: Reg. No. 1621. Brackman-Ker Mlg. Co. Ltd., Vancouver, B.C.	12·43	68·98	8·20	.....	.....	10·59
84540	Royal Standard Edible Fish Meal: Reg. No. 589: Vancouver Mlg. & Grain Co., Vancouver, B.C.	8·96	56·58	15·88	.....	.....	19·24
84541	Hiuakookum Edible Fish Meal. Rendez-Vous Island, B.C.	7·25	69·38	12·48	.....	.....	10·14
85206	Salmon Meal: Star Construction Co., Ltd., Sooke, B.C.	7·56	61·76	13·62	.....	.....	15·30
85207	Grey Fish Meal: Star Construction Co., Ltd., Sooke, B.C.	8·67	64·42	16·86	.....	.....	10·45
87408	Fish Scrap: O'Connors Sardine Factory, St. Andrews, N.B.	47·93	27·59	8·49	.....	.....	14·72
87415	Fish Meal: British Columbia Fishing & Packing Co., Toronto, Ont.	5·86	68·68	7·39	.....	.....	14·28
87731	Grey Fish Meal, Star Construction Co., Ltd., Sooke, B.C.	11·77	60·88	17·81	.....	.....	9·45
87968	Fish Meal: Le Poisson de Gaspé Ltée, Montreal, Que.	6·81	64·28	3·91	.....	.....	24·31
87969	Fish Meal: Le Poisson de Gaspé Ltée, Montreal, Que.	4·89	71·62	3·89	.....	.....	19·23
88286	Struven Fish Meal: Chas. M. Struven Co., Baltimore, Md., U.S.A.	8·31	59·92	12·36	.....	.....	17·15
	Miscellaneous						
83967	Rye Shorts, A.P. St. Sébastien d'Iberville, Que.	9·58	16·71	3·28	62·79	4·39	3·25
84800	Gr. Broken Peas, Cereal Division, C.E.F.	12·14	23·99	0·57	53·86	4·69	2·75
86609	Hominy Feed, J. B. Earlton, Ont.	11·36	10·58	6·32	64·24	6·15	1·35
85685	Flax Screenings, A.R.J., Grande Prairie, Alta.	9·31	25·48	33·17	19·61	3·76	9·72
85471	Oil Cake Meal, J. & J. L. Farnham, Que.	10·57	30·72	9·15	35·42	7·97	6·27
87329	Fox Biscuits, D.A.M. Charlottetown, P.E.I.	7·39	17·26	5·02	67·46	0·54	2·33
87730	Provender, A.A.H., Kemptville, Ont.	10·93	10·92	3·51	62·86	8·57	3·21
87914	Provender, A.A.H., Kemptville, Ont.	12·11	10·71	3·15	61·21	9·93	2·89
88160	Cod Liver Meal, Poultry Division, C.E.F., Ottawa, Ont.	6·53	40·22	38·63	12·29	.....	2·33
88335	Peanut Hearts, J.E.M. St. Thimothée, Beauharnois, Que.	3·04	28·62	47·33	16·01	2·57	2·43
86621	Garbage Feed from Hotel Waste. C.H.R., Peterboro, Ont.	90·00	22·5	8·17	2·51	1·36	0·72
86403	Tomato Pulp Waste, Pt. Dover Canning Co., Pt. Dover, Ont.	87·77	2·56	0·79	1·96	6·19	0·74

INSECTICIDES AND FUNGICIDES

Chemical analysis and physical examination of the more commonly used insecticides and fungicides appearing on the Canadian market and co-operative work with the Entomological Branch constitute the two chief phases of the division's activities in this important field. The latter phase consists in the necessary chemical assistance for the better conduct of experimental work with various sprays and dusts and is carried on mainly at Annapolis Royal, N.S., in close association with the officers of the Entomological Branch located at that point. Among the more important problems which have been thus jointly studied are those relating to mosquito control, the treatment of potatoes with mercuric chloride, the effect of various oils on insect life and plant tissue and the relative persistency on apple foliage of arsenic from combined sprays. In the mosquito control investigations it is satisfactory to note that a treatment for the oil has been found which permits it to more readily and quickly spread on the surface of the water—a matter of considerable importance in the oiling of ponds and marshes at the critical period of mosquito emergence.

A summarized account of the various phases of orchard and laboratory work carried on at Annapolis Royal, is as follows:—

The chemical investigations were diversified and dealt with field and orchard as well as laboratory work. The analyses of insecticides and fungicides and allied spray and dust materials were undertaken for many of the co-operative fruit companies as well as for individual orchardists who were often in difficulties as to whether the stocks they had in the barn were calcium arsenate, lead arsenate or simply hydrated lime. Of the large number of arsenical insecticides analysed, the majority met their guarantee for total arsenic oxide. The water soluble arsenic oxide, however, varied considerably, though the percentage found was usually within the desired standard. In this connection it is worthy of mention that orchards suffering from arsenical "burn" in 1926 were very few if any. Not one was reported to the laboratory. This was a marked improvement over the record of the previous two years. It would seem fairly certain that this very satisfactory condition was attained, in part, by the manufacturers using the method for the determination of water soluble arsenic developed in these laboratories and in part to the greater care now exercised in the manufacture of these materials.

A chemical and physical examination of the oils used in the field experimental work of the laboratory was carried on to determine if any correlation existed between the oil constants and the effect upon the insects or plant growth on which the oils were used. The constants determined for the oils were viscosity, density, capillarity, flash point, fire point, sulphonation test, distillation range and reaction to litmus. Of these data the sulphonation test is the most important criterion in deciding the toxicity or non-toxicity of an oil. The other determinations are of value but not to the same degree as the sulphonation test.

The period of adherence of arsenic throughout the growing season to apple foliage when arsenicals are used in combination with various fungicides was determined by analysing samples of 500 leaves from different plots under examination. While the results of this investigation have already appeared in detail, brief mention may be made of some of the more important findings. The lead arsenates in admixtures with lime sulphur show superior adhesion to calcium arsenate in the same fungicide. Arsenicals when incorporated in the aluminium sulphate-lime sulphur spray are found to persist on foliage for a longer period than when used in the straight lime sulphur mixture. Calcium arsenate is more adhesive to foliage when present in Bordeaux mixture than any of the arsenicals which can be used in lime sulphur sprays.

Chemical assistance has been given towards the establishing of desirable "standards" to be used in connection with the new Act governing the sale of insecticides and fungicides.

Brief reports on various insecticides and fungicides submitted and examined during the year follow.

ARSENATE OF LEAD

Two samples were analyzed; one was of excellent quality the other a gross adulteration.

ANALYSIS OF ARSENATE OF LEAD, 1926–27

Lab'y No.	Source of Sample	Vendor or Submitter	Arsenic Oxide		Lead Oxide	Moisture at 100°C
			Total	Water Soluble		
			p.c.	p.c.	p.c.	p.c.
*86356	John Dorland, Cobalt, Ont.	L. D. McClintock, Knowlton, P.Q.	nil	nil	nil	nil
88221	Deloro Chemical Co., Deloro, Ont.	W. A. Ross, Vineland, Ont.	31·71	0·08	64·80	0·28

*Taken from a 2 pound package containing instructions that the contents of the package was sufficient for 200 gallons of poison. This material was found to be ground gypsum or land plaster.

CALCIUM ARSENATE (ARSENATE OF LIME)

The samples examined show marked variation in the percentage of water soluble arsenic present; it is evident that where the process of manufacture is well controlled, the amounts of water soluble arsenic is practically negligible. Sample No. 86429 was received as lead arsenate, but analysis showed it to be calcium arsenate containing only one-half the customary percentage of total arsenic oxide. The filler or inert material being dolomitic lime.

ANALYSIS OF CALCIUM ARSENATE (ARSENATE OF LIME), 1926–127

Lab'y No.	Source of Sample (Manufacturer)	Vendor or Submitter	Arsenic Oxide (As_2O_5)		Moisture
			Total	Water-soluble	
			p.c.	p.c.	p.c.
84654	Deloro Chemical Co., Deloro, Ont.	Deloro Chemical Co., Ltd., Michel de Rougemont, P.Q.	44·06	0·08	.....
86429	.....	.....	20·14	0·82	2·38
86666	Niagara Sprayer Co., Middleport, N.Y., U.S.A.	H. Edwin Bell, Collins Bay, Ont.	40·29	1·63	2·06

Sample No. 86666 was received with the remarks that severe foliage injury had followed the application of this insecticide in a combined lime sulphur-calcium arsenate-hydrated lime spray. This insecticide when submitted to carbon dioxide aspiration in a 3-10-50 Bordeaux spray liberated no soluble arsenic whatever, thus indicating that it was chemically stable and not liable to cause foliage injury.

SOLUBLE ARSENIC IN CALCIUM ARSENATE-LIME SULPHUR SPRAYS

A consideration of the foregoing case made it desirable to ascertain to what extent soluble arsenic is liberated when calcium arsenate is added to lime sulphur, with and without added lime. Accordingly a sample of lime sulphur was obtained from the Horticultural Division and a spray solution prepared similar

to the one used in the orchard and which it was stated had caused foliage injury. The sample of lime sulphur on analysis yielded the following: Bé.—32·5° at 20° C. Total sulphur, 24·80 per cent.

The percentage of water soluble arsenic oxide set free when the concentrated spray materials are mixed and allowed to stand for forty hours is as follows:—

	Water soluble arsenic oxide
In spray (supernatant fluid)	0·69
In sediment, when lime is used	0·49
In sediment, without lime	1·42

These results show that when a combined spray of the nature of calcium arsenate or lead arsenate with lime sulphur is prepared and allowed to stand there is a decided increase in the amount of soluble arsenic formed. The sediment present is a grave source of injury, due to the arsenic which would be subsequently liberated from the spray on the foliage. Further, though the amount of soluble arsenic is markedly lessened when lime is added, this diminution is only temporary, for atmospheric conditions and the respiratory carbon dioxide from the living leaf surface will again set free soluble arsenic. Foliage injury may thus result a month or six weeks after the spray has been applied.

It is strongly recommended that only freshly prepared tanks of combined spray be applied. Care should be taken to effect thorough agitation of the mixture during spraying. If for any reason a tank of spray has stood for any length of time it should be emptied and all sediment flushed out of the tank. It is good practice to thoroughly flush out the tank in order to minimize the risk of foliage injury.

PARIS GREEN

The samples analyzed were well made and free from adulteration; the particulars are given in the following table:—

ANALYSIS OF PARIS GREENS, 1926-27

Lab'y No.	Source of Sample	Vendor or Submitter	Arsenious Oxide		Cupric Oxide
			Total	Water-soluble	
			p.c.	p.c.	p.c.
85211	Le Comptoir, Co-operatif Federe de Quebec, Montreal	Z. Vaillancourt, Petite Cote	55·48	1·15	30·42
85212	Dupuy & Ferguson, Montreal	"	56·99	1·17	30·07

SULPHUR DUST

Lab'y. No. 84794

Sulphur Dust submitted by The Grafton Fruit Company Limited, Grafton, N.S., and prepared or mixed by the Niagara Dust Company, Kentville, N.S. The sample was pure yellow powder yielding the following data on analysis:—

ANALYSIS

	p.c.
Sulphur (S)	78·60
Arsenic oxide (As_2O_5)	4·74
Water soluble arsenic oxide (As_2O_5)	0·06
Lead Oxide (PbO)	9·75

This sample is a sulphur-lead arsenate dust with a colloidal clay (Bentonite). Dust of this character combining fungicidal and insecticidal qualities—are yearly becoming more popular.

POTATO POISONS

Lab'y. No. 84653

"Potato Dust Poison" manufactured and submitted by the Deloro Chemical Company, Deloro, Ont.

ANALYSIS

	p.c.
Total arsenic oxide (As_2O_5)	9·62
Water soluble arsenic oxide (As_2O_5)	0·10
Copper (CuO)	8·07

This dust is practically a dry Bordeaux mixture with calcium arsenate; it should possess both insecticidal and fungicidal properties.

Lab'y. No. 88135

Potato Insecticide, "Handy Killer" manufactured by Ralph B. Adams, Lakeville, N.B., and submitted by R. T. Holman, Limited, Summerside, P.E.I.

ANALYSIS

	per cent
Arsenious oxide (As_2O_3)	40·67

As received, this sample was a colourless liquid, strongly alkaline with a slight residue of iron oxide. It is a solution of sodium arsenite, equivalent to 69·9 per cent as Na_2HAsO_3. Its caustic nature necessitates its use with lime or Bordeaux mixture; without such addition it would defoliate the crop.

INSECTICIDE

Lab'y. No. 85841

Submitted by the Dominion Entomologist and manufactured by A. St. Leger, Lago Maggiore, Italy; as received, a dark coloured, odoriferous liquid, strongly alkaline.

It is a sulphonated tar oil neutralized with ammonia, and containing apparently the active principle of Derris root, "Rotenon." This is one of the more newly introduced insecticides under investigation by the Entomological Branch.

CORROSIVE SUBLIMATE TABLETS No. 2

Lab'y Nos. 84012-20

These tablets were submitted by the Live Stock Branch, Department of Agriculture. Their corrosive sublimate content is given in the following table:—

ANALYSIS OF MERCURIC CHLORIDE TABLETS, 1926-27

Lab'y No.	Source	Average Weight per Tablet	Corrosive Sublimate (Mercury Bichloride)	
			Per cent	Grains per Tablet
		Grains	p.c.	Grains
84012	The Lawrence Dairy Supply, Ottawa	5·15	76·20	3·92
84013	Frank W. Horner, Montreal	7·16	38·44	2·75
84014	The de Laval Co., Peterboro, Ont	5·28	76·84	4·05
84015	C. Richardson & Co., St. Marys, Ont	5·31	61·42	3·26
84016	D. Derbyshire & Co., Brockville, Ont	7·01	37·76	2·65
84017	Parke Davis & Co., Walkerville, Ont	5·22	78·57	4·10
84018	Chas. E. Frosst & Co., Montreal	5·04	64·62	3·26
84019	Lymans, Limited, Montreal	3·39	75·20	2·55
84020	W. A. Drummond Ltd., Toronto	14·80	47·30	7·01

TOBACCO LEAVES AND STALKS

Lab'y. Nos. 88708-14

Samples submitted by the Chief, Tobacco Division, C.E.F. for determination of nicotine content. These are stated to be representative of the range in nicotine content of leaves and stalks of the variety "Nicotina Rustica," grown in Southwestern Ontario.

ANALYSIS OF TOBACCO LEAVES AND STALKS, 1926-27

Lab'y No.	Ident. No.	Variety and Condition	Nicotine ($C_{10}H_{14}N_2$)	Moisture, etc. (Loss at 100° C)
		Samples dry and finely ground	p.c.	p.c.
88708	1	Tobacco leaves	2·45	6·45
09	3	" "	9·59	6·89
10	4	" "	4·80	6·50
11	6	" stalks	0·65	5·83
12	18	" "	0·85	5·91
13	19	" leaves	5·08	6·67
14	20	" "	5·00	6·44

From the very wide range in nicotine content it is evident that a careful selection as to variety should be made, looking to the economic manufacture of nicotine products.

KAMFORITE "H"

Lab'y. No. 83957

Manufactured by Heneman Bros., Horncastle, England and submitted by the Horticultural Division, C.E.F.

The manufacturers claim this material to be the best combined pest destroyer, fumigant and fertilizer yet produced. The sample was of a greyish colour having a strong odour of naphthalene with crystals of naphthalene throughout the mass. Ground bone, soot, lime and iron were also present.

ANALYSIS

	Per cent
Naphthalene	25·41
Nitrogen	0·25
*Phosphoric Acid	4·33
Potash	Nil

*Equivalent to phosphate of lime, 9·46 (p.c.)

Its value as a soil fumigant and pest destroyer would depend on the quantity of naphthalene present. The bone meal present may be regarded as the chief fertilizing constituent, supplemented to some degree by the soot and calcium sulphate present.

WEEVIL BAIT

Lab'y. Nos. 84362 and 84655

"Strawberry Weevil Bait" submitted by the Superintendent of the Experimental Station at Saanichton, B.C., and "Go-West" Weevil Bait submitted by the Dominion Entomologist, Ottawa. The baits were manufactured by M. R. Forsell, Seattle, Washington.

The baits were composed of dried or shredded apple waste coated with a white powder.

ANALYSIS

	Lab'y No.	
	84362	84655
	p.c.	p.c.
Arsenic oxide (As_2O_5)	1·54	1·39
Water soluble arsenic oxide (As_2O_5)	0·61	0·68
Calcium oxide (CaO)	0·42	0·45
Magnesium oxide (MgO)	1·42	1·55
Moisture	7·24	12·68

The base of the baits is dried apple with magnesium arsenate as the poison component. Field experiments have shown that this bait is relished by the weevils so that it is unnecessary to add any further lures or attractants. The moisture content of the bait, whether dried apples or apple waste should be below 20 per cent in order that the bait will distribute freely without caking.

Further field experiments carried on by one of the officers of the Entomological Branch stationed in British Columbia have shown that a bait made of dried raisin waste and calcium arsenate (95-5) is equally as effective in controlling this serious marauder.

DERRIS ROOT

Lab'y. No. 81338

The sample, as received, was a finely ground, yellowish-coloured powder. It was submitted by A. Kelsall, Entomological Laboratory, Annapolis Royal, N.S. This newly introduced insecticide is regarded as a contact and stomach poison.

ANALYSIS

	Per cent
Moisture	6·48
Ether extract	8·79
*Methoxyl content	14·90
**Alcohol extract after ether extract	14·25

The desirability of fine grinding of the root may be pointed out, with a view to maximum effectiveness:—

PHYSICAL EXAMINATION

	Per cent
Passing 20 mesh sieve	100
" 40 "	100
" 60 "	91
" 80 "	79
" 100 "	72

The most important constituents of the root as determined by several investigators, are a white crystalline substance "Tubatoin" or "Rotenon" and a resin or series of resins called "Derride" or "Tubain". In addition, the roots contain mucilage, gums, tannin, fat and fatty bodies. The poisonous constituents are relatively non-volatile and only slightly soluble in water and solid.

In the tropics, and especially in the Malayan Peninsula, in addition to its employment as an insecticide, derris root is used as a fish poison. It is only necessary to macerate the green roots in water and pour the milky suspension into the stream. The fish rapidly come to the surface and are captured while in a more or less stupified state.

* The percentage of ether extract *per se*, cannot be regarded as a measure of the toxicity of the sample, but considered in conjunction with methoxyl content, it serves towards a decision in respect to genuineness and strength.

** Gives a general indication of the non-toxic constituents having some value as emulsifying or wetting agents. The percentage found is high, indicating that this sample possesses high emulsifying properties, confirmed later by actual use of the root in spray preparations.

The pieces of root on arrival in this country are quite dry, indicating a drying up of the sap and the consequent coagulation of the poisons. For this reason the root should be ground to an impalpable powder and special means taken that it is thoroughly dispersed throughout the spray fluid; for maximum efficiency the use of organic solvents e.g. wood spirit, is advisable.

Derris is quite poisonous to the lower forms of life; in moderate doses it is non-poisonous to man. Its uses are many; it has been found very effective as a moth preventative, as an exterminator of lice and fleas and also as an agent in mosquito control work.

FLY AND MOTH PREPARATIONS

Lab'y. Nos. 86841-45

Five preparations were submitted by the Dominion Entomologist. The specific or brand names with names and addresses of the manufacturers are as follows:—

Lab'y No.	Nature of Sample	Manufacturer
86841	Flit	The Standard Oil Co., Bayonne, N.J.
86842	Fly-tox	Canada Rex Spray Co., Brighton, Ont.
86843	Sapho "Fly X"	The Kennedy Mfg. Co., Montreal.
86844	Sapho Liquid	The Kennedy Mfg. Co., Montreal.
86845	Larvex	The Larvex Corp., Brooklyn, N.Y.

The base of these preparations, with the exception of Larvex, is kerosene. The details of analysis are given in the following table:—

ANALYSIS OF FLY AND MOTH PREPARATIONS

Preparation	Flit	Fly-tox	Sapho "Fly X"	Sapho-Liquid	Larvex
Specific gravity at 19° C.	0·810	0·830	0·844	0·844	1·007
Flash point	60° C.	66° C.	67° C.	67° C.	.....
Fire Point	69° C.	78° C.	77° C.	78° C.	.....
*Relative volatility	5·5%	3·78%	5·6%	7·25%	31·98%
Residue at 100° C	0·28%	0·31%	0·15%	0·81%	
Methyl salicylate (by weight)	0·75	3·13	2·08	.....	.....
Phenol (carbolic acid)	.....	.....	.....	1·68%	
Sodium fluosicilicate	.....	.....	.....	.....	1·80%
Pyrethrum	.....	present			

OILS AND INSECTICIDES

Lab'y. No. 88430-434

Five oils used in the preparation of emulsions for spray purposes have been examined. They were submitted by W. A. Ross, Entomologist in Charge, Vineland, Ont., and were the product of the Barrett Co., New York City.

Lab'y No.	Oil	Specific Gravity at 20° C.	Reaction	Approximate Composition		
				Light oils (up to 200° C.)	Carbolic and creosote oils (200°-270° C.)	Residue (Tar)
				p.c.	p.c.	p.c.
88430	Hydrocarbon oil	1·003	Alkaline	25	72	3
88431	Cresylic acid	1·025	Acid	2	94	4
88432	Carbo cresol	1·039	Alkaline	20	60	20
88433	25 per cent tar acid oil	1·016	Acid	26	70	4
88434	Crude creosote	1·033	Alkaline	15	65 above 270° C 6	14

These oils are being used in emulsions for the destruction of hibernating insects and eggs during the dormant season and it is hoped that the physical constants of this examination may assist in the inquiry.

Lab'y. No. 84123

Two petroleum oils—heavy and light—submitted by the Dominion Entomologist and the product of The Imperial Oil Co. have been examined. These oils, it was proposed, should be mixed in the proportion of 30 parts of heavy oil to 70 parts of light, the resultant mixture to be used for mosquito control on pools, ponds, etc. The light oil had a specific gravity of 0·8535 at 20° C.; the heavy oil, 0·8875.

Neither of these oils would readily form a film when poured on water. The compounded oil on analysis yielded the following results:—

ANALYSIS OF MIXED OIL

Mixed oil (70 parts light oil to 30 parts heavy)

Flash point	87° C.
Fire point	95° C.
Specific gravity at 20° C	0·864
Volatility—	
4 hours at room temperature—0·84 per cent.	
4 hours at 100° C.—19·89 per cent.	

Mixtures of the light and heavy oil in various proportions were prepared and in no case would a continuous oil film form when the resultant oil was poured on water. Further experiments were undertaken towards film formation and it was found that the addition of ·004 per cent of a solution of caustic soda in water or alcohol was sufficient to cause the oil to spread rapidly and evenly when sprayed on water; the oil film was then continuous: In field work when the treated oil was used at the rate of 1 ounce to 15 square feet a continuous film remained for at least a week even though subjected to occasional heavy rains.

In subsequent experiments with a number of dusts as mosquito controls, finely ground derris root was found to be highly effective.

THE EXAMINATION OF SPRAYED APPLES FOR ARSENIC

Owing to the appearance in the autumn of 1925 of statements that cases of arsenical poisoning had occurred in England from eating imported apples, steps were taken to procure for analysis samples of Canadian apples from sprayed orchards in various parts of the Dominion. The work of collection was undertaken by the Dominion Entomologist, who through his provincial officers secured authenticated sprayed apples from the chief apple exporting districts.

Forty-three samples in all were subjected to analysis: eight from Nova Scotia, eight from Quebec, seventeen from Ontario, and ten from irrigated orchards in British Columbia.

Each sample consisting of from six to twelve apples was divided and each portion separately analysed. The examination was confined to skin, calyx and stalk, as it generally is agreed that the flesh of the apple is free from arsenic even though "ponderable amounts" of this poison may be present in the skin.

A detailed report of this work was made which included particulars as to province, variety, spraying (nature of arsenical, date of last spraying, etc.), but it may serve, for the purpose of this report to summarize the results as follows: (1) Approximately one half the samples were entirely free from arsenic, (2) one-sixth of the samples showed traces of arsenic in amounts less than 1/10000 of a grain per pound—negligible quantity; and (3) one-third of the samples contained arsenic in quantities ranging from 1/10000 to 1/190 of a grain per pound.

With the heaviest amount of arsenic found, viz., 1/190 of a grain per pound it would require three pounds or one dozen apples of average size to supply the minimum medical dose of arsenic and twelve pounds or four dozen applies of average size to supply the maximum medical dose.

The second annual examination of Canadian sprayed apples for arsenic was made on the crop of 1926. As in 1925 the collection of samples was made by officers of the Entomological Branch (Department of Agriculture), who, in addition to securing and forwarding the fruit, furnished detailed information in respect to the spraying as practised in the several orchards from which the apples were picked.

The total number of samples subjected to analysis was 56. These may be considered as representative of sprayed orchards from the chief apple exporting districts in the several provinces, the number of samples from the respective provinces being as follows:—

	No. of samples
Nova Scotia	18
New Brunswick	6
Quebec	11
Ontario	15
British Columbia	6

Each sample consisted of 12 apples, instructions having been given to select fruit from the orchard picking with the largest apparent residue.

One-third of the samples were entirely free from arsenic or contained arsenic in negligible traces only. Ninety-five per cent of samples contained arsenic in amounts less than 1/100 grain per pound.

The results of this enquiry now extending over two years furnish evidence to the effect that a very large proportion of Canadian sprayed apples is entirely free from arsenic and that in such cases in which arsenic has been detected the quantities are negligible.

WELL WATERS FROM FARM HOMESTEADS

The examination of waters from farmers' wells continues as an important and appreciated phase of the combined work of the Divisions of Chemistry and Bacteriology. The waters analyzed during the year include samples from every province in the Dominion.

A detailed report is forwarded to the sender of each sample but it may suffice here to summarize our findings in the following classification:—

	Per cent.
Pure and wholesome	34
Suspicious and probably dangerous	18
Seriously polluted	24
Saline	24

The percentage of samples returned as "safe and wholesome" is lower than last year but the division's records since 1887 would indicate that it is a fair average. It is evident that there is still need of propaganda urging the establishment of a pure water supply on many Canadian farms and, what is just as important, its subsequent protection from contamination.

Attention may be drawn to wells in villages. These at the outset may furnish excellent water. As the village grows and houses crowd closer and closer together, the danger of pollution increases. Septic tanks for the disposal of the household sewage are decidedly preferable to cess pits, but in too many cases sufficient attention has not been paid to their location in respect to that of the well, with a result that the effluent in the course of a short time contaminates the household water supply. The septic tank with its distributing tiles is to be highly commended; it is the most sanitary method of sewage disposal that the rural homestead can adopt, but the well should not be located in its vicinity. In this connection some interesting facts have come to light following recent investigations with regard to the draining or flow of polluted matter through sand or soil. The polluted drainage travels normally in the direction of the flow of the "underground water", but this direction may be reversed by heavy pumping of the well. If the direction of flow of ground water is unknown, distance from the source of pollution represents the one great factor of safety. During wet weather the level of underground water rises, falling again when a drought follows. Pernicious bacteria accompanying the drainage tend to collect in the zone between the high level and low level of the ground water, hence this is a zone of special danger. This fact emphasizes the desirability of lining the dug well with concrete or puddled clay, say, to a depth of 10 feet, which though not an absolute security against the entrance of contaminating water is a safeguard of very considerable value. In certain types of soil drainage matter of an objectionable character may travel, in the direction of the flow of underground water, great distances. Evidence of this has been obtained at from 200 to 400 feet from the source of pollution. A minimum safe distance from a possible contaminating source at which to locate a well would appear to be 150 feet.

If a farmer is in any doubt as to the purity of his well water he should have it examined. On application to the Division of Chemistry, Experimental Farm, Ottawa, the necessary directions for the collection and shipment of the sample for analysis will be forwarded.

SOFT PORK INVESTIGATION

During the past year this Division has co-operated with the Division of Animal Husbandry in an investigation of the causes of "softness" in pork. Some years ago a very comprehensive study of this question was made at the Central Experimental Farm and the results of this investigation and the conclusions drawn were published in Department of Agriculture Bulletin No. 38 (1901).

The matter is not a serious one in Canada to-day, but there have been a sufficient number of cases of softness recently reported—more particularly in the western part of the country—to warrant the reopening of the inquiry.

The present investigation is still in progress, but it is satisfactory to note that the results so far have confirmed our previous deductions and justify the statement that immaturity and lack of thrift (from whatever cause) are the two chief, perhaps the sole, causes of softness.

The work in these laboratories has chiefly consisted in ascertaining the percentage of unsaturated fats present in the fat itself from determinations of the iodine numbers and butyre-refractometer readings of the purified fats.

During the past year we have analyzed one hundred and four samples, of which thirty-two were submitted by the Experimental Station at Lennoxville, P.Q., forty-four by the Central Experimental Farm, Ottawa, sixteen by the Experimental Station at Lacombe, Alta., and twelve by the Experimental Farm at Brandon, Man.

APPLE WRAPS

In co-operation with the Division of Horticulture this Division has continued to assist in the inquiry respecting the influence of various plain, waxed and oiled papers on apple in storage. The results of the analysis of eight papers used as apple wraps in this investigation at the Experimental Station, Summerland, B.C., are given in table 37.

TABLE No. 37—OILED AND WAXED APPLE WRAPS, 1926

Lab'y No.	Description	Moisture	Petrolic Ether Extract	Butyro-Refract-ometer Reading at 25° C.	Refractive Index
		p.c.	p.c.		
86309	Oiled wraps—heavy No. 1	6·02	18·18	52·7	1·461
86310	" medium, No. 2	5·39	16·87	52·1	1·460
86311	" light, No. 3	5·02	16·44	53·3	1·461
86312	" Protexit, No. 4	5·35	14·79	52·8	1·461
86313	" Keystone, No. 5	5·74	13·53	72·7	1·474
86314	Sulphite wrap No. 6	6·03	0·33	.....	
87353	Paper Protectors—Hot Kaps (Paraffin Wax)	5·41	20·64	(M.P. of wax 50-51° C.)	
87354	Paper Protectors—Glassine (glazed)	6·77	0·17	.....	

The data indicate that the oil used in Nos. 1, 2, 3 and 4 is essentially of the same grade and quality.

Respecting these papers the Superintendent of the Experimental Station, Summerland, B.C., writes as follows:—

"Papers 1, 2, 3, 4 and 6 have been manufactured by the Westminster Paper Mills of New Westminster, B.C. Paper No. 5 is manufactured by the Pacific Pulp and Paper Mills. Paper No. 6 is plain sulphite, having no oil and is the basis of papers Nos. 1, 2, 3 and 4. Papers Nos. 4, 5 and 6 are the regular commercial stock which is being used in the Okanagan Valley packing houses this season (1926)."

PRESERVED AND FROZEN EGGS

PRESERVED EGGS

At the request of the Poultry Division of the Live Stock Branch an investigation was instigated for the determination of a method for the identification of eggs preserved by the most recent commercial process. In this process the eggs are dipped, momentarily, in a bland mineral oil, then placed in storage and, immediately before being marketed, are subjected to a fine sand blast which removes dirt and outside traces of the oil.

By the method developed in this laboratory it has been possible for the Live Stock Branch to classify properly several carloads of preserved eggs which might otherwise have come into competition on the market with fresh or new laid eggs.

FROZEN EGGS

Comparison of the composition of the domestic products from two Canadian firms was made with that of two long established firms operating in China: one English, the other American.

The chemical composition of the various products was found to be quite uniform and in no case was artificial colour present. Any inferiority exhibited by the local product was attributed to incomplete mixing of yolk and albumen and recommendations were made to correct this undesirable feature.

ANALYTICAL AND EXAMINATIONAL WORK ON SAMPLES SUBMITTED BY THE HEALTH OF ANIMALS BRANCH, DEPARTMENT OF AGRICULTURE

During the year 2,292 samples were examined and reported on. This report gives a brief summary of the analytical results obtained for each class of product.

CLASSIFIED LIST OF SAMPLES EXAMINED DURING THE YEAR, 1926-27

Condensed and evaporated milks	792
Milk and cream powders	352
Evaporated apples	204
Colours and inks	9
Salts and preservatives	41
Spices and condiments	156
Denaturing oils	47
Lards, lard compounds, edible oils and fats	37
Canned and preserved fruits and vegetables	213
Tomato products	79
Sausages, potted and preserved meats and fish pastes	193
Pickled pork and bacon	76
Miscellaneous	93
Total	2,292

CONDENSED AND EVAPORATED MILKS

Seven hundred and ninety-two samples were examined under this heading. The average, maximum and minimum percentages of fat of one hundred and forty-nine samples of sweetened condensed milk were 8·31, 9·43 and 7·26, respectively. Eleven samples, or 7 per cent of the number examined, contained less than 8 per cent, the minimum allowed by the regulations for this class of milk product.

In two samples only was a deposit of sugar found at the bottom of the can. This is a decided improvement over last year, when 16 per cent had " sugar down ".

Six hundred and forty-three samples of evaporated milks were examined. A summary of results is given in table 38.

TABLE 38.—SUMMARY OF RESULTS AND ANALYSES OF EVAPORATED MILKS

Net Weight			Total Solids			Fat		
Number of samples	Net weight	Per cent number under weight	Number of samples	Total solids	Per cent Number below standard (25·5 p.c.)	Number of samples	Fat	Per cent number below standard (7·8 p.c.)
	oz.			p.c.			p.c.	
193	Ave 6·15....	5	153	Ave. 26·00....	Nil	153	Ave. 7·86....	3
	Max. 6·29....			Max. 26·78....			Max. 8·22....	
	Min. 5·85....			Min. 25·76....			Min. 7·78....	
450	Ave.16·31....	14	490	Ave. 31·80....		490	Ave. 9·15....	
	Max.16·92....			Max. 33·95....			Max. 9·76....	
	Min.14·69....			Min. 31·42....			Min. 8·97....	

Last year 41 per cent of samples contained in the larger cans were underweight. This year only 14 per cent were found to be low, which shows a decided improvement.

SKIM-MILK, WHOLE MILK AND CREAM POWDERS

Three hundred and fifty-two samples were examined. A summary of results is given in table 39.

TABLE 39.—SUMMARY OF RESULTS OF ANALYSES OF MILK AND CREAM POWDERS

Moisture			Ash		Fat		
Number of samples	Moisture	Per cent number above standard (5 p.c.)	Number of samples	Ash	Number of samples	Fat	Per cent number below standard (26 p.c.)
	p.c.			p.c.		p.c.	
	Skim-milk Powder						
222	Ave. 3·28	8	222	Ave. 8·02			
	Max. 6·74			Max. 8·52			
	Min. 1·37			Min. 7·25			
	Whole Milk Powder						
123	Ave. 1·99	Nil	123	Ave. 5·87	123	Ave. 27·32	7
	Max. 4·47			Max. 6·40		Max. 34·77	
	Min. 0·52			Min. 4·45		Min. 24·16	
	Cream Powder						
4	Ave. 0·89	Nil	4	Ave. 2·34	4	Ave. 69·50	
	Max. 1·67			Max. 2·54		Max. 70·13	
	Min. 0·45			Min. 2·15		Min. 69·31	

Two samples of " ice-cream mix " contained 34·16 per cent and 32·28 per cent fat respectively. One sample of " Dryco " milk powder contained 11·95 per cent fat.

All samples examined were found to be free from borates and carbonates.

EVAPORATED APPLES

Two hundred and four samples were examined for water content. Table 40 gives a comparison of results of analysis for the past five years.

TABLE 40.—WATER CONTENT OF EVAPORTAED APPLES

Year	Number of samples	Water per cent			Number of samples containing water in excess of standard (25 p.c.)	Per cent number containing water in excess of standard
		Average	Maximum	Minimum		
1922–23	604	21·4	33·3	2·8	101	17
1923–24	300	22·1	31·1	6·2	53	18
1924–25	412	21·8	31·3	4·8	56	14
1925–26	561	21·7	34·4	3·9	72	13
1926–27	204	22·2	27·7	4·2	28	14

SALTS AND PRESERVATIVES

Forty-one samples were examined: all were free from harmful ingredients. One sample of "Meat Preserver" imported from Germany consisted of sodium chloride, sugar, sodium phosphate, and 3 per cent of sodium benzoate.

SPICES AND CONDIMENTS

One hundred and fifty-five samples were examined. Two samples of mace were adulterated with foreign starch. All other samples were free from adulteration.

COLOURS AND INKS

Six samples of branding ink were examined. None contained arsenic in excess of 5 parts per million.

Two samples of colouring for fish pastes were examined. One consisted of a solution of caramel and the other a solution of colour closely resembling rhodamine 3 B (S. & J. 505).

One sample of red colour for jams was found to be Ponceau 2 R (S. & J. 55), a non-permissible colour.

DENATURING OILS

Forty-seven samples were examined. A summary of results is given in table 41.

TABLE 41.—NUMBER AND PERCENTAGE NUMBER OF DENATURING OILS WHICH SATISFY THE VARIOUS STANDARD TESTS

Tests	Standards required	Satisfy requirements	
		Number	Per cent number
All		16	36
Flash point	Not below 75° C. (167° F.)	44	98
Boiling point	Not below 205° C. (401° F.)	23	51
Specific gravity	Not below 0·819	45	100
Taste	Easily recognized when present in the proportion of 1 part oil to 1,000 parts fat	26	58

LARD, LARD COMPOUNDS AND EDIBLE OILS

Thirty-seven samples were examined. One sample only of lard contained more than 1 per cent moisture. All others were free from adulteration.

One sample of imported yellow shortening contained Sudan G (S. & J. 10), a non-permissible coal tar colour.

CANNED AND PRESERVED FRUITS AND VEGETABLES

Two hundred and thirteen samples were examined under this heading. These included one hundred and eleven samples of jams prepared in Canada, fifty-two samples of imported jams, thirty-seven samples of glace cherries, eight samples of canned fruits and three samples of canned vegetables.

A summary of results of analyses of jams and marmalades is given in table 42.

TABLE 42.—SUMMARY OF RESULTS OF ANALYSES OF JAMS AND MARMALADES MADE IN CANADA AND OF IMPORTED JAMS AND MARMALADES

Description	Glucose			Preservatives, Benzoates and Salicylates			Coal Tar Colours		
	Number of samples	Number containing glucose	Per cent number containing glucose	Number of samples	Number containing preservatives	Per cent number containing preservatives	Number of samples	Number containing coal tar colour	Per cent containing coal tar colour
Jams and marmalades made in Canada.....	110	12	11	111	10	9	110	45	41
Imported jams and marmalades.....	52	1	2	49	0	.....	49	7	14

No samples of jams or marmalades were found to contain preservatives in excess of that allowed by the regulations.

Non-permissible coal tar colours were found in five of the samples of imported jams.

The samples of Canadian jams included forty-eight samples specially collected from various bakeries. In twelve of these, microscopical examination showed the presence of apple pulp.

Five samples of imported glace cherries were found to contain non-permissible coal tar colours. No samples of this product contained more than traces of sulphites.

The average, maximum and minimum percentages of glucose in thirty-four samples of glace cherries were 46·3, 67·1 and 23·1, respectively.

One sample of maraschino cherries contained 0·30 parts per 2000 of sulphur dioxide in the drained fruit and 0·72 parts per 2000 in the syrup.

TOMATO PRODUCTS

Seventy-nine samples were examined under this heading.

The average, maximum and minimum percentages of total solids of twenty-three samples of tomato pastes were 35·3, 46·2 and 19·6, respectively.

All samples were free from coal tar colours and preservatives.

Fifty-four samples of tomato ketchups, pulps and sauces were examined for coal tar colour and preservatives.

Twenty-nine samples contained preservatives (benzoates or salicylates).

Eight samples contained preservatives in excess of the maximum amounts allowed by the regulations.

Twenty-three samples contained coal tar colour. Ponceau 3 R. (S. & J. 56), a permitted colour, was the only colour found in this class of food product.

Several samples of tomato ketchup were examined to see if they contained any gum. A small amount of gummy substance was found in all of them, but this was not considered excessive in any of the samples submitted.

SAUSAGE, POTTED AND PRESERVED MEATS AND FISH PASTES

One hundred and ninety-three samples were examined. Fifty samples of sausages were examined for water, protein and starch content.

Summaries of results are given in table 43.

TABLE 43.—SUMMARY OF RESULTS OF ANALYSES OF SAUSAGES FOR WATER, PROTEIN AND STARCH CONTENT

Fifty Samples	Water	Protein (N x 6·25)	Water: protein ratio	Starch
	p.c.	p.c.		p.c.
Average	56·3	13·1	4:4	3·0
Maximum	69·3	21·6	6:7	7·1
Minimum	41·6	8·6	2:6	Free

TABLE 44.—NUMBER AND PERCENTAGE NUMBER OF SAUSAGES CONTAINING WATER AND STARCH IN EXCESS OF AMOUNTS ALLOWED BY THE REGULATIONS, AND SUMMARY OF WATER-PROTEIN RATIOS

Fifty Samples	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
Number	17	12	14	22	34	39	9
Per cent number	34	24	28	44	68	78	18

Ninety-three samples of imported fish pastes were examined for adulteration. Fourteen contained a coal tar colour, rhodamin (S. & J. 505). No preservatives were found.

Forty-seven samples of imported meat pastes were examined. No coal tar colour and no preservatives were found in this class of food products.

The average, maximum and minimum percentages of cereal starch in eighteen samples of fish paste were 2·7, 7·9 and nil respectively.

The average, maximum and minimum percentages of cereal starch in ten samples of meat paste were 4·2, 6·9 and 1·2, respectively.

PICKLED PORK AND BACON AND PICKLING SOLUTIONS

Thirty-nine samples of pork and bacon were examined for sodium nitrite content.

The maximum amount of sodium nitrite allowed by the regulations is 200 parts per million. Fourteen samples, thirty-six per cent, contained excessive amounts of this preservative.

Thirty-seven samples of pickling solutions were examined for sodium nitrite content. Seven samples contained more than 200 parts per million, one of these containing as much as 1,820 parts per million.

MISCELLANEOUS

Ninety-three samples were examined under this heading, including vinegars, flours, sugars, Fuller's earths, jellies, mincemeats, lemon curds, corn syrup, gelatin and various brands of pickles. One sample of "Solum" for bleaching tripe was found to be pure sodium perborate. Small amounts of copper were found in six samples of pickled cucumber, which appeared to be highly coloured.

INDEX

OTTAWA. Printed by F. A. ACLAND, Printer to the King's Most Excellent Majesty, 1928.