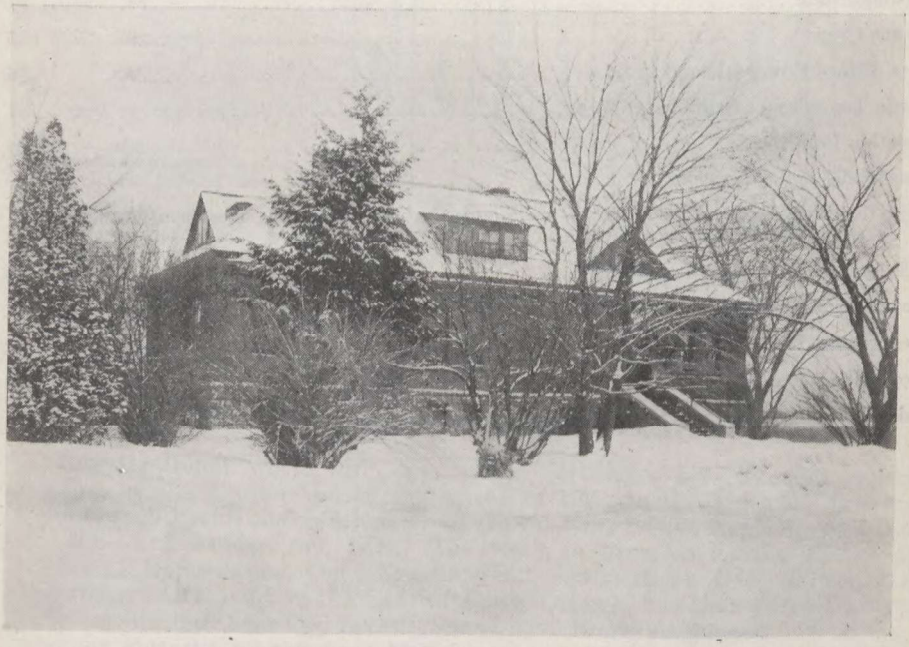
DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

DIVISION OF CHEMISTRY

REPORT OF THE DOMINION CHEMIST

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

FOR THE YEAR ENDING MARCH 31, 1924



Chemical Laboratories—Central Experimental Farm, Ottawa.

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Conditions necessitate that this report—the thirty-seventh in the history of the division—be written in the briefest manner possible. It is to be regarded therefore merely as a summary, enumerating the more important phases of the work with the omission of all but the most essential details.

The construction of a wing to the Chemical Building, almost ready for occupation, will afford much needed extra accommodation for efficiently carrying on the ever increasing volume of work. The extension contains six small laboratories suitable for special investigations, a milling room, an apparatus store room and large attic to be used as a library.

The character and in some degree the volume of the work of the division during the past fiscal year is indicated by the following table, in which the samples received for analysis and report are roughly classified.

SAMPLES RECEIVED FOR EXAMINATION AND REPORT FOR TWELVE MONTHS ENDING MARCH 31, 1924

—	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	Total
Soils	46	13	202	1	103	66	5	7	4	487
Manures and fertilizers	16	1	.....	.....	36	41	19	28	21	162
Forage plants, fodders and feeding stuffs	34	207	19	136	1,893	423	262	163	2	3,139
Waters, including rains and snows	8	10	7	11	265	24	10	8	1	344
Samples, Meat and Canned Foods Division	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,635
Miscellaneous, including dairy products, insecticides and fungicides	34	36	23	15	672	50	18	15	8	802
Total	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,569

INVESTIGATIONAL WORK WITH FERTILIZERS

Investigational work with commercial fertilizers has received especial attention by the division during the season of 1923, in the Maritime provinces on the branch Farms and Stations at Charlottetown, P.E.I., Kentville and Nappan, N.S., and Fredericton, N.B. The work in progress on the Farms and Stations at Kapuskasing, Ont., Agassiz, B.C., Summerland, B.C., Sidney, B.C., Beaverlodge, Alta., and on the Central Farm, Ottawa, has been carried forward and in certain instances new investigations have been commenced. In addition, numerous inquiries of correspondents in respect to the economic and rational employment of fertilizers have been dealt with.

As the space available in this report does not permit of any detailed discussion of the results obtained during the season of 1923, a brief outline only will be given of the more important phases of this branch of investigational

work. It is the intention of the division however to publish separately in the near future detailed results of the experiments conducted during the last two years 1922-23.

Experiments with Nitrate of Soda.—From experiments conducted at Charlottetown, P.E.I., Fredericton, N.B., Sidney, B.C., and Invermere, B.C. to determine the most advantageous time to apply nitrate of soda to the potato crop, it was found that the best returns were obtained from an application of all the nitrate at planting time, closely followed by results obtained when two-thirds of the nitrate was applied at planting time and one-third when the crop appeared above ground. No doubt seasonal conditions affect results in this matter.

The results from nitrate of soda applied as a top dressing to oats at Kentville, N.S., indicated that a heavier application than 100 pounds per acre was not warranted. The nitrogen applied to the grain crop of this experiment had no residual effect on the clover hay crop of the following year. Also at this Station an application of nitrate to grass lands at the rate of 100 pounds per acre was found to give a larger profit than heavier dressings of this fertilizer.

Experiments with Ground Limestone.—As data from experimental work with ground limestone on the soils at Kentville and Nappan, N.S., and Fredericton, N.B., accumulate, the beneficial influence of this soil amendment is becoming more evident, being particularly noticeable on the clover hay crops. In Experiment No. 5 at Kentville, N.S. the favourable influence of lime on the development of the clover crop under adverse seasonal (winter) conditions must be regarded as a valuable and important result of this soil amendment.

The experiments at Nappan and Kentville, N.S., to determine the most desirable rate at which to apply ground limestone have, up to the present time, shown at these Stations that rates of from one to two tons per acre have proved the most profitable, although yields increased with larger applications.

"Fertilizer Formulae for Potatoes" Experiment (at Charlottetown, P.E.I., Nappan, N.S., and Fredericton, N.B.).—This experiment was commenced in 1922, in an endeavour to obtain information as to the amount and nature of plant food most profitable to apply for the potato crop. A large number of formulae were put under trial and full discussion of the data obtained must be postponed until there is an opportunity to consider the results in detail.

Basic Slag Experiments.—In the spring of 1923 an experiment to compare the effect of Bessemer Slag, Fortified Slag and Ground Natural rock phosphate on crop yields in a three-year rotation of grain, clover hay, timothy hay was commenced at Fredericton, N.B., Kentville and Nappan, N.S., and Charlottetown, P.E.I. Field data are being supplemented with chemical analysis of the various materials used. Final deductions from this work cannot be made until the end of the crop rotation—1925.

Experiments at Kapuskasing, Ont.—Experimental work on the branch Station at Kapuskasing, Ont., has been temporarily discontinued due chiefly to the unsuitability of the areas on which the experiments were being conducted. A survey of this farm with a view to selecting a more satisfactory area for investigational work with fertilizers was begun in the fall of 1923. In the course of this survey it was found that a stratum of calcareous clay subsoil occurs below the surface clay soil at depths of from 2 to 5 feet containing approximately 30 to 35 per cent of carbonate of lime and 6 to 8 per cent of carbonate of magnesia. The occurrence of this calcareous deposit may be more or less general in the district and if such is the case it makes possible a cheap and valuable source of lime for agricultural purposes.

The predominance of clay and muck areas in this district, both of which would be largely benefited chemically and physically by applications of lime make this discovery one of very considerable agricultural value. The matter is of sufficient interest to warrant the publication of the analytical data obtained on the samples collected at Kapuskasing.

ANALYSIS OF SUB-SOILS, EXPERIMENTAL STATION, KAPUSKASING, ONT.

Lab'y. No.	Location	Depth	Moisture, Loss on Ignition etc., by difference	Insoluble Residue	Oxide of Iron and Alumina	Carbonate of Lime	Carbonate of Magnesia
		ft.	p.c.	p.c.	p.c.	p.c.	p.c.
66184	Face of cut near Kapuskasing, Riv.....	4 (approx.)	.....	51·74	3·50	35·75	9·46
66186	From excavated material at Sheep Barn...	?	1·83	51·10	3·88	35·08	8·11
66519	From clay area, lot 25, con. 12.....	1	8·71	73·50	11·80	1·85	4·14
66520	" " ..	2	5·81	58·16	13·23	16·35	6·45
66521	" " ..	3	3·41	49·66	8·64	32·30	5·99
66522	" " ..	4	2·72	48·67	7·22	32·56	8·83
66523	" " ..	5	1·98	48·84	8·34	33·45	7·39

Experiments at Sidney, B.C.—In the spring of 1923 an experiment was commenced at this Station to ascertain (1) the influence of each of the essential elements of plant food in a complete fertilizer. (2) The relative values of sulphate of ammonia and nitrate of soda as sources of nitrogen in a complete fertilizer and (3) the value of barnyard manure (10 tons per acre) applied, alone, and in conjunction with a complete commercial fertilizer. The crop used was potatoes.

The results show that while each of the three elements of plant food have a distinct influence on crop yields, nitrogen apparently is the one most needed for the potato crop. As a source of nitrogen, nitrate of soda and sulphate of ammonia gave practically equal returns; however, larger yields were obtained when nitrogen was supplied equally by a mixture of these two materials. The yields also indicate that in the year of its application barnyard manure though of distinct value was not superior to commercial fertilizers and that manure used in conjunction with the fertilizers did not materially further increase the yields. This may have been due partly to the very dry season of 1923 and partly to the fact that the soil was quite well supplied with organic matter, a crop of peas having been ploughed down in 1921.

Other important experiments with fertilizers in progress and distributed throughout the various branch Farms and Stations have the following objects: To obtain data on the growing of potatoes with manure alone, fertilizers alone, and fertilizers in conjunction with manure (1) continuously, (2) in rotations at Charlottetown, P.E.I.; to ascertain the influence chemically and botanically of basic slags on meadows and pastures at Cap Rouge, Que.; to ascertain the influence of phosphoric acid on the yield and date of maturity of the wheat crop at Scott, Sask.; to ascertain the effect of distributing fertilizer applications over the different years of the crop rotation at Kentville, N.S., and Agassiz, B.C.; to ascertain the influence of various fertilizer treatments in the development of the apple tree and the yield of fruit at Kentville, N.S.; to ascertain the fertilizing value of Humber Fish Manure at Central Experimental Farm, Ottawa, Ont.; to ascertain the effect of (1) commercial fertilizers and lime on the alfalfa crop. (2) nitrate of soda applications to cereal crops and meadows, and (3) the residual effects of various grasses on subsequent crop growth, at Beaverlodge, Alberta.

INFLUENCE OF BASIC SLAG ON THE CHARACTER AND COMPOSITION OF HERBAGE

This experiment conducted at St. Joachim, Quebec, under the supervision of the Superintendent of the Experimental Station, Cap Rouge, Que., was planned to ascertain the influence, chemically and botanically of basic slag on meadows.

Two areas were employed, the one a new meadow, the other an old pasture on a side hill, an untreated strip being left on each area as a check.

The application of slag was at the rate of 800 pounds per acre, broadcasted in the spring of 1923. The slag used was Treble X Quality Basic Slag and Florida Phosphate. Total phosphoric acid 17 per cent, fineness 80 per cent.

New Meadow—Plot A: with slag
Plot B: without slag.
Old Pasture—Plot C: with slag
Plot D: without slag.

New Meadow.—Both plots were cut on the same date and the cured samples forwarded to the laboratories for examination and analysis.

COMPOSITION OF HAYS: NEW MEADOW

Constituent	Plot A (Slagged) No. 65666		Plot B No. 65667	
	As received	Dry matter	As received	Dry matter
	p.c.	p.c.	p.c.	p.c.
Moisture	7·45	.....	7·20	.....
Crude protein*	9·85	10·63	9·27	9·98
Crude fat	2·34	2·52	2·17	2·35
Carbohydrates	45·13	48·78	47·02	50·66
Fibre	28·78	31·10	28·55	30·77
Ash	6·45	6·97	5·79	6·24
	100·00	100·00	100·00	100·00
*Albuminoids	8·75	9·45	8·01	8·64
Non-albuminoids	1·10	1·18	1·26	1·34

The botanical examination of these samples yielded the following data:—

BOTANICAL COMPOSITION OF HERBAGE

	Plot A (Slagged) per cent	Plot B per cent
Clover	29·0	13·0
Grasses	65·0	84·0
Weeds*	6·0	3·0

"The clovers present are principally red clover and a sprinkling of vetch. The grasses are 40 per cent red top and 60 per cent timothy. Naturally there are some other grasses present but they do not amount to very much."

It is significant that the hay from the slagged plot is the richer in protein and ash and that it contains the larger proportion of clovers. However, it would not be safe from one year's results—and that the year of application—to conclude that the superior quality of the hay on this plot is directly due to the slag.

*Principally equisetum.

Old Pasture.—The chemical data from the hays of plots C and D may be tabulated as follows:—

COMPOSITION OF HAYS: OLD PASTURE

Constituent	Plot C (Slagged) No. 65668		Plot D No. 65669	
	As received	Dry matter	As received	Dry matter
	p.c.	p.c.	p.c.	p.c.
Moisture	5·73	.....	6·66	.....
Crude protein*	8·05	8·52	6·94	7·44
Crude fat	1·98	2·10	2·05	2·20
Carbohydrates	46·78	49·64	46·73	50·06
Fibre	31·72	33·66	32·29	34·59
Ash	5·74	6·08	5·33	5·71
	100·00	100·00	100·00	100·00
*Albuminoid	7·15	7·57	6·03	6·46
Non-albuminoid	0·90	0·95	0·91	0·98

The results of the botanical examination are as follows:—

BOTANICAL COMPOSITION OF HERBAGE

	Plot C (Slagged) per cent	Plot D per cent
Clovers	5·0	21·0
Grasses	90·0	70·0
Weeds	5·0*	9·0**

As in the case of the samples from the New Meadow the hay from the slagged plot in the Old Pasture is the richer in protein and ash. The hay of the slagged plot, however, in this series, according to the botanical separation, contains less clover than that of the check or unslagged plot—which apparently gives rise to a discrepancy between the chemical and botanical results. No satisfactory explanation can at present be offered which will account for these unexpected data, but it may be stated that in no sample of hay from either of the series does the protein content denote any markedly influencing proportion of clover.

The yields of hay per acre, together with the percentages and amounts of dry matter and crude protein, per acre, are included in the following table:—

HAYS: YIELDS, DRY MATTER AND CRUDE PROTEIN, PER ACRE

Plot and Treatment	Yield of hay in pounds per acre	Dry Matter		Crude Protein	
		Percentage	Pounds per acre	Percentage	Pounds per acre
New Meadow—					
A (slagged)	3,560	92·55	3,295	9·85	350·5
B (check)	2,915	92·80	2,705	9·27	270·2
Old Pasture—					
C (slagged)	2,430	94·27	2,291	8·05	195·6
D (check)	3,110	93·34	2,903	6·94	215·8

While the results from the New Meadow area might well be construed as showing a marked response in quality and quantity of hay from the application

*Principally Chrysanthemum leucanthemum.
**Principally Ranunculus acris.
Clovers: Red clover and a little vetch.
Grasses: Approximately 40 per cent red top, 60 per cent timothy.

of basic slag, the data from the Old Pasture area furnish corroborative data only in respect to response in quality. This experiment will be continued for a number of years and it may be expected that the results of future seasons—after the slag has had an opportunity to become effective—will be more consistent.

OATS FOR HAY PRODUCTION

This experiment, conducted at the Experimental Station, Cap Rouge, Que., was established for the purpose of comparing over a number of years certain of the more important varieties or strains of oats for hay production.

The crops were cut when the grain was in the late milk stage and the weights per acre (yields) were taken on the cured hay.

	Oat Hay, 1923	Dry Matter
Lab'y. No.	Variety	Pounds per acre
65314	Banner	5,180
65315	Gold Rain	2,799
65317	Victory	4,455

The data for the dry matter per acre, calculated from the analytical results and the yields of hay as furnished by the superintendent, would indicate the superiority of Banner in respect to this important matter, more or less closely followed by Victory. The variety Gold Rain, compared with Banner furnished but little more than fifty per cent of the dry matter per unit of area.

Analysis of Oat Hay, 1923

Constituent	Banner No. 65314	Gold Rain No. 65315	Victory No. 65317
	p.c.	p.c.	p.c.
Dry matter of crop, as cut	66·54	70·87	64·07
Composition of Hay—			
Moisture	9·52	8·96	8·61
Protein*	8·78	7·91	8·13
Fat	3·69	4·17	4·25
Carbohydrates	52·92	50·00	51·46
Fibre	20·24	23·59	21·67
Ash	4·85	5·37	5·88
	100·00	100·00	100·00
*Albuminoids	8·40	7·44	7·47
Non-albuminoids	0·38	0·47	0·66

The variety, Banner, again takes the first place in the series, by reason of its higher protein content and its lower percentage of fibre, but the differences in composition throughout the series are not large and hence the relative values of these oat hays are determined by their yields of dry matter per acre. The varieties under comparison being approximately at the same stage of growth when cut, their dry matter, it may be assumed, will be equally digestible and the data generally strictly comparable.

THE FERTILIZING VALUE OF RAIN AND SNOW

Rain and snow possess a distinct fertilizing value from the soluble nitrogen compounds they wash out of the atmosphere and the present inquiry has had for its object the determination of this value in the precipitation—summer and winter—as falling at Ottawa. The data for the seventeenth year of the investigation, closing February 29, 1924, are now presented in summarized form (table

1) together with the figures permitting a comparison of the annual precipitation and the amounts of nitrogen furnished per acre by the rain and snow for the period of investigation, 1908-1924 (table 2).

TABLE 1—RAIN AND SNOW AT OTTAWA, ONT., FOR THE YEAR ENDING FEBRUARY 29, 1924

Month and Year	Precipitation in Inches			Nitrogen			Total	Pounds of Nitrogen per Acre
	Rain	Snow	Total in Inches of Rain	In Free Ammonia	In Albuminoid Ammonia	In Nitrates and Nitrites		
				p.p.m.	p.p.m.	p.p.m.	p.p.m.	
1923								
March	0·48	24·55	2·93	0·386	0·054	0·163	0·603	0·401
April	2·45	1·50	2·60	1·309	0·096	0·534	1·938	1·142
May	2·51	.....	2·51	1·262	0·071	0·841	1·752	0·993
June	4·87	.....	4·87	0·973	0·060	0·681	1·714	1·891
July	3·51	.....	3·51	1·000	0·050	0·902	1·952	1·553
August	3·06	.....	3·06	1·080	0·082	0·270	1·432	0·993
September	1·84	.....	1·84	1·520	0·060	0·554	2·134	0·890
October	2·37	.....	2·57	1·450	0·086	0·317	1·853	1·079
November	2·89	.....	2·89	0·652	0·032	0·239	0·923	0·605
December	1·84	10·75	2·92	0·868	0·065	0·460	1·393	0·920
1924								
January	1·30	41·50	5·45	0·320	0·055	0·218	0·593	0·732
February	.....	27·50	2·75	0·247	0·087	0·125	0·459	0·286
Total for twelve months	27·32	105·80	37·90	.....	.....	.....	.....	11·485

TABLE 2—PRECIPITATION AND AMOUNT OF NITROGEN PER ACRE, OTTAWA, ONT., 1908-1924

	Rain in Inches	Snow in Inches	Total Precipitation in Inches of Rain	Pounds of Nitrogen per Acre	By Rain		By Snow	
					Pounds	Proportion	Pounds	Proportion
						p.c.		p.c.
Year ending February 29, 1908	24·05	133·0	37·35	4·322	3·243	75	1·080	25
" 28, 1909	22·99	96·05	32·63	8·364	7·528	90	0·836	10
" 28, 1910	28·79	80·75	36·87	6·869	5·830	85	1·040	15
" 28, 1911	19·67	73·00	26·97	5·271	4·424	84	0·847	16
" 29, 1912	20·33	104·25	30·76	6·100	5·075	83	1·025	17
" 28, 1913	30·34	96·25	39·96	6·144	5·113	83	1·031	17
" 28, 1914	23·31	84·75	31·78	6·208	5·192	84	1·016	16
" 28, 1915	16·70	86·25	25·34	4·905	3·976	81	0·929	19
" 29, 1916	23·13	105·25	33·65	9·765	8·065	83	1·700	17
" 28, 1917	24·62	118·25	36·44	7·877	6·226	79	1·651	21
" 28, 1918	19·99	128·75	32·86	6·259	4·719	75	1·540	25
" 28, 1919	27·77	77·97	35·59	5·845	4·929	84	0·916	16
" 29, 1920	23·39	98·50	33·23	7·117	5·909	83	1·208	17
" 28, 1921	27·21	66·90	33·90	6·525	5·195	80	1·330	20
" 28, 1922	27·11	79·25	35·05	7·111	6·118	86	0·993	14
" 28, 1923	23·01	93·00	32·31	7·413	5·860	79	1·553	21
" 29, 1924	27·32	105·80	37·90	11·485	10·064	88	1·421	12
Average for 33 years	24·499	93·225	33·813					
Average for 17 years	24·293	93·954	33·688	6·917	5·733	83	1·183	17

Table 1.—The highest monthly rainfall, 4.87 inches, was in June and, the concentration of nitrogen being decidedly above the average (1.714 p.p.m) the maximum quantity of nitrogen was recorded in this month, viz., 1.891 pounds per acre.

The total precipitation was highest in January, 5.45 inches. Of this, 4.15 inches was in the form of snow (41.5 inches). Since the concentration of

nitrogen is always lower in snow than in rain—in this case 0.593 p.p.m.—the gain to the land in this month was only 0.732 pounds per acre.

The concentration of dissolved nitrogen was highest in the month of September when the precipitation was the lowest for the year. It is interesting to note that the second highest concentration was recorded for July, closely followed by April. It was lowest in the all-snow month of February and second lowest in March, which had a large snowfall with only 0.48 inches of rain.

Table 2.—The total precipitation for the year (37.90 inches) was very high—indeed the highest in the series since 1908. The rain exceeded the average of seventeen years by approximately 3 inches and the snow by about 12 inches, making a total precipitation in terms of rain of more than 4 inches above the average. This rainfall has been exceeded only twice during the period of the investigation viz. 1909-10 with 28.79 inches and 1918-19, with 27.77 inches. The precipitation of snow, 105.8 inches, has been three times exceeded, in 1907-8 (133.0 inches), 1916-17 (118.25 inches), and 1917-18 (128.75 inches).

The number of pounds of nitrogen furnished per acre this year, 11.485, is 4.568 pounds above the average for the seventeen years of this inquiry. While the exceptional precipitation for the year, already noted, may account in part for this very high figure, there is another and more influential factor that has played a part in increasing this datum. It is the larger and more extensive use of bituminous or semi-bituminous (soft) coal in the city of Ottawa. This coal is now very largely employed in the place of anthracite in the heating of the larger buildings, including those of the Government. The effect of this is the production of much heavy smoke, rich in nitrogen compounds and hence the atmosphere at the point of collection of samples—Central Experimental Farm—on the outskirts of the city is no longer representative of that generally prevailing in the rural parts.

It will be observed that there is a much larger amount of nitrogen washed out of the atmosphere by rain than by snow. The figures are 10.064 pounds and 1.421 pounds, respectively. There are two factors to account for this: the larger precipitation as rain—27.32 inches as against 10.58 inches (105.8 inches of snow) as snow—and the fact that rain more thoroughly cleanses the atmosphere than does snow. The solvent power of rain is between two and three times that of snow.

As there is no doubt that the results of this investigation are now most seriously affected by the heavy smoke from soft coal present in the atmosphere of Ottawa and its immediate surroundings, as already noted, the decision has been reluctantly reached to discontinue this inquiry—the atmosphere (and hence the composition of the rain and snow) is no longer representative in this respect of our normal rural atmosphere.

From a study of the data of the seventeen year period of this work it would seem fair to conclude that the amount of nitrogen furnished, per acre, by the rain and snow and estimated in the neighbourhood of Ottawa, would be approximately 6.5 pounds annually.

LIMESTONE

The division is frequently appealed to with respect to the value for agricultural purposes of limestone deposits occurring throughout the Dominion. Limestones are variable as to composition and hence it is important, before actual quarrying is begun and a crushing plant set up, that representative samples be taken, analysed and proved to be of good quality. In this matter we have given assistance to provincial agricultural authorities and farmers' co-operative associations about to establish crushing outfits, by analysing and

reporting on such representative samples. In this connection it may be pointed out that, while undoubtedly it is desirable to reduce transportation charges as far as may be practicable by crushing the rock at a number of points in agricultural districts rather than at one centre with a necessarily wide distribution area, it is equally important that the rock crushed should be high grade, i.e. contain but little inert mineral matter. Reference to past reports of this division will furnish a considerable amount of evidence as to the composition of limestone outcrops in different parts of Canada.

During the past year thirteen of such samples have been submitted and reported on; the data, with locality of occurrence, are given in Table No. 3.

TABLE 3—ANALYSES OF LIMESTONES, 1922–1924

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 ($MgCO_3$) by difference
		p.c.	p.c.	p.c.	p.c.
	ONTARIO—				
60502	Tp. Parkins, N.W. of Sudbury	10·32	0·54	88·89	0·25
64122	Cochrane	1·66	0·33	56·19	42·57
69608(a)	Sheguiandah	2·65	2·43	54·33	42·50
69608(b)	Sheguiandah	1·67	4·06	54·91	40·37
	QUEBEC—				
58926	Leeds, Inverness Rd., Megantic	29·78	1·30	40·50	28·03
58927	Leeds, Inverness Rd., Megantic	98·66	.....	.....	.....
62411	Chambly	72·72	10·52	10·24	6·52
63268	Neuville, Portneuf Co	0·68	0·16	98·62	0·54
63269	Neuville, Portneuf Co	0·66	0·28	99·65	.....
63270	Neuville, Portneuf Co	1·74	0·40	98·13	.....
64819	Ste. Martine, Que	6·04	1·03	90·47	1·63
	NEW BRUNSWICK—				
58999	West Bathurst	2·44	0·50	92·25	4·81
60755	Oxbow	16·06	2·48	79·00	2·46
60756	Oxbow	8·06	1·60	89·50	0·84
	NOVA SCOTIA—				
58719	Leitches Creek	3·80	1·10	93·55	1·55
58720	Leitches Creek	2·63	8·93	87·12	1·32
65173	Near Pugwash	3·46	0·76	95·37	1·36
65174	Near Pugwash	12·72	1·03	84·65	2·56
68024(1)	Huntington, C.B.	3·31	0·70	90·90	5·60
68025(2)	Huntington, C.B.	9·30	0·92	87·45	3·26
68026(3)	Huntington, C.B.	7·28	3·06	62·18	28·18
68027(4)	Huntington, C.B.	2·30	2·26	68·82	28·41
	PRINCE EDWARD ISLAND—				
60576	Bloomfield	19·60	4·50	74·52	1·38
60577	Bloomfield	33·10	4·50	59·25	3·15
	BRITISH COLUMBIA—				
58642	Okanagan District	0·58	0·35	99·50	.....
62394	Salmon Arm	60·18	1·16	38·53	0·13
63688	Prince George	3·32	0·30	96·29	trace

ONTARIO

Lab'y. No. 60502.—From the township of Parkins, 25 miles northwest of Sudbury, Ont. Pinkish-white, crystalline limestone. This is of excellent quality, though not of the highest grade. It would prove satisfactory for the production of ground limestone.

Lab'y. No. 64122.—From Cochrane, Ont. Hard, fine grained, creamy white, dolomitic limestone of exceptionally good quality.

Lab'y. No. 69608 (a) and (b).—From Sheguiandah, Ont. Sample (*a*) is grey and sample (*b*) brown in colour. They are dolomitic limestones, practically identical in composition and of good quality.

QUEBEC

Lab'y. Nos. 58926-7.—From Lower Ireland, Que. Sample No. 58926 is a low grade magnesian limestone or dolomite containing practically 30 per cent of inert rock matter. It could not be recommended for agricultural use.

Sample No. 58927 is of the nature of quartzite. It contains no carbonate of lime and would be useless for agricultural purposes.

Lab'y. No. 62411.—From Chambly Basin, Que. This sample consisted of the fine material (passing an $\frac{1}{8}$-inch sieve) from a quarry being worked for material for macadamizing roads.

The analysis shows that it contains only 10 per cent of carbonate of lime and consequently cannot be considered a limestone. It would be of little if any value for application to the soil.

Lab'y. Nos. 63268-69-70.—From old and abandoned quarry at Neuville, Que., conveniently situated for transportation by rail and water.

There is practically no difference in composition between these three samples; they represent limestone of the highest grade and ground to the proper degree of fineness would be entirely satisfactory for land treatment.

Lab'y. No. 64819.—From Caughnawaga, Que. Hard dark grey limestone of excellent quality for agricultural purposes.

NEW BRUNSWICK

Lab'y. No. 58999.—From Bathurst, Gloucester county, N.B. This proves to be a limestone of excellent quality; its carbonate of lime content—over 90 per cent—places it in the rank of the best grades. It is admirably adapted for grinding for agricultural use.

Lab'y. Nos. 60755-56.—From Oxbow, N.B. Sample No. 60755 is of a greenish-grey colour and contains 79 per cent of carbonate of lime. No. 60756, of a chocolate colour, contains 89·5 per cent carbonate of lime. Both are good limestones for agricultural purposes but No. 60756 is the better—it is of excellent quality.

NOVA SCOTIA

Lab'y. Nos. 58719-20.—From Leitches Creek, C.B. Both are high grade limestones, No. 58719 being the richer. They could be advantageously used either for the production of ground limestone or burning to quicklime.

Lab'y. Nos. 65173-4.—From Pugwash, N.S. Both of these limestones are of good quality, but No. 65173, containing 10 per cent more carbonate of lime, is much the higher grade.

Lab'y. Nos. 68024-25-26-27.—From Huntington, N.S. Nos. 68024 and 68025 are calcitic limestones; Nos. 68026 and 68027, containing fairly high percentages of carbonate of magnesia, are dolomitic limestones. They are all of good grade and quite well adapted for grinding for agricultural purposes, No. 68024 being somewhat the superior.

PRINCE EDWARD ISLAND

Lab'y. Nos. 60576-77.—From Bloomfield, P.E.I. Both samples were reddish in colour and porphyritic in structure. No. 60576, with 75 per cent carbonate of lime, is much the better of the two specimens. It, however, is decidedly inferior to the limestone rock usually employed in the manufacture of ground limestone. If higher grade material is not obtainable it might be used, but it is questionable if a ground limestone richer in carbonate of lime could not be imported at a lower figure per ton than that at which this rock could be quarried and crushed. No. 60577 is too low in carbonate of lime to permit of profitable crushing.

Lab'y. No. 58642.—From Okanagan District, B.C. A crystalline limestone of excellent quality (99·5 per cent carbonate of lime) and admirably suited for the production of ground limestone.

Lab'y. No. 62394.—From Salmon Arm, B.C. This sample of (white) crystalline limestone rock contains too low a percentage of carbonate of lime to give any value for the preparation of ground limestone for agricultural purposes.

This sample was accompanied by one of "lime deposit" which proved to be a marl of excellent quality. It is described under No. 62395 in the chapter on marls. Both samples were submitted by the reeve of the district of Salmon Arm, who was anxious to advise the municipal council and the provincial agricultural authorities as to which would be the better to employ, much of the land in the district being in need of lime.

Lab'y. No. 63688.—From Prince George, B.C. A pinkish-grey limestone with a stratified structure. It is of excellent quality and eminently suitable for agricultural purposes either crushed for direct application or burnt to quick lime.

GROUND OR CRUSHED LIMESTONE

The employment of crushed limestone is on the increase, especially in Eastern Canada. It is evidently the most popular form of lime for soil treatment and we believe it is destined to become the most widely used lime compound employed in general farm practice.

The demand for this material is being met by several firms which have established crushing plants, and further, by certain of the provincial departments which have come to the assistance of the farmer in this matter by loaning crushing machinery to farmers' organizations in districts or localities in which outcrops of good quality rock occur.

During the past year a small number of ground or crushed limestones have been received by this division, for analysis and report. These have been examined as to composition and degree of fineness. The data are presented in table 4.

TABLE 4.—ANALYSES OF CRUSHED OR GROUND LIMESTONES, 1922-24

Lab'y No.	Manufacturer or Source	Chemical Analysis				Mechanical Analysis			
		Mineral matter insoluble in acid	Oxide of iron and alumina (Fe_2O_3 Al_2O_3)	Carbonate of lime ($CaCO_3$)	Carbonate of magnesia ($MgCO_3$) (by difference)	Passing 10-mesh sievs	Passing 20-mesh sisve	Passing 60-mesh sievs	Passing 80-mesh sieve
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
	ONTARIO								
60218	Simcoe	17·24	1·30	76·50	4·96	72·0	58·6	50·8	49·1
63222	Henderson Farmers' Lime Co., Beachville	0·79	0·27	96·65	2·29	99·7	74·3	48·9	43·7
63309	Blyth, Ont.	5·08	0·49	84·80	9·63	92·8	71·0	43·9	37·3
64284	(1) Grenville Crushed Rock Co.,	15·98	1·74	50·28	32·72	99·2	98·4	98·1	98·0
64285	(2) Merrickville	14·00	1·23	50·65	34·80	60·4	39·7	29·0	26·5
69268	Canada Crushed Stone Corporation, Dundas, Ont.	2·58	1·38	54·33	41·71	99·9	91·0	64·7	57·1
	QUEBEC								
62647	Canada Cement Co., Hull, Que.	4·64	0·33	92·82	2·21	100·0	99·8	98·1	93·1
63065	La Cie de Calcaire Agricole, Montreal	16·10	4·80	72·43	7·19	44·6	28·1	15·5	13·3
63066	" " "	19·02	3·00	75·90	3·18	91·2	67·8	32·7	25·1
63067	" " "	18·06	3·36	76·48	3·64	99·7	99·6	97·6	95·7
	NEW BRUNSWICK								
64840	Bertrand	12·56	1·04	85·55	1·59	90·8	61·8	28·0	21·8
69349	Burnt Land Brook	6·41	0·90	90·45	2·97	.....	98·2	64·8	54·7
	NOVA SCOTIA								
60382	Skye Glen, Inverness Co.	7·41	2·65	86·35	4·56	62·3	38·9	18·9	14·1
63475	Salmon River Lime Co., Salmon River, C.B.	11·80	2·12	56·26	30·22	63·9	39·9	21·1	17·8
	PRINCE EDWARD ISLAND								
63569	Belfast	6·74	0·70	89·71	3·49	99·2	83·6	57·7	50·6

ONTARIO

Lab'y No. 60218.—From a limestone quarry at Simcoe, Ont. This is not a limestone of the highest grade, containing 76 per cent of carbonate of lime, but may be rich enough to grind if location of quarry and other conditions are such as to make the venture safe economically.

This is a coarsely crushed sample, containing a fairly large proportion of material not passing a 10-mesh sieve. It might however prove fairly satisfactory if cost permits of heavy applications and an immediate response is not the sole desideratum.

Lab'y No. 63222.—"Calcium Brand" from Beachville, Ont. This sample is of excellent quality, ranking with the best grades of limestone. In respect to degree of fineness this product must be considered as quite satisfactory and suitable for general use, though if a quick, prompt action is of primary importance a somewhat finer grinding might be desirable.

Lab'y No. 63309.—From Blyth, Ont. As regards chemical composition this ground limestone may be considered as of first class quality and ranks with the best samples received in these laboratories for analysis. Its degree of fineness should prove fairly satisfactory, though a finer ground product may be desirable where a quick response is important.

Lab'y No. 64284-85.—From Merrickville, Ont. These are dolomitic limestones, containing a large percentage of carbonate of magnesia, and are very similar in composition. While not of the highest grade, they may be considered of fair quality. No. 64284 is very finely ground and is especially well adapted for use where a quick prompt action is desired.

No. 64285 is coarsely ground and is not to be recommended in general agricultural practice unless the cost allows heavy applications to be made.

Lab'y No. 69268.—From Dundas, Ont. This is a high quality magnesian (dolomitic) ground limestone. With respect to degree of fineness this material may be considered very satisfactory for use on most soils.

QUEBEC

Lab'y No. 62647.—From Canada Cement Co., Hull, Que. This is of excellent quality, ranking with limestones of the first grade.

As regards degree of fineness this product must be considered as extremely satisfactory, especially for application when an immediate response is desired.

Lab'y Nos. 63065-66-67.—From La Cie de Calcaire Agricole, Montreal, Que. All three are similar in composition and for practical purposes might be considered identical. This limestone while not of the highest grade might be ranked with those of fair quality.

No. 63065 is branded as quarter-inch. It is altogether too coarse; its action in the soil would be very slow.

No. 63066, branded as one-eighth-inch. This must be regarded as coarsely ground, but if cost permits of heavy application it could no doubt be advantageously used.

No. 63067. Branded as 200-mesh. This is a very finely ground sample and would be eminently adapted for cases in which a prompt action is of primary importance.

NEW BRUNSWICK

Lab'y No. 64840.—From Bertrand, N.B. The chemical composition of this limestone shows it to be one of very fair quality. For general use it is somewhat coarsely ground, and for a quick response from its application, finer grinding would be necessary.

Lab'y No. 69349.—From Burnt Land Brook, N.B.—This a high grade ground limestone, very satisfactory both as to composition and degree of fineness for use in general agricultural practice.

NOVA SCOTIA

Lab'y No. 60382.—From Skye Glen, N.S. As regards carbonate of lime content this sample is of very fair quality. In respect to its degree of fineness however, it is much coarser than we recommend in general agricultural practice.

Lab'y No. 63475.—From Salmon River, N.S. This is a coarsely ground dolomitic limestone containing a fairly high proportion of carbonate of magnesia. It is not a limestone of the highest quality and is too coarsely crushed if it is essential that there should be an immediate response.

PRINCE EDWARD ISLAND

Lab'y No. 63569.—Submitted from Belfast, P.E.I. Location of quarry not stated. An excellent limestone both as to its carbonate of lime content and degree of fineness. Its employment in agricultural practice should prove very satisfactory.

DEGREE OF FINENESS

The degree of fineness is an important factor since it determines in a very large measure the rate of solution of the ground limestone and hence the rate at which the material will neutralize or correct sourness (acidity) in the soil and furnish lime for plant growth. The finer the limestone, the greater the surface of the material exposed to the moisture of the soil and the more rapid, up to the point of saturation, will be its solution and hence its effectiveness. Fineness is also a factor in even distribution and in effecting a more perfect mixing with the soil.

In purchasing ground limestone the most desirable degree of fineness to use will be determined by a number of factors, chief among which are the desired rate of action and the cost of material.* As a rule the higher the soil's acidity

*Composition, i.e., richness in carbonate of lime, is, of course, a factor of first importance in the selection of a brand of ground limestone.

and the greater its need of lime, the finer—within limits—must be the limestone if the response is to be obtained within a reasonable time. The coarser grades, while furnishing a smaller proportion of " fines " for immediate action remain longer an ameliorating agent in the soil. Cost of grinding is in a very large measure relative to degree of fineness and hence to the price of material as marketed. It may therefore be more economical to use coarser grades in larger applications, to supply the required amount of " fines ", than the finer and more costly brands.

In a study of this question of degree of fineness as related to the right selection of a brand of ground limestone to employ, the tabulation of 36 samples of ground limestone analysed in these laboratories has been made. Arranged in the order of their percentages passing a 60-mesh sieve it was found:

1. That 18 samples, or 50 per cent of the series, furnished material of which 50 per cent or over passed the 60-mesh sieve, the percentages grading by easy steps from 50 to 100 per cent.

These samples yielded from 40 to 96 per cent of material passing an 80-mesh sieve, 85 to 100 per cent passing a 20-mesh sieve, all material passing a 10-mesh sieve.

2. That 15 samples, or approximately 42 per cent of the series, furnished from 25 to 50 per cent of material passing a 60-mesh sieve.

These samples yielded from 20 to 35 per cent of material passing an 80-mesh sieve, from 40 to 80 per cent passing a 20-mesh sieve and from 50 to 100 per cent passing a 10-mesh sieve.

3. The remaining three samples, or approximately 8 per cent of the series, contained less than 25 per cent of material passing the 60-mesh sieve.

These samples contained less than 15 per cent of material passing an 80-mesh sieve, less than 40 per cent passing a 20-mesh sieve and from 45 to 75 per cent passing a 10-mesh sieve.

From a consideration of the foregoing data we conclude that owing to differences in relative hardness and other physical characters of limestones, there will be a more or less wide range of percentages of the various " fines " from different quarries all crushing to the same single standard, e.g. 50 per cent passing a 60-mesh sieve. For this reason it is desirable in purchasing ground limestone not to depend on a statement which merely gives the percentage of material of largest diameter, as, for instance, " all passing an one-eighth-inch sieve," but to obtain the percentages passing a series of sieves, ranging, say, from one-tenth to one-sixtieth inch.

The desirability for practical purposes of a classification based on degree of fineness has led us to offer tentatively the following scheme, which has been drawn up after a careful study of available data in respect to efficiency as related to degree of fineness.

CLASSIFICATION OF GROUND LIMESTONE

Class I, Very Fine.—Ground limestones in which over 75 per cent passes an 80-mesh sieve, over 80 per cent passes a 60-mesh sieve and all passing a 20-mesh sieve.

This product is eminently suited for cases in which a quick action is of first importance.

Class II, Fine.—Ground limestones in which over 50 per cent passes an 80-mesh sieve, 65 per cent and over a 60-mesh sieve and all passing a 20-mesh sieve.

This grade will be found very satisfactory in general practice, one from which a reasonably quick response may be expected and at the same time furnishing a fair proportion of more lasting material.

Class III, Moderately Fine.—Ground limestones yielding approximately the following percentages of "fines": 40 to 65 per cent passing a 60-mesh sieve, all passing a 10-mesh sieve.

This grade provides a fair proportion of material for immediate action and a larger proportion which will extend its influence over a period of years.

Class IV, Coarse.—These are limestones falling approximately within the following degrees of fineness: 25 to 40 per cent passing a 60-mesh sieve, practically all passing a 10-mesh sieve.

It will not be found generally advantageous to use a grade of this character unless the price is such as to permit of heavy application.

Class V, Very Coarse.—Ground limestones in which less than 25 per cent of material passes a 60-mesh sieve. Such grades contain a large proportion not passing a 10-mesh sieve.

It is seldom indeed that ground limestones of this character can be economically employed.

MARL

Deposits of marl are found in nearly all the provinces of Canada and are important and valuable sources of lime for land treatment. They occur as a rule in beds from a few inches to several feet on old lake bottoms and are often overlaid by peat or muck.

Some marls are almost pure carbonate of lime, others contain more or less clay, sand, organic matter, etc., and these, of course, are of less value agriculturally. Hence an analysis is desirable before exploiting a deposit.

Usually, as found, marls are soft and pasty in consistency, frequently showing many small shells. On air-drying by simple exposure, they are found to be readily friable, breaking down to a coarse powder which easily permits of uniform distribution on the land. Not infrequently marl may be had for the cost of digging and hauling, constituting the cheapest lime amendment obtainable.

"Indurated" marl is a hard rock-like material with a honey-combed structure. It occurs by deposition from the waters of streams and springs which are rich in carbonate of lime. Large deposits of this material occur in many of the valleys of British Columbia and are composed almost entirely of pure carbonate of lime.

Marl may be used on both heavy clay and light sandy loams and is especially valuable for the former. As a supplier of lime it corrects acidity or sourness, furnishes an element for plant nutrition and promotes nitrification and hence assists in rendering available the soil's store of inert nitrogen.

In the following table we present the analytical data from the examination of a number of samples of marl sent in since the publication of the last report:—

TABLE 5.—ANALYSES OF MARLS (AIR-DRIED) 1922–24

Lab'y No.	Locality of Occurrence	Mineral matter insoluble in acid	Oxide of iron and aluminum (Fe_2O_3+ Al_2O_3)	Carbonate of lime ($CaCO_3$)	Carbonate of magnesia ($MgCO_3$)	Moisture, organic matter, etc. (Undetermined)	Remarks
	ONTARIO	p.c.	p.c.	p.c.	p.c.	p.c.	
63483	Harold	0·62	0·28	95·94	2·27	0·89	Shell marl, of very high grade.
64123	Cochrane	51·46	3·70	33·26	11·81	.....	A species of marl of low quality; suitable for employment locally.
66661	Nottawa	0·86	0·30	95·50	2·81	0·53	A marl of first quality; in powder form suitable for land treatment.
	QUEBEC						
58813	Paspebiac West	1·10	0·40	89·37	.....	9·13	Shell marl of high grade containing some peaty material.
58814	"	2·14	0·74	81·25	.....	15·87	Shell marl of very good quality.
58815	"	14·12	2·14	39·75	.....	43·99	An inferior quality of shell marl mixed with peat.
60028	Bonaventure East	6·72	1·22	86·50	.....	5·56	Shell marl of excellent quality.
60245	New Richmond Station	12·80	3·50	80·50	.....	3·20	Marl of good quality.
60447	St. Leon le Grand	2·70	0·88	88·51	.....	7·91	Shell marl of excellent quality.
60734	Grand River, Gaspé	3·86	1·34	89·58	.....	5·22	Marl of excellent quality.
62462	St. Benoit	12·09	1·88	77·50	.....	8·53	Marl of fair quality.
62619	Baie St. Laurent	1·70	0·32	91·68	.....	6·30	Marl of excellent quality.
62648	Amqui	1·42	0·42	92·69	.....	5·47	Shell marl of excellent quality.
62887	Cap Chat	2·96	0·90	92·06	.....	4·08	Shell marl of excellent quality.
65628	Sellarville	8·72	3·04	63·27	1·67	23·30	Marl of only fair quality; its value is enhanced by the presence of notable amounts of organic matter (17·41%) and nitrogen (0·71%).
69355	Venosta	9·22	1·59	86·70	1·59	0·90	Marl of excellent quality.
	NEW BRUNSWICK						
62404	Centrevills	5·53	1·29	78·65	.....	12·71	A shell marl of very fair quality.
	NOVA SCOTIA						
63641	Lower South River	8·88	1·34	87·18	3·79	.....	Of excellent quality but rather coarse.
65942	Huntington	75·02	11·96	2·09	.....	11·85	This material is not marl but appears to be a clay subsoil.
70604	Antigonish	7·52	1·35	91·32	trace	.....	Of excellent quality, but crushing might be necessary before application.
	ALBERTA						
69662	Fort Vermilion	11·41	1·07	67·34	14·83	5·35	A marl of fair quality; used in the district as "whiting" or "whitewash" to which it is similar in composition.
	BRITISH COLUMBIA						
58242	Cranbrook	5·79	0·43	81·75	.....	12·03	Marl of good quality.
58275	"	6·33	2·28	63·25	.....	28·14	Shell marl of only fair quality.
64024	Wynndel	17·06	10·00	47·94	.....	25·00	Marl of low quality but useful for soil treatment locally.
64531	Summerland	0·72	0·21	92·23	5·52	1·32	Marl of excellent quality.
64619	Telkwa (2½ miles east of)	0·21	0·18	97·27	3·18	.....	An indurated marl of the highest grade; it would require crushing before application.
65955	Colleymount	0·14	0·28	97·29	2·80	.....	An indurated marl of the highest grade; it is quite hard and would require crushing.
65956	"	0·28	0·52	85·29	3·38	10·53	Marl of excellent quality.
67324	(a) Vanderhoof	0·30	0·30	92·32	4·62	2·46	An indurated marl in the powder form.
67324	(b) "	0·48	0·50	93·46	5·19	0·37	An indurated marl; honeycombed, hard; it would require crushing.
68700	Crawford Bay, east side of Kootenay Lake.	0·45	.....	98·05	0·87	0·63	Marl of excellent quality; it is somewhat lumpy and would be improved by crushing.
69412	Basque Ranch, Ashcroft	4·59	0·64	90·17	3·37	1·23	Of excellent quality.
69560	Ashcroft	3·59	0·19	90·17	3·52	2·53	Of excellent quality.
69739	Kettle Valley	28·12	3·93	61·92	5·61	0·42	Of rather poor quality but of value for local application.
70505	Telkwa	0·83	.....	92·47	4·70	2·00	Of excellent quality.
70697	Kootenay Lake (near La France Creek)	0·38	v.f.t.	97·97	2·57	.....	A marl of the highest grade.

The larger number of the foregoing samples it will be seen are of excellent quality, and would make valuable soil amendments for acid soils and soils in need of lime. As a rule, being friable on air-drying, they do not require any preliminary crushing treatment to permit of a satisfactory and even distribution to the soil. It is encouraging to note the increased interest on the part of farmers towards the use of this valuable amendment for many classes of soil. Full advantage should be taken of this cheap and satisfactory source of lime, especially where the deposits occur in the neighbourhood of the farm.

SOILS

WESTERN PRAIRIE SOILS

In 1911 an investigation was instituted to determine the influence of continued grain growing on the nitrogen and humus content of the western prairie soils. A series of plots was set out on a number of the western Dominion Experimental Farms and Stations. The soils were sampled and analysed and the plots put under a scheme including continuous grain growing (with summer-fallowing) and a number of rotations in which grasses, clovers, alfalfa, manure, etc., found their place. Careful records of the yields obtained were kept, and at the end of the ten-year period the plots were again sampled. The analysis of this second series of soils will be found in Bulletin 44, new series, "The influence of grain growing on the nitrogen and organic matter content of the western prairie soils of Canada."

To briefly epitomize, in every instance—there was not one exception—the soil from plots under exclusive grain growing showed a distinct and in the majority of cases, a notable loss of nitrogen and organic matter. On the other hand, the soil from the plots under a rotation which included the periodic seeding down to grasses and clovers (in Alberta, alfalfa), had maintained or increased its nitrogen and organic matter content.

The lesson is obvious. If we are to maintain unimpaired the wonderful heritage, the almost invaluable asset that Canada possesses in her northwestern prairies, the present practice of grain growing must be considerably modified. More mixed farming, which of course implies the return of plant food in the form of manure, and especially the adoption of a rotation introducing grasses and clovers are to be advised as the rational means towards the maintenance of fertility. With a farming practice bearing these constantly in view, the adoption of a scheme of soil management which will include the return of part of the plant food and, what is equally important, the systematic putting of the land into sod (grasses and clovers), we believe that the problem of fertility maintenance of the western provinces will be successfully solved.

SOILS FROM PRINCE GEORGE DISTRICT, B.C.

A series of soils from the district of Prince George, B.C., and submitted as representative of surface soils in the vicinity of Tête Jaune and Sheer, has been examined. The series included sandy loams, silt loams, clays and heavy clays and practically all of the samples were characterized by a deficiency in nitrogen and organic matter—no doubt due to the severe "burning over" of the areas involved, which occurred, according to statements, between fifteen and twenty-five years ago. With a few exceptions the soils were satisfactory in respect to phosphoric acid and potash—and more especially as regards these elements in the more or less available condition.

Further and larger collections of virgin soils from these areas must be examined before generalizations as to fertility are made, but the present series

certainly indicates the paramount necessity of manure and the growth and turning under of green crops—more particularly clovers or other legumes—as an economic and rational method of improvement of these burnt-over areas.

SOILS FROM CLINTON, ONT.

A mechanical analysis and partial chemical analysis have been made of a series of cultivated soils collected on farms near Clinton, Ont., and submitted by the Flax and Fibre Division of the Experimental Farm system.

These included sandy, gravelly and silt loams and varied considerably in fertility as measured by chemical analysis. The majority were of good average quality as compared with soils generally of Eastern Canada; two members of the series contained high percentages of nitrogen and organic matter. The examination showed that lack of good tilth—harsh and refractory nature—rather than poverty in plant food was the cause of poor crops in such cases as had been adversely reported.

Suggestions as to treatment and fertilizers were made for the more successful growing of flax.

PRINCE EDWARD ISLAND SOILS

Complete chemical and mechanical analysis was made of a series of cultivated soils from Prince Edward Island. These samples, comprising in each case surface and subsoil, were collected by the Superintendent, Experimental Station, Charlottetown, P.E.I., in the following localities: Lot 45 Southport, Lot 32, York Point and Lot 34, Marshfield.

These soils have been reported on in detail and it is therefore only necessary here to very briefly summarize the results. They were all "fine sandy loams," warm, readily worked and fairly mellow. From the standpoint of plant food content they would rank with those of good average productiveness; their percentages of nitrogen, phosphoric acid and potash while fair were not equal to those of our best soils. An excellent feature, however, in this connection was that though the "total" amounts of these constituents were not large, the proportion which may be considered more or less immediately available was relatively high. The desirability of the application of ground limestone, or other form of lime, was made evident for a number of these soils, to correct acidity and furnish lime for crop use.

SOILS SUBMITTED BY FARMERS

The examination of soils submitted by farmers continues an active phase of the division's work. Several hundreds of such soils have been reported on during the past year and these have been received from all parts of the Dominion. These soils as a rule are from cultivated areas, but a few have been sent from outlying districts as yet unsettled.

Our practice is to submit these to a partial chemical analysis and such a physical examination as will enable the division to report on general character, with suggestions as to suitable crops, treatment with manures and fertilizers, the application of lime, drainage and general working operations. The records of the division show that there is a wide demand for this class of information and from letters received we may conclude that the reports made have proved in very many instances helpful towards the economic raising of soil fertility and larger yields.

SUGAR BEETS

Continuing this enquiry begun in 1902, seed of a number of approved varieties of sugar beets has been grown on the larger number of the Farms and Stations of the Experimental Farm system. Representative samples of the harvested crop have been forwarded to the laboratories at Ottawa and analysed as to sugar content and purity of juice. The object of this work, in a word, is to ascertain the districts or regions in the Dominion in which beets suitable for commercial sugar extraction can be successfully and profitably grown.

The seed chiefly used in this investigation has been Canadian grown, obtained through the courtesy of The Dominion Sugar Co., Chatham, Ont. This seed, from the stock grown by the company and distributed to its best growers, has been found from the experience of the past six years to give excellent results both in connection with the operations of the company and in our tests throughout the Dominion. Originally the source of this seed was Russia, but it has now been grown for a number of years in Ontario and may be considered thoroughly acclimatized; apparently it has fully retained its inherited high quality in respect to sugar content. It does not carry any varietal name but has been designated by the name of the locality at which it has been grown—thus Chatham, Waterloo and Kitchener.

In a more limited way imported seed has been used, the particulars being as follows: Henning and Harving, Denmark; Sluice Bros., Holland; and Vilmorin-Andrieux et Cie., (Vilmorin's Improved) Paris, France.

The Farms and Stations at which this enquiry was conducted are located as follows: Charlottetown, P.E.I., Kentville, and Nappan, N.S.; Fredericton, N.B.; Lennoxville, Cap Rouge and Ste. Anne de la Pocatière, Que.; Ottawa, Ont.; Brandon, Man.; Rosthern, Scott and Indian Head, Sask.; Fort Vermilion, Beaverlodge and Lethbridge, Alberta; and Agassiz, Sidney, Invermere and Summerland, B.C.; in all at nineteen points distributed across Canada.

Space in this summarized report will not permit the insertion of the detailed data—interesting and valuable as they are—and it must therefore suffice to present two tables of averages: (1) the average percentage of sugar for the several varieties grown throughout the Dominion and (II) the average percentage of sugar from the several varieties grown at the farms and stations included in this investigation.

TABLE 6—SUGAR BEETS: SUGAR IN JUICE AND COEFFICIENT OF PURITY

Averages from 19 points in the Dominion—from Prince Edward Island to British Columbia

Particulars of Seed	Sugar in Juice	Coefficient of Purity
	p.c.	p.c.
"Chatham"—Dominion Sugar Co	16·95	83·17
"Kitchener"—Dominion Sugar Co	17·29	83·60
Denmark—Henning & Harving	17·07	84·00
Holland—Sluice Bros	17·17	82·67
France—(Vilmorin's Improved) Vilmorin-Andrieux et Cie., Paris	17·24	80·64

The inference from these data is that Canadian grown seed (Chatham and Kitchener, Ontario) has given beets equally high in sugar and in purity as seed from the most approved varieties grown in Denmark, Holland and France. This is in full accord with the work of the past six years and therefore indicates very strongly that Canada would be well able to grow her own seed—and seed of the highest grade—when the beet sugar industry of the Dominion has so

developed as to require much larger stocks than are at present necessary.

It is also interesting to note the satisfactory character of the data both for sugar and purity—especially when it is remembered these averages are from beets grown at so many widely distant points across the Dominion. It is also worthy of record that these averages are very close to those of the preceding season.

In table 7 data are presented which denote the *average* percentage of sugar in juice, obtained from the five varieties as grown on the several Farms and Stations in this test in 1923, averages similarly obtained for the preceding four years being included for the purposes of comparison.*

TABLE 7—AVERAGE PERCENTAGE OF SUGAR IN JUICE IN SUGAR BEETS GROWN ON DOMINION EXPERIMENTAL FARMS AND STATIONS—1919–1923

Locality	1919	1920	1921	1922	1923
Charlottetown, P.E.I.	18·33	16·44	16·40	.....	18·67
Kentville, N.S.	19·25	18·36	18·06	18·72	20·43
Nappan, N.S.	17·83	18·01	18·08	18·45	17·61
Fredericton, N.B.	20·94	18·34	18·09	16·61	15·60
Lennoxville, Que.	15·91	14·55	16·01	15·12	15·99
Cap Rouge, Que.	16·88	16·69	17·04	21·27	18·61
Ste. Anne de la Pocatière, Que.	18·89	13·24	17·31	17·69	15·30
La Ferme, Que.	16·05	.....	.....	.....	.....
Ottawa, Ont.	17·79	15·09	15·61	16·44	16·16
Brandon, Man.	.....	15·24	16·82	14·14	12·19
Rosthern, Sask.	.....	14·15	13·56	17·27	13·13
Scott, Sask.	14·39	15·74	15·79	17·25	19·21
Indian Head, Sask.	15·68	20·24	.....	19·70	20·12
Fort Vermilion, Alta.	17·35	.....	14·47	16·00	14·32
Beaverlodge, Alta.	.....	.....	15·77	.....	19·16
Lacombe, Alta.	.....	12·86	13·84	15·77	.....
Lethbridge, Alta. (irrigated)	14·31	18·34	17·99	17·04	17·21
Lethbridge, Alta. (non-irrigated)	.....	19·35	16·63	17·57	15·92
Agassiz, B.C.	17·02	16·46	15·87	16·67	17·62
Sidney, B.C.	17·98	14·29	.....	.....	16·67
Invermere, B.C.	14·72	19·26	15·78	17·56	20·02
Summerland, B.C.	.....	16·85	20·03	17·36	16·92

It is evident from the forgoing data that conditions during 1923 at the larger number of the Stations included in this enquiry were favourable to sugar production, the averages in all but a few cases being quite satisfactory. Thus at seven of the eighteen points the sugar in juice averaged above 18 per cent; at five, between 16 and 18 per cent; at four, between 15 and 16 per cent—with only three averaging below 15 per cent.

This investigation has unquestionably proved that beets eminently suitable for sugar production may be grown in many widely distant districts in the Dominion.

MANGELS

The determination of the relative feeding value of farm roots, as measured by their dry matter and sugar content, has been the object of an investigation during the past nineteen years. The results have shown that large differences exist in this respect between varieties—or reputed varieties—in the same class. Thus in mangels for example, on this basis of valuation, one variety or strain may be worth twice as much as another. It is obvious therefore that the composition of a root is an important factor and one that should be taken into account when making a selection of varieties to grow.

*The report of this division for the year ending March 31, 1922, contains a table (page 72) presenting the yearly average percentage of sugar in beets grown and tested in this enquiry for the period 1902–1921.

The series of mangels analysed and now reported on comprised 129 varieties or strains of the crop of 1923, the seed being obtained from a large number of sources—domestic and imported. The roots were grown on the Central Farm, Ottawa, under the direction of the Forage Plant Division.

Since the limited space of this report will not permit the publication of the data in detail, it must suffice to epitomize by stating that the range in dry matter content was from 16·57 to 9·58 per cent and in sugar from 8·82 to 1·22 per cent.* The position or distribution of the varieties in the series, in respect to percentage of dry matter may be briefly indicated as follows**:—

Three varieties contained between 16 and 17 per cent.
Four varieties contained between 15 and 16 per cent.
Nineteen varieties contained between 14 and 15 per cent.
Twelve varieties contained between 13 and 14 per cent.
Twenty-five varieties contained between 12 and 13 per cent.
Thirty-five varieties contained between 11 and 12 per cent.
Twenty-five varieties contained between 10 and 11 per cent.
Five varieties contained between 9 and 10 per cent.

The averages for dry matter and sugar for the nineteen years of the investigation are given in the following table. In spite of the fact that the series for 1923 contained a number of varieties of distinctly low value, the averages for dry matter and sugar are most satisfactory, indicating a favourable season for this crop.

TABLE 8—MANGELS—DRY MATTER AND SUGAR IN JUICE

Year	Number of varieties analysed	Average weight of one root		Dry matter	Sugar in juice
		lbs.	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
Average for 19 years	.....	2	11	11·11	5·56

TURNIPS

The series comprised one hundred and twenty-six varieties, grown on the Central Farm, Ottawa, under the direction of the Division of Forage Plants.

Summarizing the results, the range in dry matter was from 15·93 to 8·29 per cent and in sugar content from 1·23 to 0·20 per cent. The varieties, in respect to dry matter content, fall into the following classification:—

* One sample—Red Top White Sugar—contained 19.55 per cent dry matter, an exceptionally high figure for mangels.

** Those interested in the detailed analyses of the several varieties of farm roots examined may obtain the information by application to the Division of Chemistry, Experimental Farm, Ottawa.

One variety contained between 15 and 16 per cent.
Three varieties contained between 13 and 14 per cent.
Twenty-two varieties contained between 12 and 13 per cent.
Fifty-two varieties contained between 11 and 12 per cent.
Thirty-four varieties contained between 10 and 11 per cent.
Ten varieties contained between 9 and 10 per cent.
Four varieties contained between 8 and 9 per cent.

Averages for the seventeen-year period, 1905-1923, during which the inquiry has been conducted, are presented in table 9.

TABLE 9—TURNIPS: DRY MATTER AND SUGAR IN JUICE, 1905–1923

Year	Number of varieties analysed	Average weight of one root		Dry matter	Sugar in juice
		lbs.	oz.	p.c.	p.c.
1905	20	2	13	10·09	1·10
1906	20	1	10	12·18	1·78
1907	14	3	5	10·14	1·11
1908	13	3	12	9·87	1·52
1909	13	2	10	11·30	1·43
1910	10	3	11	10·87	1·07
1912	19	3	12	8·65	1·10
1913	19	2	14	9·58	1·54
1914	30	2	..	9·68	0·76
1915	33	2	6	9·60	1·29
1916	33	1	13	10·67	0·92
1917	58	1	13	11·04	1·41
1918	16	1	..	11·18	1·06
1919	95	..	13	12·10	1·11
1920	22	1	12	12·60	1·84
1922	41	1	10	11·46	1·09
1923	126	1	8	11·22	0·61
Average for 17 years	.....	2	4	10·71	1·22

CARROTS

Forty-nine varieties of carrots, grown at Ottawa in the season of 1923, were submitted to analysis. A number of these are to be found in the lists of preceding years, but many of the varieties (as in the case of the mangels and turnips) are now reported on for the first time.

A very considerable range in dry matter content was observed—18·1 to 10·35 per cent—though it should be stated that only one sample, in which the roots were very small, exceeded 16·24 per cent. The results, on the whole, are exceptionally good and the season for this crop, as in the case of mangels and turnips, must be considered as very favourable. Their classification in respect to dry matter content may be given as follows:—

Three varieties contained more than 16 per cent.
Three varieties contained between 15 and 16 per cent.
Three varieties contained between 14 and 15 per cent.
Nine varieties contained between 13 and 14 per cent.
Eleven varieties contained between 12 and 13 per cent.
Fourteen varieties contained between 11 and 12 per cent.
Six varieties contained between 10 and 11 per cent.

The averages for dry matter and sugar in juice for the past eighteen years are presented in the following table.

TABLE 10—CARROTS: DRY MATTER AND SUGAR IN JUICE

Year	Number of varieties analysed	Average weight of one root	Dry matter	Sugar in juice
		lbs. oz.	p.c.	p.c.
1905	11	1 3	10·25	2·52
1906	10	1 2	10·59	3·36
1907	6	1 1	10·30	3·02
1908	6	1 3	10·89	3·34
1909	6	1 ..	10·40	2·30
1910	5	1 ..	10·17	3·23
1912	6	1 1	10·50	2·54
1913	6	1 8	9·11	2·11
1914	8	1 10	11·42	2·62
1915	10	.. 6	10·08	1·86
1916	10	.. 7	11·40	2·87
1917	13	.. 10	12·69	2·92
1918	3	.. 6	12·13	5·30
1919	36	.. 7	12·04	2·79
1920	15	1 7	9·48	2·25
1921	13	1 4	9·78	2·23
1922	23	1 3	12·04	2·28
1923	49	1 1	12·67	2·43
Average for 18 years	.....	.. 15	10·88	2·77

The averages for these three classes of field roots as grown on the Central Farm, Ottawa, for the experimental period, are as follows:—

TABLE 11—AVERAGE DRY MATTER AND SUGAR IN JUICE IN MANGELS, TURNIPS AND CARROTS, 1923

Class of Root	Average for period of	Dry matter	Sugar in juice
	years	p.c.	p.c.
Mangels	19	11·11	5·56
Turnips	17	10·71	1·22
Carrots	18	10·88	2·77

INFLUENCE OF EARLY AND LATE PLANTING AND SPROUTING ON THE YIELD AND DRY MATTER CONTENT OF POTATOES

The present record is that for 1923, the fourth year of this enquiry, which in so far as field work is concerned is being carried on at the Experimental Substation, Beaverlodge, Alberta. The experiment was planned by the Superintendent in 1920, and with certain slight annual modifications has been continued every season since that date.

The variety employed was the Country Gentleman. The particulars as to dates and yields and the data for the dry matter content and dry matter per acre, are given in table 12.

TABLE 12.—POTATOES: COUNTRY GENTLEMAN

Yield and Dry Matter, 1923

Laboratory No.	Date of planting	Not Sprouted			Sprouted			
		Yield per acre	Dry Matter		Weeks sprouted	Yield per acre	Dry Matter	
			per cent	Pounds per acre			per cent	Pounds per acre
		lbs.				lbs.		
66970	20-4-23	26,166	23·96	6,267				
66971	28-4-23	27,671	21·89	6,057				
66972	28-4-23				1 week	19·896	22·81	4,539
66973	4-5-23	25,080	20·77	5,210				
66974	4-5-23				2 weeks	22,739	23·15	5,264
66975	10-5-23	22,906	20·41	4,676				
66976	10-5-23				3 weeks	23,408	22·47	5,260
66977	19-5-23	19,144	19·88	3,806				
66978					4 weeks	25,247	21·73	5,488
66979	25-5-23	19,478	21·39	4,167				
66980	25-5-23				5 weeks	28,173	20·05	5,648
66981	1-6-23	18,308	20·56	3,765				
66982	1-6-23				6 weeks	27,838	22·08	6,145

YIELD PER ACRE

A consideration of these data reveals an interesting, and in the case of the sprouted sets a rather remarkable, influence of the time of planting on the yield. The crop yield from the "non-sprouted" sets decreases and conversely the yield from the "sprouted" series increases as the time of planting is deferred.

These results from the non-sprouted sets are in full accord with, and somewhat more consistent than those of 1920 and 1921, thus giving further and possibly more satisfactory evidence that in respect to yield, using unsprouted sets, the earlier the planting within certain limits the better the results.

The reverse is the case with the yields from the sprouted sets, the yields steadily increasing with advance in the date of planting until May 25. There was some evidence in this direction in the 1921 results, but it was inconclusive. On submitting these results to Mr. Albright, the Superintendent at Beaverlodge, he writes "extraordinary drought prevailed during the early part of the season. Until June 10 there had not been for thirteen months a rain heavy enough to wet the bottom of the furrow slice. This abnormally dry season would tend to diminish the advantage that might otherwise be shown by early planting, especially in the case of the sprouted rows. The average of our results to date would indicate the importance of taking full advantage of a short growing season, either by early planting or by sprouting or both. It is possible however that in special seasons the too early planting of sprouted sets may partially defeat its object."

DRY MATTER CONTENT

The percentages of dry matter in the tubers from the non-sprouted sets steadily decreased in the plantings from April 20 to May 19. For the two subsequent plantings, May 25 and June 1 it shows a slight increase. These results may be considered as in a large measure confirming those of 1920 and 1921, which afforded evidence that the crops from the earlier planted unsprouted sets possessed a higher dry matter content.

The data from the sprouted sets with respect to dry matter are irregular and show no direct trend. The same irregularity was observable in the results of 1922 from the sprouted sets.

DRY MATTER PER ACRE

Since both the yield and percentage of dry matter decrease in the crops from the earliest to the latest plantings from the non-sprouted sets, it necessarily follows that in this series the dry matter per acre must similarly decline—and this is clearly observable by reference to the foregoing table. This work, carried on in three successive seasons, has given ample and satisfactory proof that, in respect to non-sprouted sets, larger amounts of dry matter per acre are obtained from the earlier planted crops.

The reverse appears to be the case in the sprouted set series, the weight of dry matter per acre increasing with the advance of the date of planting from April 28 to June 1, the results following more or less closely those of the yields per acre.

FEEDING STUFFS

BRAN, SHORTS, MIDDLINGS AND FEED FLOURS

The milling by-products of wheat occupy a prominent—practically a premier —place among the " concentrates " on the feeding stuffs market, not merely on account of their large output by the flour milling industry but by reason of their high nutritive value and wide usefulness in the feeding of practically all classes of live stock. The importance of this stable group—and especially of the three first named—makes it imperative that their quality should be carefully guarded. To this end, following investigational work in these laboratories, revised standards have recently been established, the result of which has been not only greater uniformity among the output of the several mills but a general improvement in both quality and purity, especially in shorts and middlings which are now to be recognized as two distinct feeds. The regulations do not now allow the presence of screenings in any one of these products. As every farmer should be conversant with these revised standards we append them in convenient form.

TABLE 13.—STANDARDS: BRAN, SHORTS, MIDDLINGS AND FEED FLOUR

—	Bran	Shorts	Middlings	Feed flour
	p.c.	p.c.	p.c.	p.c.
Protein, not less than	15·0	16·0	16·5	.....
Fat, not less than	3·5	5·0	3·5	.....
Fibre, not more than	11·5	8·0	4·5	2·0

In the following table the analysis is presented of a number of samples of these feeding stuffs recently submitted for examination and report. The larger number of the samples are from stocks used at one or other of the branch Farms and Stations in feeding experiments.

Bran.—Samples Nos. 62831 and 63516 call for special comment; they are brans from soft, white Ontario-grown winter wheat. Previous analyses of brans from soft winter wheats have furnished evidence that such brans may not reach the standard in respect to protein—the present samples confirm this conclusion. In fat and fibre they satisfactorily meet the requirements of the standard. The bran of soft wheat is usually distinguishable from that of hard wheat by its " flouriness", a quality which commends it to many farmers, especially for use with young stock.

With the above exceptions the whole series is very satisfactory as to protein content, as also in percentage of fat.

The fibre content of the series is more satisfactory than that in our last report, when the range for this constituent was from 10.70 to 12.20 per cent, with an average of 11.55 per cent. In the present brans the range is from 9.77 to 11.54, with an average of 10.56—a marked improvement.

Shorts.—With the exception of the sample milled from Ontario winter (soft) wheat (No. 63615) the series meets the requirements of the Act in respect to protein most satisfactorily, one brand exceeding the requirements by nearly 4 per cent: only one sample falls below the standard in percentage of fat. One sample exceeds the limit in fibre content by nearly 1 per cent. The remainder may be considered satisfactory in this respect. The improvement in the quality of shorts, recently witnessed, may perhaps be due in part to more careful separation of this fraction in milling, but it is due in the main, we believe to the exclusion of screenings, which is now imperative.

Middlings.—Considerable variation in composition is seen in this series and uniformity, according to these results, has not been achieved. There is evidence, however, that many millers are making a distinct effort to put out a product in conformity with the regulations.

TABLE 14.—BRAN, SHORTS, MIDDLINGS AND FEED FLOUR

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
	BRAN	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
60067	Robin Hood Flour Mills, Ltd	10·98	17·02	4·39	50·61	11·54	5·46
62831*	R. M. Pincombe & Sons, Strathroy, Ont	10·37	14·75	4·75	53·40	9·77	6·96
63024	Lake of the Woods Milling Co	13·59	15·82	4·35	50·39	10·50	5·35
63064	Maple Leaf Milling Co	10·72	16·28	4·88	52·05	10·40	5·67
63516*	R. A. Thompson, Lynden, Ont	12·09	13·21	3·91	53·64	11·32	5·83
63581	" " "	13·12	15·53	4·97	51·75	9·87	4·76
65121	Rainbow Brand, Galt Flour Mills Co	12·85	16·42	5·61	49·66	10·18	5·28
70807	Lake of the Woods Milling Co	10·05	15·10	5·52	52·82	10·89	5·62
	SHORTS						
60068	Robin Hood Flour Mills, Ltd	10·66	18·68	5·15	53·34	8·08	4·09
60159	Lake of the Woods Milling Co	10·66	19·83	5·72	51·73	7·76	4·30
63019	Western Canada Milling Co	10·17	16·85	5·78	55·47	7·98	3·75
63023	Maple Leaf Milling Co	12·59	16·35	4·46	53·65	8·95	4·20
63582	R. A. Thompson, Lynden, Ont	13·57	16·43	5·48	53·02	7·75	3·75
63615*	" " "	12·49	14·61	5·10	54·74	8·17	4·89
63488	Western Canada Flour Mills	13·73	17·23	6·94	49·31	8·33	4·46
65122	Rainbow Brand, Galt Flour Mills Co	11·70	17·48	6·35	51·81	8·26	4·40
65125	Maple Leaf Milling Co	10·56	17·29	6·16	54·21	7·60	4·18
70136	Fraser Valley Delta Co-operative Ass	9·09	16·51	5·24	60·66	5·22	3·28
70137	" " "	9·13	17·20	5·33	56·40	7·57	4·37
	MIDDLINGS						
60158	Lacombe Milling Co	11·83	13·45	3·29	66·20	2·92	2·31
58829	St. Lawrence Flour Mills	12·25	18·57	5·24	53·23	6·82	3·89
60069	Robin Hood Flour Mills	10·44	18·90	4·66	58·53	4·46	3·01
63025	Ogilvie Flour Mills, Ltd	12·55	16·51	4·20	58·83	4·97	3·44
63739	J. A. Kidd & Sons, Burritts Rapids	12·77	16·32	5·13	57·23	5·31	3·24
65123	Rainbow Brand, Galt Flour Mills Co	11·52	15·16	5·64	61·00	3·42	3·26
65124	O'Dairy Brand, Ogilvie Flour Mills Co	11·54	18·89	6·32	53·65	5·99	3·61
	FEED FLOUR						
60157	Red Dog, Lacombe Milling Co	12·11	13·07	1·10	72·90	0·15	0·67
63583	R. A. Thompson, Lynden, Ont	12·26	16·51	4·03	62·35	2·51	2·34
63614*	" " "	12·23	13·59	4·62	64·77	2·52	2·27

*From Winter wheat.

No. 60158 is distinctly floury in nature and possibly should be classed as a feed flour. It has a very low fibre content, but does not meet the requirements of the regulations for middlings in respect to protein and fat. No. 58829 exceeds the standard in both protein and fat but contains too much fibre. Similarly Nos. 63025, 63729 and 65124 are too high in fibre. No. 60069 is an excellent sample in every respect. No. 65123 is somewhat low in protein but very satisfactory otherwise.

Feed Flour.—The larger use of this feeding stuff is in the ration of young pigs, which require a palatable, easily digested feed with low fibre content. The only requirement in the standard at present in force for this feed is that it shall not contain more than 2 per cent of fibre. In respect to fibre, No. 60157 is very satisfactory; indeed it might be classed as a low grade flour. The fibre content of Nos. 63583 and 63614 slightly exceeds the limit set by the standard but must otherwise be considered as satisfactory. It is worthy of note that No. 63614, from Ontario winter wheat has a distinctly lower protein content than No. 63583, which was milled Manitoba hard wheat.

OATS

Lab'y. Nos. 61191 and 63027 are fair average samples of crushed oats. The fibre is not excessive and there is no indication of admixture with hulls.

Lab'y. No. 63028. Hulless oats grown on the Central Experimental Farm, Ottawa. It will be observed that compared with the ordinary varieties of oats, the hulless has a much higher feeding value by reason of a higher protein content and a very much lower percentage of fibre.

Lab'y. No. 63583. Oat Middlings. This is somewhat lower in protein and higher in fibre than typical oat middlings and should perhaps be classed as oat shorts. It is a good feed and should prove satisfactory for many classes of live stock.

Lab'y. No. 69509.—Though containing a small amount of wheat, is essentially composed of oats. From the percentage of fibre present it may be concluded either that the grade of oats used was very poor or that there has been a certain addition of oat hulls.

BARLEY

Lab'y. No. 63026.—This is an exceedingly good sample, being characterized by high protein and low fibre.

Lab'y. No. 66544.—Though somewhat high in fibre, the analysis as a whole would indicate that this is pure barley meal.

The value of ground barley as a feeding stuff may again be emphasized, especially in pork production. It differs essentially from crushed oats in containing less fibre and a smaller percentage of fat. Good samples of barley approach closely the protein content of oats.

CORN

Lab'y No. 58871.—Hominy Feed is a by-product in the manufacture of Hominy Grits. It consists of corn bran, the germ and a part of the starchy portion of the corn kernel. It stands in the same relationship to corn as do middlings to wheat. It is a palatable, wholesome feed, fairly rich in protein with a high fat content. It is much relished by all classes of live stock.

Lab'y No. 62702.—This is a by-product in the manufacture of popcorn balls and consists chiefly of the kernels which do not "pop" readily, together with fragments of the corn broken in the popping. It differs from corn meal in possessing a somewhat higher fibre content. It should prove a valuable feeding stuff for poultry and pigs.

Lab'y No. 62716.—The analytical data are not those of pure corn meal and microscopical examination showed that it contained oat hulls, oat shorts, ground corn-cob and weed seeds.

Lab'y No. 63029.—Though low in protein it is genuine corn meal. Its fat content is satisfactory and its percentage of fibre does not exceed the average for this product.

SCREENINGS

Mill screenings as produced at the elevators and resulting from the grading and cleaning of wheat, consists of small and broken wheat kernels with weed seeds and other foreign material possessing feeding value, and must not contain more than one per cent of weed seeds considered as injurious to the health of live stock. The regulations in pursuance of the Feeding Stuffs Act limit the fibre content to eight per cent.

In the purchase of ground screenings there are two matters, more particularly, to which attention should be given—palatability and composition. Palatability can, in a very large measure, be ascertained by tasting the feed—pungency, bitterness and acridity, which would make the material objectionable to the animal, may be detected by this means. The composition, and hence the feeding value of screenings, is extremely variable and the guarantee as to protein, fat and fibre content must be carefully scrutinized.

Lab'y No. 58767.—Recleaned Wheat Screenings. (Reg. No. 880). Guarantee: protein 11.5 per cent, fat 3.5 per cent, fibre below 9 per cent. This feed meets its guarantee in protein and fibre; it is somewhat low in fat.

Lab'y No. 63008.—This sample contains excessive fibre and, further, is unpalatable by reason of objectionable weed seeds. It contained 22 vital weed seeds per ounce, while the Act permits only 5 weed seeds per ounce.

Lab'y Nos. 63428 and 63466.—The chief difference between these two, from the chemical standpoint is the higher fibre content of No. 63466. No. 63428 contains 45 per cent wheat and 35 per cent wild buckwheat, with less than 0.5 per cent of injurious matter. No. 63466 contains about 40 per cent cereal and less than 0.5 per cent of injurious material. No. 63428 is decidedly the better sample.

Lab'y No. 68699 has a high protein and low fibre content—two good features. If palatable it should make a good feeding stuff.

Lab'y No. 69493.—Though the protein content is a little low, it is a fair sample of Standard Recleaned screenings. Its fibre content is quite satisfactory. A sample of these screenings examined "before grinding" showed.

Wild buckwheat	47·8
Wheat, small and shrivelled	46·4
Wild oats	2·1
Flax seed	1·5
Chaff and weed seeds	2·2
	100·00

Lab'y Nos. 69494 and 69495.—Sample No. 69495, labelled "oat scalpings" is much the better, being richer in protein and fat and lower in fibre.

Lab'y No. 70209.—This was ground from a further car-load of the stock which yielded No. 69493. The two analyses agree except in the case of the fibre, which is one per cent lower in No. 70209.

Lab'y No. 71809.—Oat Scalpings. This contains a large excess of fibre. Further, there are present a number of noxious weed seeds which undoubtedly would render the feed objectionable, if not indeed injurious to live stock.

DISTILLERS' DRIED GRAINS

This by-product is one of the most favourably known of the high-protein concentrates. It is the dried residue of the grains—barley, wheat, rye, corn, etc., after malting and distillation in the manufacture of alcohol. It constitutes a digestible, rich, satisfactory and, at recent prices, an economic feeding stuff for use in the ration of dairy cows and fattening steers. Its chief value has been found in milk production. Like other by-products from manufacturing processes, this product should always be purchased on guaranteed analysis.

Lab'y No. 68879.—The analysis of this sample, and particularly the data for the protein content, would indicate rye as the source of these " grains". It is an excellent cattle feed, of the class with medium protein content.

Lab'y Nos. 70208 and 70806.—These are " grains " stated to be from corn, rye and barley and were sold under a guarantee of protein 33 per cent; fat 9.5 per cent; fibre 13.8 per cent. They will meet the guarantee in respect to fat and fibre, though decidedly low in protein. Their protein content, however, puts them in the higher class of distiller's grains.

Lab'y No. 71039.—The source of this feed is stated to be corn. The tag bore the following guarantee: protein 35.0 per cent; fat 5.5 per cent and fibre 9.6 per cent. In fat content it exceeds its guarantee by nearly 5 per cent—an excellent feature—but is 1.5 per cent too low in protein and practically 2 per cent too high in fibre. Its percentages of protein and fat give it a very high feeding value.

CALF MEALS

Calf meals are compounded feeds intended as whole milk substitutes and to be as supplementary to skim-milk in the feeding of young calves. As a class they are to be regarded as highly nutritious feeds, being more or less rich in digestible protein, fat and carbohydrates and low in fibre.

Lab'y Nos. 71690-95 and 71697 constitute a series of calf meals compounded by the Animal Husbandry Division and used by that division in a comparative feeding trial. Their ingredients, with proportions, are as follows:—

No. 1. Corn 2 parts, linseed 1 part, oats 2 parts.
No. 2. Corn 2 parts, linseed 1 part, hulless oats 2 parts.
No. 3. Corn 2 parts, linseed 1 part, hulless oats 1 part, oats 1 part.
No. 4. Oats 2 parts, linseed 1 part, hulless oats 2 parts.
No. 5. Corn 2 parts, linseed 1 part, oats 2 parts, blood meal 5 per cent.
No. 6. Corn 2 parts, linseed 1 part, oats 2 parts, mineral mixture (phosphate of lime 20 lb., phosphate of soda 20 lb., sulphate of magnesia 12 lb., sulphate of soda 8 lb., and sulphur 4 lb.), 2·5 per cent.
No. 9. Corn 2 parts, linseed 1 part, oats 2 parts, milk albumen 10 per cent.

Commenting on this series it may be stated:—(1) That in substituting hulless for ordinary oats the protein and fat have been increased and the fibre and ash reduced (See Nos. 1 and 2). (2) That the percentage of protein for No. 3, as recorded, is somewhat higher than would be expected from the formula of preparation, which would place it between the percentages of No. 1 and No. 2. This has probably arisen from incomplete mixing of the ingredients. (3) That in comparing Nos. 2 and 4 it will be seen that the effect of substituting oats for corn has been to raise the percentages of protein, fat and fibre. (4) That in comparing Nos. 1 and 5, it will be observed that the addition of 5 per cent blood meal has raised, very considerably, the percentage of protein. (5) That the addition of 10 per cent of milk albumen has enriched the protein content of the mixture to the same degree as the addition of 5 per cent of blood meal (See lots 5 and 9).

Lab'y No. 71696.—Gold Dollar Calf Meal is claimed by the manufacturer to be prepared from flax, corn, wheat and oatmeal and is sold under a guarantee

of protein 18 per cent, fat 5.0 per cent and fibre 4.2 per cent. It falls short a little in protein but exceeds its guarantee in fat. Comparing this product with the foregoing Central Experimental Farm compounded series it is characterized by a higher protein content and a marked lower percentage of fat.

POULTRY FEEDS

Lab'y. No. 63725.—This chick feed is a mixture of meals with corn predominating. Finely divided charcoal and a small proportion of minute fragments of rock—the latter presumably for the purpose of acting as grit in the trituration of the food in the gizzard. The feed is moderately rich in protein and fat and desirably low in fibre.

Lab'y No. 67397.—This product, sold under the name of Darling's Meat Crisps, is manufactured by Darling & Co., Chicago, Ill. Its guarantee reads: protein 75 per cent, fat 0·5 per cent, fibre 3 per cent. It is stated to be composed of azotine, cracklings and bone. While not conforming to its guarantee --being lower in protein and higher in fat—it is a sweet and wholesome product. A lower fat content would make it a more desirable product for poultry and enhance its keeping qualities.

Lab'y. No. 68798.—The protein and fat data would indicate a "mash" of excellent quality for laying stock; the fibre content is somewhat high for younger birds. It is composed of bran, corn meal, oatmeal, bean and pea meal, oil cake meal, meat meal, blood meal, cotton seed meal, hominy feed, cocoa shell meal, alfalfa meal, wheat middlings, carbonate of lime and salts.

Lab'y. Nos. 69606-07.—These are two products sold as poultry bone meal. Both are sound, of good quality and suitable for use in poultry feeding. The percentages of bone phosphate are: No. 69606, 49·58 per cent; No. 69607, 53·08 per cent. While No. 69606 is richer in protein No. 69607 contains a larger percentage of bone phosphate.

SWEET CLOVER AND ALFALFA MEALS

These meals are simply ground hay and their quality is therefore dependent on the quality of the legume hay as harvested and cured. A young and leafy crop well cured will yield a much more nutritious meal than a riper hay or one that has been partially spoiled in the curing. For this reason these meals should always be purchased on guaranteed analysis and special attention given to the figures for the fibre content, which should not exceed 30 per cent.

Lab'y. No. 69764.—Sweet Clover Meal. This is of very poor quality, being characterized by a low protein content, and a very high percentage of fibre. It is a coarsely ground material of strawy appearance and is evidently from an over-ripe crop. Though offered at $20 per ton, it is of too poor a quality to purchase at any price.

Lab'y. Nos. 69765-66.—Alfalfa Meal. Both samples were obtained from Woltz Brothers, Cayuga, Ont., and were priced as follows: No. 69765, $29 per ton; No. 69766, $31 per ton. The same guarantee—protein 12 per cent, fat 1 per cent and fibre 35 per cent—was given for both meals, the difference in price, it was stated, being due to the finer grinding of No. 69766.

The analysis shows that No. 69766 is much the superior, being higher in protein and lower in fibre; it evidently contains a much larger percentage of younger and finer material.

Lab'y. No. 71703.—Alfalfa Meal manufactured in the United States and purchased through the Maple Leaf Milling Co. A meal of medium fineness and judging from appearance, from a fairly mature crop. The analysis indicates a meal of poor quality; it is low in protein and exceeds the limit in its percentage of fibre.

FEEDS—UNCLASSIFIED

Lab'y. No. 63033.—Oil Cake Meal, sold under the guarantee of protein 33 per cent, fat 5·5 per cent and fibre 7·5 per cent. The sample meets its guarantee very satisfactorily and is of excellent quality.

Lab'y No. 63205.—The data for the sample are in accord with those of good quality oil cake meals.

Lab'y No. 58748.—The analysis is in fairly close accord with the data of the best grades of cotton seed meal.

Lab'y No. 63630.—This feed was stated to be compounded of oats 4 parts, bran 1 part. As a pig fed it is too low in fat and protein and much too high in fibre; it must be considered as undesirable and unsuitable even for mature swine. If it does not contain added oat hulls, the oats used in compounding the feed must have been of very poor quality.

Lab'y Nos. 64095 and 68738.—The analysis of the samples of "Peanut Meal" shows that they are essentially of the same composition as "peanut hearts" and "peanut kernels." They are probably a by-product in the manufacture of "peanut butter." They are concentrates of very high nutritive value but their very large percentage of fat or oil (nearly 50 per cent) would necessitate their judicious use *i.e.* they should be fed in moderation and with poorer foods.

Lab'y No. 66739.—Semi-solid buttermilk, manufactured by the Ottawa Dairy Co. A thick, smooth paste, free from lumps, and of a yellowish cream colour, with odour of sour milk; taste distinctly sour.

The product contains 40.78 per cent of total solids, of which 3.19 per cent is fat, 14.20 per cent casein or curd and 19.55 per cent of milk sugar and lactic acid.

Lab'y No. 68455.—This sample consists very largely of pea hulls with a small proportion of broken pea. The hull of the pea is an extremely poor feed; it is practically worthless. It is, however, evident from the analysis, as well as from inspection, that this sample contains a sufficiency of the broken pea grain to give the feed a certain small nutritive value.

Lab'y Nos. 68817-18.—Two brands of fox biscuits forwarded for examination from Prince Edward Island. Both are apparently sound and wholesome biscuits but No. 68817 is much the superior by reason of its higher percentages of protein and fat. Further, No. 68817 is drier and would therefore be likely to have the better keeping qualities.

Lab'y Nos. 69064-65.—Rye Hard-tack "S" and "T." Imported. Forwarded from New Westminster, B.C. Examination showed that these are genuine rye biscuits and practically identical in composition. Presumably they would prove of value in the feeding of dogs and foxes.

Lab'y No. 69278.—This "Mill Chop" is a feed of medium protein content and of fair nutritive value. The percentage of fibre is comparatively low and it might therefore be used in pig feeding.

Lab'y No. 63440.—Rush-joint *(Equisetum fluviatile)* hay, cut from low-lying lands overflowed by the Kootenay river, southern British Columbia. The correspondent forwarding the sample for analysis states that this "grass grows over large acreages in abundance under water on over-flowed lands and may be cut on the ice when the lands are not drained. It is a most valuable feed for cows." The sample as received was quite dry, harsh and of a green colour; fruiting (spore) spikes were absent.

The data indicate a low nutritive value. No scientific evidence, apparently, is available as to digestibility but the low protein and the high percentages of fibre and ash would place this hay in the class of very poor forages. It may safely be concluded that its digestibility is very low. The ash is largely silica, which in addition to being valueless to the animal, would probably prove irritating to the lining membranes of the digestive tract.

Since it is widely held that the *Equisitaceæ* (horse-tails) are poisonous to live stock, this sample was submitted to the Dominion Botanist for examination and report. He writes as follows: " There is little doubt of its being *Equisetum fluviatile* (horse-tail) a species which seems never to have come under suspicion as being poisonous. However, in view of the pretty well proven case against other species, including one considerably resembling this we would think it well to issue a caution. Farmers should be careful and observant in the feeding of this hay before venturing too extensively upon its use, especially in the feeding of it to horses. The danger with *Equisetum arvense* is apparently greater with horses than with cattle."

Lab'y No. 68088.—Dried ground sunflower, forwarded from a correspondent in southern Alberta, who writes as follows: " This material is the dried and ground sunflower crop which had been frozen when the flowers were at about half their full size. The stalks were allowed to 'air dry' in the field and ground. Horses and pigs had apparently liked the frozen stalks and it was therefore thought that with the addition of some needed ingredient a useful stock feed could be compounded."

The high percentage of fibre, associated as it is with such a comparatively low protein content and, in all probablity, a very low digestibility would seem to preclude the possibility of using this material to advantage in a stock feed.

TABLE 15.—ANALYSIS OF FEEDING STUFFS

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
	OATS	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
61191	Crushed oats, Kenora, Ont.	9·76	12·07	4·08	61·83	9·25	3·01
63027	Crushed oats, Ottawa, Ont.	9·02	11·35	5·87	61·08	9·97	2·71
63028	Hulless oats, Ottawa, Ont.	12·05	15·74	5·87	61·10	2·91	2·33
63583	Oat middlings, Peerless Cereal Mills, Woodstock, Ont.	7·13	13·55	6·54	59·41	10·27	3·10
69509	Oat feed, Belleville, Ont.	7·81	12·13	4·49	59·48	12·47	3·62
	BARLEY						
63026	Ground barley, C.E.F., Ottawa.	12·36	13·02	2·12	66·58	3·72	2·20
66544	Ground barley, Quebec.	11·50	12·82	2·30	64·53	6·21	2·64
	CORN						
58871	Hominy feed, Quaker Oats Co.	7·94	10·78	7·17	66·99	4·95	2·17
62702	Popcorn meal.	8·07	12·00	5·16	69·38	3·67	1·72
62716	Corn meal.	10·56	10·25	1·30	70·65	5·04	2·20
63029	Ground corn.	11·08	8·66	4·45	72·34	2·40	1·07
	SCREENINGS						
58767	Ogilvie's Standard Stock Feed No. Reg. 880	13·09	12·57	2·98	65·02	4·31	2·03
63003	Ground wheat screenings, Eburne, B.C.	10·53	13·20	5·07	56·57	10·54	4·09
63428	Screenings, No. 1.	13·44	13·34	3·14	60·79	6·84	2·45
63466	Screenings, No. 2.	11·24	13·85	4·09	58·50	9·19	3·13
68699	Ground screenings, recleaned, Lake of the Woods Milling Co.	9·89	14·37	4·05	63·22	5·89	2·58
69493	Ground screenings, recleaned, Grenville Milling Co.	8·03	11·78	3·34	67·89	6·92	2·04
69494	Ground screenings, recleaned, Maple Leaf Milling Co.	7·61	12·72	3·47	58·85	13·60	3·75
69495	Oat scalpings, Maple Leaf Milling Co.	8·39	15·85	4·08	60·48	6·83	4·37
70902	Ground recleaned, Grenville Milling Co.	12·37	11·96	3·27	63·84	5·95	2·61
71809	Oat scalpings, Maple Leaf Milling Co.	10·49	11·51	3·68	58·11	12·73	3·48

TABLE 15.—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.
	DISTILLERS' DRIED GRAINS						
68879	H. Walker & Sons Distillery	9·43	22·48	6·40	46·69	13·77	1·23
70208	Can. Industrial Alcohol Co	4·87	29·78	11·91	39·01	13·03	1·40
70806	" "	4·61	27·76	10·40	41·91	12·70	2·62
71039	Gooderham Worts, Limited	4·60	33·46	10·19	37·45	11·63	2·67
	CALF MEALS						
71690	Animal Husbandry Div. C.E.F. No. 1	9·31	13·02	11·00	58·02	5·74	2·91
71691	" " " 2	8·79	13·85	12·63	59·40	2·93	2·40
71692	" " " 3	8·13	14·22	11·58	59·50	4·21	2·36
71693	" " " 4	7·10	15·31	13·36	55·73	5·61	2·89
71694	" " " 5	8·88	16·37	10·27	56·08	5·67	2·73
71695	" " " 6	8·61	12·97	11·70	56·34	5·59	4·79
71697	" " " 9	8·97	16·32	11·35	53·70	5·36	4·30
71696	Gold Dollar, W. R. Cummings (No. 8)	8·55	17·55	6·32	60·37	4·75	2·46
	POULTRY FEEDS						
63726	Chick feed, Wingham, Ont	10·89	13·84	4·35	59·51	2·94	8·47
67897	Darling's meat crisps	5·38	70·08	13·54	.....	.....	9·83
68798	Dry mash, Blatchford's Calf Meal Co	9·84	19·32	4·42	48·31	7·92	10·82
69606	Swift's Can. poultry bone meal	9·24	27·29	3·23	.....	.....	56·19
69607	Nat. Fert. Co. poultry bone meal	6·40	24·62	3·61	.....	.....	59·00
	MEALS FROM LEGUME CROPS						
69764	Sweet clover meal, King, Ont	9·25	8·23	2·68	29·72	46·82	3·30
69765	Alfalfa meal (medium)	9·86	12·45	3·14	37·58	30·94	6·03
69766	" (fine)	11·17	16·60	3·72	36·01	24·22	8·28
71703	"	9·25	13·55	3·20	35·01	31·18	7·81
	MEALS AND FEEDS—MISCELLANEOUS						
63033	Oil cake meal, Sherwin Williams	7·09	37·12	8·30	35·76	6·99	4·74
63205	"	8·78	36·84	7·89	34·43	7·77	4·29
58748	Cotton seed meal, Moncton, N.B	10·17	43·72	8·58	22·72	9·52	5·29
63630	Feed, K. McL., Arnprior, Ont	10·26	9·11	2·96	58·32	15·61	3·74
64095	Peanut meal, Toronto	3·66	28·50	48·53	14·23	2·71	2·37
66739	Semi-solid buttermilk, Ottawa Dairy Co	59·22	14·20	3·19	19·55	.....	3·84
68455	Pea bran, Vancouver, B.C	6·92	10·58	3·29	36·16	39·60	3·45
68738	Peanut hearts, Vancouver, B.C	1·96	28·64	44·70	20·05	2·27	2·38
68817	Fox biscuits, Imperial Biscuit Co	8·52	15·07	5·96	68·41	0·47	1·57
68818	" L. Arcand, Deschambault	18·44	10·86	4·08	60·39	1·58	4·65
69064	Rye hard-tack "S"	8·78	13·87	1·04	.....	.....	2·15
69065	" "T"	6·99	13·69	1·25	.....	.....	2·33
69278	Mill chop, Peterborough, Ont	12·12	11·04	3·22	65·60	5·60	2·42
63440	Rush-joint hay, Kootenay, B.C	10·89	7·94	2·76	41·28	24·89	12·24
68088	Dried ground sunflower, Alberta	8·28	8·38	1·87	39·17	33·64	8·66

DRY MATTER DETERMINATIONS OF FORAGE CROPS

The Division of Forage Crops, the Cereal Division and the Division of Field Husbandry submitted during the year almost 2,000 samples of fresh and air-dried material representative of a large number of different forage crops grown on the Central Farm, Ottawa and Experimental Stations at Nappan, N.S., Fredericton, N.B., Lennoxville, La Ferme, Ste. Anne de la Pocatière and Cap Rouge, Que., Brandon, Man., Scott, Sask., Fort Vermilion, Alta. and Invermere, B.C. The laboratory work has consisted in determining the percentage of "dry matter", the data being used to calculate the respective yields of dry matter per acre—a more reliable basis from which to estimate the real feeding value of the crops than the yields of field-cured materials heretofore used.

OATS

Among the cereal crops of Canada that of oats ranks next in importance to wheat. Apart from the large volume used in the manufacture of oatmeal and other forms of breakfast foods, oats constitute the chief cereal used in Canada in stock feeding. As a feed for the horse they have no equal and ground or chopped and mixed with other concentrates they are very largely used in the ration of dairy cows. For young pigs and calves ground oats from which the hulls have been sifted out, form a wholesome and nourishing feed. The importance of this crop is therefore evident and the value of investigatory work in the breeding and selection of varieties and strains which are prolific and of high quality, obvious. Since the hull of oats from the standpoint of furnishing digestible food nutrients is almost worthless, and the further fact that the range in the percentage of hull to kernel in varieties grown is from 20 to 40, the value of analysis, to supplement the field data, will be apparent.

An interesting series comprising six well-known varieties of oats grown on the Dominion Experimental Station, Charlottetown, P.E.I., has been critically examined. The results show very considerable differences between the several varieties, in many particulars, and emphasize the value of chemical work in the development of oats of good quality.

Table 16 permits a study of the relationship of the weight of seed, protein and fibre content and percentage of hull. As might be expected, there is a direct (though not constant) ratio between the percentage of fibre and the percentage of hull. The data also show in a general way that the heavier the seed, the higher the percentage of kernel, and, vice versa, the lighter the oat, the higher the percentage of hull.

TABLE 16.—OATS—CROP OF 1922

Experimental Station, Charlottetown, P.E.I.

Lab'y No.	Variety	Weight of 1,000 seeds	Protein	Fibre	Hulls	Kernels
		grams.	p.c.	p.c.	p.c.	p.c.
63600	Golden Rain	29·07	9·99	9·97	26·07	73·93
601	Banner	28·22	9·91	11·52	30·80	69·20
602	Victory	32·79	8·44	10·85	28·43	71·57
603	O. I. Black	27·42	10·08	11·54	31·95	68·05
604	O. A. C. 72	32·73	9·10	9·79	25·18	74·82
605	Daubenay	31·29	10·61	8·85	20·71	79·29

In table 17 the data of the complete fodder analysis are presented and marked differences in nutritive value, as measured or gauged by percentage of protein, fat and fibre, will be observed.

TABLE 17.—OATS—CROP OF 1922

Experimental Station, Charlottetown, P.E.I.

Lab'y No.	Variety	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
63600	Golden Rain	9·25	9·99	5·40	62·48	9·97	2·91
601	Banner	8·46	9·91	4·67	62·38	11·52	3·06
602	Victory	9·03	8·44	6·15	62·56	10·85	2·97
603	O. I. Black	8·67	10·08	5·28	61·77	11·54	2·76
604	O. A. C. 72	9·41	9·10	4·02	64·69	9·79	2·99
605	Daubenay	9·65	10·61	7·47	60·48	8·85	2·94

As opportunity permits, it is proposed to follow up this work. It may show that apart from the influence of soil and seasonal conditions on the composition of the grain, varieties may possess distinct inherited qualities, e.g., the proportion of hull to kernel, the percentage of protein and of fat to that of the carbohydrates; and such knowledge would be of considerable service towards increasing the value of the oat crop.

CATTLE TONICS AND CONDIMENTAL FEEDS

A number of samples of this nature have been submitted by farmers throughout the country, generally accompanied by complaints that these preparations have been of little or no value and in some instances that they have been positively harmful.

In general, analysis shows these feeds and tonics to be mixtures containing two, three or more of the following: charcoal, salts of tartar, sulphur, sodium chloride, sodium bicarbonate, copperas, saltpetre, Epsom salts, Glauber's salts, Venetian red, tartar emetic, calcium phosphate and calcium carbonate, nux vomica, pepper, gentian, fenugreek, licorice, elecampane, ginger and mandrake, linseed and other meals, etc.

A survey of this list of ingredients will show that the medicinal value of these preparations depends upon a number of chemicals and drugs of a very cheap and simple nature; there is nothing extraordinary or exceptional in these "tonics" and usually the prices asked for them are altogether exorbitant.

There is no evidence to show that the continued or general use of these so-called tonics and condimental foods is either necessary or economical. It has been shown that animals on sufficient and wholesome feed and in good health do not thrive any better for the addition of such preparations to their ration and it seems only reasonable that it would be more rational to treat stock out of condition as their ailments require.

Lab'y No. 65701.—Stock Tonic (Hog). Manufactured by the Maple Leaf Stock Tonic Mills, Kitchener, Ont.

This preparation is a finely ground, greyish mixture with a strong odour of linseed. Its analysis gave the following results.

ANALYSIS

Moisture	6·21
Charcoal, vegetable and other organic matter	49·63
Sulphur	3·43
Phosphate of lime (bone phosphate)	14·12
Nitrate of potash (saltpetre)	0·42
Chloride of soda (common salt)	2·16
Sulphate of magnesia (Epsom salts)	4·47
Sulphate of iron (copperas)	3·83
Tartar emetic, as antimony	0·62
Mineral matter insoluble in acid	7·05

Microscopical examination showed the sample to contain moss (with débris gathered with it), ground oil cake, bone, charcoal, fenugreek, chaff and weed seeds and unidentified material.

Lab'y No. 69279.—Stock Tonic.—Manufactured by the Maple Leaf Stock Tonic Mills, Kitchener, Ont., and submitted by the Animal Husbandry Division, C.E.F., Ottawa.

This preparation, a finely ground mixture of a dark greyish colour with odour of fenugreek.

ANALYSIS

Moisture	5·67
Charcoal, vegetable and other organic matter	46·71
Sulphur	2·48
Phosphate of lime (bone phosphate)	17·56
Carbonate of lime	7·03
Nitrate of potash (saltpetre)	1·15
Chloride of soda (common salt)	2·17
Sulphate of iron (copperas)	3·34
Tartar emetic	trace
Mineral matter insoluble in acid	14·14

This preparation consists essentially of moss or peat, a feed stuff containing a wheat by-product, carbonate of lime and bone phosphate with smaller quantities of charcoal, copperas, sulphur, salt, saltpetre and fenugreek and a trace of antimony which is perhaps accidental.

Lab'y No. 66068.—Watkins Stock Tonic, manufactured by the J. R. Watkins Co., Hamilton, Ont.

This material is a finely ground greyish mixture with a strong odour of fenugreek and a saline and bitter taste. Its analysis gave the following data.

ANALYSIS

Moisture	6·46
Charcoal, vegetable and other organic matter	51·02
Sulphur	7·32
Phosphate of lime (bone phosphate)	3·65
Nitrate of potash (saltpetre)	trace
Chloride of soda (common salt)	28·10
Bicarbonate of soda	trace
Sulphate of magnesia (Epsom salts)	4·65
Sulphate of iron (copperas)	1·95
Salts of tartar	trace

Microscopical examination showed it to contain shorts and screenings, ground oil cake, charcoal, fenugreek, gentian, anise seed, capsicum, coriander and other umbelliferous seeds.

This product consists largely of common salt with smaller quantities of sulphur, Epsom salt, bone phosphate, copperas and traces of saltpetre and salts of tartar, mixed with a certain proportion of feed and medicinal seeds.

Lab'y. No. 69413.—Canadian Zip Conditioner, manufactured by the Canadian Zip Products Co., Montreal, Que.

This is a reddish coloured mixture, evidently containing a large proportion of salt.

ANALYSIS

Sodium chloride (common salt)	38·76
Venetian red (oxide of iron)	2·01
Phosphate of lime (bone phosphate)	1·31
Meal (buckwheat, corn, oats, etc.), approximately	50·00

This is a condimental feed consisting essentially of a meal or mixture of meals with common salt (38·76 per cent), Venetian red (2 per cent, to colour the compound) and traces of potassium nitrate (saltpetre) and sulphate of magnesia (Epsom salts).

The feed basis was a meal made from milling by-products of oats, wheat, rye, corn, buckwheat and linseed. Pumpkin seed was also observed.

ABORTION REMEDIES

A number of preparations, sold for use with cattle as abortion preventives have been examined in these laboratories. A brief report on the results of this examination follows:—

Lab'y. No. 63686.—"Germ-a-tone (Calf Saver)". Manufactured by The Germicide Co., Denver, Colo. This sample was submitted for examination by the Pathologist of the Health of Animals Branch, Department of Agriculture.

This preparation may be described as a slightly moist, violet-blue coloured crystalline mixture in a fairly fine state of division, with odour of carbolic acid and liquorice.

ANALYSIS

Moisture	3·03
Sodium chloride (common salt)	90·03
Phenol (carbolic acid)	3·64
Glycerrhizae (liquorice)	1·80
†Sulphate of lime	1·03
†Carbonate of lime	0·40
	99·93

†Probably present as an impurity in the salt.

It will be observed that this preparation is essentially common salt with some 4 per cent of phenol (carbolic acid). The liquorice, about 2 per cent, is present, chiefly, if not wholly, for the purpose, apparently, of making the preparation palatable to stock.

Lab'y. No. 63890.—Dr. Cook's Abortion Remedy. Manufactured by the Gallagher Remedy Co., Ltd., Peterborough, Ont. The sample was submitted by the Division of Animal Husbandry, Central Experimental Farm.

This preparation is a fine powder of a light greyish colour, showing particles of sulphur and possessing a bitter and pungent (ginger) taste.

ANALYSIS

Moisture	3·12
Sulphur	19·88
Charcoal	2·62
Nitrate of potash (saltpetre)	16·43
Sodium chloride (common salt)	20·56
Carbonate of lime	10·80
Tartar emetic	0·48

The " herb " content could not be absolutely determined but probably included ginseng, mustard, aloes and ginger.

Lab'y. No. 66050.—Dr. Calkins Abortion Remedy. Manufactured by the United States Live Stock Remedy Co., Denver, Colo. This preparation was submitted by the Division of Animal Husbandry, C.E.F.

In pink coloured tablets or lozenges; strongly alkaline and soluble in water with the exception of traces of foreign matter.

ANALYSIS

Sodium chloride (common salt)	5·84
Sodium carbonate (washing soda)	5·92
Sodium bicarbonate (baking soda)	77·00
†Calcium sulphate (sulphate of lime)	0·86
Magnesium sulphate (Epsom salts)	9·65
Undetermined	0·73
	100·00

†Probably present as an impurity in one or other of the principal constituents.

The tablets are free from arsenic and do not yield any extract on treatment with ether.

The results of this examination show that the " remedy " is essentially bicarbonate of soda and Epsom salts.

Lab'y. Nos. 66051 and 69572.—Bowman's Abortion Remedy. Manufactured by Erick Bowman Remedy Co., Owatonna, Minn., U.S.A. The samples were submitted, respectively, by the Division of Animal Husbandry, C.E.F., and the Dominion Experimental Farm, Brandon, Man.

Both samples as received had the appearance and, essentially, the properties of brown or raw sugar; the material was very sweet to the taste and yielded an aqueous solution which gave a *very slightly* acid reaction to litmus paper.

Both samples were submitted separately to a careful and searching analysis. The results from these analyses were in very close agreement, indicating that the composition of both samples was practically identical. The analysis from the closely concordant data is as follows:—

ANALYSIS

Moisture	4·48
Sucrose (cane sugar)	77·12
Reducing sugar (brown sugar)	6·81
Residue insoluble in cold water (bran)	9·35
Glycerine	0·61
Ash or mineral matter	1·57
	99·94

The sucrose (cane sugar) and reducing sugar are in the proportion found in ordinary brown sugar and thus the chemical data support the conclusion drawn from the physical characters of this material—that it is essentially brown sugar.

The bran present was identified by its physical characters, confirmed by microscopical and chemical analysis.

Glycerine was found in very small quantities—less than 1 per cent.

The percentage of ash or mineral matter is in fair accord with that of a mixture of brown sugar and bran in the proportion herein found. The detailed analysis of this ash gave 0·33 per cent lime, 0·27 per cent phosphoric acid, 0·27 per cent magnesia, with traces of iron, alumina, silica, potassium, sodium and sulphates. They, further, exclude the possibility of the presence of any added mineral matter.

Absence of phenol (carbolic acid), salicylic acid and salicylates and boric acid and borates, was proven.

Exhaustive search failed to find any alkaloid or " active principle."

This " remedy " is essentially sugar (9 parts) and bran (1 part) with apparently a very little glycerine.

INSECTICIDES AND FUNGICIDES

The work on insecticides and fungicides has been essentially of an investigatory nature. It has been undertaken chiefly with a view to ascertaining the composition of the insectides and fungicides on the Canadian market, to assist in determining their value in insect and fungous control and to obtain information respecting misbranding if such existed. It is to be regarded as a preliminary step towards the formulation of an insecticide and fungicide act which shall establish " standards " and protect the farmer and orchardist. The general and increasing use of spraying materials for the control of insects pests and fungous diseases make the question of the composition of such materials of much economic and practical importance. A brief review of some of the more important preparations examined follows:—

PARIS GREEN

An analytical survey of a number of samples of Paris green indicates that, in general, the greens on the market are well made and conform to accepted standards.

The limits heretofore accepted in Canada for Paris green are arsenious oxide (As_2O_3) not less than 50 per cent, and not more than 1 per cent water-soluble arsenious oxide.

Only two samples showed a water-soluble arsenious oxide content higher that one per cent and all samples examined except one had a total arsenious oxide content of not less than fifty six per cent.

One sample (Lab'y No. 63207) though labelled "guaranteed pure Paris Green" was adulterated with approximately 65 per cent of heavy spar ($BaSO_4$).

TABLE 18—ANALYSIS OF PARIS GREEN, 1923–1924

Lab'y. No.	Source of Sample (Manufacturer)	Vendor or Submitter	Cupric Oxide (CuO)	Arsenious Oxide As_2O_3		Residue insoluble in ammonia foreign matter
				Total	Water-soluble 1 day	
			p.c.	p.c.	p.c.	p.c.
60388	May & Baker, Battersea, London, England.	Ottawa Paint Works, Ottawa.	31·09	55·91	1·10	nil
63206	P. Barruel & Cie., Paris, France..	Société des Products Françaises, Montreal.	31·03	56·87	0·68	0·01
63207	" " " ..	" " ..	7·89	14·66	0·50	65·53
64230	Blundell Spencer Ltd., Hull, England.	Dupuy & Ferguson, Montreal.	30·61	56·46	0·76	trace
69344	" " " ..	Carvell Bros., Charlottetown, P.E.I.	30·84	56·90	0·83	0·62
69795	Lewis Berger & Sons, London, England.	Entomological Branch, Ottawa.	29·83	55·90	1·02	0·96

TABLE 19—PARIS GREEN: SUSPENSIBILITY, FINENESS AND WATER-SOLUBLE ARSENIC

Lab'y No.	Apparent density(1)	Suspension Properties after Standing (2)			Fineness					Arsenious Oxide			
		5 min.	10 min.	60 min.	Retained by 1 mm.	Retained by ·5 mm.	Retained by ·25 mm.	Retained by ·1 mm.	Passing ·1 mm.	Total	Water-soluble 1 day	Water-soluble 3 days	Water-soluble 10 days
	grams	cc.	cc.	cc.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
60388	86	246	244	230	–	0·1	0·7	1·2	98·0	55·91	1·10	1·10	1·33
63206	101	220	190	80	–	0·1	0·6	1·3	98·0	56·87	0·69	0·69	0·80
63207	105	240	238*	210**	–	0·0	0·0	1·0	99·0	14·66	0·50	0·50	0·56
64230	112	242	240	220	–	0·1	0·3	1·6	98·0	56·46	0·76	0·85	0·88
69344	110	242	240	220	–	0·0	0·3	1·0	98·7	56·90	0·83	0·83	0·90
69795	98	233	230	210	1·0	1·0	0·4	0·6	97·0	55·90	1·02	1·24	1·46

(1) Weight of green occupying a volume of 100 cc. without jarring.
(2) Volume of suspension of 1 gram after shaking and standing 5 minutes, 10 minutes and 1 hour as measured on the scale of a 250 cc. graduate. It should be noted that the suspension is due to the fine fluffy material, the heavier particles settling almost immediately, indicating the necessity of agitation in the spray tank.
*Suspension is essentially Barytes; suspension due to Paris green below 180 cc.
**Suspension is essentially Barytes; suspension due to Paris green below 30 cc.

PHYSICAL PROPERTIES OF PARIS GREEN

A series of tests was undertaken to obtain comparative data on the apparent density, suspensibility, fineness and stability of the greens.

The *apparent density* is based on the number of grams occupying a volume of 100 cc. in the ordinary 100 cc. graduate, without jarring.

The suspensibility, or stated otherwise, the rate of subsidence was determined by shaking one gram of the Paris green with 250 cc. of water, allowing to stand and noting the suspension after 5, 10 and 60 minutes (table 19). It was found that the greens, Lab'y Nos. 63206 and 63207, considering solely

the suspension of the Paris green, settled much more rapidly than the remainder of the series which subsided in a uniform manner. The rapidity of subsidence of samples Nos. 63206 and 63207, was due to the physical condition of the green, which was in the form of very small compact green balls.

Fineness was determined by shaking 5 grams for a period of 30 minutes and noting the percentage retained by 1, 0.5, 0.25 and 0.1 millimeter sieves and the percentage passing a 0.1 millimeter sieve. These results are only relative as Paris green being amorphous, some of the fine powder adheres to the sides of the sieves (table 19).

Stability was determined by ascertaining the amount of soluble arsenious oxide by the 1, 3 and 10 day water extraction methods, the latter period giving in addition some arsenic due to the decomposition of the green by water. It is considered that the portion of the green which is so loosely combined as to furnish soluble arsenic in 10 days would, in all likelihood, when applied to the plant, soon break up and possibly scorch the foliage quite as badly as free arsenious oxide. While the one day water extraction method indicates the percentage of soluble arsenious oxide, the 10-day method will express more accurately the safety of the sample in actual field work (table 19).

ARSENATE OF LIME

Lab'y No. 63855.—Pyroca arsenate (arsenate of lime). Manufactured by The Deloro Chemical Co., Ltd., Deloro, Ont. Sample submitted by The Entomological Branch, Department of Agriculture.

ANALYSIS

	Found p.c.	Guaranteed p.c.
Calcium oxide	43·50	.....
Total arsenic oxide, not less than	38·31	40·00
Total arsenic (as metallic) not less than	24·98	26·00
Arsenic (metallic) in water-soluble form, not more than	0·39	0·75
Active ingredients:		
"Pyro calcium arsenate" not less than		70·00
Inert ingredients, not more than		30·00
		100·00

PYROX

Lab'y No. 64096.—Bowker's Pyrox. This is labelled "A combined poison and fungicide" manufactured by the Bowker Insecticide Co., Boston. Sample submitted by the Entomological Branch. This material is of a pasty consistency; sample as received had the upper surface quite dry and hard.

ANALYSIS

	Found p.c.	Guaranteed p.c.
Arsenate of Lead ($PbHAsO_4$)	*18·53	16·67
Copper (Cu)	9·40	8·50
*Total arsenic (As)	3·83	3·26
Arsenic (As) in water-soluble form	0·09	0·30

This preparation is a mixture of arsenate of lead and Bordeaux mixture and therefore conforms to the statement of the manufacturer that it is a combined insecticide and fungicide. It fully meets its guarantee and apparently is well made.

ARSENATE OF LEAD

Lab'y No. 66362.—This sample was submitted by a correspondent who stated that it had not given effective control. No information was supplied, however, as to its source or to application.

Analysis	p.c.
Moisture	0·49
Arsenic oxide (As_2O_5)	31·36
Lead oxide (PbO)	64·44

From these data it may be concluded that this insecticide is of full strength; there was no evidence of adulteration.

NICOTINE PREPARATIONS

Lab'y No. 63465: "Black Leaf 40." Manufactured by The Tobacco By-products and Chemical Co., Louisville, Ky., U.S.A., submitted by H. Huber, Sardis, B.C. A thick brownish black liquid with penetrating odour.

Nicotine by distillator—48.56 per cent.

This would appear to be an unusually rich sample; previous analyses in these laboratories have indicated a nicotine content between 38 and 41 per cent.

An enquiry was received as to the advisability of adding potassium permanganate to "Black Leaf 40." This is not advisable for the reason that besides a heavy immediate deposit of manganese oxide, the nicotine is oxidized to nicotinic acid.

Lab'y No. 66543.—Extract of tobacco: sample submitted by the Entomological Branch, imported from Italy by Consiglio Bros., Montreal.

This extract, it was stated by the importers, was "concentrated and prepared according to the prescription of a specialist." It was further stated that it could be sold in Canada between 40-50 cents per pound.

Nicotine by distillation, 4.59 per cent.

Analysis indicated that the sample contained traces of pyridine. At the price quoted it would prove an expensive substitute for the nicotine preparations at present on the market in Canada.

CLIFT'S MANURIAL INSECTICIDE

Lab'y No. 64593.—Manufactured by Robinson Bros., West Bromwich, England and submitted by the Horticultural Division.

This material claimed to be a combined "insecticide" and "fertilizer." The material was of a brownish-yellow colour with a strong naphthalene odour, crystals of naphthalene being apparent throughout the sample.

An extract from the literature of the manufacturers is quoted as follows: "This powder is a most effective and unfailing agent for the extermination of any species of insect pest which spends any portion of its life in or upon the soil. It is also a powerful fertilizer and its invigorating effect upon all plant life is most noticeable."

The analysis afforded the following data:—

Analysis	p.c.
Moisture	2·95
Naphthalene	56·12
Phosphoric acid (P_2O_5)	3·01
Potash (K_2O)	0·25
Nitrogen	0·27

Its value as a soil fumigant or insect repellant depends on its naphthalene content, roughly 50 per cent. Its direct fertilizing properties must be very small, since its percentages of plant food constituents are almost negligible.

THALASSOL OR BUDGE

Lab'y No. 62782.—Manufactured by Budge, Ltd., London, England. This is labelled a non poisonous disinfectant and deodorant.

It is a colourless liquid having a saline taste and strong odour of chlorine. The available chlorine in a freshly drawn sample was 0.52 per cent.

Its value as a disinfectant undoubtedly depends on its available chlorine content.

CLENSEL

Lab'y No. 62123.—Manufactured in Scotland: sample submitted by the Superintendent, Experimental Station Sidney, B.C. It is claimed to act as an insecticide and fungicide.

This material is a dark-coloured, soapy liquid or emulsion smelling strongly of ammonia and oil of citronella.

ANALYSIS

	p.c.
Water and volatile matters*	76·24
Combined fatty acids and resins	18·50
Potassium carbonate (K_2CO_3)	5·11
Arsenic	Nil
Nicotine	"

*Includes ammonia, 2·04 per cent.

BUNT AND SMUT PREVENTATIVES

SEED-O-SAN

Lab'y No. 62121.—Manufactured by Bayer Co., Germany. Sample submitted by the Superintendent, Experimental Station, Sidney, B.C.

A pinkish-red earthy powder, it is claimed to be a fungicide preventing smut and rust on grain and serving to promote growth and increase the yield. Its use apparently is restricted to the treatment of seed grain.

This fungicide is an organic compound of mercury with a zinc salt, paraffin and a colouring substance,—a yellow dye, added to facilitate the distinction between the treated and untreated seed.

The analysis of the material shows moisture and volatile matter including phenol, 5.95 per cent, mercury, as metallic mercury, 15.07 per cent, zinc carbonate, 5.11 per cent, sodium carbonate, 10.02 per cent, paraffin, 58.16 per cent with small amounts of calcium and potash. The plant food ingredients were found to be potash (K_2O) 0.57 per cent and nitrogen 0.79 per cent.

CHLOROPHOL

Lab'y No. 62122.—Manufactured by Bayer Co., Germany. This sample is a deep orange-yellow powder and like Seed-O-San is a fungicide for the prevention of smut and rust by treatment of seed. It further is supposed to promote growth and increase the yield. It is a chlorophenol mercuric compound. Analysis showed the following: moisture and volatile matter including phenol, 14.48 per cent; mercury, (as metallic) 12.02 per cent, sodium carbonate, 30.89 per cent; sodium sulphate, 16.82 per cent; potassium nitrate and chloride. This material contains a blue dye, used to facilitate the distinction between the treated and untreated seed.

In this phase of the division's work a departure has been made leading to a closer co-operation with the Entomological Branch and incidentally to an increased usefulness of the purely chemical studies in insecticides and fungicides. With this in view a member of the chemical staff during a part of the year has carried out the major portion of the investigatory work with these materials at the laboratories at Annapolis Royal, N.S., in conjunction with the Entomological staff there stationed. This has permitted a closer observation as to the degree of success of certain "dusts" and sprays in controlling noxious insects and fungi and their effect upon foliage. It has also made possible a more intimate linking up of the chemical composition of these compounds with results in the orchard—a matter of very considerable importance looking to the progress in this field. The work at Annapolis was varied, including the analysis of many

brands of "dusts" of an insecticidal and fungicidal nature now upon the market, and a study of foliage injury and its causes in apple orchards throughout the Annapolis valley and Nova Scotia generally.

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

During the past year a total of two thousand, six hundred and thirty-five samples were reported on.

There was again a large increase in the number of evaporated milk and powdered milk samples.

As in previous years this report is limited to a brief summary of the analytical results obtained for each class of product.

CLASSIFIED LIST OF THE SAMPLES REPORTED ON DURING THE YEAR 1923-1924

Condensed and evaporated milks	1,183
Milk powders	395
Evaporated apples	300
Colours and inks	15
Spices and condiments	57
Salts and preservatives	6
Denaturing oils	40
Butters and oleomargarines	22
Meat and vegetable extracts	2
Lards, lard compounds and edible oils	43
Canned and preserved fruits	216
Sausages, sausage meats, potted and preserved meats	93
Canned vegetables, tomato products	53
Dehydrated products	181
Miscellaneous	29
Total reported, 1923-1924	2,635

CONDENSED AND EVAPORATED MILKS

A complete summary of results of analysis is given in table 20.

Eighty-nine samples of condensed milk were found to have "sugar down," that is, a deposit of milk sugar at the bottom of the can. In five of these only it was heavy. One sample only of condensed milk contained mould.

TABLE 20—SUMMARY RESULTS OF ANALYSES OF EVAPORATED AND CONDENSED MILKS

Description	Net Weight			Total Solids			Fat		
	Number of samples	Net weight ounces	Per cent number under weight	Number of samples	Total solids, per cent	Per cent numbers below standard	Number of samples	Fat per cent	Per cent numbers below standard
Evaporated	735	Aver 16·14 Max 16·68 Min 11·99	12	827	Aver 27·54 Max 32·67 Min 25·51	Nil	574	Aver. 7·86 Max 8·08 Min. . 7·65	4
Evaporated	82	Aver. 6·17 Max 6·49 Min. . 5·85	4	.....	.....	.....	251	Aver. 9·05 Max 9·60 Min. . 8·75	.....
Condensed	284	Aver 14·06 Max 14·52 Min 11·89	28	.....	.....	.....	311	Aver. 8·33 Max 10·63 Min. . 7·96	3
Condensed	29	Aver. 7·05 Max 7·14 Min. . 6·98	3	.....	.....	.....	.....	.....	.....
Condensed skim. .	31 special brand	Aver. 9·10 Max 12·89 Min. . 6·48	.....	39	Aver 74·00 Max 76·73 Min 71·33	Nil	31 special brand	Aver. 5·23 Max 5·50 Min. . 4·63	.....

SKIM MILK, WHOLE MILK AND MALTED MILK POWDERS

A complete summary of results of analysis is given in table 21.

None of the samples examined contained borates, carbonates or bicarbonates.

TABLE 21—SUMMARY RESULTS OF ANALYSES OF MILK POWDERS AND MALTED MILKS

Description	Moisture			Ash		Fat		
	Number of samples	Moisture, per cent	Per cent number above standard	Number of samples	Ash per cent	Number of samples	Fat per cent	Per cent number below standard
Skim-milk powder	389	Aver. 3·10 Max 6·74 Min. 0·79	7	332	Aver. 8·01 Max 8·45 Min. 5·78	.....	.....	.....
Whole milk powders	.....	.....	.....	58	Aver. 5·43 Max 5·95 Min. 2·20	45	Aver 27·85 Max 28·78 Min 26·34	Nil
Whole milk powders (High fat content)	.....	.....	.....	.....	.....	13	Aver 42·61 Max 43·58 Min 41·16	.....
Malted milk	6	Aver. 6·47 Max 9·89 Min. 4·67	.....	.....	.....	6	Aver. 9·91 Max 12·50 Min. 7·28	.....

EVAPORATED APPLES

Three hundred samples only were examined this year for water content. A summary of results is given in Table 22. Last year for six hundred samples the average water content was 21.4 and 17 per cent had a water content in excess of standard. There has therefore been no improvement in this product.

TABLE 22.—WATER CONTENT OF EVAPORATED APPLES

Number of samples	Water per cent	Number of samples containing water in excess of standard	Per cent number containing water in excess of standard
300	Average 22·07 Maximum 31·11 Minimum 6·18	53	18

SPICES AND CONDIMENTS

Fifty-seven samples were examined. Only one sample was found to be adulterated.

SALTS AND PRESERVATIVES

Six samples were examined and all were free from adulteration.

COLOURS AND INKS

Twelve colours were examined. Three were found to be non-permissible colours, viz., Orange II (S. & J. 86), Azo-rubin (S. & J. 103), and a blue mixture which could not be identified. These three samples were imported colours from England.

Four colours contained arsenic, of which one contained more than ten parts per million, the maximum amount allowed by law.

Three branding inks were examined and were found to be satisfactory.

Forty samples were examined. A summary of results is given in Table 23.

DENATURING OILS

TABLE 23.—NUMBER AND PERCENTAGE NUMBER OF DENATURING OILS, WHICH SATISFY VARIOUS STANDARD TESTS

Tests	Standards required	Satisfied Requirements	
		Number	Percentage Number
All		12	30
Flash point	Not below 75° C. (167° F.)	36	90
Boiling point	Not below 205° C. (401° F.)	15	38
Specific gravity	Not below 0·819	39	98
Taste	Easily recognized when present in proportion 1 part oil to 1,000 parts fat	32	80

LARDS, LARD COMPOUNDS AND EDIBLE OILS

Forty-three samples were examined. All satisfied requirements of regulations except one sample of shortening, which contained 4.18 per cent water.

MEAT AND VEGETABLE EXTRACTS

Two samples only were examined. Both were free from adulteration.

BUTTERS AND OLEOMARGARINES

Twenty-two samples of butters for use in the manufacture of oleomargarine were examined. One sample only contained coal tar colour.

CANNED AND PRESERVED FRUITS

Two hundred and sixteen samples were examined, including eleven samples of whole fruits and pulps, eighty-six samples of Canadian-made jams and one hundred and nineteen samples of imported jams.

A full summary of results of analysis of Canadian and imported jams is given in table 24.

Fourteen samples of jam made in Canada were examined for formic acid. Three of these samples contained this preservative. All coal tar colours found were permissible by law.

TABLE 24.—SUMMARY OF RESULTS OF ANALYSES OF JAMS FOR GLUCOSE, PRESERVATIVES AND COAL TAR COLOURS

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 containing preservative in excess of standard	Per cent number containing preservative in excess of standard	Number of samples	Number containing coal tar colours	Per cent number containing coal tar colours
Jams made in Canada	30	1	3	81	30	37	3	3·7	77	42	55
Imported jams	118	24	20	111	17	15	4	3·6	115	18	16

TABLE 25.—SUMMARY OF RESULTS OF ANALYSES OF STRAWBERRY AND RASPBERRY JAMS MADE IN CANADA FOR PRESERVATIVES AND COAL TAR COLOURS

—	Preservatives Benzoates and Salicylates					Coal Tar Colours*		
	Number of samples	Numbers containing preservatives	Per cent number containing preservatives	Number containing preservatives in excess of standard	Per cent Number containing preservatives in excess of standard	Number of samples	Number containing colours	Per cent number containing colours
Strawberry	23	7	30	1	4	23	14	61
Raspberry	23	8	35	1	4	23	13	57
Total	46	15	33	2	4	46	27	58

*The only colours found were Amaranth (S. and J. 107) and Ponceau 3 R (S. and J. 56).

In collaboration with the Department of Health a special survey was carried out to determine the proportion of strawberry and raspberry jams made in Canada, which contained benzoates and salicylates and coal tar colour. Forty-six samples were examined and a summary of results is given in table 25.

SAUSAGES, SAUSAGE MEATS, POTTED AND PRESERVED MEATS

Forty-five samples of sausages were examined for water, protein and starch content. Summaries of results are given in tables 26 and 27.

In comparison with the results of last year a decrease of 3 per cent is shown in the number of samples containing more than 60 per cent water and an increase of 4 per cent in number of samples containing more than 5 per cent starch.

There has been a slight lowering throughout in the water: protein ratio as compared with last year; this indicates some improvement in the quality of the sausage.

TABLE 26.—SUMMARY OF RESULTS OF ANALYSIS OF SAUSAGES FOR WATER, PROTEIN AND STARCH

45 samples	Water per cent	Protein (N. x 6·25) per cent	Water: Protein ratio	Starch per cent
Average	58·46	13·70	4·4	3·32
Maximum	68·78	18·31	5·7	9·38
Minimum	45·67	9·85	3·1	0·29

TABLE 27.—NUMBER AND PERCENTAGE NUMBER OF SAUSAGE CONTAINING WATER AND STARCH IN EXCESS OF AMOUNTS ALLOWED BY THE REGULATIONS, AND SUMMARY OF WATER : PROTEIN RATIOS

—	Samples containing more than 60 per cent water	Samples containing more than 5 per cent starch	Samples having water : protein ratios				
			Above 5	Above 4·5	Above 4	Above 3·6	Under 3·6
Number	17	8	11	18	27	34	7
Per cent number	38	20	27	45	67	84	16

Twenty-five samples of untreated sausage meat were examined. A summary of results is given in table 28.

No less than sixteen samples, or 64 per cent of total number examined, contained more than 60 per cent water and the results given in table 28 show that the average water content is above 60 per cent.

The water: protein ratio was never found to be in excess of 4 and it would appear that it would be better to control the manufacture of sausages by setting the standard on the water: protein ratio rather than on the water content itself.

TABLE 28.—SUMMARY OF RESULTS OF ANALYSES OF SAUSAGE MEATS INCLUDING WATER : PROTEIN RATIOS

25 samples	Water per cent	Protein (N. x 6·25) per cent	Water: Protein Ratio	Samples having Water : Protein Ratio		
				Above 4	Above 3·6	Under 3·6
Average	60·36	17·82	3·3	Number.....1	10	15
Maximum	75·87	25·27	4·0	Per cent.....4	40	60
Minimum	31·73	14·03	3·1			

Nineteen samples of sausages, corned meat and meat pastes were examined for preservatives. Of these one only contained preservative. Five samples of imported sausages were examined for coal tar colours. In two samples added colour was found in the casings.

CANNED VEGETABLES AND TOMATO PRODUCTS

Thirty-one samples of tomato paste were examined. The average, maximum and minimum percentages of total solids were 35.11, 43.99 and 20.27 respectively.

Forty-five samples of tomato pastes and pulp were examined for preservatives (benzoates and salicylates), and coal tar colours. Three only contained preservative and one only contained coal tar colour.

Three samples of canned peas, two of which were labelled "artificially coloured," were examined for copper. The two which were labelled both contained small amounts of copper salts.

MISCELLANEOUS

Twenty-nine samples were examined under this heading. Samples included binders, jellifying agents, "Seam dope," discolouring and filtering materials, and brines.

DEHYDRATED FRUITS AND VEGETABLES

During the years an experimental dehydration plant was installed at the Central Experimental Farm, Ottawa, and two semi-commercial dehydrators were set up and used, one at Grimsby, Ont., and one at Penticton, B.C. The control in connection with the products of these dehydrators has been carried out in these laboratories.

One hundred and seventy-one samples of fruit and ten samples of vegetables have been examined.

Plums and Peaches:—Several varieties of plums and peaches grown in the Niagara peninsular were dehydrated in the experimental dehydrator with a view to finding out which varieties would yield the best product and to what special treatment—chemical and physical—they should best be subjected. It is not possible from this year's results to draw any definite conclusions, but a summary of the work that has been done is given in tables 29, 30, 31, 32, 33. The dehydrating temperature for plums was 160° F., for peaches, beginning at 170° F., ending at 180° F.

From tables 30, 31 it will be seen that on the average there is not much variation in the amount of sugar lost following the various treatments. Comparing with the fresh fruit, there is for plums an average loss of 10.6 per cent sugar in the process of dehydration and for peaches an average loss of 3.2 per cent sugar. These losses in sugar occur essentially through loss of juice in dripping.

From table 32 it will be seen that the same drying period, *i.e.* for the same heat-supply previous treatment with carbonate of soda causes an appreciable greater loss of water in plums, reducing the period necessary for dehydration. Sulphuring does not seem to materially affect the rate of loss of water. It will also be seen that in the case of the peaches the rate of loss of water is appreciably increased by dipping the fruit in lye so as to remove the skins.

From table 33, it appears that lye-dipping increased the amount of sulphur dioxide absorbed by the peaches.

A summary of percentage water found in fruits and vegetables after various treatments is given in table 34.

TABLE 29.—PLUMS AND PEACHES: FRESH (PITTED) FRUIT

Analyses of fresh fruits used in dehydration work at the Central Experimental Farm

Fruit	Number of samples	Water per cent		Number of samples	Total sugars per cent		Number of samples	Acidity (as H_2SO_4) per cent	
Plums	12	Average	85·4	12	Average	8·2	10	Average	1·03
		Maximum	88·0		Maximum	10·0		Maximum	1·75
		Minimum	82·1		Minimum	5·1		Minimum	0·36
Peaches	11	Average	87·2	11	Average	8·3	11	Average	0·48
		Maximum	89·7		Maximum	9·4		Maximum	0·59
		Minimum	85·2		Minimum	6·6		Minimum	0·28

TABLE 30.—PLUMS

Comparison of average per cent sugar content and acidity (as H_2SO_4) of dehydrated plums with values for fresh plums

Treatment	Dehydrated Fruit							Fresh fruit
	Unpitted				Pitted		All treatments	
	Natural	Sodium Carbonate	Sulphured	Natural	Sodium Carbonate	Sulphured		
Per cent sugar content on dry basis	44·7	45·3	44·5	46·1	46·5	46·7	45·6	56·2
Per cent acidity (as H_2SO_4) on dry basis	7·97	7·52	7·57	8·60	7·80	8·93	8·06	7·05

TABLE 31.—PEACHES—HALVED AND PITTED

Comparison of average per cent sugar content and acidity (as H_2SO_4) of dehydrated peaches with values for fresh peaches

Treatment	Dehydrated Fruit			Fresh fruit
	Sulphured	Lye (2%) dipped and sulphured	Both treatments	
Per cent sugar content on dry basis	61·6	61·6	61·6	64·8
Per cent acidity (as H_2SO_4) on dry basis	41·9	4·90	4·54	3·00

TABLE 32.—PLUMS AND PEACHES

Comparison of rates of loss of water in the dehydration of Plums and Peaches, after various treatments

Fruit	Treatment	Number of samples	Dehydration period in hours			Water content of dehydrated fruit percentage			Average loss of water per cent	Average per cent loss of water per hour
			Average	Maximum	Minimum	Average	Maximum	Minimum		
Plums	Unpitted: Natural	12	15	18	12	23·0	31·6	17·1	62·4	4·1
	" Sodium carbonate	13	12	18	9	23·0	31·3	17·4	62·4	5·2
	" sulphured	13	14	18	10	21·5	24·3	15·7	64·4	4·6
	Pitted: natural	11	8½	11	7	15·1	17·8	13·0	70·3	8·8
	" sodium carbonate	11	7	10	5	14·9	16·5	12·5	70·5	10·1
	" sulphured	12	9	12	7	15·5	22·4	10·3	69·9	7·8
Peaches	Sulphured	11	8	9	7	20·2	29·8	14·5	67·0	8·4
	Lye (2%) dipped and sulphured	10	6½	8	5	18·1	22·6	14·5	69·1	10·6

TABLE 33.—PEACHES

Comparison of sulphur dioxide content of dehydrated peaches (11 varieties) after various treatments

Treatment	Number of samples	Sulphur dioxide parts per 2,000 parts of dehydrated fruit		
		Average	Maximum	Minimum
Sulphured 3 hours	11	1·16	1·92	0·12
Lye (2%) dipped and sulphured 3 hours	11	2·13	5·36	0·91
Sulphured 1½ hours	5	0·97	1·67	0·41
Lye (2%) dipped and sulphured 1½ hours	4	1·62	2·46	0·74

TABLE 34.— SMALL FRUITS AND VEGETABLES

Water content of dehydrated products after various treatments: experimental dehydrator, Ottawa

Dehydrated product	Treatment	Time of dehydration hours	Water content after dehydration per cent
Cherries, sour	Natural, 132°-162° F., unpitted	7	54·7*
" Tartarian	2% Na_2CO_3, 132°-162° F., unpitted	5	34·7*
" Sweet	Natural, 132°-162° F., unpitted	5½	62·9*
" "	2% Na_2CO_3, 132°-162° F., unpitted	5½	43·2*
" Early Richmond	Natural, 146°-170° F., unpitted	9	21·2
" "	2% Na_2CO_3, 146°-170° F., unpitted	7	22·0
" Montmorency	Natural, 140°-170° F., unpitted	10	23·1
" "	2% Na_2CO_3, 140°-170° F., unpitted	7	21·1
" "	Natural, 165°-170° F., unpitted	6	29·5
" "	2% Na_2CO_3 165°-170° F., unpitted	5	25·3
" "	Sulphured, (15 min.) 165°-170° F., unpitted	6	27·5
" "	Natural, 165°-170° F., pitted	4½	24·9
" "	2% Na_2CO_3, 165°-170° F., pitted	4	25·1
Black Currant	Natural, 140°-170° F	7½	23·9
Gooseberries	" "	11	12·2
Red Currants	" "	8	7·2
Raspberries	2% Na_2CO_3 130°-150° F	7½	12·8
Apples	Natural, 165°-180° F	3	18·9
Beans	Blanched, 134°-160° F	4	26·4
"	Parboiled, 150°-175° F	4	17·5
Peas	Natural, 136°-154° F	4	20·5
"	2% Na_2CO_3, 136°-154° F	4	16·5
"	Sulphured, 136°-154° F	4	18·6
"	Blanched (15 min.), 136°-154° F	4	24·5
"	Natural, 136°-170° F	4	14·6
"	2% Na_2CO_3, 136°-170° F	4	11·5
"	Blanched, 136°-170° F	4	19·7
"	Parboiled, 136°-170 °F	4	13·6

*Incompletely dehydrated.

WATERS FROM FISH HATCHERIES

Two years ago the division was asked to undertake the examination of the waters of the fish hatcheries of the Dominion. During the year thirty of these samples have been analysed, the results showing, with one or two exceptions, the very excellent quality of these supplies and their eminent suitability for hatching purposes.

Since these are natural waters—from lakes, rivers, creeks and springs, in various parts of the Dominion the series furnishes a record of very considerable interest and value—scientific and industrial. The detailed reports on these waters have been submitted to the Fisheries Branch, Department of Marine and Fisheries.

WELL WATERS FROM FARM HOMESTEADS

The analysis of farm water supplies has proved one of the most directly useful phases of the division's work. It has served to emphasize the vital importance of pure water on the farm and led to the closing of many polluted wells. An ample supply of pure water is an asset of no mean value, in preserving the good health of the family, in promotion of thrift of the live stock and in protecting the purity of the dairy products.

A review of the results for the past year's work permits the following classification of the waters examined.

	Per cent
Pure and wholesome	19
Suspicious and probably dangerous	19
Seriously polluted	45
Saline (non-potable)	17

It is not to be concluded from this statement that not more than 20 per cent of farmer's wells yield water which is safe and wholesome for drinking purposes, since it is those who strongly suspect their supplies who chiefly forward samples for examination. These results, however, do point to the importance of the work and the desirability of its continuance.

The analysis and report are made for farmers free of charge, but the express charges on the sample must be prepaid. It is particularly requested that farmers desiring an analysis should write to the division for directions for collection and shipment of the sample, as a large number of the samples sent in by those unacquainted with the requirements for a satisfactory examination, are valueless for analysis, owing to insufficient quantity, dirty containers, old corks, etc.

EXPERIMENTAL PROJECTS UNDER WAY IN THE DIVISION OF CHEMISTRY AT THE CENTRAL EXPERIMENTAL FARM

EXPERIMENTS WITH FERTILIZERS

C. 26. Basic slag, Fortified vs. Bessemer for field crops.
C. 55. The examination of samples of naturally-occurring fertilizers submitted by farmers.
C. 101. The effect on crop yields of mercuric chloride applications to the soil.
C. 102. Magnesian vs. calcitic ground limestone.
C. 104. The effect of gypsum and sulphur applications to a three-year rotation of potatoes, grain, hay.
C. 105. Sources of organic matter for market-garden crops.
C. 106. Fertilizers for carrot crop.
C. 107. Fertilizers for beet crop.
C. 108. Fertilizers for onion crop.

SOIL INVESTIGATIONAL WORK

C. 53. General soil laboratory work for farmers.
C. 83. The analyses and examination of soils of Prince Edward Island.
C. 84. Peace River soil investigatory work (Beaverlodge).
C. 85. British Columbia investigatory work (Prince George district, B.C.).
C. 86. Northern Ontario investigatory work (Kapuskasing, Ont.).
C. 145. The collection and analyses of soils from apple orchards at Rougemont, Abbotsford and Chateauguay, Que., in co-operation with the Division of Horticulture.
C. 146. The analyses of soils and twigs of apple trees for the Horticultural Division in connection with greenhouse work.
C. 147. The analysis of soils from Beaverlodge in connection with the residual effects of various grasses on subsequent crops.

FEEDING STUFFS AND FODDERS, INVESTIGATIONAL WORK

C. 54. Examination of feeding stuffs for farmers.
C. 76. Potato planting—the influence of early planting on the quality and yield of potatoes.
C. 87. Feeding values of oats and barley cut for hay at different stages of growth.
C. 88. Corn for silage—value of the more commonly grown varieties.
C. 89. Sunflower silage: best stages at which to cut.
C. 90. Moisture content of hays.
C. 91. Value of clover hay under various treatments.
C. 92. Condimental foods and cattle tonics.
C. 93. Feeding Stuffs Act investigatory work.
C. 94. Determination of the acre-value in nutriments of various forage crops and of the same crops at different stages of growth.
C. 95. Effect of irrigation on the composition of oats, peas, barley and wheat.
C. 133. The determination of the nutritive value of the kernel in different varieties of oats.
C. 135. The determination of the cumarin content of different varieties of sweet clover.

MISCELLANEOUS INVESTIGATORY WORK

C. 10. Sugar beets for factory purposes.
C. 11. Agricultural meteorology—The influence of seasonal and soil conditions on the yield and composition of wheat.
C. 51. Water supplies for farm homesteads.
C. 56. Meat and canned foods investigatory work.
C. 77. Cause of breakdown in Jonathan apples.
C. 136. Investigatory work with insecticides and fungicides.
C. 137. Feeding value of field roots: mangels, carrots, and turnips.
C. 141. Investigatory work in dehydration of fruits and vegetables.

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