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, 1923

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

INTRODUCTORY

This report—the thirty-sixth in the history of the division—records in brief the results obtained during the past year in a number of the more important investigations involving the application of chemistry to the solution of Canadian agricultural problems attacked at one or other of the farms and stations of the Dominion Experimental Farms System.

The Division of Chemistry is in full co-operation with the several divisions of the Dominion Experimental Farms System—Field Husbandry, Animal Husbandry, Forage Crops, Cereal, Poultry, etc., and all possible assistance is rendered them, as well as the branch farms and stations, whenever chemistry is necessary for the satisfactory conduct of their work. Chemical work has also been undertaken for other branches of the Department of Agriculture—Seed Branch, Dairy and Cold Storage Branch, Health of Animals' Branch, etc. Further, it should be stated that, as in past years, a considerable amount of time and labour has been given to other departments of the Government service—e.g., Department of the Interior, Department of Marine and Fisheries, Department of Customs and Excise, Post Office Department—and in this way the division has acted as a bureau of chemistry of general and national usefulness.

Assistance has been given in the establishment of "standards" and in the drawing up of regulations in connection with the administration of the Acts governing the sale of feeding stuffs and fertilizers, the division carrying out the necessary scientific investigatory work upon which these standards and regulations are based.

The only strictly "control" work of the division is that carried on for the Health of Animals' Branch, Department of Agriculture, in connection with the administration of the Meat and Canned Foods Act. This consists of investigatory and critical analytical work on all classes of packing-house and cannery products—preserved meats, fruits, vegetables, condensed milks, milk powders, etc. The volume of work in this important branch of the division's activities has greatly increased in recent years, now requiring the services of four chemists for its satisfactory prosecution.

Reference must be made, though no details can be given in this report, of that important and useful phase of the division's work—chemical service for farmers. True to its traditions, the division continues to act as a bureau of information accessible to the man on the land, assisting him with advice and, whenever practicable, chemical analysis, in matters pertaining to agriculture. It is gratifying to note, although this work in correspondence and analysis at times fully taxes the division to its limit, that this branch of work is meeting with an ever-increasing response—satisfactory and ample evidence of its appreciation and value. Its prosecution is educational and advisory and undoubtedly is exerting a beneficial influence on Canadian farm practice.

These prefatory remarks may be concluded by presenting, in the following table, a classification of the samples received by the division during the fiscal year ending March 31, 1923. It indicates roughly the character and scope of the work and, in some degree, its volume.

SAMPLES RECEIVED FOR EXAMINATION AND REPORT FOR TWELVE MONTHS ENDING MARCH 31, 1923

—	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	Total
Soils	29	437	27	4	65	39	7	15	3	626
Manures and fertilizers	21	.....	.....	.....	29	56	17	15	6	144
Forage plants, fodders and feeding stuffs	26	31	155	34	493	88	13	16		856
Waters, including rains and snows	7	28	12	3	193	25	8	4	3	283
Samples from Meat and Canned Foods Division	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,792
Miscellaneous, including dairy products, insecticides and fungicides	19	31	7	2	80	32	7	7	2	187
Total	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,888

INVESTIGATIONAL WORK WITH FERTILIZERS

During the season of 1922, investigational work with commercial fertilizers was conducted on the branch Farms and Stations at Charlottetown, P.E.I.; Kentville and Nappan, N.S.; Fredericton, N.B.; Kapuskasing, Ont.; Agassiz, B.C.; Invermere, B.C.; Summerland, B.C.; Saanichton, B.C.; Beaverlodge, Alta., and on the Central Farm, Ottawa.

The investigations commenced in the spring of 1921 have produced important data during the past two seasons, but no detailed discussion of the results will be made until the end of the crop rotation 1923. Experiments with respect to orchard fertilizing, the use of different forms of lime, etc., have been continued and give promise of supplying information of considerable interest and value.

The increasing interest in, and use of, fertilizers by farmers, especially in the Maritime Provinces, made it advisable to institute several new experiments during the past season.

The data are necessarily voluminous and as it has unfortunately become necessary to very materially shorten this report, it has been deemed advisable to defer their publication until the results for 1923 in this work are ready for consideration. In the meantime the inquiries of correspondents in respect to the economic and rational use of fertilizers will, as in the past, receive our best attention.

LIMESTONE

The function and use of lime and lime compounds in agriculture have been very fully discussed in recent publications of this division, copies of which are still available.* It will not therefore be necessary here to consider this subject in detail, important as it is, and the analytical data on samples examined during the year must unfortunately be omitted following the demand for the severe reduction of this report.

A word or two, however, must be said with respect to the use of magnesian limestone (dolomite) in agriculture, since many inquiries on this subject have been recently received by the division.

* *Report of the Dominion Chemist*, 1922, pp. 12-28. Bulletin No. 80, entitled "Lime in Agriculture."

MAGNESIAN LIMESTONE

Hitherto, in making any pronouncement on this subject we have issued a warning in respect to heavy and repeated applications, especially on sandy loams, of ground limestone containing large percentages of carbonate of magnesium, fearing that if soluble compounds of magnesium were formed in the soil injury to crop growth might result. Field, laboratory and pot experiments had proven the poisonous character of the soluble magnesium salts to vegetation. It had, further, been shown that these salts form one of the toxic constituents of the "alkali" occurring in soils of arid districts. There were good grounds, therefore, for the caution, which, we may add, received the endorsation of several of the highest agricultural authorities in Great Britain. It is to be admitted that we had no field evidence of our own to offer, for all the experiments carried on during the past five years with ground limestone on the Farms and Stations of the Experimental Farms System have been made with high-grade calcium limestone, material practically free from, or containing negligible amounts only of magnesium carbonate. Until quite recently all the ground limestone manufactured in Canada was of this character.

Within the last two years, however, ground magnesian limestone (dolomite) containing from 30 to 40 per cent of carbonate of magnesium has appeared on the market, more especially in western and southwestern Ontario (in which dolomitic limestones prevail), and has been more or less extensively used on soils in need of lime, both clays and sands. Transportation charges make it desirable to obtain material from the nearest working quarry—if such limestone is safe for agricultural purposes. No report as to toxic effect on growing crops or depressing influence on yields from this employment of magnesian limestone has reached us, nor, so far as we are aware, has such appeared in the press. The argument might be advanced that it is as yet too early for any appearance of injury to show itself in Canada, but be that as it may, it was deemed desirable to make inquiries and collate evidence in the matter from reliable sources, with the view of a further pronouncement on the subject. To this end we have had correspondence with those Experimental Stations and agricultural authorities in the United States having had in recent years investigational work on this question in hand.

We find that a considerable amount of evidence of a reliable character can be brought together which will show that limestones high in magnesium carbonate—dolomitic limestones—have been used on many types of loam without apparent depression of crop yields and, apparently, without injury to the soil. We find that, falling back on these results, many agricultural chemists of note in the United States are of the opinion that the presence of magnesium carbonate in ground limestone, even in large percentages, does not injuriously affect vegetation.

In view of the foregoing, the use of magnesian limestone cannot be condemned. We do, however, hold to the opinion that a high calcic limestone is preferable for light and sandy loams. We shall endeavour to obtain Canadian data in the matter, but this will take time. The opinion we have held that the use of magnesian limestone is attended with some degree of uncertainty as to results must for the present, in the face of the evidence from the United States, be modified; experience alone will show whether it must be entirely relinquished and magnesian carbonate considered non-injurious on all classes of soils.

MARL

Deposits of marl, varying in extent and in purity, occur in many parts of Canada; they constitute a useful and effective amendment for soils in need of lime. These deposits vary in thickness from a few inches to several feet and occupy as a rule old lake bottoms. They are frequently overlaid by muck—a material also valuable agriculturally as a supplier of humus-forming material. A large volume of analytical data is available to all interested in this subject.

MUDS, MUCKS, AND SIMILAR DEPOSITS

Under this caption are included a number of materials which may be classed as amendments, that is materials of too low a manurial value to be regarded as fertilizers but which are of a certain value for the improvement of soils, chemically or physically or both. Swamp mucks and allied deposits find their value chiefly in furnishing semi-decomposed vegetable matter—humus-forming material—and nitrogen, though the latter is not in a form directly usable by crops. The "muds"—of which there are many kinds, both fresh and salt water—are not as a rule rich in nitrogen and organic matter, but may be found of more or less value for their mineral plant food content and their influence on the tilth or texture of certain soils. The percentages of their plant food constituents are always very small, but analysis has shown that in certain of these deposits at least these traces, as they may be termed, of plant food exist in a condition slightly more available for crop growth than the mineral plant food of the average soil. Carbonate of lime in notable quantities is occasionally a constituent of both mucks and muds—and this enhances their value, especially for soils in need of lime. For the reason already given the publication of the data from the samples of the past year is deferred.

Past reports have dealt with these deposits at some length, as every year a certain number are submitted by farmers for examination and report as to agricultural value.

MISCELLANEOUS FERTILIZER MATERIALS

ALUNITE

Alunite, also known as alum-stone and alum-rock, is a mineral consisting essentially of the hydrous sulphate of aluminium and potassium, but as mined, the ore frequently contains silica in greater or less amounts. The samples of alunite ore submitted to these laboratories were obtained from a mine located at Kyuoquot Sound, 205 miles from Victoria on the west coast of Vancouver island, B.C. The object of the analysis was to ascertain its value as a potash fertilizer.

Lab'y. No. 59077.—Alunite ore, crushed and roasted. Sample was received in the form of a pinkish-mauve powder, quite finely ground.

Lab'y. No. 59362.—Alunite ore (No. 1), raw, uncrushed. Received as masses of rock, variegated with a colour range from white to dark brown, crushing to a brownish-white powder.

Lab'y. No. 59363.—Alunite ore (No. 2), raw, crushed. A light yellowish brown powder, finely ground and considerably darker in colour than the powder of No. 59362.

Lab'y. No. 59364.—Alunite ore (No. 3), crushed and roasted. A fine powder of a pinkish-mauve colour.

ANALYSIS OF ALUNITE ORE

Potash	No. 59077, Crushed and Roasted	No. 59362, Raw Uncrushed	No. 59363, Raw Crushed	No. 59364, Crushed and Roasted
Total potash (K_2O)	0·946	0·108	0·960	1·81
Water-soluble potash (K_2O)	0·362	0·058	0·960	1·66

From these data it will be observed that the percentage of potash in the roasted ore is considerably higher than the rock as mined due to the loss of combined water in the process of roasting. It is evident, however, that although the potash is present in water-soluble, available form, the roasted ore has too low a percentage of this element to merit its recognition as a potash fertilizer of any great value.

ALUNOGEN

Lab'y. No. 63124, 63489.—Alunogen is described in mineralogical works as a native hydrous sulphate of alumina. The two samples examined were from a deposit in the Okanagan valley near Vernon, B.C.

ANALYSIS OF ALUNOGEN

	No. 63124	No. 63489
Mineral matter insoluble in water	21·25	18·35
Aluminium sulphate	59·55	53·63
Magnesium sulphate	18·73	26·87
Iron, soda, etc. (by difference)	0·47	1·15
	100·00	100·00

These results clearly show that this mineral has no value in furnishing the essential elements of plant food.

The Geological Survey has kindly furnished the following information respecting this mineral.

"Alunogen is of common occurrence in the dry belt of British Columbia. It has been found in Ashcroft, Cariboo, Kamloops and Lillooet Mining Divisions. So far it has not been found in commercial quantities and from its occurrence it is quite uncertain whether it ever will be. Artificial (manufactured) aluminium sulphate is used largely in water purification and in the paper industry."

LIME SLUDGE

Lab'y. No. 60247.—Dried waste "lime sludge," a by-product in the manufacture of Kraft pulp and submitted by the Bathurst Company, Ltd., Bathurst, N.B. As received it was in the form of a white, very fine (floury) dry powder with a slight greenish tinge due to traces of manganese. It is essentially carbonate of lime.

ANALYSIS

Moisture	0·54
Mineral matter insoluble in acid	0·49
Oxide of iron and alumina	2·75
Lime (CaO)	53·54
Magnesia (MgO)	1·23
*Carbonic acid (CO_2)	40·36
Sulphur present as sulphides	0·23
Sulphur present as sulphates	0·12
Manganese	traces
	99·26
*Equivalent to carbonate of lime	91·73

This " dried lime sludge " by reason of its high carbonate of lime content and its excellent mechanical condition would prove a suitable form of lime for agricultural purposes, i.e. land treatment. Carbonate of lime in such a very fine state of division must approach quick lime in its rapidity of action, and this material therefore must be regarded as specially valuable for very acid soils in which a prompt action is desired.

The small percentage of sulphur as sulphides (practically traces) could not be considered as harmful in any degree to vegetation.

Lab'y. No. 55004.—Waste lime sludge, a by-product from the acetylene gas plant of L'Air Liquide Society, West Toronto, Ont. As received it was quite wet and pasty, and of a light grey colour.

ANALYSIS

	As received	Air-dried
	per cent	per cent
Water (at 100°C)	49·60	20·40
Hydrated lime ($Ca(OH)_2$)	41·32	65·28
Magnesia (MgO)	Nil	Nil
Oxide of iron and alumina	2·16	3·41
Insoluble mineral matter	1·98	3·12

This material as produced is essentially calcium hydrate (slaked lime) with a large excess of water.

By simple exposure to the air the water content was reduced to 20 per cent, the material then containing, roughly, 65 per cent hydrated (slaked) lime, the equivalent say of 50 per cent quick lime. Distribution on the land would be much facilitated and transportation costs per unit of lime very considerably reduced by drying this product, which should then make a very satisfactory source of lime for land treatment.

HYDRATED (SLAKED) LIME

Lab'y. No. 63068.—From the Standard Lime Company, Joliette, Que. In the form of a fine, floury powder.

ANALYSIS

Moisture	26·28
Mineral matter insoluble in acid	3·44
Lime (CaO)	67·83
Carbon dioxide etc (undetermined)	2·45
	100·00

This is a partially slaked lime, containing 67·83 per cent of lime (CaO), the equivalent of 121·13 per cent carbonate of lime or of 89·58 per cent of fully slaked lime. It would prove excellent for agricultural purposes, and could be specially employed to advantage on clays and heavy loams in need of lime.

POWDERED CLAM SHELL

Lab'y. No. 62120.—A by-product in the manufacture of poultry grit; it was prepared from shells obtained in the vicinity of Saanichton, Vancouver island, B.C.

ANALYSIS

Moisture	1·03
Mineral matter insoluble in acid	1·20
Carbonate of lime	92·87
Carbonate of magnesia	1·85
Oxide of iron and alumina	0·40
Phosphate of lime	0·44
Undertermined (organic matter etc.)	2·21
	100·00

MECHANICAL ANALYSIS

Passes 10 mesh sieve	99·67
" 20 "	76·53
" 60 "	27·49
" 80 "	18·09
" 100 "	10·17

This material should prove a useful amendment for soils in need of lime; its percentage of carbonate of lime (92·87) places it in the first grade in respect to composition. In regard to degree of fineness, it would be classed as a coarse grade, but, provided the price would permit of heavy application it no doubt could be used to advantage in its present condition. However, for a reasonable quick action, further grinding would be desirable.

CALCAREOUS DEPOSIT

Lab'y. No. 62579.—From the bed of a creek tributory to the Vermilion river, some forty-two miles west of Banff, Alberta, and submitted for analysis by the Commissioner, Canadian National Parks, Department of the Interior, Ottawa.

As received this material consisted of rock masses made up of a matrix holding rounded pebbles, and a few fragments of rock, the whole cemented to form a conglomerate, evidently of sedimentary origin.

ANALYSIS

	Rock (matrix and pebbles)	Matrix
Carbonate of lime	61·30	69·90
Carbonate of magnesia	8·06	7·95
Oxide of iron and alumina	4·87	2·12
Mineral matter insoluble in acid	25·57	19·72
Undetermined	0·20	0·31
	100·00	100·00

These results show that the matrix is essentially carbonate of lime, formed no doubt by deposition from the water of the creek. The pebbles are mostly quartzite with fragments of slate, limestone, etc.

As a source of ground limestone for agricultural use, the economic employment of this material would be doubtful, owing to its comparatively low carbonate of lime content, its unfavourable location and occurrence and the cost of grinding, as the material is very hard.

VOLCANIC ASH

Lab'y. No. 10773.—A white material forming a deposit at Rock Creek, B.C., and thought to have an agricultural value. On examination it proved to be volcanic ash.

Lab'y. No. 53943.—From Grand Forks, B.C. This was forwarded as marl, with a request for information as to its value as an amendment for soils in need of lime. It is a fine greyish powder giving no effervescence with acids. Microscopical examination shows it to be volcanic ash.

ANALYSIS

	No. 10773	No. 53943
Mineral matter insoluble in acid	94·73	89·24
Oxide of iron and alumina	1·45	5·89
Lime (CaO)	0·35	very slight
Magnesia (MgO)	0·21	traces "
Phosphoric acid	0·11	"
Potash	0·08	"
Nitrogen	0·04	0·03

These materials have practically no agricultural or fertilizing value, the percentages of plant food being considerably lower than those found in soils of moderate fertility.

DRIED MANURES

Lab'y. Nos. 62384-6.—" Wizard Brand, Concentrated Manures," prepared by the Pulverized Manure Co., Union Stock Yards, Chicago, U.S.A. From the firm's advertising literature we learn that these manures " are pure animal manures accumulated in Western Stock Yards." " They are dried and completely sterilized with 1000 to 2000 degress of heat and then screened and pulverized," when it is packed in 100 pound bags for the market.

Lab'y. No. 62384.—" Wizard Dried Manure, Shredded," received in the form of brown shredded particles and coarse powder, dry and dusty.

Lab'y. No. 62385.—" Wizard Dried Manure, Pulverized," received in the form of a chocolate brown, finely ground powder, dry and dusty.

Lab'y. No. 62386.—" Wizard Dried Manure, Phosphated," manufactured by the Phosphated Manure Company, Kansas City, Mo.; received in the form of a mixture of dry, finely ground brown powder and a light grey granular material resembling and stated to be superphosphate of lime. There was approximately 50 per cent by weight of each material in the mixture.

ANALYSIS

	Shredded No. 62384	Pulverized No. 62385	Phosphated No. 62386
Water	7·27	7·54	5·05
Organic matter	73·69	67·22	50·55
Ash or Mineral matter, plus sand, etc	19·04	25·24	44·40
	100·00	100·00	100·00
Nitrogen	2·12	2·06	1·14
Phosphoric acid	1·54	1·49	8·70
Potash	1·47	1·81	1·47

Apparently no statement is made by the Pulverized Manure Company as to the percentages of plant food contained in the "shredded" and "pulverized" brands, but our analyses would indicate that in this respect one ton of these brands is the equivalent, approximately, of from four to five tons of fresh, mixed, manure of good average quality.

The "phosphated" brand is stated to be a mixture of dried manure and superphosphate, with a plant food content as follows: Nitrogen 0·82 per cent, phosphoric acid 9·0 per cent, potash 1·0 per cent. This statement as to the character of the mixture is evidently correct and our analysis shows that this guarantee is fully met.

In respect to sterilization it may be pointed out that this operation, if thorough and complete, may be both an advantage and a disadvantage. As an advantage it would presumably constitute a protection or safeguard against vital weed seeds and the disemination of such diseases as may be transmitted by manure from affected animals. On the other hand, sterilization, as an operation destroying all micro-organism in the manure must be regarded as a disadvantage, since one highly important function of manure is to inoculate the soil with those bacteria which in the course of their development prepare the stores of inert soil plant food for crop uses. Sterilized manure must be valued largely, if not entirely, according to its plant food content and its ability to furnish humus-forming material—the latter undoubtedly a valuable property though not one to which a dollar and cent appraisement can be attached.

It is not at all probable that these "dried, concentrated manures" will find a place in ordinary farm practice, but for the amateur city gardener, for market gardening lawns, golf courses and other phases calling for intensive fertilizing, it is evident that they will be found effective and convenient.

THE FERTILIZING VALUE OF RAIN AND SNOW

The primary object of this investigation, carried on at the Central Experimental Farm, Ottawa, is the determination of the value of the precipitation as a source of available nitrogenous crop food. The results for the sixteenth year of the inquiry, ending February 28, 1923, are here presented.

The economic restoration to the soil of the chemical constituents abstracted by the growth of crops is one of the most important problems of science as applied to agriculture, and this study has shown that as regards nitrogen, an essential and, when purchased in the form of fertilizer, the most costly constituent of plant food, rain and snow are factors of some value in the up-keep of soil fertility. The fresh greenness and the rapid growth of the herbage following a rain in the earlier weeks of the season are in part due to the rain's store of immediately assimilable nitrogenous food. The chief function of rain, of course, is the bringing into solution the plant food of the soil, thus making it available for absorption by the plant's rootlets, but it is also true that rain and snow contribute a notable, though not a large, part of those nitrogen compounds necessary for the life and growth of plants.

The quantity of the nitrogen compounds present in rain and snow is by no means a constant. It varies somewhat from season to season, even in the same locality and still more so, apparently, according to the locality in which the determination is made. The condition of the atmosphere at the time of precipitation in respect to smoke, etc., markedly affects the nitrogen content, for it is by the washing, filtering, cleansing action of the rain and snow that they derive their fertilizing value. Heavy bush fires immensely increase the rain's nitrogen content and we may rightly conclude that the analysis of collections made near large industrial centres will show a greater richness than that made of rain and snow collected in the open country.

The chief features in connection with the precipitation of the year—its amount and distribution—may be found in the following table:—

TABLE I.—RAIN AND SNOW AT OTTAWA, ONT., FOR THE YEAR ENDING FEBRUARY 28, 1923

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		
1922				p.p.m.	p.p.m.	p.p.m.	p.p.m.	
March	1·42	6·50	2·07	0·931	0·073	0·220	1·224	0·574
April	2·80	10·50	3·85	0·519	0·050	0·235	0·804	0·702
May	1·87	–	1·87	0·698	0·079	0·028	0·805	0·341
June	5·52	–	5·52	0·685	0·096	0·263	1·045	1·307
July	1·98	–	1·98	0·951	0·135	0·434	1·520	0·682
August	2·24	–	2·24	0·506	0·065	0·310	0·881	0·447
September	1·68	–	1·68	0·455	0·108	0·293	0·856	0·326
October	3·29	2·00	3·49	0·828	0·080	0·391	1·299	1·028
November	1·33	4·50	1·78	1·076	0·101	0·346	1·523	0·614
December	0·48	13·75	1·85	0·535	0·048	0·192	0·775	0·325
1923								
January	0·40	32·25	3·63	0·528	0·057	0·277	0·862	0·709
February	–	23·50	2·35	0·238	0·056	0·378	0·672	0·358
Total for twelve months	23·01	93·00	32·31	.....	.....	.....	.....	7·413

TABLE II—PRECIPITATION AND AMOUNT OF NITROGEN PER ACRE, OTTAWA, ONT., 1908-1923

	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
" " 1910	28·79	80·75	36·87	6·869	5·830	85	1·040	15
" " 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
" " 1914	23·31	84·75	31·78	6·208	5·192	84	1·016	16
" " 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
" " 1918	19·99	128·75	32·86	6·259	4·719	75	1·540	25
" " 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
" " 1922	27·11	79·25	35·05	7·111	6·118	86	0·993	14
" " 1923	23·01	93·00	32·31	7·413	5·860	79	1·552	21
Average for 32 years	24·411	92·832	33·686					
Average for 16 years	24·104	93·213	33·425	6·631				

INVESTIGATIONAL WORK ON SOILS FOR THE RECLAMATION SERVICE

This work which is undertaken for and reported to the Reclamation Service, Department of the Interior, covers two phases of investigation: (1) The chemical and physical analysis of soils from irrigable areas in the semi-arid areas of southern Alberta and southwestern Saskatchewan with the view of determining their alkali content. The results are interpreted from the standpoint of the possibility of " rise of alkali " and consequently of injury to crops if the land were placed under irrigation; and (2) the examination of soils from proposed drainage projects situated in the northern parts of the Prairie Provinces. In this case the alkali content is not necessarily determined on all soils submitted, but such an analysis and examination are made as will determine if the lands in question after drainage, will be suitable for agriculture.

For the twelve months ending March 1, 1923, the number of soil groups analysed and reported from irrigation projects was sixty-five, or a total of about 260 samples; from drainage projects twenty groups were analysed and reported, comprising about eighty samples. The irrigation projects included the following: Robsart-Vidora or Cypress Lake Project, Canadian Pacific Railway, Eastern Section, Maple Creek Experimental Plots, and twenty-three investigatory groups from the Canadian Pacific Railway, Eastern Section. The drainage projects dealt with were: Waterhen Lake, Carrot River Triangle and Rocky Mountain House, with a few miscellaneous samples such as lake water, etc.

During the past year considerable investigatory work in connection with alkali problems has been carried on. It includes those investigations which have been carried on for some years past, viz: The Vertical Movement of Alkali in Heavy Clay Soils, the Nature of Burnouts and the Toxicity of Alkali Salts with respect to Crop Growth.

The results of these investigations have been recorded from year to year in the form of papers in the Transactions of the Royal Society of Canada. This year's contributions give a summary of the work to date.

The new field investigation started this year is located on six plots situated near the town of Maple Creek, Alberta. This has been undertaken to ascertain the effect of irrigation on the alkali salts in the heavy clay soils which prevail in this district and the agricultural possibilities of these lands. The location chosen for the plots was an area of virgin prairie about 130 feet by 100 feet. This was divided into six plots, comprising three duplicate plots growing three different crops, viz., original prairie vegetation, brome grass and wheat. Careful measurements are taken each year of the amount of rainfall, evaporation, irrigation water applied, weight of crops cut, moisture in soil, etc., and the alkali content of the soil to a depth of 5 feet, is determined at least once a year. From the results of this experiment, which will probably cover from five to ten years, interesting and important data should be obtained with regard to the behaviour of the soil under cultivation and the movement of alkali under irrigation. These results will undoubtedly greatly assist in determining the possibilities of successful cultivation of heavy lands under irrigation.

Considerable progress has been made this year in completing the reclassification of the Canadian Pacific Railway, Eastern Section, and the final report on this matter is at present under our consideration.

SUGAR BEETS FOR FACTORY PURPOSES

The production of home-grown sugar is not, as yet, a large or wide-spread industry in Canada. There is to-day but one company making beet sugar in the Dominion—the Dominion Sugar Company, operating in the southwest peninsula of Ontario, with factories at Wallaceburg and Chatham. The extent of this company's operations as regards beet sugar may be learned from the following figures for 1921, furnished by the Bureau of Statistics, Ottawa: acreage in sugar beets, 23,535; yield, 199,334 tons; total value, $1,974,384; price per ton, $9.90; refined beet sugar, 52,882,377 tons; value at 8 cents per pound, $4,545,154.

The question arises, could the beet sugar be further and profitably developed in Canada? Undoubtedly this is a question of interest and importance not only to the agriculture but also to the commerce of the Dominion. Its complete answer would involve the consideration of many factors among which the most important, for any particular district, are: suitability of soil and climatic conditions to the growth of high quality beets, available labour at a reasonable price for the proper cultivation and harvesting of the crop, and cost of fuel and limestone required in the refining process. The first of these, the quality, i.e., the richness in sugar and purity of juice of the beets as grown in various parts of the Dominion, may be considered from the evidence afforded by this investigation. The other factors are more or less of an economic nature and for their satisfactory discussion other information and data would be required.

The primary object, then, of this inquiry now reported on for 1922, has been to ascertain the districts or regions of the Dominion in which beets suitable for sugar extraction can be successfully grown. The results to date, and these cover a period of twenty years, unquestionably prove that beets of excellent quality for this purpose can be raised in many widely distant portions of Canada, our field experiments being carried on at a number of points from Prince Edward Island in the East to Vancouver island in the West. They also indicate districts in which the climatic conditions are not favourable to such growth.

In outline the plan has consisted in growing beets of approved varieties for sugar production on the larger number of the Farms and Stations of the Experimental Farms System and analysing, as to richness and purity, a representative sample of the harvested crop in the laboratories at Ottawa.

The seed used in 1922 was of two classes: home-grown and imported. The Canadian-grown seed, which has given most satisfactory results, was obtained, with one exception, through the courtesy of the Dominion Sugar Company, Wallaceburg, and is designated simply by the name of the province or locality in which it was grown. It is from the stock of seed grown by the company and distributed to its beet growers. Though presumably originally from imported Russian seed, its specific or varietal name could not be ascertained. In the table of data it is simply designated, British Columbia, Chatham, Waterloo, and Kitchener. In addition to these, seed produced at the Experimental Station at Sidney, B.C., was used; its results were also highly satisfactory, both as to richness and purity.

The second class, the imported seed, obtained and furnished by the Division of Forage Crops, is designated in the tables as Denmark, Vilmorin's Improved and Vilmorin's Improved B (Paris, France), and Klein Wanzleben (Germany).

The locations of the Experimental Farms and Stations at which the enquiry was conducted are: Charlottetown, P.E.I.; Kentville and Nappan, N.S.; Fredericton, N.B.; Cap Rouge, Ste. Anne de la Pocatière and Lennoxville, Que.; Ottawa, Ont.; Brandon, Man.; Rosthern, Scott and Indian Head, Sask.;

Fort Vermilion, Lacombe and Lethbridge, Alberta; and Agassiz, Sidney, Invermere and Summerland, B.C. Details as to analysis of varieties tested at each location are available to those interested. Description of soil and conditions under which crop was grown may be found in previous reports.

Table I presents interesting and instructive data in giving the averages for sugar in juice and coefficient of purity for the six stocks of seed used in this investigation, at the eighteen Farms and Stations during the season of 1922.

AVERAGES; SUGAR IN JUICE AND COEFFICIENT OF PURITY, 1922.

Origin of Seed	Sugar in Juice	Coefficient of Purity
	p.c.	p.c.
British Columbia	17·26	83·82
Chatham, Ont.	17·31	83·20
Waterloo, Ont.	17·38	83·27
Denmark	17·45	83·49
Sidney, B.C.	16·92	82·34
Vilmorin's Improved, France	17·37	83·92

These results are somewhat better than those of 1921, and indicate an excellent quality for factory purposes.

It is again satisfactory to record that Canadian-grown seed has given excellent results—fully equal to those obtained from imported seed of the best factory varieties.

FIELD ROOTS

This chapter will prove of greatest interest to farmers in Eastern Canada, for roots thrive best in districts characterized by comparatively cool summers. In those parts of the Dominion in which the summers are hot and corn flourishes, corn silage will remain the premier succulent winter forage—especially for dairy stock. In these districts—and they occupy large areas in Canada, for corn is grown successfully in every province—roots cannot compete with corn in digestible dry matter per acre. From the standpoint of economy of production, corn undoubtedly occupies the first place among Canadian succulent forages, for winter feeding, and it is with no object to attempt to displace it that this investigation into the relative nutritive value of roots was undertaken.

Apart, however, from the standpoint of economy of production of dry matter per acre, it must be recognized that roots hold an important place in a rational scheme of feeding, for they have a dual value, nutritive and medicinal. They have a very appreciable feeding value and in addition to being palatable, appetizing, almost wholly digestible and wholesome, they possess certain qualities which are of particular importance in maintaining the health and thrift of the animal—the latter qualities being attributed chiefly to the potash compounds they contain and in which they are fairly rich.

This investigation, dating from 1904, has determined the dry matter and sugar content—upon which the purely nutritive value of roots depends—in a large number of varieties or strains of mangels, turnips and carrots, and has thus been useful in indicating those best to grow, although yield per acre and keeping qualities are also matters to be taken into consideration. It has shown that wide differences in feeding value exist among varieties in the same class—and especially among the many varieties and strains of mangels—and it has also proven that while season is a potent factor, heredity may markedly influence composition, both as to dry matter and sugar.

MANGELS

Analysis has been made of the several varieties and strains—fifty in all of mangels grown during the season of 1922 on the Central Farm, Ottawa, under the direction of the Forage Crops Division. The results are presented in table I, the varieties having been arranged in the order of their dry matter content. The percentage of sugar in juice—sugar being the most important nutrient in field roots—is given in the second column of data. The average weight of root, as obtained by weighing twelve representative specimens, and the dry matter per acre, as calculated from the percentages of dry matter and the field yields, are also recorded.

TABLE I.—ANALYSIS OF MANGELS, CENTRAL EXPERIMENTAL FARM, OTTAWA, ONT., 1922

Variety	Source of Seed	Dry Matter	Sugar in Juice	Average Weight of one Root		Dry Matter per Acre	
		p.c.	p.c.	Lbs.	Oz.	Tons.	lbs.
Giant Long Red	A. E. McKenzie & Co., Brandon, Man	15·50	7·43	2	11	4	85
Sugar Rose	Halifax Seed Co., Halifax, N.S.	14·94	7·34	2	14	5	105
Giant Sugar	Chas. E. Bishop & Son. Belleville, Ont.	14·73	7·01	2	6	4	36
Danish Sludstrup	Graham Bros., Ottawa, Ont.	14·56	8·10	2	2	4	856
Red Mammoth Long	Chas. E. Bishop & Son, Belleville, Ont.	14·39	6·75	3	5	5	552
Red Globe	Graham Bros., Ottawa, Ont.	14·29	7·53	2	3	3	939
Giant Rose	J. A. Bruce & Co., Hamilton, Ont.	14·25	7·26	3	10	4	1897
Manitoba Giant Yellow	A. E. McKenzie & Co., Brandon, Man.	14·07	6·65	3	2	4	849
Long Red Gatepost	J. A. Bruce & Co., Hamilton, Ont.	13·94	8·20	3	5	5	1441
Giant Yellow Globe	A. E. McKenzie & Co., Brandon, Man.	13·88	6·41	2	15	4	49
Yellow Leviathan	United Seed Growers, Penticton, B.C.	13·76	7·01	2	5	3	1329
Yellow Intermediate	Halifax Seed Co., Halifax, N.S.	13·65	6·43	3	3	4	1634
Mammoth Long Red	Graham Bros.. Ottawa, Ont.	13·59	6·94	2	6	4	881
Mammoth Prize Long Red	K. McDonald & Son, Ottawa, Ont.	13·50	7·26	3	4	4	137
Mammoth Long Red	Beaton, Oshawa, Ont.	13·47	6·37	2	10	4	1816
Giant Red Sugar	J. A. Bruce & Co., Hamilton, Ont.	13·26	7·53	3	5	4	1222
Danish Sludstrup	United Seed Growers, Penticton, B.C.	13·12	5·05	3	0	5	420
Royal Giant Sugar Beet	Steele Briggs & Co., Toronto, Ont.	13·01	7·26	3	10	4	1728
Gatepost	Halifax Seed Co., Halifax, N.S.	12·86	5·25	3	2	4	1538
Yellow Leviathan	D. M. Ferry & Co., Windsor, Ont.	12·76	6·06	2	4	3	208
Golden Tankard	Graham Bros., Ottawa, Ont.	12·74	5·25	2	13	3	1460
Yellow Intermediate	Experimental Farm, Ottawa, Ont.	12·74	6·15	3	2	5	58
Champion Yellow Globe	Graham Bros., Ottawa, Ont.	12·72	4·75	2	7	3	1622
Yellow Intermediate	Chas. E. Bishop & Son, Belleville, Ont.	12·70	5·27	2	1	3	1322
Yellow Intermediate	United Seed Growers, Penticton, B.C.	12·68	6·06	4	8	5	1546
Yellow Globe	Halifax Seed Co., Halifax, N.S.	12·64	5·92	2	12	3	1690
Long Red	D. M. Ferry Co., Windsor, Ont.	12·63	5·76	2	12	3	1231
Yellow Intermediate		12·61	5·36	3	2		
Golden Tankard	Leonard Seed Co., Chicago, Ill.	12·60	5·78	2	11	3	1529
Golden Tankard	K. McDonald & Son, Ottawa, Ont.	12·59	6·25	2	14	3	1293
Giant Yellow Oval	Steele Briggs Co., Toronto, Ont.	12·58	5·24	2	12	4	977
Mammoth Long Red	Graham Bros., Ottawa, Ont.	12·56	5·98	2	9	4	396
Peerless	A. E. McKenzie Co., Brandon, Man.	12·38	5·36	3	11	5	11
Ottawa, Yellow Intermediate		12·29	5·06	3	8		
Red Globe	Halifax Seed Co., Halifax, N.S.	12·25	5·06	2	8	2	1857
Sugar Mangel	Steele Briggs Co., Toronto, Ont.	12·24	5·24	3	3	4	1135
Golden Tankard	A. E. McKenzie Co., Brandon, Man.	12·24	6·35	2	13	3	1654
Giant Yellow Intermediate	J. A. Bruce & Co., Hamilton, Ont.	12·12	4·54	3	9	4	1941
Danish Sludstrup	K. McDonald & Son, Ottawa, Ont.	12·10	4·96	3	1	4	1348
Giant White Feeding	J. A. Bruce & Co., Hamilton	12·10	4·45	2	11	4	590
Long Red	Halifax Seed Co., Halifax, N.S.	12·04	5·46	2	10	3	1994
Yellow Globe	Beaton, Oshawa, Ont.	11·94	4·77	1	15	2	1878
Giant Yellow Intermediate	Halifax Seed Co., Halifax, N.S.	11·93	4·84	2	13	3	1706
Giant White Sugar	United Seed Growers, Penticton, B.C.	11·81	5·92	3	2	4	674
Giant Yellow Intermediate	K. McDonald & Son, Ottawa	11·63	5·24	3	0	3	1519
Golden Tankard	Halifax Seed Co., Halifax, N.S.	11·54	5·15	2	13	3	593
Sugar Beet	D. M. Ferry Co., Windsor, Ont.	11·44	4·85	2	4	3	305
Yellow Globe	K. McDonald & Son, Ottawa	11·42	5·25	2	1	3	120
Prizetaker Yellow Globe	A. E. McKenzie & Co., Brandon, Man.	11·12	5·07	3	0	4	140
Eclipse	A. E. McKenzie & Co., Brandon, Man.	11·02	3·46	3	2	4	1427

Considering the series as a whole the results, both as to dry matter and sugar in juice, are much superior to those of the two previous years; the yield per acre is also more satisfactory. It should be noted in this connection that the distinctly low results of 1920 and 1921 were due to unfavourable seasons and are not to be attributed to varietal causes; the season of 1922 at Ottawa was excellent for roots—the summer was conducive to a good growth and the autumn to a satisfactory ripening of the roots.

In neither dry matter nor sugar is the range or spread so great as that of the past two years; between the richest and the poorest there is not the wide difference which has been noticed in certain seasons of this investigation. Nevertheless, notable differences in nutritive value among the varieties analysed, are to be observed. Thus the richest root in the series contains 15·50 per cent dry matter, while the poorest but 11·02 per cent, a difference of 90 pounds dry matter per ton of roots. And, similarly, in sugar, which in a general way follows the dry matter content, we find a range from 8·20 per cent to 3·46 per cent—though the results for the greater number of the varieties are fairly close.

TABLE II—MANGELS—YIELD AND AVERAGE COMPOSITION, 1904-1922

Year	Number of varieties analysed	Average weight of one Root		Dry Matter	Sugar
		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
Average for 18 years		2	12	11·34	5·57

Table II is one of considerable interest. It presents the yearly averages from 1904 to 1922, inclusive—the eighteen-year period of the investigation. The differences to be observed in both dry matter and sugar from year to year are no doubt in the main to be attributed to variations in seasonal conditions, but it is also true that in some degree they are due to the yearly introduction into the series of new strains, some of which have proved of good quality, others of poor quality.

The average percentage of dry matter for the past season exceeds that of the average of the eighteen-year period and is fully equal to the best in the series.

MANGELS GROWN ON BRANCH FARMS AND STATIONS

In table III particulars and data are presented of certain varieties of mangels grown during the season of 1922 at several of the branch Farms and Stations.

TABLE III—MANGELS GROWN ON DOMINION EXPERIMENTAL FARMS—1922

Station	Variety	Source of Seed	Dry Matter	Sugar in Juice	Average weight of one Root	
			p.c.	p.c.	Lbs.	Oz.
Cap Rouge, Que.	Long Red Mammoth	Wm. Ewing, Mont., Que.	19·13	11·53	1	4
	Giant Yellow Intermediate	" "	18·49	11·88	1	2
	Giant White Sugar	" "	18·15	10·84	1	8
	Yellow Intermediate	C.E.F., Ottawa	17·16	7·47	1	–
	Giant Yellow Globe	Wm. Ewing, Mont., Que.	17·11	10·98	1	–
	Golden Tankard	" "	17·04	9·41	1	4
Kentville, N.S.	Giant Yellow Intermediate	C.E.F., Ottawa	12·79	6·78	2	15
	Half Sugar White	Wm. Rennie, Tor., Ont.	12·13	6·76	3	7
Ste. Anne de la Pocatière, Que.	Yellow Intermediate	C.E.F., Ottawa	16·58	9·05	1	11
	Half Sugar Rose	Ste. Anne de la Pocatière, Que.	14·70	9·07	1	13
	Sludstrup	Kenneth McDonald, Ottawa	13·19	8·10	1	10
	Half Sugar Giant White	Wm. Ewing Co., Montreal, Que.	12·86	7·05	1	15
Rosthern, Sask.	Yellow Intermediate		14·80	8·01	2	8

Cap Rouge, Que.—The exceptionally high results for the six varieties under test is no doubt to be accounted for largely by the small size of root. In both dry matter and sugar content the mangels surpass those grown at Ottawa. While soil conditions were evidently not favourable to good growth, the roots ripened well, resulting in high percentages of dry matter and sugar.

Kentville, N.S.—Two varieties only were sent for analysis from this Station, the results indicating roots of medium or average richness in dry matter and sugar and of moderate weight.

Ste. Anne de la Pocatière, Que.—Four varieties were forwarded. In dry matter content they range from 16·58 to 12·86 per cent and in sugar from 9·07 to 7·05 per cent, indicating roots of good quality and somewhat above the average. The roots, however, were undersized.

Rosthern, Sask.—One variety only—the Yellow Intermediate—was submitted; its results both as to composition and weight are very satisfactory.

TURNIPS

Hitherto in this report the results from the examination of turnips have been placed in one table, arranged in order of their dry matter content. This year the data of the swede and fall turnips will be considered separately, as marking more properly the distinctive characteristics of these two classes.

Swede turnips or rutabagas are those most largely grown; they are earlier, have better keeping qualities and give higher yields than the fall turnip. The series for the season of 1922 comprises forty-one varieties or strains, the larger number of which have appeared in this investigation in past seasons. The data as to dry matter and sugar, together with information as to source of seed, etc.,

are presented in table IV. It is of interest to note that the varieties examined include several from Canadian-grown seed, the Experimental Station at Charlottetown, P.E.I., at Ste. Anne de la Pocatière, Que., and at Kentville and Nappan, N.S., contributing.

TABLE IV—ANALYSIS OF SWEDE TURNIPS, CENTRAL EXPERIMENTAL FARM, OTTAWA, ONT., 1922

Variety	Source of Seed	Dry Matter	Sugar in Juice	Average Weight of one Root		Dry Matter per Acre	
		p.c.	p.c.	Lbs.	Oz.	Tons	Lbs.
Bangholm	Experimental Station, Charlottetown, P.E.I.	13·58	1·42	1	9	2	460
Champion Purple Top	Graham Bros., Ottawa	13·54	1·32	1	6	2	853
Sutton's Champion	D. M. Ferry Co., Windsor, Ont.	13·09	1·12	–	11	1	1593
Champion Purple Top	United Seed Growers, Penticton, B.C.	12·96	1·22	1	11	2	1617
Champion Purple Top	K. McDonald & Son, Ottawa	12·91	1·73	1	7	1	1604
Bangholm	Denmark	12·81	0·92	1	11	2	1188
Canadian Gem, Purple Top	J. A. Bruce & Co., Hamilton, Ont.	12·73	1·01	1	12	2	1616
Kangaroo, Bronze Top	Graham Bros., Ottawa	12·66	1·52	–	13	1	1894
New Century, Purple Top	J. A. Bruce & Co., Hamilton, Ont.	12·14	1·32	1	8	2	1302
Best of All Swedes	Graham Bros., Ottawa	12·06	1·12	1	9	2	369
Canadian Gem	D. M. Ferry Co., Windsor, Ont.	12·00	1·22	1	10	2	160
Monarch or Tankard	D. M. Ferry Co., Windsor, Ont.	11·67	1·01	1	13	2	516
Magnum Bonum	K. McDonald & Sons, Ottawa	11·66	1·12	2	2	3	23
Improved Purple Top Mammoth	Halifax Seed Co., Halifax, N.S.	11·58	1·02	1	8	1	1788
Hartley's Bronze Top	D. M. Ferry Co., Windsor, Ont.	11·47	1·22	1	13	1	1943
Hartley's Bronze Top	Graham Bros., Ottawa, Ont.	11·45	1·12	2	3	2	1032
Canadian Gem	Gasper Smith Co., Oshawa, Ont.	11·38	1·22	1	14	2	844
Kangaroo	K. McDonald & Son, Ottawa, Ont.	11·30	1·02	1	6	1	1512
Good luck	Exp. Sta. Ste. Anne de la Pocatière, Que.	11·29	0·92	2	3	1	1700
Elephant or Jumbo Purple Top	J. A. Bruce & Co., Hamilton, Ont.	11·24	1·02	1	13	2	657
Magnum Bonum, Purple Top	Graham Bros., Ottawa	11·24	0·91	1	14	1	1578
Northwestern Purple Top	A. E. McKenzie Co., Brandon, Man.	11·18	0·92	1	11	2	260
Monarch	Experimental Farm, Nappan, N.S.	11·14	0·92	1	10	1	1905
Sutton's Champion, P.S.	Chas. E. Bishop & Son, Belleville, Ont.	11·11	1·22	1	11	2	186
Hartley's Bronze Top	K. McDonald & Son, Ottawa, Ont.	11·09	1·12	2	–	1	1985
Bangholm Purple Top	Halifax Seed Co., Halifax, N.S.	11·08	1·02	1	15	2	30
Hall's Westbury	K. McDonald & Sons, Ottawa, Ont.	11·06	1·12	1	8	2	763
Hall's Westbury	J. A. Bruce & Sons, Hamilton, Ont.	11·00	0·92	1	12	2	1137
Carter's Improved Purple Top	D. M. Ferry Co., Windsor, Ont.	10·95	0·92	1	11	1	1551
New Perfect	J. A. Bruce & Co., Hamilton, Ont.	10·91	1·02	1	10	1	1900
Selected Purple Top	Steele Briggs Co., Toronto, Ont.	10·86	1·02	1	14	1	1700
Canadian Gem	United Seed Growers, Penticton, B.C.	10·72	1·12	1	12	2	1049
Jumbo	Steele Briggs Co., Toronto, Ont.	10·71	1·01	1	11	2	1189
Ditmar's	Experimental Station, Kentville, N.S.	10·67	1·02	1	15	2	50
Monarch	Experimental Farm, Nappan, N.S.	10·67	1·12	1	14	1	1905
Elephant	Chas. E. Bishop & Son; Belleville, Ont.	10·62	0·92	2	–	2	761
Hall's Westbury	Graham Bros., Ottawa, Ont.	10·62	0·92	1	9	1	1651
Elephant	Halifax Seed Co., Halifax, N.S.	10·55	0·92	1	10	2	689
Kangaroo	Halifax Seed Co., Halifax, N.S.	10·39	1·22	1	8	1	1850
Improved Hardy Purple Top	Halifax Seed Co., Halifax, N.S.	10·17	1·12	1	14	2	1048
Purple Top	J. A. Bruce & Co., Hamilton, Ont.	9·80	1·02	1	15	1	1041

The results, considering the series as a whole, are excellent and it is very satisfactory to note that roots grown from Canadian-produced seed head the list, and are superior in respect to dry matter content to roots of the same variety from imported seed. Of the forty-one varieties or strains analysed, eleven contain 12 per cent and over dry matter, an exceedingly good showing; seventeen between 11 and 12 per cent; and twelve between 10 and 11 per cent. Only one sample fell below 10 per cent. The quality of last season's turnips as grown at Ottawa must be considered as exceptionally good.

Between the richest and the poorest of the series there is a difference of 3.78 per cent dry matter, which if we assume the dry matter content to be a measure of feeding value, means that 2,000 pounds of the roots first on the list are equivalent to 2,772 pounds of the poorest.

The sugar content, as in past years, is fairly constant throughout the series; it is approximately one fifth that of mangels.

TABLE V—SWEDE TURNIPS, YIELD AND AVERAGE COMPOSITION, 1905-22

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	·76
1915	33	2	6	9·60	1·29
1916	33	1	13	10·67	·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
Average for 16 years	.....	1	15	10·81	1·26

Table V presents the yearly average data for sixteen seasons. It will be seen that the range or spread in dry matter is not so great as in mangels and that the sugar content shows still less fluctuation.

Fall turnips are grown only to a limited extent. They are sown some three or four weeks later than swedes, of a white or yellow rather soft flesh and by reason of poor keeping qualities are only suitable for fall feeding. The series analysed consists of twenty-four varieties or strains.

Table VI presents the data, from which it will be seen that the dry matter ranges from 11.95 to 8.02 per cent, the average for the series being 10.14 per cent—a figure decidedly lower than the average for swedes. Further, they are somewhat lower in sugar than the swede turnips, with an average of 0.80 per cent, as compared with 1.09 per cent. In weight of root and yield per acre, also, they are slightly inferior.

TABLE VI—ANALYSIS OF FALL TURNIPS, CENTRAL EXPERIMENTAL FARM, 1922

Variety	Source of Seed	Dry Matter	Sugar in Juice	Average Weight of one Root		Dry Matter per Acre	
		p.c.	p.c.	Lbs.	Oz.	Tons	Lbs.
Hardy Green Round	Sutton, England	11·95	0·51	–	9	1	388
Greystone	Beaton, Oshawa, Ont	11·86	0·92	–	9	1	1581
Greentop Yellow Aberdeen	Wm. Ewing & Co., Montreal	11·66	0·92	–	9	–	1244
White Globe	Halifax Seed Co., Halifax, N.S.	11·47	0·91	1	–	1	130
Early Six Weeks	Sutton, England	11·43	1·12	–	11	1	909
Improved Greystone	J. A. Bruce Co., Hamilton, Ont	11·37	1·23	–	10	1	1224
Aberdeen Yellow Purple Top	Steele Briggs Co., Toronto	11·34	1·23	–	13	–	1476
Purple Top Mammoth	Steele Briggs Co., Toronto	10·94	1·02	–	15	1	1566
Devonshire Greystone	Halifax Seed Co., Halifax, N.S.	10·72	0·91	1	2	1	1154
Perfection Greentop	Sutton, England	10·64	0·51	–	12	–	1351
Redtop Strap Leaf	Steele Briggs Co., Toronto	10·39	0·82	1	4	–	1833
Yellow Aberdeen Green Top	J. A. Bruce Co., Hamilton, Ont	10·20	0·51	–	10	–	1052
Purple Top Yellow Aberdeen	J. A. Bruce Co., Hamilton, Ont	9·80	0·31	–	11	–	1034
Red Paragon	Sutton, England	9·79	1·23	1	8	1	549
F. J. Devonshire Greystone	Steele Briggs Co., Toronto	9·78	0·81	–	12	1	1078
Favorite Purple Top Aberdeen	Sutton, England	9·73	0·41	–	14	–	1476
Purple Top, Mammoth	Sutton, England	9·60	0·82	1	6	1	1075
Flat Norfolk	Wm. Ewing Co., Montreal	9·44	0·51	–	10	–	1557
Strap Leafed	United Seed Growers, Penticton, B.C.	9·22	1·13	1	1	–	1388
White Globe	Wm. Ewing Co., Montreal	8·61	0·41	–	13	–	1163
Ostersundam	Sweden	8·60	0·92	1	1	1	761
Purple Top White Globe	D. M. Ferry & Co., Windsor, Ont.	8·47	0·72	1	4	–	1937
Pomeranian White Globe	Steele Briggs Co., Toronto	8·37	0·51	–	13	–	1319
Ostersundam	Sweden	8·02	0·71	1	7	–	–
Average		10·14	0·80				

SWEDE TURNIPS, CAP ROUGE, QUE.

Samples of eleven varieties of swede turnips grown on the Experimental Station at Cap Rouge, Que., were sent in for analysis. The results, with particulars, are given in table VII.

TABLE VII—ANALYSIS OF SWEDE TURNIPS, CAP ROUGE, QUE., 1922

Variety	Source of Seed	Dry Matter	Sugar in Juice	Average Weight of one Root	
		p.c.	p.c.	Lbs.	Oz.
Bangholm	Experimental Station, Charlottetown, P.E.I.	14·60	0·81	1	13
Good Luck	Steele Briggs Seed Co., Toronto, Ont.	13·33	0·61	2	–
Kangaroo	Steele Briggs Seed Co., Toronto, Ont.	13·17	0·61	1	14
Perfection	Steele Briggs Seed Co., Toronto, Ont.	12·84	0·50	2	5
Magnum Bonum	Wm. Rennie, Montreal, Que.	12·69	0·61	2	7
Ditmar's	C.E.F., Ottawa, Ont.	12·62	0·61	2	7
Invicta	Wm. Rennie, Montreal, Que.	12·32	1·00	2	–
Bangholm	Steele Briggs Seed Co., Toronto, Ont.	12·31	0·51	2	10
Mammoth Clyde	Wm. Ewing Co., Montreal, Que.	12·26	0·61	1	11
Derby	Steele Briggs Seed Co., Toronto, Ont.	12·16	0·51	2	7
Monarch	C.E.F., Ottawa	11·11	0·50	1	14

The data are very satisfactory, especially as to dry matter, which ranges from 14.60 to 11.11 per cent. Further, the roots reached a good size. As a series, these turnips are to be considered as of excellent quality and somewhat above the average in nutritive value.

CARROTS

Twenty-three samples of carrots, as grown at Ottawa in the season of 1922, were submitted to analysis. These included a number of varieties that have been repeatedly under test in past seasons and a few which are now examined for the first time.

TABLE VIII—ANALYSIS OF CARROTS, CENTRAL EXPERIMENTAL FARM, 1922

Variety	Source of Seed	Dry Matter	Sugar in Juice	Average Weight of one Root		Dry Matter per Acre	
		p.c.	p.c.	Lbs.	Oz.	Tons	Lbs.
Long White Belgian	A. E. McKenzie & Co., Brandon, Man.	14·74	3·43	1	6	2	1842
Danvers	D. M. Ferrys Co., Windsor, Ont.	13·49	1·92	–	12	2	988
Giant Yellow Intermediate	Halifax Seed Co., Halifax, N.S.	13·14	2·72	1	5	1	1680
Orange Belgian	A. E. McKenzie & Co., Brandon, Man.	13·08	3·44	1	–	2	486
Danish Champion	K. McDonald & Son, Ottawa, Ont.	12·81	4·12	1	1	2	1137
Danish Champion	C.E.F. Ottawa, Ont.	12·79	2·94	1	4	3	960
Giant White Vosges	A. E. McKenzie, & Co., Brandon, Man	12·74	2·24	1	11	3	1366
Improved Long Orange	D. M. Ferry Co., Windsor, Ont.	12·57	2·42	1	4	2	1252
Half Long White	United Seed Growers, Penticton, B.C.	12·35	1·32	–	13	2	1653
White Belgian	Graham Bros., Ottawa, Ont.	12·31	2·24	1	5	3	679
Improved Half White	A. E. McKenzie & Co., Brandon, Man.	11·79	2·12	1	2	2	1507
Large White Short Vosges	Graham Bros., Ottawa, Ont.	11·68	1·92	1	8	3	913
Danish Champion		11·65	2·63	1	8	–	–
Improved Short White	Steele Briggs Co., Toronto, Ont.	11·58	1·72	1	6	3	995
Improved Short White	Steele Briggs Co., Toronto, Ont.	11·50	1·52	1	11	3	701
Oxheart	D. M. Ferry Co., Windsor, Ont.	11·48	2·94	–	15	2	610
Improved White Belgian	K. McDonald & Son, Ottawa, Ont.	11·46	1·52	1	5	2	1258
White Belgian	Halifax Seed Co., Halifax, N.S.	11·33	1·83	1	7	2	1491
Ontario Champion	Graham Bros., Ottawa, Ont.	11·16	2·03	1	13	2	1933
Chantenay	D. M. Ferry Co., Windsor, Ont.	11·07	1·62	1	3	2	1249
White Vosges	Halifax Seed Co., Halifax, N.S.	10·99	1·53	1	5	2	1347
Improved Short White	K. McDonald & Sons, Ottawa, Ont.	10·97	2·33	1	11	3	788
Danish Champion		10·39	2·13	1	–		

The results both as to dry matter and sugar are exceptionally good. The range in dry matter is from 14.74 to 10.39 per cent and in sugar from 3.43 to 2.13 per cent. It is evident that the season at Ottawa was particularly favorable to the growth and quality of this crop.

TABLE IX—CARROTS—YIELD AND AVERAGE COMPOSITION, 1905-1922

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	- 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
Average for seventeen years	.....	15	10·78	2·79

Averages for the past seventeen years are presented in table IX. The carrots of 1922 make an excellent showing, with results considerably higher than those of the average for the period of the experiment.

The averages for the several classes of roots as grown on the Central Farm, Ottawa, for the experimental period, are presented in table X.

TABLE X.—AVERAGE COMPOSITION OF MANGELS, TURNIPS AND CARROTS, C.E.F.

Class of Roots	Average for Period of	Dry Matter	Sugar in Juice
		p.c.	p.c.
Mangels	18 years	11·34	5·57
Turnips	16 "	10·81	1·26
Carrots	17 "	10·78	2·79

These figures are interesting and significant, since they represent the analysis of a very large number of varieties and strains from home-grown and imported seed as produced at Ottawa under many varying conditions of seasons.

CARROTS ON EXPERIMENTAL STATIONS IN QUEBEC

The Stations at Cap Rouge and Ste. Anne de la Pocatière, Que., submitted for analysis samples of carrots of the season of 1922, the results of which appear in table XI.

TABLE XI—CARROTS GROWN ON DOMINION EXPERIMENTAL STATIONS—1922

Station	Variety	Source of Seed	Dry Matter	Sugar in Juice	Average Weight of one Root
			p.c.	p.c.	Lbs. Oz.
Cap Rouge, Que.....	Danish Champion.....	C.E.F., Ottawa.....	14·94	5·13	1 5
	Improved Short White...	Wm. Rennie, Montreal	14·28	6·33	1 7
	Mammoth White Intermediate.....	Wm. Rennie, Montreal.	13·44	4·74	1 3
	Danish Champion.....	Ken. McDonald & Sons Ottawa, Ont.....	12·96	3·53	1 6
Ste. Anne de la Pocatière, Que.....	Blanche de Belgique.....	Wm. Ewing & Sons....	12·93	1·62	– 11
	White Intermediate.....	Montreal, Que.....	11·90	2·08	– 12
	Danish Champion.....	Montreal, Que.....	11·78	1·21	– 10

Cap Rouge, Que.—The quality of the four varieties examined is very good, of two exceptionally so. In dry matter the range is from 14.94 to 12.96 per cent and in sugar from 6.33 to 3.53 per cent. It is quite exceptional for the sugar in carrots to exceed 3.00 per cent. The roots from the sample standing first on the list is from Ottawa grown seed.

Ste. Anne de la Pocatière, Que.—This series comprises three varieties, the data as to dry matter and sugar indicating roots of average quality only and, as to weight, undersize.

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

In the report of this division for 1921 the results were recorded of an interesting experiment conducted in 1920 at the Experimental Station for the Grande Prairie District, Beaverlodge, Alberta, to ascertain the influence of early and late planting on the yield and dry matter content of potatoes.

The superintendent, Mr. W. D. Albright, continued the inquiry in 1921 and 1922, and after recording the yields from the several plantings, forwarded representative samples to the laboratories for the determination of the dry matter content. The variety employed in the test 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 set forth in the accompanying table.

POTATOES—YIELD AND DRY MATTER 1921 AND 1922

Laboratory No.	Date of Planting	Not Sprouted			Sprouted		
		Yield per acre	Dry Matter		Yield	Dry Matter	
			Percent	Pounds per acre		Percent	Pounds per acre
		lbs.			lbs.		
56406	22-4-21	29,638	20·13	5,967			
56407	29-4-21	29,808	19·71	5,875			
56408	29-4-21				29,522	19·59	5,782
56409	6-5-21	28,527	19·34	5,518			
56410	6-5-21				30,833	20·29	6,256
56411	13-5-21	27,588	19·76	5,451			
56412	13-5-21				29,125	20·69	6,027
56413	20-5-21	25,196	18·36	4,627			
56414	20-5-21				28,954	20·89	6,049
56415	27-5-21	25,196	17·70	4,461			
61139	26-4-22	11,459	23·57	2,697			
61140	3-5-22	9,551	20·75	1,982			
61141	3-5-22				12,103	21·99	2,661
61142	12-5-22	10,210	22·83	2,331			
61143	12-5-22				10,621	19·95	2,118
61144	19-5-22	8,810	19·61	1,688			
61145	19-5-22				10,293	22·69	2,334
61146	25-5-22	10,045	20·71	2,081			
61147	25-5-22				13,338	21·60	2,882
61148	1-6-22	7,657	20·93	1,603			
61149	1-6-22				11,939	21·86	2,610

Non-sprouted.—The results from the unsprouted sets furnish in a general way confirmatory evidence of the conclusion drawn from the 1920 series, viz., that the earlier planted sets gave larger yields of potatoes with a higher percentage of dry matter and hence larger amounts of dry matter per acre. Certain rather exceptional results, however, occur in the 1922 series and these perhaps, may be accounted for in part by unfavourable weather (a snow-storm) at the time of second planting (May 3) and in part by the somewhat unsatisfactory conditions of the tubers on their arrival at the laboratories. The general trend of the results, however, is sufficiently marked to support the conclusion reached from the previous season's work.

Sprouted.—The data from the "sprouted" series indicate, as did the 1920 results that sprouting previous to planting may markedly offset the disadvantages of late planting, both as regards yield and dry matter content. Sprouting previous to planting evidently advances the growth of the plant and we may conclude that when by reason of unfavourable weather planting is deferred, tubers with a higher percentage of dry matter and crops furnishing heavier yields may be expected from sprouted than from unsprouted sets.

CLOVER HAY AND THRESHED CLOVER HAY

In the report of this division for the year ending March 31, 1922, the results are given of an experiment conducted at The Experimental Station, Cap Rouge, Que., which had for its object the determination of the value of the clover crop from an area of which the first and second cuttings were cured as hay, as compared with that from an adjacent area yielding a first cutting of hay and a second cutting allowed to produce seed and threshed. The results of this experiment in 1922 are now recorded.

In addition to the foregoing, data are presented of threshed clover hay from three plots: one sown broadcast, a second sown in rows two feet apart, and a third sown in rows one foot apart.

DISCUSSION OF DATA

Plot A.—For hay and seed. Attention may be drawn to the great difference in composition, and hence in nutritive value, between the hay of the first cutting and that of the second cutting—the latter being threshed. The hay of the first cutting possesses twice as much protein and a much lower fibre content than the second cutting, threshed hay, and hence has a much higher feeding value. Perhaps a fair estimate, based on the results of 1921 and 1922 in this enquiry, would be that the hay of the first cutting would be almost twice as valuable as the second cutting threshed hay.

The difference here noted between two hays while due in part to the removal of the seed from the threshed clover, is undoubtedly in large part due to the loss of leaf material, rich in protein and low in fibre, in the operation of threshing. There is probably also another factor affecting the results—the longer growing period of the later cut hay, which would tend to lower the feeding value.

Plot B.—For hay only. Comparing the composition of the two cuttings of this plot, it is to be observed that the hay of the second cutting is decidedly the richer. On the dry matter basis, this hay contains almost four per cent more protein, while the fibre content is but slightly higher than that of the first cut. Although in the results now reported, as well as in those of the previous season, this enquiry has shown that the hay of the second cutting is the richer, it does not necessarily follow that this will always be the case. Factors affecting the relative feeding value of the hays of the two cuttings would include the length of growing period and the character of season during growing period and curing.

Plot C.—For seed. This plot permits of the comparison of threshed clover hay following several types of sowing—the experiment being primarily planned as one in seed production.

No very great differences exist between the three hays of this plot, but it is of more than passing interest to note that the hay from the 2-feet apart rows was the highest in protein and lowest in fibre and that the crop from the broadcasted area was lowest in protein and highest in fibre. As compared with the threshed clover hay of plot A, these three from plot C present a general agreement; they are, however, somewhat higher in fibre, due probably to their longer growing period.

The results from this plot furnish further and confirmatory evidence as to the inferiority of threshed clover hay as compared with that from a crop not grown for seed.

The data of 1922, it is satisfactory to note, strongly confirm the conclusions reached from the 1921 results in respect to the primary objects of the investigation.

ANALYSIS OF CLOVER HAY: FIRST AND SECOND CUTTING: THRESHED CLOVER HAY

Experimental Station, Cap Rouge, Que. 1922..

Lab'y No.	Plot and Cutting	Date of Cutting	As Received						Dry Matter					
			Moisture	Crude Protein	Crude Fat	Carbohydrates	Fibre	Ash	Protein		Fat	Carbohydrates	Fibre	Ash
									Albuminoid	Non-albuminoids				
			p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
59549	A—First cutting, hay	22–6–22	9·81	16·19	1·24	37·84	28·67	6·25	15·67	2·24	1·38	41·98	31·80	6·93
60482	A—Second cutting, threshed hay	2–9–22	6·81	8·19	1·47	38·86	38·94	5·73	7·88	0·91	1·57	41·70	41·80	6·14
59552	B—First cutting, hay	3–7–22	7·36	14·32	2·09	44·09	25·01	7·13	13·68	1·79	2·26	47·59	26·99	7·69
60253	B—Second cutting, hay	26–8–22	7·25	17·93	2·67	39·05	26·24	6·86	16·39	2·94	2·88	42·10	28·30	7·39
60481	C—Broadcast, threshed hay	31–7–22	5·73	8·19	1·54	34·22	45·89	4·43	8·69	.....	1·63	36·30	48·68	4·70
60475	C—Rows, 2 ft. apart, threshed hay	31–7–22	6·05	8·83	1·82	35·41	43·17	4·72	8·86	0·53	1·98	37·68	45·93	5·02
60476	C—Rows, 1 ft. apart, threshed hay	31–7–22	6·41	8·70	1·58	35·06	43·65	4·65	8·83	0·46	1·69	37·46	46·59	4·97

TABLE I—FORAGE CROPS: FRESH OR GREEN, AS CUT FOR THE SILO: 1922-23

Lab'y No.	Particulars	As Received						Water-free Substance					
								Protein					
		Moisture	Crude Protein	Crude Fat	Carbohydrates	Fibre	Ash	Albuminoids	Non-albuminoids	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
	CORN												
60227	Wisconsin No. 25, Experimental Station, Cap Rouge, Que.	72·68	1·95	0·46	16·57	6·63	1·71	6·58	0·56	1·68	60·63	24·27	6·28
60266	Compton's Early, Experimental Station, Cap Rouge, Que.	79·02	1·78	0·32	12·00	5·34	1·54	8·21	0·27	1·53	57·21	25·45	7·33
60267	Longfellow, Cap Rouge Seed, Experimental Station, Cap Rouge, Que.	77·19	1·77	0·37	13·73	5·63	1·31	7·28	0·47	1·62	60·18	24·68	5·77
60268	North Dakota, Experimental Station, Cap Rouge, Que.	76·72	1·91	0·37	13·50	5·96	1·54	7·80	0·39	1·61	57·98	25·59	6·63
60269	Longfellow, Ottawa Seed, Experimental Station, Cap Rouge, Que.	77·54	2·04	0·37	13·53	5·10	1·42	8·81	0·27	1·65	60·23	22·70	6·34
60286	Bailey, Experimental Station, Cap Rouge, Que.	79·30	1·70	0·27	11·88	5·48	1·37	7·83	0·36	1·31	57·36	26·50	6·64
60287	Leaming, Experimental Station, Cap Rouge, Que.	77·46	1·69	0·39	12·65	6·37	1·44	7·08	0·41	1·75	56·10	28·26	6·40
60288	Wisconsin, No. 7, Experimental Station Cap Rouge, Que.	76·12	1·85	0·39	13·76	6·25	1·63	7·66	0·07	1·65	57·62	26·18	6·82
60289	Yellow Dent, Experimental Station Cap Rouge, Que.	76·72	1·91	0·45	14·24	5·34	1·34	7·72	0·49	1·91	61·19	22·92	5·77
60349	Golden Glow, Experimental Station, Cap Rouge, Que.	77·72	1·70	0·28	13·38	5·57	1·35	7·34	0·29	1·28	60·04	25·00	6·05
60350	Stowell, Evergreen, Experimental Station, Cap Rouge, Que.	79·80	1·73	0·27	11·74	5·01	1·45	7·78	0·78	1·36	58·09	24·83	7·16
60384	Eureka, Experimental Station, Cap Rouge, Que.	73·87	1·94	0·35	15·79	6·52	1·53	7·09	0·35	1·34	60·40	24·97	5·85
60319	Longfellow, Experimental Station, Cap Rouge, Que.	78·41	1·69	0·41	11·84	6·33	1·32	7·52	0·30	1·89	54·84	29·31	6·14
60419	Longfellow, Experimental Station Ste. Anne de la Pocatière, Que.	81·73	1·73	0·28	10·31	4·74	1·21	9·09	0·37	1·53	56·46	25·92	6·63
60420	Wisconsin, Experimental Station, Ste. Anne de la Pocatière, Que.	82·68	1·67	0·37	9·02	5·01	1·25	8·87	0·77	2·15	52·03	28·95	7·23
	SUNFLOWER												
60226	Sown 13–5–22, Cut 31–8–22, 50 p.c. in bloom, C.E.F., Ottawa.	84·68	1·62	0·15	5·37	6·15	2·03	10·27	0·29	1·02	35·04	40·14	13·24
60282	Sown 13–5–22, Cut 11–9–22, 50 p.c. in bloom, C.E.F., Ottawa.	75·86	1·94	0·54	13·32	5·78	2·56	6·77	1·24	2·24	55·22	23·92	10·61

60264	Sown 23–5–22, Cut 7–9–22, 40 p.c. in bloom, thinned to 10", C.E.F.	82·91	1·40	0·14	6·36	6·84	2·35	7·94	0·24	0·81	37·21	40·04	13·76
60273	Sown 23–5–22, Cut 7–9–22, 40 p.c. in bloom, thinned to 6", C.E.F.	83·94	1·36	0·14	5·61	6·87	2·08	7·99	0·47	0·89	34·94	42·79	12·92
60274	Sown 23–5–22, Cut 7–9–22, 40 p.c. in bloom, thinned to 3", C.E.F.	80·94	1·74	0·26	7·20	7·49	2·37	8·91	0·22	1·37	37·74	39·31	12·45
60265	Sown 2–6–22, Cut 7–9–22, 30 p.c. in bloom, thinned to 6", C.E.F.	88·14	1·56	0·12	4·33	4·14	1·71	12·14	1·01	0·98	36·57	34·93	14·37
60320	Giant Russian Sunflower, Experimental Station, Cap Rouge, Que.	72·24	1·86	0·89	14·76	7·82	2·43	6·68	0·03	3·20	53·16	28·18	8·75
60423	Sunflower, Experimental Station Ste. Anne de la Pocatière, Que.	81·30	1·72	0·52	8·87	5·40	2·19	8·82	0·35	2·80	47·44	28·89	11·70
	Mixed Crops												
60422	Corn and Sunflower, Experimental Station, Ste. Anne de la Pocatière, Que.	78·89	1·54	0·63	9·97	6·71	2·26	7·31	.....	2·97	47·21	31·78	10·73
59813	Peas and Oats, Experimental Station, Cap Rouge, Que.	61·48	3·79	1·20	17·88	12·66	2·99	8·40	1·43	3·11	46·44	32·86	7·76

FORAGE CROPS

CORN

Variety Test.—The first twelve samples of corn, as appearing on the tabulated sheet of data (table I) constitute a series forwarded from the Experimental Station, Cap Rouge, Que., the particulars of which may be briefly given as follows:—

The twelve samples represent as many varieties, all sown on the same date (May 10) and all cut at approximately the same stage of growth—"dough" stage—though at different dates, from August 23 to September 19, as the desired condition was reached. The object of the inquiry was to ascertain the variety or varieties which afforded the largest amount of dry matter per acre at such a stage of the crop as would be considered suitable for ensiling.

There is a wide range in the dry matter content, the maximum being 27.32 per cent, the minimum 20.20 per cent. The difference, 7.12 per cent, represents a percentage increase in dry matter content over the minimum of approximately 35. The average for the series is 23 per cent and six of the twelve members reach or exceed this figure, which may be considered as fairly representative for corn in the "dough to glazing" condition.

TABLE II—CORN: YIELD AND DRY MATTER, PER ACRE, CAP ROUGE, QUE., 1922

Lab'y No.	Variety	Date of Cutting	Dry Matter	Yield per Acre (actual)		Dry Matter per Acre (actual)		Yield per Acre (corrected)		Dry Matter per Acre (corrected)	
			p.c.	Tons	Lbs	Tons	Lbs.	Tons	Lbs.	Tons	Lbs.
60227	Wisconsin No. 25, (Dent)	23-8-22	27·32	11	1661	2	1822	12	612	3	723
60266	Compton's Early, (Flint)	5-9-22	20·98	15	221	3	340	18	612	3	1681
60267	Longfellow, Cap Rouge Seed (Flint)	4-9-22	22·81	12	213	2	1522	13	654	3	78
60268	North Dakota (Flint)	5-9-22	23·28	13	52	3	64	16	1845	3	1877
60269	Longfellow, Ottawa Seed,, (Flint)	2-9-22	22·46	14	811	3	471	18	579	4	217
60286	Bailey (Dent)	8-9-22	20·70	10	1516	2	454	17	1168	3	1281
60287	Leaming (Dent)	8-9-22	22·54	11	619	2	1090	16	1762	3	1610
60288	Wisconsin, No. 7, (Dent)	8-9-22	23·88	13	236	3	267	18	1857	4	1042
60289	Yellow Dent (Dent)	8-9-22	23·28	12	888	2	1793	18	377	4	470
60349	Golden Glow (Dent)	13-9-22	22·28	12	642	2	1489	16	670	3	1278
60350	Stowell Evergreen (Sweet)	15-9-22	20·20	9	1738	1	1988	19	180	3	1713
60384	Eureka (Dent)	19-9-22	26·13	15	405	3	1945	22	284	5	1570

This series furnishes no evidence as to any relation between "growing period" (number of days between sowing and cutting) and dry matter content, as will be observed by a consideration of table II; the variety with the largest percentage of dry matter having the shortest "growing period" while that with the lowest has the second to longest period, the remaining ten permitting of no systematic arrangement.

A study of the composition of the dry matter reveals a certain relationship between the dry matter content and its percentage of protein—as the former increases the latter decreases—a trend noted in our work on the chemistry of the corn plant in 1896 (Report of Chemist, 1896, page 209) and there attributed to advance in maturity. This decrease in the percentage of protein in the dry matter is, of course, in no way contradictory to the statement that the amount (weight) of protein per acre may appreciably increase as the crop advances towards maturity, as indeed do all the nutrients.

In table II we present, in addition to certain particulars as to variety, dates of cutting, etc., data respecting yields and amounts of dry matter per acre. It will be observed that these results are given in two forms, "actual" and "corrected." The former term as applied to yield is the actual weight obtained in the field, the latter term, "corrected," has been used by the Superintendent to denote the weight of the yield which would have been obtained had all varieties possessed the same number of plants per unit of area as the variety with the greatest number.

Since, naturally, no correlation can be found between actual and corrected yields and therefore between the actual and corrected amounts of dry matter per acre, we place in parallel columns varieties in the order of their weight of dry matter per acre, as calculated on the basis of actual and corrected yields respectively.

VARIETIES IN THE ORDER OF DRY MATTER PER ACRE, CAP ROUGE, QUE.

Actual			Corrected		
Variety	Dry Matter per Acre		Variety	Dry Matter per Acre	
	Tons	Lbs.		Tons	Lbs.
Eureka	3	1945	Eureka	5	1570
Longfellow (Ottawa Seed)	3	471	Wisconsin No. 7	4	1042
Compton's Early	3	340	Yellow Dent	4	470
Wisconsin No. 7	3	267	Longfellow (Ottawa seed)	4	217
North Dakota	3	64	North Dakota	3	1877
Wisconsin No. 25	2	1822	Stowell's Evergreen	3	1713
Yellow Dent	2	1793	Compton's Early	3	1681
Longfellow (Cap Rouge seed)	2	1522	Leaming	3	1610
Golden Glow	2	1489	Bailey	3	1281
Leaming	2	1090	Golden Glow	3	1278
Bailey	2	454	Wisconsin No. 25	3	723
Stowell's Evergreen	1	1988	Longfellow (Cap Rouge Seed)	3	78

Lab'y. No. 60319.—Longfellow corn from Experimental Station, Cap Rouge, Que. This sample, received September 14, was essentially stalk and leaf, no cob apparent, finely cut, fresh and green.

This sample has a dry matter content (21·59 per cent) approaching that of corn in the late milk or early dough stage, though its percentage of fibre (6·33) might betoken a somewhat more mature condition. The proportion of albuminoid to non-albuminoid nitrogen, further, is indicative of fairly well advanced corn. It may be considered as a fairly good sample and in a desirable condition of growth for ensiling.

Lab'y. No. 60419.—Longfellow corn from Experimental Station, Ste. Anne de la Pocatière, Que. This sample was received September 23, 1922. No statement as to "stage of growth" was recorded, but it is of interest to note that though cut eleven days later than the preceding sample at Cap Rouge (No. 60319) it contained 3·32 per cent less dry matter, indicating a less mature condition.

Lab'y. No. 60420.—Wisconsin No. 7 corn from Experimental Station, Ste. Anne de la Pocatière, Que. Received September 23. The dry matter content of this sample, 17·32 per cent, is lower than that of the Longfellow variety grown at the same Station and cut on the same date, by approximately 1 per cent.

SUNFLOWER

Lab'y. Nos. 60226, 60282, 60264, 60273, 60274 and 60265.—These six samples of Giant Russian sunflower submitted by the Field Husbandry Division, Central Experimental Farm, Ottawa, constitute a series collected with the object of obtaining information as to the influence of period of growth and thinning, on the composition of the plants.

For the purpose of consideration of the data, these samples may be grouped as follows: Group I, two samples (Nos. 60226 and 60282) sown May 13 and cut August 31 and September 11, respectively, both crops being reported as 50 per cent in bloom; Group II, three samples (Nos. 60264, 60273 and 60274) sown May 23 and cut September 7, thinned in the row to 10 inches, 6 inches and 3 inches, respectively, and all 40 per cent in bloom; Group III, one sample (No. 60265) sown June 2, cut September 7, thinned to 6 inches, and 30 per cent in bloom.

The data would indicate that, within the dates of the experiment, the dry matter content increases with the length of the growing period and this trend was observed in the investigational work with this crop (Series I) in the previous season (Report, Division of Chemistry, 1922). There is also to be noticed, as observed in previous work, that with the increase of dry matter content the proportion of protein and ash in the dry matter decreases.

Lab'y. No. 60320.—Giant Russian sunflower, from crop grown at Experimental Station, Cap Rouge, Que. Sample received, September 14, with the request for a comparative analysis with sample of Longfellow corn No. 60319. The following data furnish the chief results for the comparison:—

	Dry Matter	Yields per acre		
		Green	Dry Matter	Crude Protein
	p.c.	Lbs.	Lbs.	Lbs.
No. 60319, Longfellow corn	21·59	18,984	4,099	320·5
No. 60320, Giant Russian sunflower	27·76	18,246	5,065	339·8

In this instance although the yield per acre from the corn is the larger, the much higher percentage of dry matter in the sunflower, results in the weight of dry matter per acre for this latter crop being the greater. This is interesting in that both crops were cut on the same date and both were regarded by the Superintendent as being in the " dough " stage.

Lab'y. No. 60423.—Sunflower, from Experimental Station, Ste. Anne de la Pocatière, Que. Received, September 23, 1922. From the appearance of the sample the crop as harvested was quite immature, most of the flower heads still having their ray florets attached.

SILAGE CROPS

Lab'y. Nos. 60419, 60420 60422, and 60423 were forwarded for analysis from Experimental Station, Ste. Anne de la Pocatière, for the purpose of determining their comparative values as silage crops. The following table giving the amounts per acre of their dry matter and protein, permits this comparison:—

FORAGE CROPS, AS CUT FOR SILO, STE. ANNE DE LA POCATIÈRE, QUE.

Lab'y Number	Crop	Dry Matter	Yield per Acre	Dry Matter per Acre	Crude Protein per Acre
		p.c.	Lbs.	Lbs.	Lbs.
60419	Longfellow corn	18·27	24,342	4,447	420·6
60420	Wisconsin corn	17·32	22,114	3,830	369·2
60423	Sunflower	18·70	30,474	5,698	522·5
60422	Corn and sunflower	21·11	22,882	4,830	353·1

Lab'y. No. 60422.—Corn and sunflower, from Experimental Station, Ste. Anne de la Pocatière, Que. Received, September 23, 1922. This sample contains the highest dry matter content in the series from this Station, 21·11 per cent, but ranks second as regards amounts of dry matter per acre. In amount of crude protein per acre it stands last in the list.

Lab'y. No. 59813.—Green fodder composed of Arthur peas and Banner oats from Experimental Station, Cap Rouge, Que. This material has a much higher dry matter content (38·52 per cent) than any of the other forage crops considered in table I. From this fact and the further one that the dry matter has a high protein content, the resulting silage would possess, weight for weight, a higher nutritive value than silage from corn or sunflower.

HAYS AND CURED FODDERS

Lab'y. Nos. 59370-71.—Sweet clover hay, from Division of Field Husbandry, Central Experimental Farm, Ottawa. Received, June 26, 1922.

The crop, of which these samples are representative, was cut June 5, 1922. Subsequent to this date wet weather prevailed, preventing the satisfactory drying of the crop in the field. Lab'y. No. 59370 is from material cured under hay caps; No. 59371 was taken from the hay as cured, unprotected, in the field. The crop was cut as coming into flower.

The samples had been classed as good (No. 59370) and poor (No. 59371), the latter being distinctly more moist and much the darker in colour. Both might be considered as sound and were free from mould.

Both, as hays, were exceedingly moist, with a dry matter content of 66.2 and 54.71 per cent, respectively. The analyses of these samples would indicate little difference in composition other than that necessitated by the lower dry matter content of No. 59371—the hay cured without protection. Apparently the protection afforded by the hay cap had the effect of merely reducing the percentage of water in the hay.

Attention might be directed to the high percentage of protein in sweet clover, a characteristic which it shares in common with other legume hays.

Lab'y. No. 59397.—Alfalfa hay, from Division of Field Husbandry, Central Experimental Farm, Ottawa. Variety: Grimm, cut in full bloom. Received, June 27, 1922. Cured in showery weather but apparently sweet and in good condition.

The percentage of dry matter (74.19) is about 12 per cent lower than that found in well cured alfalfa hay, due no doubt to the unfavourable weather subsequent to cutting. It is doubtful whether such damp hay would possess good keeping quality and further its storage in the mow would entail a certain danger from spontaneous combustion.

Lab'y. No. 60107.—Hubam Clover hay from Experimental Station, Rosthern, Sask. Received, August 28, 1922. Sown, May 2; cut, August 4, when 50 per cent of the plants were in bloom.

Hubam is an annual variety of white sweet clover (*Melilotus alba*). The possibilities of this clover as a forage crop and soil-improver have recently been brought to the attention of agriculturists by Professor Hughes of the Iowa Experiment Station. It is stated to differ from the ordinary biennial form in "its more rapid growth and maturity."

Lab'y. No. 60108.—White Sweet Clover hay, from Experimental Station, Rosthern, Sask. Sown, May 2; cut, August 4, 1922, when 14 inches high and fifty per cent in bloom. Received, August 28.

Comparing the two hays (Nos. 60107 and 60108) we first note both were well cured and equally dry, containing in the neighbourhood of 90 per cent of dry matter. A consideration of the data of the water-free material shows that the hay of the white seed clover (No. 60108) is somewhat the superior in respect to protein and fibre.

Lab'y. No. 60421.—Oat, Pea and Vetch hay, from Experimental Station, Ste. Anne de la Procatière, Que. Received, September 22, 1922. Yield, 2 tons 551 pounds per acre.

As received, dry and straw-like; composed essentially of oats. This is a very dry hay, containing 93.69 per cent dry matter. The data in respect to protein and fibre would indicate that the oat crop (which forms the larger proportion of the fodder) was cut while still green. It is no doubt a nutritious fodder though the results show but a small proportion of the richer legumes. Compared with average Oat, Pea and Vetch hay this sample is distinctly low in protein.

Subsequent to our report on this sample, the superintendent writes: "With regard to this crop very few pea plants could be seen in the field at the time of cutting. This is due to the fact that a large percentage of the seeds did not germinate on account of the cold spring, and, further, that cut-worms did great damage to the young plants."

Lab'y. No. 60684.—Corn stover (North Western Dent), cobs removed, from Division of Field Husbandry, Central Experimental Farm, Ottawa. Cut and received, October 12, 1922.

The percentage of dry matter, 41.82, shows that this fodder is much dryer than green corn stover as recorded in American works.

Compared with corn as usually cut for the silo this stover would contain almost twice the amount of dry matter but the composition of the dry matter of the two differs but little save in percentage of fibre, which is decidedly higher in the stover, with a corresponding reduction in the carbohydrates.

Lab'y. Nos. 62946 and 63011.—Mixed Hay. These two samples were submitted by Dr. E. A. Bruce, Animal Pathologist, Veterinary Research Laboratory, Agassiz, B.C.

No. 62946, described as a poorly cured sample of mixed hay consisting of second cut clover, Italian rye grass and a little orchard grass. Examination showed that it also contained a little bracken. Dr. Bruce writes: "This hay is suspected of being deficient in calcium and responsible for a premature lambing of the Experimental Farm ewes." The second sample, No. 63011, was

sent as a well cured hay of practically the same composition. Examination proved it free from bracken and containing a larger proportion of grass.

As received, No. 62946 was very dry and very dark in colour, apparently sound and wholesome. No. 63011 was greener and as already stated contained no bracken and less clover than No. 62946; apparently sound and wholesome.

Comparing their composition, No. 62946 is seen to be richer in protein with somewhat higher percentages of fibre and ash—due very probably to its larger proportion of clover. From the nutritive standpoint the data of these hays would compare well with those recorded for hay from mixed legumes and grasses.

With respect to calcium content we obtained the following data:—

	Ash	Calcium Oxide (lime)
No. 62946 (poorly cured)	8·48 p.c.	1·69 p.c.
No. 63011 (well cured)	8·12 p.c.	1·28 p.c.

It is evident therefore that the suspicion that the poorly cured hay was deficient in calcium is not confirmed by the chemical results.

Lab'y No.	Particulars	As received						Water-Free					
								Protein					
		Moisture	Protein	Fat	Carbohydrates	Fibre	Ash	Albuminoid	Non-albuminoid	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
59370	Sweet clover hay, C.E.F., Ottawa...	33·80	12·19	1·92	24·25	22·61	5·23	12·49	5·92	2·90	36·63	34·15	7·91
59371	" " " ...	45·29	10·14	1·43	19·76	18·80	4·58	12·67	5·87	2·62	36·11	34·36	8·37
59397	Alfalfa hay, C.E.F., Ottawa.....	25·81	11·05	1·72	25·52	30·13	5·77	12·67	2·22	2·32	34·41	40·61	7·77
60107	Hubam clover hay, Rosthern, Sask...	10·00	14·12	1·42	38·05	28·99	7·42	10·31	5·38	1·57	42·28	32·22	8·24
60108	Sweet clover (white) hay, Rosthern, Sask.....	10·41	15·03	1·59	41·18	22·51	9·28	11·26	5·52	1·77	45·96	25·13	10·36
60421	O-P-V. hay, Experimental Station, Ste. Anne de la Pocatière, Que.....	6·31	9·28	2·80	47·94	25·70	7·97	9·68	0·22	2·99	51·17	27·43	8·51
60684	Corn Stover, C.E.F., Ottawa.....	58·18	2·80	0·39	21·59	14·89	2·15	5·95	0·74	0·94	51·63	35·60	5·41
62946	Mixed hay, Agassiz, B.C.....	7·39	13·65	1·69	37·94	30·85	8·48	11·75	2·99	1·82	40·97	33·32	9·15
63011	" "	8·07	11·08	2·28	41·91	28·54	8·12	10·47	1·58	2·48	45·59	31·05	8·83

DRY MATTER CONTENT OF FORAGES

For the purpose of considering relative yields it has been customary in field plot work to employ weights of the green fodder or hay as obtained on the crop as harvested or as stored. This method, however, cannot be considered as altogether satisfactory, for it merely gives data as to yield and no information as to dry matter content—which is the real measure of the crop's feeding value. Freshly cut grasses and fodders may differ by five or more per cent, in dry matter content, so that total weights, no matter how carefully obtained may be very misleading if regarded as indicative of relative feeding values. And the same is true, to a large degree, of hays.

This division has therefore undertaken to co-operate in this work towards a closer estimate of the nutritive values and during the past year has made a number of laboratory determinations of dry matter content of forages for the Division of Field Husbandry, Animal Husbandry, Cereal Husbandry, as follows:—

Corn, as cut for the silo	19	samples
Corn stover	2	"
Grasses, clovers etc	78	"
Barley, as cut for hay	13	"
Oats, as cut for hay	34	"

FEEDING STUFFS

Space does not permit a detailed report of the large amount of analytical work covering examination of samples of wheat by-products, including bran, shorts, middlings and feed flour; barley products, oat products, corn products, elevator wheat screenings, linseed oilcake meal and cotton seed meal. However, valuable information on this subject is available to applicants, in the form of bulletins and reports.

ALFALFA MEALS

In view of the ever increasing interest in the subject of meal and grain substitutes, the following data on alfalfa products will be of interest:—

ANALYSIS

Lab'y No.	Particulars	Moisture	Crude Protein		Fat	Carbohydrates	Fibre	Ash
			Albuminoid	Non-albuminoid				
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
62834	Chopped alfalfa straw	7·04	12·61		4·75	39·68	28·05	7·87
63009	Alfalfa meal	9·02	13·51	2·73	2·49	41·50	22·54	8·21
63069	Ground alfalfa, third cutting unscreened	7·82	14·73	2·12	2·78	39·90	23·33	9·32
63070	Ground alfalfa third cutting screened	7·63	16·69	3·03	2·41	41·23	19·41	9·60
63071	Ground alfalfa first and third cutting screened	8·47	13·39	2·07	2·23	40·05	24·86	8·93

Lab'y. No. 62834.—Forwarded from Ashcroft, B.C., and described as " chopped, threshed alfalfa straw." It may therefore be considered as mature or ripened alfalfa minus its seed. The sample consisted largely of fragments of yellow or yellowish-green fibrous stem or straw—the pieces perhaps averaging about half an inch in length—together with a fair proportion of more or less powdered material, which on examination proves to be made up of broken leaves and seeds.

Compared with previous analyses made in these laboratories of good quality alfalfa hay, this sample is characterized by a lower protein and higher fibre content. Both as to composition and digestibility, i.e., practical feeding value, it must be considered as distinctly inferior to the best quality of alfalfa hay.

Lab'y. No. 63009.—Alfalfa meal prepared at Canfield, Ont., by cutting and grinding the second and third crops. The sample was finely chopped and apparently largely composed of ripe alfalfa.

The analytical results indicate a product made from alfalfa hay of good quality.

Lab'y. Nos. 63069-70-71.—Three samples of "ground alfalfa," from a crop grown at King, Ont. These may be described as "finely cut" rather than "ground." Nos. 63069 and 63070 were decidedly green while No. 63071 appeared to be of riper material and yellower. The first cutting was on June 25, the third cutting in October. Nos. 63070-71 are screened material, having passed through a 12-mesh screen.

Nos. 63069 and 63070 are both of the third cutting, but the former is unscreened and the latter screened, i.e., consists of material which has passed the 12-mesh sieve. The superiority of the finer sample is well brought out by the higher protein and lower fibre content. As might be expected the sieve holds back the coarser, more fibrous parts, which are of lower feeding value than the finer portion made up largely of the foliage.

Nos. 63070 and 63071 are identical as to treatment—both screened—but differ in that the former is entirely "third cut" material while the latter is a mixture of the first and third cuttings. Nos. 63070, third cutting, screened, is the choicest sample of the series, containing the highest protein and the lowest fibre content. This is in accord with results previously obtained in these laboratories, which showed that the latter cuttings of alfalfa were decidedly richer in protein than the material from the first cutting. It may be added, however, that all three samples of this series are of good quality.

TANKAGE

The feeding stuffs on the market under the generic name of tankage are by-products of the packing house. They consist of varying proportions of meat scrap, fatty tissue and bone, according to their source and method of preparation. As a class, they are highly nitrogenous, containing from 40 to 60 per cent of protein, with bone meals proper containing in the neighbourhood of 25 per cent. As a rule the fat will be between 5 and 10 per cent. The proportion of bone (phosphate of lime) is also variable, from a negligible quantity to 55 per cent tricalcic phosphate. These "concentrates" constitute a valuable source of protein and bone making material and are especially useful in the feeding of swine and poultry. It is essential that they should be prepared from fresh material and, as purchased, should be sweet and sound, free from rancidity and mould. Owing to their variable character, these feeding stuffs should always be purchased on guaranteed analysis.

ANALYSIS

Lab'y No.	Particulars	Moisture	Protein	Fat	Ash	Phosphate of Lime
		p.c.	p.c.	p.c.	p.c.	p.c.
59118	"Fishotein"	7·04	70·92	13·45	4·19	.....
59229	Beef scrap	7·47	51·30	6·50	31·07	.....
59360	Beef scrap	5·77	41·24	17·92	29·84	.....
61821	Beef and bone meal	1·43	23·62	10·30	57·19	34·22
62658	Lard cracklings	5·63	48·71	38·72	3·54	.....
63030	Bone meal	7·80	26·20	5·48	58·52	51·67
63031	Beef, bone and meat meal	2·71	24·96	20·52	46·99	39·63
63034	Digester tankage	11·50	48·08	8·26	26·43	21·21
63035	Meat meal	8·81	44·84	7·79	32·22	26·00

Lab'y. No. 59118.—"Fishotein," prepared and sold as a food for fry and mature fish, by the Darling Company of Chicago. Submitted for analysis by the Department of Marine and Fisheries, Ottawa. It carries a guarantee of 75 per cent protein and the claim is that it is made from selected meat trimmings gathered daily in the city meat markets, hand picked and at once cooked under a special process which destroys all bacteria and leaves the material in a desirable and convenient form for use.

The analytical data are in close accord with those which would be obtained from meat, liver, etc., dried to the same water content.

It is apparently a sound and wholesome product. There is no indication that this product is lacking or deficient in any nutrient necessary for fish life, but no opinion can be expressed as to its alleged specific suitability for the feeding of fish.

Lab'y. No. 59229.—Beef scrap manufactured by the Darling Manufacturing Company, Chicago, Ill. A rather coarse product, consisting of bone and meat fragments with some finer material. No offensive smell and apparently sound and wholesome. Its guarantee read: protein 50 per cent, fat 5 per cent and fibre 3·0 per cent.

This product fully meets its guarantee in respect to protein and fat. Its "ash" includes a large proportion of bone phosphate.

Lab'y. No. 59360.—Beef scrap manufactured by the Trianagle Fertilizer Company, New Westminster, B.C. A comparatively fine material consisting of meat and bone products in fragments and powder. No offensive smell and apparently sound and wholesome. Its guarantee read: protein 50 per cent, fat 2·0 per cent, fibre 4·0 per cent.

It does not meet the protein requirements of its guarantee by almost 9 per cent. It, however, greatly exceeds its guarantee in fat; such an amount as 18 per cent might seriously, under certain conditions of storage, affect the keeping qualities of the product. Of course for certain classes of stock, e.g. laying hens, products with such a large percentage of fat must be used sparingly.

Lab'y. No. 61821.—Beef and bone meal manufactured by the St. John Fertilizer Company, St. John, N.B. A dry, coarsely granular product consisting of particles of meat and bone. Possesses a rather unpleasant "scorched" smell but apparently sound and wholesome. No guarantee received. The analysis was made at the instance of the Animal Husbandry Division, Central Experimental Farm.

This feeding stuff evidently is composed chiefly of bone; it belongs to the class of tankage products characterized by low protein and high phosphate content. Its economic use in the ration would necessitate a recognition of these facts.

Lab'y. No. 62658.—Lard Cracklings. This product is defined in the regulations made in pursuance of the Feeding Stuffs Act as the residue after partially extracting the fats and oils from animal tissues.

This by-product from an abattoir at Palmerston, Ont., was of a light brown colour, partly in granular form and partly in flakes, with an odour of lard. Apparently sweet and wholesome.

This material differs from Tankage in its very high percentage of fat. From this fact it would have to be used judiciously, and while it could not be considered a milk substitute, if fed rather sparingly, it could be advantageously employed in pig feeding, though it is better adapted for the finishing ration of swine than for very young pigs. It is worthy of note that it contains almost 50 per cent of protein, a percentage approximating that in the best grades of tankage.

Lab'y. No. 63030.—Bone meal manufactured by Swift's Canadian Company.

This analysis is in accord with that of genuine bone meal, which roughly shows a ratio of protein to phosphate of lime of 1:2.

Lab'y. No. 63031.—"Beef and Bone Meal," manufactured by the St. John Fertilizer and Stock Feed Company, St. John, N.B. In the form of a dry, light brown, coarse powder showing lighter coloured fragments of bone. Sweet and sound and apparently wholesome.

From the analysis we judge this meal consists of about 75 per cent bone. The remainder—25 per cent—is evidently largely fatty tissue.

Lab'y. No. 63034.—"Digester Tankage," Swift's Canadian Company. A dark, yellowish-brown, fine homogeneous powder, dry and sweet. No offensive odour; apparently sound and wholesome.

This tankage appears to consist of about 40 per cent bone and 60 per cent meat.

It was sold under a guarantee of protein 60 per cent, fat 8 per cent, phosphates 6 per cent. This feeding stuff does not meet its guarantee in protein by approximately 12 per cent. It, however, exceeds its guarantee in phosphates by 15 per cent. In fat, the guarantee is very closely met.

Lab'y. No. 63035.—Meat Meal, "Low per cent Tankage." Reg. 546, manufactured by Swift's Canadian Company. Similar in appearance to No. 63034. No offensive odour; apparently sound and wholesome.

This tankage contains about 50 per cent of bone.

It differs from No. 63034 in containing about 3 per cent less protein and about 5 per cent more phosphate of lime.

Its guarantee read: protein 46 per cent, fat 4 per cent, and phosphates 10 per cent. While slightly lower than the guarantee in protein, it greatly exceeds its guarantee in phosphates.

FISH MEALS

Fish meal is a feeding stuff product obtained by the utilization of surplus fish and fish offal, the process of manufacture comprising the reduction of the fish or offal by steam cooking, the separation by skimming and pressure of the larger proportion of the oil and the drying and grinding of the residue. The fish and fish wastes employed must be fresh and sound and the several operations carefully and thoroughly carried out, if a wholesome, palatable meal with good keeping qualities is to result. Unsound fish or waste will result in unwholesome and rancid products, unpalatable to stock, likely to produce scouring and other digestive troubles, and apt to cause tainted meats, milk and eggs.

The composition of fish meal varies greatly, depending on the nature of the raw product—whole fish or offal—and the thoroughness with which the several steps in its preparation have been carried out. It appears to be essential to the keeping qualities of the meal that the oil should be extracted fairly thoroughly, and the high-grade meals are those with a low oil content.

The series of fish products analyzed during the past year consist of four samples labelled fish meal and one labelled fish scrap.

ANALYSIS

Lab'y No.	Particulars	Moisture	Protein	Fat	Ash	Phosphate of Lime
		p.c.	p.c.	p.c.	p.c.	p.c.
59002	Fish meal scrap	5·65	25·42	10·23	55·56	43·96
61820	Fish meal	7·24	27·51	·70	60·08	33·81
62890	Fish meal	7·49	58·84	9·70	13·64	13·55
62891	Fish meal	7·46	54·20	10·25	15·47	11·21
63032	Fish meal	14·00	43·94	2·61	34·07	26·77

Lab'y. No. 59002.—This sample of fish meal or fish scrap was submitted for analysis by the Poultry Division, Department of Agriculture, B.C. It is stated to be the product of the Dominion Canning Company. There was no guarantee attached.

This material consisted of a greyish-brown powder and small fragments of bone. From condition and appearance it was judged to be sound and wholesome.

Fish meals, when sound and free from rancidity, have given excellent results in stock feeding, especially in rations for swine and poultry.

Lab'y. No. 61820.—Fish meal manufactured by the St. John Fertilizer Company, St. John, N.B., and submitted for analysis by the Animal Husbandry Division, Central Experimental Farm.

This product consisted essentially of small fragments of bones and particles of dried flesh (fish). There was very little or no fine powder. It possessed a slight "burnt" or "scorched" odour. It was apparently sound and might be judged to possess good keeping qualities.

Lab'y. No. 62890.—"Salmon Offal Meal," made under the Henshall Patent Process, Victoria, B.C. Submitted to analysis at the instance of the Poultry Division, Central Experimental Farm.

As received this product was in small fragments and coarse powder, dry, brown, with a distinct though not objectionable fishy odour. It appeared to be sweet, sound and wholesome.

In respect to protein content, this sample would rank with fish meals of the highest quality. The percentage of fat presumably is not in excess of that desirable in a poultry meat meal and the material, further, is characterized by a fair phosphate content.

Lab'y. No. 62891.—"Dogfish Meal," made under the Henshall Patent Process, Victoria, B.C. Submitted by the Poultry Division, Central Experimental Farm.

A reddish-brown, dry product, in the form of coarse powder. Practically odourless; apparently sweet and wholesome.

It possesses a high protein content, though somewhat lower than that of Lab'y. No. 62890 (Salmon Offal Meal), with which it is practically identical in respect to fat and phosphates.

Lab'y. No. 63032.—Fish meal, manufactured by the St. John Fertilizer and Stock Feed Company, St. John, N.B.

A dry, yellowish-brown product, in the form of a fine and coarse powder; odour not altogether pleasant but not distinctly offensive; apparently sound and wholesome.

The protein content is to be considered as satisfactory having in view the somewhat large percentage of bone that is present. The percentage of fat is exceptionally low for a fish meal; this while probably reducing its nutritive value, may be regarded as enhancing the keeping qualities of the product.

HOG FEEDS

Hog feeds should be characterized by good percentages of digestible protein and fat, a low fibre content and a sufficiency of phosphate of lime to act as bone-making material. It is particularly desirable when intended for young pigs that the fibre content be kept low.

Examination in these laboratories of hog feeds on the market has shown that a great variety of feeding stuffs enters into their composition: oilcake meal, blood meal, tankage, gluten feed, cornmeal, bran, shorts, pulverized oats, barley meal, ground buckwheat, have all been found, and in certain cases objectionable and poisonous weed seeds have been detected. Necessarily the nutritive value of any particular brand will be determined by the nature and proportion of its component parts.

ANALYSIS

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
62541	Hog Feeds	8·88	19·00	6·79	55·63	5·36	4·34
63036	Hog Feeds	11·35	16·29	4·16	56·68	2·95	8·57

Lab'y. No. 62541.—Hog feed, manufactured by Harvey Bros., Exeter, Ont. The feed contained tankage, standard recleaned screenings, shorts, barley, oats and corn.

The percentages of the essential nutrients—protein and fat—conform closely to those of well-compounded pig-feeds and the fibre content is desirably low.

Lab'y. No. 63036.—Motherwell Staminax Milk Hog Feed, manufactured by the Motherwell Grain Company, Dundas, Ont. It was sold under the following guarantee: protein, 17.0 per cent; fat, 4.0 per cent; fibre, 3.9 per cent.

This feed is a little lower than its guarantee in protein; in fat and fibre the guarantee is met satisfactorily.

POULTRY FEEDS

Like hog feeds, poultry mashes and laying mixtures are compounded of many meals and milling by-products, with, as a rule, tankage, fish meal or other high protein concentrates to increase the nutritive value.

ANALYSIS

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
59128	"Ideal" Poultry Food	7·05	50·90	10·61	5·28	3·78	22·38
59583	Poultry Mash	10·90	17·18	4·22	61·02	3·14	3·54
63012	Poultry Mash	10·25	16·68	6·22	54·06	6·18	6·61

Lab'y. No. 59128.—Burns' Ideal Poultry Food, manufactured by P. Burns & Company, Vancouver, B.C. A finely ground dark brown powder, without any offensive smell; apparently sound and wholesome. It carried a guarantee of 50 per cent of protein. This is a meat and bone product, useful as a high protein concentrate in the ration for laying stock.

Lab'y. No. 59583.—Poultry mash, the residue of wheat flour, after extract-in the germ, and manufactured by Strachan, Limited, Montreal, Que. It is a by-product in the manufacture of a special bread termed "Germos," and may be considered as ground wheat minus the germ.

This is a somewhat coarsely ground meal of a light yellowish-brown colour and has the appearance of a good grade of middlings. Perfectly sweet and sound.

This is evidently a high-grade feed and one which should prove of particular value in poultry feeding. Points of special interest in this connection are high protein and moderate fat content with a low percentage of fibre.

Lab'y. No. 63012.—Poultry mash, forwarded for examination by the Provincial Poultry Department, Victoria, B.C. A meat mixture stated to contain 300 pounds of beef scrap in 4,000 pounds of mash.

From appearance it would seem to consist largely of bran and shorts with meat scrap fragments and smaller proportions of corn meal; it is evidently essentially a cereal product.

While not ranking with laying mashes of the highest protein content, it contains a very fair percentage of protein and may be regarded as quite satisfactory in respect to fat and fibre.

MISCELLANEOUS FEEDS

These include a number of samples of fodders and feeding stuffs submitted during the year and which it has been impossible to consider under the classification of feeding stuffs adopted in this report.

ANALYSIS OF MISCELLANEOUS FEEDS

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbo-hydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
59075	Live Stock Feed No. 1	5·14	12·09	16·71	58·02	3·95	4·09
59076	Live Stock Feed No. 2	7·61	10·96	14·91	58·62	3·40	4·50
59255	Semi-solid Buttermilk	69·74	12·24	2·86	.....	.....	2·76
60603	Sedge Hay	4·71	6·18	2·80	50·56	30·20	5·75
62829	Sedge Hay	5·14	8·70	4·77	45·39	31·44	4·56
62908	Mixed Feed	6·99	22·21	9·43	43·87	13·59	3·91
63037	Prolac	11·42	16·72	5·82	55·28	5·12	5·64
63126	Third Grade Milk Powder	3·10	24·30	15·72	.....	.....	6·81

Lab'y. Nos. 59075-76.—Live stock Feeds No. 1 and No. 2. These are largely cocoa and chocolate by-products, with waste macaroni and waste portions of Barcelona nut. No. 2 differs from No. 1 only in containing 10 per cent of molasses. These feeds were compounded in Montreal and sent forward to the Animal Husbandry Division for a report as to their suitability for various classes of live stock.

No. 1 as received was a mixture of chocolate coloured powder with small fragments of nuts and macaroni. Strong sweetish chocolate-like odour and taste.

No. 2 as received was coarsely granular, dark brown and largely made up of fragments of nuts, macaroni and cocoa bean hulls. In taste and smell, similar to No. 1.

These feeds are essentially similar in nature and composition and might be classed with concentrates characterized by a high fat and low fibre content. They further are in the category of medium protein feeds. Their place and value in the ration would be determined by these facts. No. 1 is the richer, both

in protein and fat. It might be assumed from taste and odour that they would be found quite attractive and palatable to stock.

Lab'y. No. 59255.—Semi-solid Buttermilk, manufactured by Bowes, Limited, Toronto, and submitted by the Poultry Division, Central Experimental Farm, with a request for information as to its nutritive value.

As received, a very thick liquid, practically a paste, of a dark cream colour with a slight pinkish tinge and decidedly " cheesy " smell.

In the following table we give the analysis of the sample as received, the data calculated to the water-free basis and, for comparison, the composition of the dry matter of fresh buttermilk.

ANALYSIS OF SEMI-SOLID BUTTERMILK

	As received No. 59255	Dry Matter	
		No. 59255	Fresh Buttermilk average
Water	69·74	.....	.....
Protein	12·24	40·45	40·30
Fat	2·86	9·45	13·32
Lactose	9·26	30·60	36·03
Lactic acid	3·14	10·37	3·41
Ash	2·76	9·13	6·94
	100·00	100·00	100·00

Comparing the composition of the dry matter of this sample with that of fresh buttermilk, the agreement in protein is excellent. The chief differences lie in that No. 59255 contains less fat and a larger proportion of its lactose (milk sugar has been converted into lactic acid.

Lab'y. No. 60603.—Sedge hay, commonly known as slough or cut-throat hay, from Peace River, Alberta. The correspondent forwarding this sample stated, owing to the dry season, the hay crop on the uplands was very light (1922) and that farmers would have to depend very largely on this slough hay for wintering their stock. It was important therefore to know its feeding value.

As received this hay consisted of stems and leaves of a pale green colour, very dry, harsh, barbed and brittle, from 3 to 4 feet in length. There were no signs of inflorescence. It was practically free from dead growth of preceding seasons, known as " bottom," a fact which would enhance its feeding value. This absence of " bottom " was evidently due to the fact that the slough from which it had been cut had been burnt over the previous winter.

This sedge hay, though decidedly inferior in composition, palatability and digestibility to the well-cured hay of the true grasses, has a distinct feeding value.

Considering the analytical data and comparing them with those of sedge hays previously analysed in these laboratories, this sample is of fair average quality for this class of hay—some samples have been richer in protein and lower in fibre and again others which have been examined have proved poorer in protein and higher in fibre—the difference is due in part to the character of the sedge preponderating in the hay but chiefly no doubt to the time of cutting—the younger sedge yielding the more nutritious hay.

This sample was submitted for identification and comment to Dr. M. O. Malte, late Dominion Agrostologist, who reports as follows:—

"I beg to advise you that this slough hay is composed almost exclusively of two species of Carex (sedge), viz., *Carex aquatilis* Wahlend and *Carex atherodes* Soreng.

"Concerning the first species mentioned, *Carex aquatilis*, I have not been able to find any reference to its agricultural value, but judging from its comparatively soft texture I am inclined to surmise it may be regarded as one of the better species of Carex for hay.

"About the latter species, which in Grey's botany and other botanical works is called *Carex aristata*, Prof. Macoun in 'Manitoba and the Great Northwest, 1882,' page 245, says: 'When this grass (Agropyron) is old or not to be had, horses repair to the round depressions in the prairie, where water stands nearly all summer and crop the succulent tops of *Carex aristata*, which produces very little seed but abundance of stems and leaves. This species is preferred until the first severe frost, when they abandon the marsh and take to the hill top.'

"In this sample of hay I also found a sprinkling of *Calamagrostis canadensis* (Mx) Beauv. (Blue joint grass) *Epilotium augustifolium* (fire weed) Rosa sp. *Petasistes sagittata* (Pursh) Gray: wheat, oats but these admixtures are too insufficient to influence in a perceptible manner any chemical analysis of the hay."

A number of years ago a series of hays from the native grasses (including sedges), as grown in the Canadian Northwest, was submitted to analysis in these laboratories. It was observed that the lowland or slough hay was composed chiefly, sometimes wholly, of sedges, which are usually considered by reason of their harshness and toughness, as markedly inferior in nutritive qualities to the true grasses. Yet at that time (1908) we had the testimony of many ranchers and stockmen that both horses and cattle thrive well and fatten on hay entirely made up of sedges. Col. Herchmer informed us that the horses of the Northwest Mounted Police eat the sedge hay with avidity and keep in good condition.

In conclusion it is to be admitted that our work has shown that, from the standpoint of chemical analysis, many of the sedges compare well with cultivated grasses. This particularly is the case with the hay of *Carex aristata;* some samples analyzed by us would presumably have a feeding value of a high order. The richer samples no doubt are from the earlier cut hay, as sedges—like true grasses—deteriorate as they ripen.

Lab'y. No. 62785.—Peerless Poultry Grit, forwarded from London, Ont., to the Poultry Division, Central Experimental Farm, for trial.

This consists of fragments of crystalline quartz (silica). Certain of the particles are white, others are of a light pinkish colour. There is no carbonate of lime present and the value of the material as a poultry grit rests entirely in its power of attrition and the suitability of the size of the fragments.

Quartz is an exceedingly hard material, so that unless there were counteracting disadvantages it would prove an admirable poultry grit. In respect to the size of the particles, 98·5 per cent does not pass a sieve of ten meshes to the inch and it may be said to consist essentially of fragments varying from one-quarter to one-half inch in size.

Lab'y. No. 62829.—Sedge hay, from Ste. Clothilde de Horton, Arthabasca, Que. Our correspondent states: "This hay is from the black soils, which cover a large part of this parish. As much of this class of hay will be used this year, it is important to learn if it is a nutritious and satisfactory forage."

This sedge hay was determined as *Carex oligosperma,* a sedge which is not considered to possess any great feeding value.

The sample as received was of good colour but extremely harsh and sharp.

The hay of this sedge is not considered of any appreciable agricultural value, owing to its harshness and indigestible character. It is not a desirable forage, its use only being warranted by necessity.

Lab'y. No. 62908.—"Mixed Feed" manufactured by Thos. S. Tookey, Benton Harbor, Mich., and submitted by the Animal Husbandry Division, Central Experimental Farm. No information was obtained as to its components beyond that it contained soya bean meal and corn.

This, judging from appearance, is a mixture of fine fragments or particles of fibrous tissue, as of a fodder material, with ground corn, flax and soya bean meal. It is not of a floury or mealy character.

The percentage of protein and of fat would indicate a concentrate of very considerable value; the comparatively high fibre points to the presence of some bulky fodder. One of its components, soya bean meal, is recognized as a very valuable feeding stuff.

Lab'y. No. 63037.—Prolac, manufactured by the Prolac Milling Company, Des Moines, Iowa, is described in the advertising literature as "Whole buttermilk reinforced with choice cereal and animal proteins and fats," for which the following analysis is given:—

Protein	27·45 per cent
Fat	4·75 "
Fibre	3·00 "
Carbohydrates	55·00 "

This product, used in a pig-feeding trial by the Animal Husbandry Division, Central Experimental Farm, is a reddish rather coarsely ground mixture. It has a pleasant odour and is apparently sweet and sound.

While from the analysis this may be judged to be a useful and nutritious feed especially suitable for pigs, it must be pointed out that it fails to meet its guarantee in protein by more than 10 per cent and further exceeds its guarantee in fibre by 2 per cent.

Lab'y. No. 63126.—Third Grade Milk Powder, manufactured by the Canadian Milk Products Company, Limited, Toronto. The sample was submitted by the Animal Husbandry Division, which had it under experiment as a substitute for skim-milk.

The sample was a cream coloured powder, inclined to cake; sweet and wholesome.

It is a product of very considerable feeding value, with high percentages of protein and fat in an assimilable form.

DULSE *(Rhodymenia palmata)*

This investigation as to the composition and food value of fresh and dried dulse was undertaken at the instance of the Department of Marine and Fisheries, which considered that a profitable market for this seaweed might be developed in Canada.

Four samples in all were forwarded for analysis—one of the freshly gathered material as taken direct from the rocks on Grand Manan Island, N.B., in February, a sun-dried sample from the same locality, and two samples of the green seaweed collected in March from the "front and back of the island," respectively. These two last samples were analyzed in the air-dried condition.

ANALYSIS

	Fresh Dulse No. 58219	Sun-dried Dulse No. 58220	Air-dried (Laboratory) Dulse	
			"Front" No. 58381	"Back" No. 58382
Water	79·07	13·50	8·86	11·51
Crude protein*	3·96	16·44	26·62	25·05
Ether extract (fat)	·12	·47	·91	1·38
Carbohydrates	11·49	47·92	40·84	40·78
Fibre	·56	2·31	3·98	3·35
Ash	4·80	19·36	18·79	17·93
	100·00	100·00	100·00	100·00
*Albuminoids	3·69	15·35	23·26	21·05
Non-albuminoids	·27	1·09	3·36	4·00

NOTE: No. 58219. Water content determined, the remaining data obtained by calculation from analysis of No. 58220.

The outstanding result in all these analyses from the nutritive standpoint is the high protein content. This protein appears to be very largely in the form of the true albuminoids or flesh formers and therefore it might be concluded that dulse possessed a very considerable nutritive or food value. In the absence, however, of direct scientific evidence in respect to the digestibility of this protein, the value of this seaweed as a nitrogenous food cannot be definitely stated.*

The ash or mineral content of dulse is a matter of more than scientific interest, and the following data are therefore presented:—

MINERAL CONSTITUENTS

	Fresh Dulse	Sun-dried Dulse
Total ash	4·80	19·36
containing:		
Potash (K_2O)	1·964	8·120
Iodine(I_2)	0·071	0·294
Chlorine (Cl_2)	1·56	6·46
calculated as common salt	2·14	10·65

In common with many seaweeds, dulse has a high ash content—and, as the above results show, this mineral matter is particularly rich in potash and iodine. This is an important feature, for both iodine and potash are elements which possess well marked and specific physiological and theurapeutic properties. For this reason it may be concluded that dulse, in addition to its food value, has notable medicinal qualities.

Dulse is a bright red seaweed with broad wedge-shaped fronds. It is common between tide marks, extending into deeper waters and adhering to rocks. It is eaten in New England and Scotland and is an important crop in Iceland. After the process of sun-drying it is stored in casks; it is eaten with fish.

The following interesting information respecting the occurrence, collection and drying of dulse on Grand Mannan Island has been kindly furnished by Mr. Calder, Inspector of Fisheries, Campobello, N.B.:—

"The dulse crop is gathered during the months of May, June, July, August, and September. Very little dulse can be procured during the remainder of the year. The best dulse picking takes place on high tides. At such time, the tide when going out, bares a strip around the shores, which is uncovered at ordinary tides and which yields the best crop of dulse. The north side of Grand Manan is very high and devoid of harbours. Consequently it is unsettled. On the south side of the island, the land is low and there are a number of excellent harbours, and it is there that the villages are located. Early in May the dulse gatherers leave their homes on the south side of the island and go to the north side, where they reside in camps during the dulse-gathering season. In gathering dulse, the only boat which is employed is a 13-foot dory; this is grounded out on the beach at about two hours to low water. The dulse is picked off the rocks, put in a basket, carried over and emptied into the dory. This operation is repeated until about two hours flood, when the dory floats, and by which time the dulse beds are submerged. At high tide the dulse is unloaded from the dory, and spread on the sea wall to dry, provided the weather is suitable. Dulse is prepared by being dried in the sun, which takes from one to three days' sun to thoroughly dry it."

*A very considerable difference in protein content will be observed between the samples Nos. 58220 and the samples Nos. 58381-82, the results being on material of approximately the same moisture content and therefore fairly comparable. The particulars of occurrence as furnished do not supply any satisfactory reason for this difference—which may be due to differences in stage of growth or in the manner of collection and drying. It is significant to note that the authorities consulted give a very wide range in the percentage of protein in dried dulse.

FEED MOLASSES

Lab'y. No. 59898.—"Maple Leaf Brand 100 per cent Pure Sugar Cane Feed Molasses," manufactured by the Canadian Industrial Alcohol Company, Limited, Montreal.

ANALYSIS

Water	28·64
Dry matter	71·36
	100·00
Sucrose (cane sugar)	39·40
Reducing sugars	14·42
Total sugars	53·82
Albuminoids (N x 6·25)	1·68
Ash	5·56

This is a sample of cane molasses of good quality.

Molasses is a by-product in the refining of cane sugar. In addition to its nutritive value, which may be said to entirely depend on its sugar content, it is considered, when fed in moderation, to increase the digestibility of roughages used therewith and to assist in keeping the animal in a healthy, thrifty condition. While molasses supplies little or no protein or fat, its high sugar content gives it a very considerable feeding value. Owing to its well-known palatability and appetizing properties it is specially useful in conjunction with forages deficient in palatability.

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

This work has continued to increase during the past year. A total of two thousand seven hundred and ninety-two samples were sent in for examination and analysis, as compared with two thousand and forty-five which were received last year.

The greatest increase has been in the evaporated and powdered milk samples. The time of one analyst is now fully occupied in dealing with this type of food product.

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 SAMPLES RECEIVED

During the year ending March 31, 1923

Condensed and evaporated milks	499
Milk powders	307
Evaporated apples	604
Colours and inks	46
Spices and condiments	48
Denaturing oils	59
Butters and oleomargarines	35
Salts and preservatives	11
Meat and vegetables extracts	3
Lards, lard compounds and edible oils	49
Canned and preserved fruits	136
Sausages, potted and preserved meats	121
Canned vegetables, tomato products	47
Miscellaneous	47
Samples received and awaiting attention	548
Total received, 1922-23	2792

CONDENSED AND EVAPORATED MILKS

Four hundred and ninety-nine samples were examined during the past year.

The average net weight of 100 samples of condensed milk in cans labelled "14 ounces net weight" was 14·12 ounces.

The average fat content of 94 samples of condensed milk stated to contain 8 per cent butter fat was 8·15 per cent.

The average fat content of 14 samples of condensed milk stated to contain 9 per cent butter fat was 9·20 per cent.

The average net weight of 408 samples of evaporated milk in cans labelled "16 ounces net weight" was 16·14 ounces.

The average net weight of 17 samples of evaporated milk in cans labelled "12 ounces net weight" was 12 ounces.

The average net weight of 18 samples of evaporated milk in cans labelled "6 ounces net weight" was 5·99 ounces.

The average fat content of 442 samples of evaporated milk was 7·86 per cent. The standard for this product is 7·8 per cent.

The average total solids content of 442 samples of evaporated milk was 26·3 per cent. The standard requires 25·5 per cent.

Of all these samples one only, a sample of condensed milk, was found to have a bad odour and to be unfit for consumption.

Eight samples of condensed milk contained mould.

In one sample of evaporated milk, butter fat had separated out.

SKIMMED MILK, WHOLE MILK AND MALTED MILK POWDERS

Three hundred and seven samples of skim-milk and whole milk powders were examined for water content.

The average water content was 2·82 per cent. The maximum water content was 6·70 per cent and the minimum was 0·22 per cent. Seventeen samples, 5·5 per cent, contained more water than the law allows, i.e. more than 5 per cent.

Many more samples were examined this year than last; the results seem to show a decided improvement in the reduction of the water content of this product.

Two hundred and fifty-three samples of skimmed milk powder were examined for ash content: no samples were found to have a high ash. The average ash content for all the samples was 8·11 per cent.

Fifty-two samples of whole milk powder were examined for fat content. Thirty-eight samples had an average fat content of 27·68 per cent. The standard calls for not less than 26·0 per cent. Three samples only were found to have a fat content less than 26 per cent. Fourteen samples were found to have an average fat content of 42·66 per cent.

One sample of "Trucream" cream powder had a fat content of 71·50 per cent.

Four samples of malted milk were examined. The average protein content (N. x 6·38) was 13·29 per cent. The maximum protein content was 14·85 per cent and the minimum 10·89 per cent.

No samples were found to contain borates, bicarbonates or carbonates.

EVAPORATED APPLES

Six hundred and four samples of evaporated apples were examined for water content.

Details of average, minimum and maximum water contents for the last three years are given in the table below.

WATER CONTENT OF EVAPORATED APPLES

Year	Number of Samples Examined	Maximum percentage of water	Minimum percentage of water	Average percentage of water
1920-21	449	33·5	8·5	21·4
1921-22	729	29·5	5·1	20·6
1922-23	604	33·3	2·8	21·4

One hundred and one samples, 17 per cent, had a water content in excess of 25 per cent, the maximum allowed by the regulations. This percentage (17) is high and shows that the improvement in this product noted in our last report has not been maintained during the past year.

SPICES AND CONDIMENTS

Forty-eight samples were examined. One sample only contained foreign starch. Two samples gave a high ash, showing the presence of earth or sand.

One sample showed the presence of insect infestation.

A sample of Maggi's seasoning, imported from Switzerland, was examined and found to be a purely vegetable extract.

COLOURS AND INKS

Forty-four samples of colours were examined.

Four samples were found to contain traces of arsenic, but none of these contained more than 10 parts per million, the maximum limit allowed.

One sample only was found to be a non-permissible colour.

Two samples of stamping inks were examined: both were found to be free from arsenic.

DENATURING OILS

Fifty-nine samples were examined under this heading.

As in previous years, a great many of the samples submitted were highly refined paraffin oils, which seldom satisfy the taste requirement. Thirty-four samples, 58 per cent, were declared unsuitable as denaturants for this reason. Thirty-four samples, 58 per cent, satisfied all requirements. All samples satisfied the specific gravity test. Ninety-six per cent of samples satisfied flash point requirements.

During the year, the official boiling point test apparatus was installed and this test is now generally applied.

Since the installation of this apparatus in October 1922, five samples have been given a lower boiling point than that required by the regulations.

LARDS, LARD COMPOUNDS AND EDIBLE OILS

Forty-nine samples were examined: most of these consisted of lards and shortenings and all except two were found to meet the requirements of the regulations. Two samples labelled "shortening" were found to contain 6·58 per cent and 6·46 per cent water and 5·97 per cent and 5·72 per cent ash respectively, and were shown to be in reality oleo-margarine.

MEAT AND VEGETABLE EXTRACTS

Three samples were examined under this head. All were found to be free from preservatives.

SALTS AND PRESERVATIVES

Eleven samples were examined. Two samples of "Freeze-em Pickle" were examined and found to consist of refined sodium chloride and potassium nitrate.

BUTTER AND OLEOMARGARINE

Twenty-one samples of butter for use in the manufacture of oleomargarine were examined. All were found to be free from added colour.

In some countries the regulations require that a minimum amount of some substance which can be readily detected in the laboratory shall be added to oleomargarine in order to distinguish it readily from butter.

In order to determine what this minimum should be for sesame oil and potato flour, fourteen samples of oleomargarine containing various amounts of sesame oil and potato flour were tested. The results seemed to show that not less than 2 per cent sesame oil or 2 per cent potato flour should be added.

JAMS AND JELLIES

Fifty-six samples of jams and jellies manufactured in Canada were examined. Forty-six were examined for glucose, of which twenty-one, 46 per cent, contained glucose. The highest percentage of glucose found was 12·8 per cent.

Thirty-five samples were examined for preservatives (benzoates and salicylates), of which seven, 20 per cent, contained benzoate. All samples contained less than the maximum limit (1 part per 1,000) allowed by the Food and Drugs Act.

None of the samples contained salicylate.

Thirty-six samples were examined for coal tar colouring matter, of which twenty, 55 per cent, contained coal tar colours.

All colours except one were identified as permissible colours under the Act; one colour was not identified.

Eleven samples of jams and jellies manufactured in Canada were examined for water content. Three of these were found to contain more than 30 per cent, the greatest amount being 34·65 per cent, which was found in a sample of peach jam.

One hundred and four samples of imported jams were examined. One hundred of these were examined for glucose, of which ten, 10 per cent, contained this material. The highest percentage of glucose found was 12·4 per cent. One hundred and three samples were examined for preservatives (benzoates and salicylates), of which none contained either preservative. Ninety-one samples were examined for coal tar colouring matter, of which fourteen, 15 per cent, contained coal tar colours. Ten colours were identified as permissible colours under the Act. Four colours were not identified.

Ten samples of imported jams were examined for water content. Seven of these, 70 per cent, contained more than 30 per cent, the greatest amount being 47·88 per cent, which was found in a compound jam of plum and orange from Portland, Oregon.

During the year an extensive investigation was carried on to find out if it would be possible to determine by chemical analysis whether foreign fruit juice or pectin preparation in excess of that allowed by the regulations had been added to jams. The results have been submitted in a separate report.

The work included the analysis of thirty-seven samples of strawberry jam, twenty-seven samples of raspberry jam, twenty-six samples of strawberry and raspberry pulps, thirty-seven samples of apple juice and pectin preparations, and thirty-three samples of miscellaneous jams and fruit pulps.

FRUITS, FRUIT PULPS AND JUICES

Seventeen samples of fruit pulps were examined. Fifteen of these were examined for preservatives (benzoates and salicylates), of which five, 33 per cent, contained benzoates. One sample only contained more than the maximum limit allowed.

Two samples of cold pack strawberries were examined and found to contain 45·87 per cent and 46·12 per cent total solids, respectively, of which 42·16 per cent and 38·61 per cent consisted of invert sugar.

Five cans of blueberries were examined to determine the reason for "hard swells." The tin was found to be extensively eaten off the inside of the cans and the fruit contained an excessive amount of tin.

There is no doubt that the "hard swells" were due to evolution of hydrogen from the action of organic acids in the fruit on the metals of containers.

Similar cases of "hard swells," due to the same cause, were found in seven samples of canned rhubarb.

An apple product, "Delecto," manufactured by W. Graves & Company, Limited, Bridgetown, U.S., was examined and the results of analysis are given below:—

	p.c.
Total solids	78·02
Total sugars	68·15
Ash	0·472

SAUSAGES, SAUSAGE MEATS, POTTED AND PRESERVED MEATS

Forty-four samples of sausages were examined for water, starch and protein and the results are summarized in the following table:—

RESULTS OF ANALYSIS OF FORTY FOUR SAMPLES OF SAUSAGES

	Water	Starch	Protein	Water-protein Ratio
	p.c.	p.c.	p.c.	
Maximum	70·69	8·85	20·43	6·19
Minimum	40·84	0·37	8·18	2·76
Average	55·59	3·14	12·82	4·58

Sixteen per cent contain starch in excess of the "standard," 5 per cent. Forty-one per cent contained water in excess of 60 per cent, the limit set by law. Five per cent had a water-protein ratio in excess of 6. Twenty-nine per cent had a water-protein ratio in excess of 5. Fifty per cent had water-protein ratio in excess of 4·5. Seventy-one per cent had a water-protein ratio in excess of 4. Eighty-six per cent had water-protein ratio in excess of 3·6. Fourteen per cent had water-protein ratio equal to or less than 3·6.

A comparison of these results with those obtained from an examination of seventy-four samples of sausages during the previous year shows a decrease in the average percentages of water and starch and in the water-protein ratio.

We may therefore conclude that there has been some improvement in the quality of this food product, although we consider that a sufficiently good standard has not yet been attained by all the manufacturers.

In order to determine to what extent water was being added in making sausages, twenty-five samples of the meats used in sausage manufacture were examined and the results are given in the table below:—

RESULTS OF ANALYSIS OF TWENTY-FIVE SAMPLES OF SAUSAGE MEAT

	Water	Protein	Water-protein Ratio
	p.c.	p.c.	
Maximum	73·02	18·61	5·22
Minimum	40·66	10·22	3·32
Average	58·86	14·43	4·10

Fifty-two per cent contained water in excess of 60 per cent; twelve per cent had a water-protein ratio in excess of 5; twenty per cent had a water-protein ratio in excess of 4·5; forty-four per cent had a water-protein ratio in excess of 4; ninety-six per cent had a water protein ration in excess of 3.6; four per cent had a water-protein ratio equal to or less than 3·6.

NOTE.—Subsequent to the writing of this chapter it was discovered that these samples had not been taken according to directions issued and were not representative of natural meats. It was learned that they were meats which had been cominuted and watered in preparation for the filling of sausage casings.

Further work in this investigation is being carried on, authentic samples of meat from various portions of the carcass being examined as to the water-protein ratio.

Fifty-two samples of potted and preserved meats were examined for preservatives. Three samples were found to contain very slight amounts of borates. All other samples were free from borates, sulphites, benzoates and salicylates.

CANNED VEGETABLE AND TOMATO PRODUCTS

Thirty-three samples of tomato products were examined. Twenty-eight samples of tomato paste were examined for total solids with the following results:—

	Per Cent.
Total solids—Maximum	43.64
Minimum	27.27
Average	35.80

Ten samples were examined for preservatives (benzoates and salicylates), of which one only, 10 per cent, contained benzoate. Thirty samples were examined for coal tar colouring matter, of which two, 6 per cent, contained permissible colour.

Fourteen samples of canned vegetables were examined. Of eight samples of canned peas which were analysed two were found to contain copper.

Two samples of canned tomatoes were examined and were found to contain excessive amounts of tin, the tin coating of the container being almost entirely eaten off.

One sample of canned corn was found to contain quite an appreciable amount of sulphuretted hydrogen, the odour of which could be distinctly detected.

MISCELLANEOUS

Forty-seven samples were examined under this heading. The samples consisted chiefly of baking powders, flours and starches used in the manufacture of sausages; custard powders; disinfectants and cleansing compounds.

Two samples of " Jel-a-fruit " for use in the manufacture of jams and jellies were examined. One sample was found to contain as much as 64 per cent pectin by the double alcohol precipitation method of analysis.

OXYGEN CONTENT OF WATER SUPPLY AT DOMINION FISH HATCHERY, THURLOW, NEAR BELLEVILLE, ONT.

This inquiry was undertaken at the request of the Department of Marine and Fisheries, which reported that there had been an unusual mortality of fry the previous season and that the water supply was suspected of being the cause. It was thought that the supply might be polluted by drainage from the distillery on the Moira river which flows into the bay near Belleville.

After a consideration of the matter as presented to us and some preliminary analyses of the water, members of this staff visited the hatchery, to make determinations of dissolved oxygen and carbon dioxide.

The first visit was made in February when the eggs were in course of incubation and the second in May, when all the eggs were hatched and the fry ready for distribution.

Omitting the analytical data, which are rather voluminous, it may be stated that the results obtained in February showed that the water supply had an average degree of oxygen saturation of nearly 70 per cent, which may be considered as ample for optima results.

The results in May were very satisfactory, showing still higher degree of oxygen saturation, varying from 90 per cent in the supply troughs to 70 per cent in the exhaust troughs. From these results it would appear that approximately 20 per cent of the dissolved oxygen was consumed by the fry.

The proportion of free carbon dioxide in the exhaust troughs was found to be very low, approximating 40 milligrams of carbon dioxide per litre of water.

WELL WATERS FROM FARM HOMESTEADS

For more than thirty years this division has annually emphasized the vital importance of a pure water supply on the farm, pointing out, on the one hand, how such is essential to the good health of the farmer and his family and the thrift of his stock and, on the other, how a polluted supply is a constant menace, an insidious source of danger, to both man and beast.

Further to support and supplement this teaching the Division has analysed, free of charge, several thousands of samples, more or less representative of farm wells throughout the Dominion, reporting the results in detail, with comments and advice to the individuals sending the sample. Advice also has been given to those about to sink wells, in respect to a suitable and safe location, protection of the supply, etc. In this connection, a pamphlet entitled "The Farm Well " has been issued which summarizes the main points or features in respect to sources and nature of contamination, precautionary measures to prevent pollution of the well and certain methods for the sterilization of water intended for drinking and culinary purposes in cases in which the supply is suspected.

This work has borne good fruit; our large correspondence relating to the farm water supply affords excellent evidence that a keen interest has been awakened among the more progressive farmers in this very important matter. Though it is to be admitted there are as yet many farmers who do not realize the gravity of the question, there is good reason to believe that this practical

and helpful phase of the Division's work has, directly and indirectly, been the means of improving the farm water supply generally throughout the Dominion. As this work continues we further believe its beneficial influence will spread; no work could be more useful, more valuable, to the farming community, whether we consider its bearing on the health of the family or on the health and thrift of the live stock.

As has been stated in previous reports, the chief fault in the present condition of affairs has been found to be in the unfortunate location of the well. Too often safety has been sacrificed to convenience. It is pollution of an excretal character that has most to be feared and when the well is in the barnyard or is in the vicinity of some similar source of pollution, contamination of its water must sooner or later occur. If analysis confirms the suspicion that the well is receiving drainage of this dangerous character the only remedy in nine cases out of ten is to fill up the well—for the soil surrounding it will be impregnated with filth—and to sink another on a safer site—at least 50 yards from a possible source of contamination. There are many matters to be observed in locating the site for a new well and in protecting its water from pernicious drainage, and these are treated of in the pamphlet already referred to, "The Farm Well," of which a copy will be sent on application.

It may perhaps be safely assumed that only those strongly suspecting their supply forward samples for examination, but the following classification of the waters examined during the past year at least shows the necessity of continuing the propaganda for pure water on the farm.

	p.c.
Pure and wholesome	17
Suspicious and probably dangerous	28
Seriously polluted	36
Saline	19

A word may be said in respect to the last-named waters in the above category—saline waters. These are waters unfit for domestic use by reason of their high mineral content. They occur more commonly in certain districts of sparse and irregular precipitation of the Northwest, but are occasionally to be met with in other parts of the Dominion from drilled wells tapping deep-seated sources. Such waters may be merely non-potable by reason of their disagreeable taste but there are many which undoubtedly may be distinctly injurious to health if continuously used. An analysis is necessary to determine the nature and amount of saline matter in solution. If a drinking supply free from saline matter is to be obtained from these waters, distillation must be resorted to—for which purpose domestic or household stills may be purchased.

As every year the Division receives a large number of samples quite unsuitable for satisfactory analysis, by reason of insufficiency of water, dirty containers, etc., farmers desirous of an examination are urged to apply to the Division for an application form giving necessary instructions for the correct collection and shipment of the sample. No fee is charged for the analysis but the express charges must be prepaid. This application form contains a number of questions respecting the well and its surroundings. These should be answered as fully as possible as the information so given is required for the satisfactory interpretation of the analytical data.

EXPERIMENTAL PROJECTS UNDER WAY IN THE DIVISION OF CHEMISTRY

CHEMISTRY DIVISION

Project No.	Title.
C. 11.	Agricultural Meteorology.
C. 51.	Water supply for Farm Homesteads.
C. 52.	Rain and Snow Investigations.
C. 10.	Sugar Beet Investigation.
C. 53.	Soil Investigatory Work.
C. 54.	Feeding Stuffs Investigatory Work.
C. 55.	Fertilizer Investigatory Work.
C. 56.	Meat and Canned Foods Investigatory Work.
C. 63.	Canadian Apatite and Sulphur Experiment, C.E.F. Greenhouse, 1923.
C. 81.	Humber Fish Manure Experiment.

SOIL INVESTIGATIONAL WORK FOR THE RECLAMATION SERVICE, DEPARTMENT OF THE INTERIOR

C. 64.	To determine the agricultural value and reclamation of soils in Northern Alberta, under drainage.
C. 65.	To ascertain the alkali content of soils as related to crop growth.
C. 66.	To ascertain the cause of eroded areas (burnouts) in semi-arid districts.
C. 67.	To determine the suitability of soils from the C.P.R. tracts of Saskatchewan and Alberta, for farming under irrigation.
C. 68.	To enable a report to be made on miscellaneous materials such as waters, deposits, cements, etc.

SOIL SECTION

C. 42.	Rotation Check Plot.
C. 82.	Special Soil Investigatory Work (Indian Head, Sask.).
C. 83.	Prince Edward Island Soil Investigatory Work.
C. 84.	Peace River Soil Investigatory Work.
C. 85.	British Columbia Soil Investigatory Work.
C. 86.	Northern Ontario Soil Investigatory Work.
C. 87.	Clinton, Ontario, Soil Investigatory Work.

FODDERS AND FEEDING STUFFS SECTION

C. 87.	"Feeding Value" Investigatory Work.
C. 88.	"Corn for Silage" Investigatory Work.
C. 89.	"Sunflower Plant" Investigatory Work.
C. 90.	"Moisture Content of Hays" Investigatory Work.
C. 91.	"Value of Clover Hay under various Treatments" Investigatory Work.
C. 92.	"Condimental Foods and Cattle Tonics" Investigatory Work.
C. 93.	"Feeding Stuffs Act" Investigatory Work.
C. 94.	Special Investigatory Work for other Divisions, C.E.F.
C. 95.	"Effect of Irrigation" Investigatory Work.

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