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, 1929

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Soils Laboratory, Division of Chemistry, Central Experimental Farm, Ottawa.

DIVISION OF CHEMISTRY

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The character, scope and value of the work of the division for the past year are roughly indicated in the following table, which presents a classification of the samples submitted, analyzed and reported. These include those collected in connection with investigations instituted and carried on by the Experimental Farm System and those received from farmers and others interested in agriculture. Among the matters dealt with by this division and undertaken at the request of other branches of the Department of Agriculture, are the examination of dairy products for the Dairy and Cold Storage Branch, meats and canned foods and other packing house products from the Health of Animals Branch, and canned and preserved fruits and vegetables from the Fruit Branch. The table also includes samples received in connection with matters submitted to the division by other departments of the Government service.

TABLE No. 1.—SAMPLES RECEIVED FOR EXAMINATION AND REPORT FOR TWELVE MONTHS ENDING MARCH 31, 1929

—	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	Total
Soils	66	19	10	15	166	198	23	2	6	505
Manures and fertilizers	11	1	1	.....	18	23	7	2	2	65
Forage plants, fodders and feeding stuffs	11	43	71	17	814	60	66	95	2	1,179
Waters	8	2	2	7	91	43	2	2	1	158
Samples from Meat and Canned Foods Division	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,852
Miscellaneous, including dairy products, insecticides	36	37	22	21	204	124	16	27	17	504
										4,263

CHEMICAL SERVICE FOR FARMERS

This branch of the division's work has been steadily maintained since the earliest days in the history of the Experimental Farms. In this connection during the past year 617 samples were analyzed and reported on. They may be classified as follows:—

TABLE 2.—SAMPLES SUBMITTED BY FARMERS

—	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Soils	7	2	18	97	95	1	5	26	49
Limestones, marl, etc.	.....	3	1	5	7	.....	.....	1	7
Mucks, peats and muds	.....	1	5	9	6	.....	.....	.....	.....
Waters	1	2	2	43	91	7	2	2	8
Fodders and feeding stuffs	2	3	1	9	34	3	2	1	13
Miscellaneous	.....	2	7	16	13	.....	3	1	4
	10	13	34	179	246	11	12	31	81

While the number of soils submitted by farmers, gardeners and district representatives precludes the possibility of a complete analysis of each, sufficient work, both chemical and physical, is carried out on each to permit of a fairly comprehensive report and to advise on the economic methods of improving these soils by manuring, fertilizing, liming, etc., where needed. Farmers desirous of availing themselves of this service are asked to write to the division for directions for the proper collection of the sample.

Samples of limestone and marl are subjected to complete analysis and in the case of ground products a mechanical analysis to show the fineness of grinding is also carried out.

Waters and feeding stuffs from home-grown crops are being received in increasing numbers; it is evident that this service is proving of value to the farming community.

CLOSE GRAZING EXPERIMENT

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

An investigation into the value of the Close Grazing System of pasturage to Canadian farmers was begun at the Central Experimental Farm in 1927. This management of pasture lands, results in the furnishing of grass of high protein content throughout the entire growing season and depends upon the successful application of two principles: the grazing of the pasture while the grass is still young and rich in protein and the liberal dressing with fertilizer, more particularly nitrogenous, to promote continuous growth and to increase the nitrogen content of the herbage.

In May of 1927 four experimental plots, A, B, C and D, were staked off and these plots were cut respectively weekly, fortnightly, every third week and for hay with aftermath, with analysis of the product, in order to learn how far this system might be practicable under local conditions.

The season of 1927 was one very favourable to the successful operation of a close grazing scheme. A heavier precipitation than the average (14·79 inches) characterized the season May to September, but more important was the fact that this heavy rainfall was well distributed. No period of drought occurred during the entire growing season. In consequence, fresh growths of grass sprang up readily, after cuttings frequent enough to have discouraged growth in a less favourable season.

The summarized data for the several plots are as follows:—

TABLE 3.—PROTEIN AND FIBRE CONTENT AND PROTEIN AND DRY MATTER YIELDS, 1927

Plot	No. of Cuttings	Average Protein (Dry-Matter Basis)	Average Fibre (Dry-Matter Basis)	Yields per acre	
				Dry Matter	Protein
		p.c.	p.c.	lb.	lb.
A—cut weekly	10	21·20	19·38	2,918	439
B— " fortnightly	8	18·69	20·50	3,344	466
C— " every 3rd week	5	17·17	22·06	4,304	571
D— " for hay with aftermath	2	10·16	28·65	5,311	520

*For the detailed results of the first season (1927) in this investigation see Report of the Dominion Chemist for year ending March 31, 1928.

These data compiled from the weights and chemical analysis of each cutting of grass warranted the following conclusions:—

1. That the plot cut for hay with one aftermath yielded the greatest weight of dry matter, with C plot next in rank, B third and A last, that is, yields of dry matter increase with lengthening of the intervals between cuttings.

2. That grass of one, two and three weeks' growth is of a high protein content (from 22 to 17 per cent on the dry matter basis), the shorter the period the higher the protein content.

3. That while the fibre increases with the growing period as the protein decreases, the grass from all three frequently cut plots was soft and succulent with no sign of lignification of fibre.

4. That for the season of 1927, a three weeks' growing period was more favourable to *protein yield* than the shorter intervals.

5. That plot D (hay with aftermath) yielded the second heaviest weight of protein for the season but that the grass from this plot possessed two distinctly unfavourable features: (*a*) A protein concentration of only 10 per cent, and (*b*) an average fibre content of 29 per cent (compared with 19 to 22 per cent on the other plots)—a factor which undoubtedly depresses the digestibility of the herbage.

Second Season's Results, 1928

Immediately after the final cutting of the first season (September 29, 1927) an application of a complete fertilizer was made to all four plots. This consisted of ammonium sulphate 50 pounds, superphosphate 350 pounds, and muriate of potash 100 pounds per acre. Early in the spring of 1928 and before active growth, the plots were dressed with nitrate of soda at the rate of 100 pounds per acre. The plan of the experiment, as to frequency of cutting, etc., was that of the previous season.

The precipitation between the first and last cutting—May 11 and October 26—was 27·7 inches, an unusually heavy rainfall. There were several very heavy rains, and no week between the above dates passed without at least a shower.

The scheduled dates of cutting were interfered with in a number of cases by rain, it being necessary for a satisfactory carrying on of the work that the plots should be reasonably dry when cut. The season as a whole was undoubtedly favourable for the scheme, though at certain periods there was too much rain for optimum results.

Frequency of Cutting as Affecting Percentages of Moisture, Protein and Fibre

The herbage for 1928 on all four plots shows a decidedly higher percentage of moisture than that of the previous season. This, in part, may be accounted for by the absence of all dead grass from the preceding year (present to some extent in the earlier cuttings of 1927), and in part possibly by the heavy rainfall of the 1928 season which kept the growth fresh and green. There was no period of drought during which the grass might partially dry out.

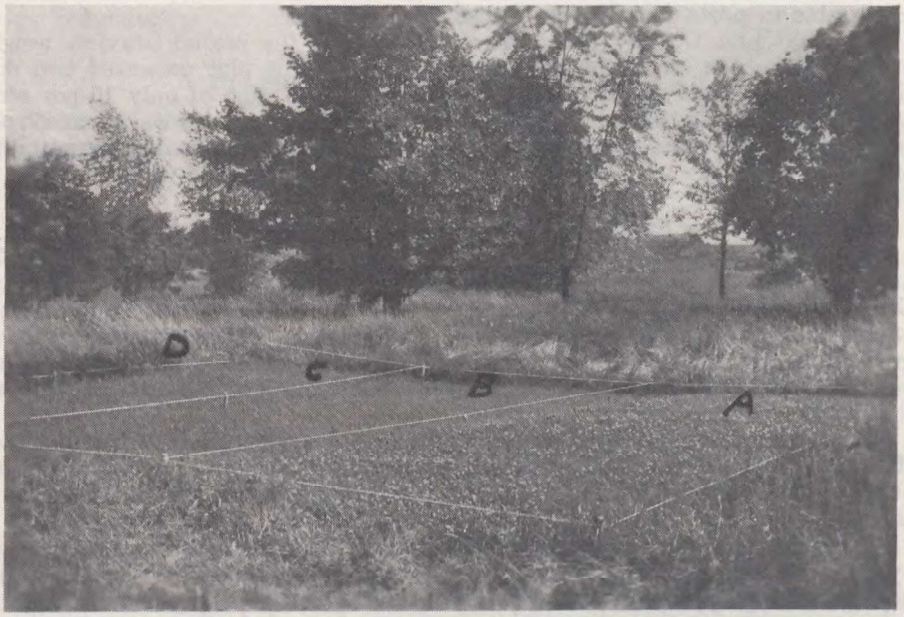
Table 4.—Moisture Content of Grasses as Cut, 1928

—	Plot A. 16 cuttings	Plot B 9 cuttings	Plot C 8 cuttings	Plot D 8 cuttings
	p.c.	p.c.	p.c.	p.c.
Maximum	82·61	80·38	83·60	74·99
Minimum	72·92	71·15	68·70	64·41
Average	78·66	78·68	77·16	68·81

Little difference is to be noticed between plots A. B. and C in respect to moisture content—there was no steady decline with the lengthening of the periods between cuttings as noted in the previous season—but plot D, cut for hay, with two aftermaths, as might be expected, is markedly lower.

PROTEIN

The protein percentages (dry matter basis) of all four plots, and more especially those of A and B, are very much higher than those of 1927. In respect to Plots A and B this is undoubtedly due to the rapid encroachment by white Dutch clover; by the end of July, "A" was carpeted with this plant



Close-grazing experiment. View of plots on June 26, 1928. Note White Dutch clover in bloom on plot A.

over the greater part of its area, while in "B" this clover had spread over more than one third of the plot. At this period in 1927 there was only an occasional plant of clover on these plots. The growth and spread of this legume to such a degree as to practically drive out the grasses, must be attributed to the conditions incident to this scheme—mainly exposure to light.

On plot C clover began to show in the herbage during September and October—and this is reflected in the higher protein recorded during the latter part of the season. At the time of the last cutting the clover had become firmly esablished over possibly one fifth of the plot.

No white Dutch clover was observed on plot D at any time during the season, but a few plants of red clover were to be noted.

Another factor contributing to these higher protein percentages and affecting the herbage of all four plots is the fertilizer applications; the two dressings of nitrogen (sulphate of ammonia in the autumn of 1927 and nitrate of soda in the spring of 1928) might assuredly be credited with some share in raising the protein content of the herbage.

TABLE 5.—PROTEIN (DRY MATTER BASIS), 1928

Dates of Cutting	Plot A 16 cuttings	Plot B 9 cuttings	Plot C 8 cuttings	Plot D 3 cuttings
	p.c.	p.c.	p.c.	p.c.
May 11	29·95	.....	.....	.....
" 18	28·45	26·04	.....	.....
" 26	28·75	.....	18·52	.....
June 1	25·24	17·80	.....	.....
" 8	28·26	.....	.....	.....
" 15	26·69	21·37	14·52	.....
July 3	27·65	23·80	.....	11·96
" 6	.....	.....	20·99	.....
" 13	29·39	.....	.....	.....
" 20	29·38	21·99	.....	.....
" 27	32·60	.....	19·44	.....
Aug. 10	28·34	20·82	.....	.....
" 17	31·30	.....	22·17	.....
" 27	31·26	23·65	.....	11·61
Sept. 7	28·29	.....	24·90	.....
" 22	31·05	22·39	.....	.....
" 28	.....	.....	25·71	.....
Oct. 26	27·56	24·96	19·64	16·34

The foregoing data are summarized in the following table:—

TABLE 6.—PROTEIN (DRY MATTER BASIS), 1928

(Maximum, Minimum and Average Data)

1928

—	Plot A 16 cuttings	Plot B 9 cuttings	Plot C 8 cuttings	Plot D 3 cuttings
	p.c.	p.c.	p.c.	p.c.
Maximum	32·60	26·04	25·72	16·34
Minimum	25·24	17·80	14·52	11·61
Average	28·95	22·54	20·74	13·30

In 1927 the increase in protein content from D to A was to be attributed, very largely, if not solely, to an increase in the frequency of cutting, or, stated otherwise, to the fact that very young grass is richer in protein than that of more mature growth. The higher protein content of A, B and C, in 1928, as compared with that of D, followed the operation of two factors: frequency of cutting and the development of clover—with the latter the more potent of the two.

FIBRE

The results of 1927 showed very distinctly that frequency of cutting markedly affects the fibre content; the longer the period of growth the higher the percentage of fibre. From this and the relation of protein content to frequency of cutting it necessarily follows that high protein is associated with low fibre and vice versa.

TABLE 7.—FIBRE (DRY MATTER BASIS), 1928

Dates of cutting	Plot A Cut weekly	Plot B Cut fort-nightly	Plot C Cut every third week	Plot D Cut for hay with aftermath
	p.c.	p.c.	p.c.	p.c.
May 11	13·79	.....	.....	.....
" 18	15·12	16·82	.....	.....
" 26	18·41	.....	22·30	.....
June 1	18·65	20·86	.....	.....
" 8	17·88	.....	.....	.....
" 15	17·31	20·49	23·86	.....
July 3	18·75	20·89	.....	34·33
" 6	.....	.....	22·72	.....
" 13	18·64	.....	.....	.....
" 20	18·82	21·57	.....	.....
" 27	17·52	.....	22·88	.....
Aug. 10	15·54	20·24	.....	.....
" 17	16·02	.....	20·76	.....
" 27	16·83	20·22	.....	28·69
Sept. 7	14·78	.....	19·36	.....
" 22	14·05	16·25	.....	.....
" 28	.....	.....	14·34	.....
Oct. 26	12·39	12·65	11·96	17·54

The 1928 data support and confirm those of the preceding season in respect to the relationship of fibre to protein and, show that the trend of fibre content as influenced by frequency of cutitng—*i.e.* the younger the grass, the lower the percentage of fibre—is maintained.

TABLE 8.—FIBRE (DRY MATTER BASIS)

(Maximum, Minimum and Average Data)—1928

—	Plot A 16 cuttings	Plot B 9 cuttings	Plot C 8 cuttings	Plot D 3 cuttings
	p.c.	p.c.	p.c.	p.c.
Maximum	18·82	21·57	23·86	34·33
Minimum	12·39	12·65	11·96	17·54
Average	16·53	18·88	19·77	26·85

Table 8 presents in summarized form the fibre data of the season. The percentages for all four plots are decidedly lower than those of 1927. This is accounted for on A, B, and C, by the large proportion of leafy clover present and in the case of D by the two aftermaths of comparatively young grass.

To obtain data applicable to the present discussion as to the protein and fibre content of grass and clover, respectively, analysis was made of the herbage of plot A of the cutting of July 3 as a whole and of its grass and clover separately.

ANALYSIS OF HERBAGE OF PLOT A
Cutting of July 3, 1928
(Dry Matter Basis)

—	Herbage as Cut	Grass	Clover
	p.c.	p.c.	p.c.
Protein	27·65	23·40	30·70
Fibre	18.75	25·07	17·29

These figures show the influence of clover on the herbage, in raising the protein and lowering the fibre.

FREQUENCY OF CUTTING AS AFFECTING AMOUNTS OF DRY MATTER AND PROTEIN, PER ACRE

Dry Matter Yields

Table 9 presents, in addition to weights of dry matter the dates of cutting, data of precipitation and mean temperatures for the growth period preceding each cutting.

TABLE 9.—WEIGHT OF DRY MATTER, POUNDS PER ACRE, 1928

Date of cutting	Precipitation	Temperature (mean)	Plot A — Cut weekly	Plot B — Cut fortnightly	Plot C — Cut every three weeks	Plot D — Cut for hay with aftermath
1928	in.	°F.	lb.	lb.	lb.	lb.
May 11	.....	54·7	34·9	.....	.....	.....
" 18	0·04	50·3	293·8	698·9	.....	.....
" 26	1·48	56·8	420·8	.....	1,249·6	.....
June 1	0·64	53·7	245·3	968·4	.....	.....
" 8	0·45	54·2	196·9	.....	.....	.....
" 15	0·37	60·2	190·6	351·6	976·0	.....
July 3	5·48	64·2	550·5	423·5	.....	6,579·4
" 6	0·75	69·3	.....	.....	388·4	.....
" 13	0·66	71·1	237·0	.....	.....	.....
" 20	2·41	69·1	130·1	535·3	.....	.....
" 27	0·17	65·7	228·3	.....	608·5	.....
Aug. 10	3·45	63·9	484·9	875·6	.....	.....
" 17	0·25	69·3	139·7	.....	404·6	.....
" 27	1·23	66·0	143·9	333·5	.....	2,412·0
Sept. 7	0·43	66·5	146·1	.....	260·0	.....
" 22	3·19	56·2	145·1	284·3	.....	.....
" 28	0·81	44·1	*	*	114·0	.....
Oct. 26	5·93	48·7	181·9	139·2	47·4	315·0

*Growth too short to allow of cutting.

As in 1927 the season of 1928 was characterized by a very heavy and well-distributed rainfall. The total precipitation between May 11 and October 26, the period between the first and last cuttings, was 27·7 inches—an amount greatly exceeding the normal, and no week passed within this period without rain.*

It is obvious that rainfall is a factor of prime importance to the success of a close-grazing scheme; a sufficiently ample and well-distributed precipitation greatly aids the rejuvenation of the grazed area—periods of severe drought result in very slow and sparse growth. The season of 1928 was on the whole undoubtedly very favourable to the scheme, though possibly at certain periods there was too much moisture for optimum growth.

The yields from all the plots in 1928 are greatly in excess of those of 1927 and this is to be attributed to the application of fertilizer, and a longer growing season associated with a favourable moisture supply.

The results in general show that yields, as in 1927, are closely related to the precipitation of the preceding growth period. The work of both seasons has shown that moisture, *i.e.* rainfall, is the factor of first importance towards recovery and vigourous growth. Further, in this connection, it was noted that as clover replaced grass, as more particularly in plots A and B, recovery was quicker than in the preceding season, when grass was the predominating herbage.

* At certain periods during the season the intervals between the rains were so short that it was not possible to adhere to the regular scheduled dates of cutting, it being found impracticable to satisfactorily harvest the plots immediately after a heavy rain.

SEASONAL YIELDS, DRY MATTER, PER ACRE, 1927 AND 1928

—	Plot A — Cut weekly	Plot B — Cut fortnightly	Plot C — Cut every three weeks	Plot D — Cut for hay with aftermath
	lb.	lb.	lb.	lb.
1927	2,918	3,344	4,304	5,311
1928	3,770	4,610	4,048	9,306

Much larger yields were obtained from plots A, B, and D in 1928 than in 1927. This heavier herbage is attributable to a number of factors, chief among which are the increasing replacement of grass by clover, the influence of fertilizer applications, a thickening of the "stand" by cutting and a longer season in which the growth received no set-back from the periods of drought.

The heaviest dry matter yield was obtained, as in 1927 from plot D. There was a very heavy growth as cut for hay on July 3 with two good aftermaths—the last date of cutting, October 26, indicating an exceptionally long season of growth.

The positions of "B" and "C" in relation to each other are reversed to those held in 1927, the yield of B now exceeds that of C. Weather conditions prevented the regular fortnightly harvesting of B to such a degree that only one more cutting was made on it than on C and this removes from consideration the factor of "interval" or frequency of cutting. Plot C is the only one of the series which gave a lighter yield in 1928 than in 1927. This plot due to its topography suffered from flooding and gullying, with a destruction of grass over a part of its area. This naturally reduced its yield.

The dry matter yield of A as in 1927 is the lowest in the series.

The results of 1928, outstandingly those of A but also notably those of B and C, have furnished confirmatory evidence of the depressing action of frequent cutting on yield. The data of both seasons have conclusively shown that the plot least frequently cut (D) has given the highest weight of dry matter.

Protein Yields

The protein yields in 1928 for all four plots greatly exceed those of 1927. Factors affecting all the plots of the series and favourably influencing yields were a good growing season and the fertilizer applications made in the fall of 1927 and the spring of 1928.

SEASONAL YIELDS: PROTEIN, PER ACRE, 1927 AND 1928

—	Plot A — Cut weekly	Plot B — Cut fortnightly	Plot C — Cut every three weeks	Plot D — Cut for hay with aftermath
	lb.	lb.	lb.	lb.
1927	439·0	466·0	571·0	520·0
1928	1,078·1	1,008·0	766·0	1,119·0

Plot D furnished the heaviest weight of protein but this yield, however, is closely followed by those of plots A and B. Owing to the length of season there were two aftermaths from this plot and these furnished growth of higher protein content and digestibility than grass cut for hay. But since the protein of the

hay (cut July 3) constitutes seven-tenths of the total protein yield of D, and is of lower digestibility than the protein of A and B, it may be safely concluded that although D furnished slightly the highest weight of protein, this protein did not equal in nutritive value that of the more frequently cut plots.

The protein yield of C in 1927 was higher than that of B; the reverse is true in 1928. This exchange of position was due in part to destruction of herbage on C from flooding, and in part to the spread of white Dutch clover on B. It was seen in discussing dry matter yields that C, in 1928 similarly fell behind B. Thus it would appear justifiable to consider plot C in the second season, by reason of its injury, as temporarily removed from the scheme.

The protein yield of B is practically equal to that of A. This, in a large measure is to be attributed to the fact that towards the close of the season the herbage of this plot consisted of probably 70 per cent of white Dutch clover, thus approximating in botanical composition that of A.

Plot A in this second season was essentially clover, and this accounts for its very high protein yield associated with its comparatively low dry matter yield. It is of interest to note that in the short course of two seasons the character of herbage and its nutritive value could, by the adoption of a close grazing scheme, be so profoundly changed.

SUMMARY

From a study of the data of two season's work the following observations may be made:—

Frequency of grazing with a view to the successful operation of the scheme will depend on a number of factors, chief among which is the character of the herbage and its growth. Recovery and vigour of growth are primarily dependent on rainfall and secondarily on the fertility of the soil, which may be increased by fertilizer applications. Rainfall, its amount and distribution, has in this investigation shown itself the most potent of all influences in the recovery of the plots. The results in general of 1928 indicate that the application of fertilizers in which nitrogen predominates, greatly assisted in the maintenance of vigorous growth.

The protein content of the herbage increases with the shortening of the period between cuttings, due in the first season solely to the fact that the protein content of the grass falls off with age but in the second and subsequent season, in a very large measure, to the incursion of white Dutch clover.

A consideration of protein yields per acre in relation to frequency of cutting reveals that in the first season when the herbage is essentially grass the shortening of the period between cuttings tends to reduce the protein yield; in the second season when clover largely replaces grass (roughly in proportion to the shortening of the growing period) the higher protein content of the legume tends to counteract the depressing effect on yield of frequent cutting.

There is evidence to show that yield of dry matter per unit area decreases with frequency of cutting. In both seasons the largest yield of dry matter was obtained from the plot cut as hay with aftermath.

The close-grazing scheme appears to be essentially one productive of herbage rich in protein and of high digestibility.

Both years' results have given strong support to this conclusion. The herbage of the frequently cut plots, is to be regarded as a feed of high protein concentration diluted it is true with water but with a narrow nutritive ratio, *i.e.* the proportion of protein to the other nutrients is high. The production of such a forage during the grazing period would undoubtedly enable the farmer to substitute this home-grown product for expensive commercial feeds.

In practical trials of this scheme of pasture management involving rotational cropping and heavy fertilizations, the carrying power with both cattle and

sheep has been greatly increased within a few—two or three—seasons. Instances are recorded from Europe in which the acre value has been raised from one cow to nearly three cows in a period of three years. The experiment here recorded, in which analysis is substituted for grazing, explains and confirms the results from practical pasturage trials. The increased feeding value is due to the higher protein content of the young grass and the incursion of clover which follows naturally on the operation of the scheme.

DYKE AND UPLAND HAYS FROM NOVA SCOTIA AND NEW BRUNSWICK

The results from the examination of a first series of hays from dyked lands from the Maritime Provinces and of the crop of 1927—an inquiry undertaken to learn their nutritive value as compared with upland hays—have already appeared. The chief conclusion from this preliminary survey was that the nutritive value of couch grass hay was distinctly lower than that of timothy.*

The series now reported, of the crop of 1928, comprises both dyke and upland hays, collected at Sackville, N.B., and Amherst and Experimental Farm, Nappan, N.S. Both early and late cut hays are represented.

Of the nine samples of early cut hays (July 18), seven are dyke and two upland. The eight samples of late-cut hay (July 25-August 16) comprise two upland and six dyke hays.

An attempt was made to obtain a more or less detailed statement of the several grasses, legumes, weeds, etc., present in the samples, but on examination it was found that the "hays" were so exceedingly mixed and broken up that a separation of their herbage giving the proportions of the several grasses present, was practically impossible.

DYKE AND UPLAND HAYS COMPARED

Referring to table 10, the data permit of the comparison among the "Early Cut" hays, of timothy and alsike clover from dyke and upland, though owing to the somewhat mixed character of the herbage of these samples, the deductions from the data must be considered as indicative only.

In the case of the timothy samples (Nos. 94492, 94497 and 95465) the percentages of protein and fibre—constituents upon which a judgment as to relative nutritive value may be made—indicate very little difference between the hays as grown on dyke and upland: the slightly higher percentage of protein found in the dyke-grown timothy is scarcely sufficient to give a superior rating.

The alsike clover samples unfortunately do not permit of a strict comparison. Though No. 94493—dyke grown—possesses the higher protein and the lower fibre, No. 94496 from the upland area contained a considerable proportion of timothy, which would lower its percentage of protein and raise the fibre.

With respect to the hays labelled "Late cut," it will be observed that the samples harvested from the upland area were cut from three to four weeks earlier than those from the dyke lands. Since the younger the grass the higher the protein content, this fact may account for the superiority, in respect to higher protein content, of the upland couch and mixed grass hays.

*Report of the Dominion Chemist for year ending March 31, 1928, pp. 61-62.

EARLY AND LATE CUT HAY COMPARED

The data of table 11 are those presented in table 10, but arranged in such a way as to permit of a ready comparison of the early and late-cut samples.

Dyke Hays.—Comparing couch grass hay from early and late cuttings the earlier cut is slightly superior by reason of its higher percentage of protein—about one per cent.

In the five samples representative of hay from "mixed grasses," three are early and two are late cut. The data for the protein content on the dry matter basis of these are as follows:—

HAY FROM MIXED GRASSES

Protein (Dry matter basis)

Lab'y No.	Early cut	Late cut
	p.c.	p.c.
94490	8·37	.....
94494	6·83	.....
94495	7·62	.....
95468	.....	9·44
95469	.....	6·29

If No. 95468 is omitted from the comparison, it having been found on examination to contain approximately 5 per cent of legumes, the early cut hays are the richer in protein—from 0·5 to 2·0 per cent.

The two samples of timothy hay, an early and a late cut, show a difference in protein content of 2 per cent in favour of the early cut hay.

Upland Hays.—The only variety of hay from an upland area, cut early and late, is timothy. The early-cut samples are approximately 2 per cent richer in protein than the late cut.

Owing to the fact that it was not found practicable to procure hays of the same botanical composition from dyke and upland areas, this series has not, unfortunately, furnished data which would allow a *strict* comparison as to the relative nutritive value of dyke and upland hays. It may be recorded, in view of the above statement, that arrangements have been made for the forthcoming season for the collection of samples which, by virtue of coming from the same areas growing but one variety and cut on the same dates, will be valuable in settling the question of the relative value of dyke and upland hays.

This series however has afforded data which confirm the conclusion reached from previous inquiries of this nature, viz., that early cut hays are richer in protein and hence have a higher nutritive value than those which are cut late in the season.

99105—3½

TABLE 10.—DYKE AND UPLAND HAYS FROM NOVA SCOTIA AND NEW BRUNSWICK—CROP OF 1928

Lab'y No.	Locality	Variety	Cutting	Date of Cutting	As received						Water-free					Moisture basis of 12·5 per cent					
					Moisture	Protein	Fat	Carbohydrate	Fibre	Ash	Protein	Fat	Carbohydrate	Fibre	Ash	Moisture	Protein	Fat	Carbohydrate	Fibre	Ash
				1928	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
	Dyke Hays																				
94489	L. Ayer, Sackville, N.B.	Couch	Early	18·7	9·29	6·09	2·49	46·58	29·27	6·38	6·71	2·75	51·24	32·27	7·03	12·50	5·87	2·41	44·83	28·23	6·16
94491	J. L. Dickson, Sackville, N.B.	Couch	Early	18·7	9·99	6·33	2·39	46·34	28·29	6·66	7·03	2·65	51·48	31·44	7·40	12·50	6·15	2·32	45·05	27·51	6·47
95463	Experimental Farm, Nappan, N.S.	Couch	Late	16·8	5·69	5·35	2·18	50·40	30·25	6·13	5·67	2·31	53·45	32·07	6·50	12·50	4·96	2·02	46·77	28·05	5·70
94490	F. Harper, Sackville, N.B.	Mixed grasses	Early	18·7	8·36	7·67	2·56	45·02	29·62	6·77	8·37	2·79	49·13	32·32	7·39	12·50	7·32	2·44	42·99	28·28	6·47
94494	Chas. Logan, Amherst, N.S.	Heavy grasses	Early	19·7	7·88	6·29	2·55	48·99	27·83	6·46	6·83	2·77	53·18	30·21	7·01	12·50	5·98	2·42	46·52	26·43	6·15
94495	Chas. Logan, Amherst, N.S.	Mixed grasses	Early	19·7	8·02	7·10	2·90	46·64	28·35	7·08	7·62	3·15	50·71	30·82	7·70	12·50	6·67	2·76	44·35	26·98	6·74
95469	Chas. Logan, Amherst, N.S.	Mixed grasses	Late	15·8	6·37	5·89	2·50	49·82	27·07	8·35	6·29	2·67	53·21	28·92	8·91	12·50	5·50	2·34	46·56	25·30	7·80
95468	Shipley's	Mixed grasses	Late	14·8	6·18	8·86	2·47	45·37	29·26	7·85	9·44	2·63	48·38	31·19	8·36	12·50	8·26	2·30	42·33	27·29	7·32
94492	G. Campbell & Son, Sackville, N.B.	Timothy	Early	18·7	8·70	7·01	2·56	41·40	32·74	7·59	7·68	2·80	45·36	35·85	8·31	12·50	6·72	2·45	39·69	31·37	7·27
95467	Experimental Farm, Nappan, N.S.	Timothy	Late	16·8	5·85	5·36	2·19	49·30	30·65	6·65	5·69	2·33	52·36	32·56	7·06	12·50	4·98	2·04	45·81	28·49	6·18
94493	L. Ayer, Sackville, N.B.	Alsike clover	Early	18·7	11·79	14·68	2·87	36·46	24·58	9·62	16·64	3·25	41·33	27·87	10·91	12·50	14,56	2·84	36·16	24·39	9·55
	Upland Hays																				
95466	Experimental Farm, Nappan, N.S.	Couch	Late	22·7	5·79	6·64	2·30	49·21	30·45	5·61	7·05	2·44	52·24	32·32	5·95	12·50	6·17	2·14	45·71	28·28	5·20
95462	Experimental Farm, Nappan, N.S.	Mixed grass	Late	26·7	5·56	6·54	2·54	46·53	32·18	6·65	6·92	2·69	49·28	34·07	7·04	12·50	6·05	2·35	43·12	29·82	6·16
94497	F. George, Sackville, N.B.	Timothy	Early	18·7	9·17	6·21	2·85	45·40	32·12	4·25	6·83	3·14	49·99	35·37	4·67	12·50	5·98	2·75	43·74	30·95	4·08
95465	Experimental Farm, Nappan, N.S.	Timothy	Early	17·7	5·85	6·65	2·14	47·93	33·11	4·32	7·06	2·27	50·91	35·17	4·59	12·50	6·18	1·99	44·54	30·77	4·02
95464	Experimental Farm, Nappan, N.S.	Timothy	Late	25·7	5·35	4·50	2·67	53·93	30·39	3·16	4·75	2·82	57·00	32·10	3·33	12·50	4·16	2·47	49·87	28·09	2·91
94496	F. George, Sackville, N.B.	Alskie clover	Early	18·7	8·78	10·29	2·66	42·39	30·11	5·78	11·28	2·92	46·46	33·00	6·34	12·50	9·87	2·56	40·65	28·87	5·55

TABLE 11.—DYKE AND UPLAND HAYS FROM NOVA SCOTIA AND NEW BRUNSWICK—CROP OF 1928. EARLY AND LATE CUTTING

Lab'y No.	Locality	Variety	Cutting	Date of Cutting	As received						Water-free					Moisture basis of 12·5 per cent.					
					Moisture	Protein	Fat	Carbohydrate	Fibre	Ash	Protein	Fat	Carbohydrate	Fibre	Ash	Moisture	Protein	Fat	Carbohydrate	Fibre	Ash
	Early Cuttings			1928	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
94489	L. Ayer, Sackville, N.B.	Couch	Dyke	18·7	9·29	6·09	2·49	46·48	29·27	6·38	6·71	2·75	51·24	32·27	7·03	12·50	5·87	2·41	44·83	28·23	6·16
94491	J. L. Dickson, Sackville, N.B.	Couch	Dyke	18·7	9·99	6·33	2·39	46·34	28·29	6·66	7·03	2·65	51·48	31·44	7·40	12·50	6·15	2·32	45·05	27·51	6·47
94490	F. Harper, Sackville, N.B.	Mixed grass	Dyke	18·7	8·36	7·67	2·56	45·02	29·62	6·77	8·37	2·79	49·13	32·32	7·39	12·50	7·32	2·44	42·99	28·28	6·47
94495	Chas. Logan, Amherst, N.S.	Mixed grass	Dyke	19·7	8·02	7·01	2·90	46·64	28·35	7·08	7·62	3·15	50·71	30·82	7·70	12·50	6·67	2·76	44·35	26·98	6·74
94494	Chas. Logan, Amherst, N.S.	Heavy mixed grass.	Dyke	19·7	7·88	6·29	2·55	48·99	27·83	6·46	6·83	2·77	53·18	30·21	7·01	12·50	5·98	2·42	46·52	26·43	6·15
94492	G. Campbell & Son, Sackville, N.B.	Timothy	Dyke	18·7	8·70	7·01	2·56	41·40	32·74	7·59	7·68	2·80	45·36	35·85	8·31	12·50	6·72	2·45	39·69	31·37	7·27
94497	F. George, Sackville, N.B.	Timothy	Upland	18·7	9·17	6·21	2·85	45·40	32·12	4·25	6·83	3·14	49·99	35·37	4·67	12·50	5·98	2·75	43·74	30·95	4·08
95465	Experimental Farm, Nappan, N.S.	Timothy	Upland	17·7	5·85	6·65	2·14	47·93	33·11	4·32	7·06	2·27	50·91	35·17	4·59	12·50	6·18	1·99	44·54	30·77	4·02
94493	L. Ayer, Sackville, N.B.	Alsike clover	Dyke	18·7	11·79	14·68	2·87	36·46	24·58	9·62	16·64	3·25	41·33	27·87	10·91	12·50	14·56	2·84	36·16	24·39	9·55
94496	F. George, Sackville, N.B.	Alsike clover	Upland	18·7	8·78	10·29	2·66	42·39	30·10	5·78	11·28	2·92	46·46	33·00	6·34	12·50	9·87	2·56	40·65	28·87	5·55
	Late Cuttings																				
95463	Experimental Farm, Nappan, N.S.	Couch	Dyke	16·8	5·69	5·35	2·18	50·40	30·25	6·13	5·67	2·31	53·45	32·07	6·50	12·50	4·96	2·02	46·77	28·05	5·70
95466	Experimental Farm, Nappan, N.S.	Couch	Upland	22·7	5·79	6·64	2·30	49·21	30·45	5·61	7·05	2·44	52·24	32·32	5·95	12·50	6·17	2·14	45·71	28·28	5·20
95467	Experimental Farm, Nappan, N.S.	Timothy	Dyke	16·8	5·85	5·36	2·19	49·30	30·65	6·65	5·69	2·33	52·36	32·56	7·06	12·50	4·98	2·04	45·81	28·49	6·18
95464	Experimental Farm, Nappan, N.S.	Timothy	Upland	25·7	5·35	4·50	2·67	53·93	30·39	3·16	4·75	2·82	57·00	32·10	3·33	12·50	4·16	2·47	49·87	28·09	2·91
95468	Shipley's	Mixed grass	Dyke	14·8	6·18	8·86	2·47	45·38	29·26	7·85	9·44	2·63	48·38	31·19	8·36	12·50	8·26	2·30	42·33	27·29	7·32
95469	Chas. Logan, Amherst, N.S.	Mixed grass	Dyke	15·8	6·37	5·89	2·50	49·82	27·07	8·35	6·29	2·67	53·21	28·92	8·91	12·50	5·50	2·34	46·56	25·30	7·80
95462	Experimental Farm, Nappan, N.S	Mixed grass	Upland	26·7	5·56	6·54	2·54	46·53	32·18	6·65	6·92	2·69	49·28	34·07	7·04	12·50	6·05	2·35	43·12	29·82	6·16

INVESTIGATIONAL WORK IN CEREAL CHEMISTRY

WHEAT: COMPOSITION OF THE WHEAT KERNEL AS INFLUENCED BY DATE OF CUTTING (STAGE OF GROWTH) 1928

GARNET WHEAT, EXPERIMENTAL STATION, LACOMBE, ALBERTA, CROP OF 1928

This series consists of nineteen samples from a crop of Garnet wheat cut at two day intervals from August 9 to September 14. The "stages of growth" are from "late milk" to "firm dough", *i.e.*, beginning with wheat too immature for milling and ending with wheat fully ripe.

The Superintendent reports that ripening of the grain was very slow; the grain on September 6 was not quite hard. Slight frosts were recorded on August 23 and 27 and September 8, 9 and 10.

TABLE 12.—GARNET WHEAT, EXPERIMENTAL STATION, LACOMBE, ALBERTA—CROP OF 1928

Lab'y No.	Date of cutting	Stage of maturity	No. of cutting	Weight of 1,000 kernels	Moisture	Water-free basis		Data furnished by Experimental Station, Lacombe, Alta.	
						Protein (N x 5·7)	Ash	Grade	Price per bushel at local elevator
				gms.	p.c.	p.c.	p.c.		cents
95249	9·8	Late milk	1	14·78	10·69	14·02	2·06	Feed wheat	48
95250	11·8	" to early dough	2	17·46	10·73	13·87	1·78	"	48
95251	13·8	Early dough	3	21·01	11·08	13·77	1·65	No. 6 Northern	55
95252	15·8	"	4	22·11	10·61	13·73	1·71	No. 5 "	67
95253	17·8	Soft dough	5	26·02	10·40	13·76	1·59	No. 4 "	79
95254	19·8	"	6	26·07	11·01	13·30	1·44	No. 3 "	89
95255	21·8	Soft to medium dough	7	27·31	11·07	13·78	1·51	No. 2 "	95
95256*	23·8	Medium dough	8	27·27	11·40	13·68	1·43	No. 4 "	79
95257	25·8	"	9	24·21	10·72	13·61	1·52	No. 5 "	67
95258*	27·8	"	10	26·56	11·02	13·51	1·46	No. 6 "	55
95259	29·8	"	11	23·63	11·15	13·57	1·52	Feed wheat	48
95260	31·8	Firm dough	12	23·64	11·15	13·48	1·45	"	46
95261	2·9	"	13	23·86	10·61	13·43	1·49	"	48
95262	4·9	"	14	24·80	10·20	13·43	1·54	"	49
95263	6·9	"	15	25·68	10·09	13·65	1·42	"	48
95264*	8·9	"	16	24·00	10·45	13·35	1·41	"	48
95265*	10·9	"	17	22·87	10·03	13·44	1·52	"	48
95266	12·9	"	18	23·75	10·42	13·52	1·51	"	48
95267	14·9	"	19	21·37	9·90	13·35	1·55	"	48

* Dates on which crop was frosted.

The early occurrence of frost markedly affected the normal development and ripening of the grain, and in consequence deductions of a definite and precise character as to the influence of stage of maturity on the composition of the kernel under frost-free conditions cannot be safely made.

However, it may be noted that there is a steady increase in the weight of kernel until the date of frosting, after which apparently there was no further development.

As has been previously found in these laboratories, the immature wheat of the late milk stage shows slightly higher percentages of protein and ash (water-free basis) than wheat of the subsequent cuttings. From the date of the first frosting the protein percentages vary but little—the differences being almost within the range of experimental error.

It is interesting and significant that the grading of the grain supports the observations made from the chemical data; the grading steadily improves from date of early cuttings until that of frosting—after which nine of the eleven cuttings were graded as "feed wheat".

REWARD WHEAT: EXPERIMENTAL STATION, BEAVERLODGE, ALTA. CROP OF 1928

This series comprises twelve samples of Reward wheat cut at two day intervals from August 2 to August 24. The grain at the date of the first cutting was slightly past the early dough stage; the crop would ordinarily have been harvested between the seventh and eighth cuttings—August 14 to 16.

The crop was sown on summer-fallow May 2.

TABLE 13.—REWARD WHEAT: EXPERIMENTAL STATION, BEAVERLODGE, ALTA.—CROP OF 1928

Lab'y No.	Number of cutting	Date of cutting	Grade Northern	Weight of 1,000 kernels	Moisture	Protein (N. x 5·7)		Ash
						13·5% moisture	Water-free basis	Water-free basis
				gm.	p.c.	p.c.	p.c.	p.c.
96994	1st	2-8-28	No. 3	28·57	9·68	15·03	17·38	1·67
95	2nd	4-8-28	3	28·43	7·98	15·02	17·36	1·55
96	3rd	6-8-28	3	30·29	9·63	16·28	18·81	1·51
97	4th	8-8-28	2	30·96	8·67	16·43	18·99	1·35
98	5th	10-8-28	2	30·78	8·78	15·94	18·43	1·40
99	6th	12-8-28	1	31·60	8·56	16·97	19·63	1·58
96700	7th	14-8-28	1	28·91	8·66	15·35	17·74	1·43
01	8th	16-8-28	1	30·22	9·12	15·53	17·96	1·41
02	9th	18-8-28	1	29·68	8·34	16·97	19·63	1·54
03	10th	20-8-28	1	28·47	7·98	16·73	19·34	1·60
04	11th	22-8-28	1	28·76	7·76	16·77	19·38	2·03
05	12th	24-8-28	1	29·34	9·24	16·13	18·64	1·43

Weight of Kernel.—There appears to be a more or less regular increase in weight of kernel from the date of the first cutting (August 2) to that of the sixth cutting (August 12). These cuttings include three samples (1st, to 3rd) in grade No. 3 Northern, two samples (4th and 5th) in grade No. 2 and one sample (6th) in No. 1. No regular trend can be observed after the sixth cutting —certainly there is no increase in weight of kernel after this date, August 12.

Protein.—The protein content (water-free basis) more or less regularly increases from the first to the sixth cutting and in this follows the weight of kernel; the results from the sixth to the twelfth cutting are somewhat irregular. Possibly the only definite conclusion which can be reached is that there was no appreciable improvement in the grain after the date of the sixth cutting, when, as stated, the crop would ordinarily have been harvested.

WHEAT: COMPOSITION OF THE WHEAT KERNEL AS INFLUENCED BY HEREDITY AND ENVIRONMENT: CROP OF 1928

In the Annual Report of this Division for the year ending March 31, 1926, there is presented the analytical data of 165 samples of wheat from 45 varieties and grown in 1924 at eighteen Farms and Stations of the Experimental Farm System. The results permitted a study of the influence of heredity and environment on the composition of the wheats. The series now reported comprise 118 samples, representative of 37 varieties, grown in 1928 at nine of the western Farms and Stations of the System.

The results allow a comparison from the chemical standpoint, chiefly as to protein content, of (1) varietal differences under the same environmental conditions and (2) of the influence of environmetal conditions on the character of the grain of the same variety.

TABLE 14.—WHEATS FROM EXPERIMENTAL FARMS AND STATIONS—CROP 1925

Experimental Farm, Brandon, Man.

Lab'y No.	Milling No.	Variety	Weight of 1,000 kernels	Moisture content	Protein (N x 5·7)		Ash	Remarks
					On 13·5% moisture basis	On water-free basis	On water-free basis	
			gms.	p.c.	p.c.	p.c.	p.c.	
97536	28-55	Axminster	39·88	11·03	13·55	15·67	1·91	Following sweet clover.
97537	28-56	Ceres	37·48	11·03	14·34	16·58	1·87	" "
97538	28-57	Garnet	33·00	11·90	11·70	13·53	2·20	" "
97539	28-58	Kota	29·86	11·69	16·57	19·15	2·22	" "
97540	28-59	Marquis, Ott. 15	39·34	11·59	14·39	16·63	2·08	" "
97541	28-60	Marquillo	38·40	10·12	13·27	15·34	1·87	" "
97542	28-61	Parker's Sel	38·53	11·61	15·92	18·41	1·93	" "
97543	28-62	Reward	38·28	10·52	16·69	19·25	2·13	" "
97544	28-63	Renfrew	41·61	11·69	14·32	16·56	2·31	" "
97545	28-64	S. 24-52	28·74	11·62	13·58	15·70	2·15	" "
97546	28-65	M. x K. 1656-83	36·21	11·86	15·63	17·96	2·12	" "
97547	28-66	M. x K. 1656-84	35·29	11·64	13·60	15·73	2·07	" "
		Experimental Station, Morden, Man.						
97548	28-18	Ceres	27·85	12·35	16·48	19·05	2·50	On summer-fallow.
97549	28-20	Garnet	27·92	11·85	10·64	12·30	1·94	" "
97550	28-21	Hope	32·20	11·38	16·27	18·80	2·45	" "
97551	28-22	Kota	25·60	10·89	17·08	19·75	2·36	" "
97552	28-23	Marquis, Ott. 15	31·06	10·99	15·88	18·36	2·16	" "
97553	28-24	Marquillo	32·61	11·43	15·89	18·37	2·22	" "
97554	28-25	Parker's Sel	35·06	11·20	17·79	20·56	2·42	" "
97555	28-26	Quality	38·08	11·25	15·57	18·00	2·40	" "
97556	28-27	Reward	34·12	10·97	16·72	19·33	2·11	" "
		Experimental Farm, Indian Head, Sask.						
97557	28-28	Garnet	27·44	11·09	12·50	14·45	1·74	On summer-fallow.
97558	28-29	Marquis, Ott. 15	34·11	12·09	13·39	15·48	1·80	" "
97559	28-30	Reward	32·72	12·01	12·98	15·01	1·75	" "
97560	28-31	Red Fife	33·62	12·37	12·33	14·25	1·81	" "
97561	28-32	Supreme	34·12	12·24	11·77	13·60	1·62	" "
97562	28-33	Red Bobs 222	34·94	12·07	11·50	13·29	1·71	" "
97563	28-34	Renfrew	41·22	11·74	11·41	13·19	1·71	" "
97564	28-35	Ceres	38·97	11·94	13·67	15·80	1·75	After corn or roots.
97565	28-36	Early Red Fife	43·41	12·46	12·38	14·31	1·75	" "
97566	28-37	Kota	36·20	12·37	13·46	15·15	1·85	" "
97567	28-38	Kitchener	40·72	12·00	12·12	14·01	1·58	" "
97568	28-39	Reliance	40·42	12·36	12·95	14·97	1·58	" "
		Experimental Station, Rosthern, Sask.						
97569	28-40	Early Red Fife	43·22	13·05	12·78	14·78	1·68	On summer-fallow.
97570	28-41	Early Triumph	39·22	12·31	12·90	15·02	1·39	" "
97571	28-42	Garnet	33·27	12·94	15·77	18·23	1·36	" "
97572	28-45	Marquis, Ott. 15	39·91	12·53	16·04	18·55	1·63	" "
97573	28-46	Ceres	39·06	12·25	16·90	19·54	1·66	" "
97574	28-47	M. x K. 1658-84	42·07	12·16	16·34	18·89	1·58	" "
97575	28-48	Preston	39·71	12·26	14·64	16·92	1·40	" "
97576	28-49	Reward	35·92	13·09	16·52	19·10	1·59	" "
97577	28-50	Red Fife	39·26	13·11	14·60	16·88	1·60	" "
97578	28-51	Suprsme	39·99	12·77	13·75	15·90	1·66	" "
97579	28-52	Garnet	35·05	12·43	13·08	15·12	1·53	" "
97580	28-53	Reward	38·57	12·44	15·96	18·45	1·75	" "
		Experimental Station, Swift Current, Sask.						
97581	28-1	Early Red Fife	39·80	12·18	14·10	16·30	1·46	On summer-fallow.
97582	28-2	Early Triumph	37·37	12·10	14·85	17·16	1·85	" "
97583	28-3	Garnet	29·48	11·81	13·51	15·62	1·52	" "
97584	28-4	Kota	36·70	11·68	15·70	18·16	1·94	" "
97585	28-5	Kitchener	36·92	12·19	13·58	15·70	1·55	" "
97586	28-6	Marquis, Ott. 15	35·40	11·78	15·12	17·49	2·03	After corn.
97587	28-7	Northcote's Sel	36·87	11·92	15·32	17·71	1·84	" summer-fallow.
97588	28-8	Ceres	36·68	12·41	15·31	17·70	1·66	" "
97589	28-9	Reward	34·86	12·14	16·47	19·04	1·93	" "
97590	28-10	Red Fife	41·12	12·06	14·12	16·32	1·81	After corn.
97591	28-11	Renfrew	35·90	12·87	15·31	17·70	1·65	On summer-fallow.
97592	28-12	Reliance	35·53	12·53	15·06	17·41	1·61	" "
97593	28-13	Red Bobs, super	33·18	12·41	13·93	16·11	1·50	" "
97594	28-14	Supreme	34·22	12·05	14·51	16·77	1·83	After corn.
97595	28-15	Marquis 10B	32·29	11·44	14·37	16·63	1·60	On summer-fallow.

TABLE 14.—WHEATS FROM EXPERIMENTAL FARMS AND STATIONS—Crop 1928—*Concluded*

Experimental Station, Scott, Sask.

Lab'y No.	Milling No.	Variety	Weight of 1,000 kernels	Moisture content	Protein (N x 5·7)		Ash	Remarks
					On 13·5% moisture basis	On water-free basis	On water-free basis	
			gms.	p.c.	p.c.	p.c.	p.c.	
97596	28-67	Early Red Fife, Ott. 16.	40·12	11·74	15·09	17·44	1·64	On summer-fallow.
97597	28-68	Early Triumph	35·27	11·83	15·26	17·65	1·50	" "
97598	28-69	Garnet, Ott. 652	31·39	11·42	13·95	16·14	1·51	" "
97599	28-70	Kota	32·25	10·82	16·61	19·20	1·56	" "
97600	28-71	Kitchener	35·88	11·15	14·33	16·57	1·39	" "
97601	28-72	Marquis, Ott. 15	34·51	10·89	15·04	17·40	1·55	" "
97602	28-73	Marquis 10B	35·25	11·26	15·17	17·54	1·50	" "
97603	28-74	Marquillo	32·43	11·05	14·35	16·60	1·52	" "
97604	28-75	M. x K. 1656-84	37·97	11·54	14·63	16·91	1·35	" "
97605	28-76	Reliance	33·80	11·29	13·42	15·52	1·42	" "
97606	28-77	Reward	35·18	11·05	17·18	19·86	1·59	" "
97607	28-78	Renfrew	37·01	10·40	14·02	16·21	1·57	" "
97608	28-79	Red Fife, Ott. 17	30·49	10·90	15·36	17·76	1·74	" "
97609	28-80	Red Bobs 222	36·53	10·94	14·48	16·74	1·52	" "
97610	28-81	Ruby, Ott. 623	31·51	10·40	15·12	17·48	1·57	" "
97611	28-82	Supreme	34·02	11·11	14·38	16·63	1·52	" "
		Experimental Station, Lethbridge, Alta.						
97612	28-83	Early Red Fife	39·58	11·56	11·87	13·73	1·98	" "
97613	28-84	Early Triumph	33·79	11·29	12·47	14·39	1·47	" "
97614	28-85	Garnet	28·44	11·06	10·39	12·00	1·87	" "
97615	28-86	Kitchener	36·70	11·16	11·21	12·97	1·87	" "
97616	28-87	Marquis, Ott. 15	33·83	11·15	12·60	14·56	2·03	" "
97617	28-88	Reward	28·67	11·00	15·87	18·35	1·70	" "
97618	28-89	Red Fife	34·56	11·33	12·91	14·92	1·95	" "
97619	28-90	Red Bobs 222	34·20	11·21	12·37	14·30	1·55	" "
97620	28-91	Renfrew	38·39	11·45	11·98	13·85	1·71	" "
97621	28-92	Supreme	31·49	11·71	13·09	15·13	1·45	" "
97622	28-93	Marquis 10B	33·47	12·24	14·20	16·43	1·64	" "
97623	28-94	Hard Federation 71	36·64	10·61	13·68	15·81	1·76	" "
97624	28-95	Hard Federation 31	39·06	11·69	14·43	16·68	1·87	" "
97625	28-96	Aurora	35·05	12·00	12·72	14·71	1·58	" "
97626	28-97	Huron	37·32	11·82	13·59	15·71	1·67	" "
97627	28-98	Ceres	34·34	11·78	14·50	16·70	1·83	" "
97628	28-99	Ruby	29·31	11·24	14·79	17·09	1·93	" "
97629	28-100	White Federation	41·84	12·45	12·71	14·69	1·87	" "
97630	28-101	Hard Federation	34·27	12·19	13·47	15·57	1·96	" "
97631	28-102	Fisher 1B	33·96	11·07	12·46	14·41	1·63	" "
97632	28-103	Fisher 2B	30·29	11·60	12·98	15·01	1·69	" "
97633	28-104	928 Q.Q. 2	30·91	11·86	15·03	17·08	1·80	" "
97634	28-105	Quality	43·56	11·12	14·16	16·37	1·63	" "
97635	28-106	Kota	34·29	11·70	14·88	17·20	1·77	" "
		Experimental Station, Beaverlodge, Alta.						
97636	28-107	Early Triumph	35·37	11·57	13·00	15·03	1·35	On summer-fallow.
97637	28-108	Garnet	25·61	12·40	13·41	15·50	1·53	" "
97638	28-109	Marquis, Ott. 15	31·66	12·01	14·11	16·32	1·41	" "
97639	28-110	Red Bobs	33·55	11·84	13·43	15·52	1·32	" "
97640	28-111	Red Bobs 222	32·75	11·87	13·00	15·03	1·36	" "
97641	28-112	Ruby	25·88	11·46	14·10	16·30	1·41	" "
97642	28-113	Reward	31·21	11·39	15·65	18·09	1·47	" "
		Experimental Station, Fort Vermilion, Alta.						
97643	28-114	Garnet	27·23	11·66	16·80	19·42	1·87	On summer-fallow.
97644	28-115	Huron	31·18	11·82	15·10	17·45	1·84	" "
97645	28-116	Kitchener	31·14	11·94	15·60	18·03	1·79	" "
97646	28-117	Marquis, Ott. 15	31·56	11·04	15·22	17·59	1·91	" "
97647	28-118	Prelude	28·79	12·11	18·11	20·93	1·99	" "
97648	28-119	Red Fife	32·58	11·74	12·96	14·99	1·72	" "
97649	28-120	Red Bobs	37·49	11·99	16·18	18·71	1·77	" "
97650	28-121	Red Bobs 222	36·07	11·77	12·51	14·46	1·52	" "
97651	28-122	Reward	29·54	12·33	18·11	20·93	1·72	After potatoes.
97652	28-123	Ruby	31·14	12·07	18·45	21·34	1·79	" "
97653	28-124	Renfrew III	42·80	11·72	17·71	20·47	1·50	" "

The data for the more important varieties in this series—Marquis, Garnet and Reward—are discussed in the following chapter, which also considers similar results for these varieties from the crop of 1927.*

*Corresponding results for the year 1925 appear in the Report of this Division for 1926; those for the year 1926 in the Report for 1928.

TABLE 15.—MARQUIS, GARNET AND REWARD WHEATS GROWN ON EXPERIMENTAL FARMS AND STATIONS IN QUEBEC, MANITOBA, SASKATCHEWAN AND ALBERTA—CROP OF 1927

Lab'y No.	Locality	Variety	Weight of 1,000 kernels	Moisture content	Protein (N. x 5·7)		Ash on water-free basis	Remarks
					13·5% moisture basis	On water-free basis		
			gms.	p.c.	p.c.	p.c.	p.c.	
	Qtebec							
94303	Experimental Station, Ste. Anne de la Pocatière, Que.	Marquis Ott	39·66	11·87	10·86	12·55	2·12	
94301	" " "	Garnet	33·42	11·40	11·20	12·96	2·02	
94305	" " "	Reward	40·42	11·49	13·77	15·92	2·14	
	Manitoba							
94248	Experimental Farm, Brandon	Marquis	32·48	10·56	11·88	13·73	1·83	Rotation: alfalfa, corn wheat.
94245	" "	Garnet	16·85	10·08	10·14	11·72	1·90	" "
94252	" "	Reward	28·77	10·49	12·29	14·21	2·06	
94193	Experimental Station, Morden	Marquis	30·90	11·11	12·44	14·38	2·16	After potatoes.
94190	" "	Garnet	28·34	11·04	11·33	13·10	2·02	"
94196	" "	Reward	35·61	11·40	14·79	17·10	2·14	"
	Saskatchewan							
94182	Experimental Station, Rosthern	Marquis O–15	33·71	10·12	12·44	14·37	1·77	On stubble land.
94179	" "	Garnet	28·56	9·87	13·02	15·06	1·68	"
94184	" "	Reward	35·12	10·81	15·46	17·87	1·78	"
94211	Experimental Station, Scott	Marquis O–15	29·61	10·33	15·06	17·41	1·49	On summer-fallow.
94212	" "	Marquis 10–B	29·05	10·62	15·71	18·17	1·61	"
94209	" "	Garnet 0652	26·48	11·48	12·89	14·90	1·41	"
94215	" "	Reward 0928	32·77	10·83	16·58	19·16	1·68	"
94258	Experimental Farm, Indian Head	Marquis O–15	34·69	10·11	13·23	15·30	1·96	"
94255	" "	Garnet	28·36	10·28	13·65	15·81	1·89	"
94263	" "	Reward	35·87	11·23	15·75	18·22	1·88	"
94222	Experimental Station, Swift Current	Marquis S.C. 103	35·09	11·02	12·67	14·64	1·69	"
94220	" "	Garnet S.C. 31	30·72	10·64	12·68	14·66	1·49	"
94226	" "	Reward	34·12	10·80	16·26	18·79	1·76	"

	Alberta							
94234	Experimental Station, Lacombe	Marquis 10–B	37·62	10·86	13·53	15·64	1·83	On summer-fallow.
94235	" "	Marquis 01–15	38·25	10·85	13·89	16·05	1·77	"
94230	" "	Garnet ·0652	33·49	11·59	13·21	15·28	1·76	"
94240	" "	Reward	37·96	10·63	15·24	17·62	1·75	"
94200	Experimental Station, Fort	Marquis 0–15	37·14	11·05	14·22	16·44	1·64	After roots.
94312	" Vermilion	Marquis	37·98	10·78	13·48	15·59	1·79	"Influence of Environment Plot."
94197	" "	Garnet	35·05	11·33	13·47	15·57	1·59	After roots.
94204	" "	Reward –928	38·55	11·40	17·38	20·09	1·96	"
94289	" Beaverlodge	Marquis	30·94	10·79	13·73	15·87	1·58	On summer-fallow.
94288	" "	Garnet	27·24	11·69	12·71	14·69	1·55	"
94290	" "	Reward	31·55	11·02	15·01	17·35	1·52	"
94277	" Lethbridge	Marquis 0–15	30·94	10·49	14·00	16·18	1·78	Irrigated plots.
94278	" "	Marquis 10–B	34·68	11·11	13·76	15·91	1·71	"
94268	" "	Garnet	29·66	10·32	12·33	14·25	1·53	"
94281	" "	Reward	36·01	11·43	15·24	17·62	1·67	"

MARQUIS, GARNET AND REWARD WHEATS GROWN ON EXPERIMENTAL FARMS AND STATIONS

Crop of 1927

This series, submitted by the Cereal Division, consists of a sample each of Marquis, Garnet and Reward from eleven stations in Manitoba, Saskatchewan, Alberta and Quebec. These three wheats were grown on plots side by side at each of the stations and consequently under the same environmental conditions; differences therefore in composition of the wheats at each station may be safely attributed to varietal or inherited qualities. On the other hand, the data permit the comparison of these varieties as affected by environmental factors obtaining in the several provinces.

Since the most important constituent, from the standpoint of bread-making, is protein (gluten), a summary has been prepared from table 15 showing maxima, minima and averages of this component. The Quebec grown samples have been omitted in making this table (No. 16), as it seemed important to compare *inter se* the results from the three prairie wheat growing provinces.

TABLE 16.—MARQUIS, GARNET AND REWARD WHEATS GROWN ON EXPERIMENTAL FARMS AND STATIONS IN MANITOBA SASKATCHEWAN AND ALBERTA. PROTEIN DATA (WATER-FREE BASIS)—CROP OF 1927

Variety	Man., Sask., Alta. *10 groups of three			Manitoba 2 groups of three			Saskatchewan 4 groups of three			Alberta 4 groups of three		
	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Marquis	18·17	13·73	15·40	14·38	13·73	14·06	18·17	14·37	15·53	16·44	15·59	15·95
Garnet	15·81	11·72	14·49	13·10	11·72	12·41	15·81	14·66	15·11	15·47	14·25	14·92
Reward	20·09	14·21	17·80	17·10	14·21	15·66	19·16	17·87	18·51	20·09	17·35	18·17

* Not including one group from Ste. Anne de la Pocatière, Que.

Reading from left to right allows a comparison of the three varieties as affected by environmental conditions of the season of 1927 in the three western provinces, respectively.

For the Marquis wheat the Albertan grown samples gave the highest average, the Saskatchewan ranked second and the Manitoban last.

In the case of Garnet, the averages for Saskatchewan and Alberta are practically equal, that for Manitoba lowest.

The average for Reward as grown in Saskatchewan stands highest, with that for Alberta a close second; Manitoba with a distinctly lower average ranks third.

Reading the table vertically shows that Reward has the highest average for protein in all three provinces, with Marquis second and Garnet third.

Crop of 1928

This series, of the crop of 1928, comprises a number of groups each containing three members—Marquis, Garnet and Reward—collected as follows: two groups from Manitoba, four from Saskatchewan, and three from Alberta. Table 17 presents the data in detail.

TABLE 17.—MARQUIS, GARNET AND REWARD WHEATS GROWN ON EXPERIMENTAL FARMS AND STATIONS IN MANITOBA, SASKATCHEWAN AND ALBERTA—CROP OF 1928

Lab'y No.	Milling No.	Locality	Variety	Weight of 1,000 kernels	Moisture content	Protein (N. x 5·7)		Ash on water-free basis	Remarks
						On 13·5% moisture basis	On water-free basis		
		Manitoba		gms.	p.c.	p.c.	p.c.	p.c.	
97540	28–59	Experimental Farm, Brandon	Marquis	39·34	11·59	14·39	16·63	2·08	Following sweet clover.
97538	28–57	" "	Garnet	33·00	11·90	11·70	13·53	2·20	"
97543	28–62	" "	Reward	38·28	10·52	16·69	19·25	2·13	"
97552	28–23	Experimental Station, Morden	Marquis	31·06	10·99	15·88	18·36	2·16	On summer-fallow.
97549	28–20	" "	Garnet	27·92	11·85	10·64	12·30	1·94	"
97556	28–27	" "	Reward	34·12	10·97	16·72	19·30	2·11	"
		Saskatchewan							
97558	28–29	Experimental Farm, Indian Head	Marquis	34·11	12·09	13·39	15·48	1·80	"
97557	28–28	" "	Garnet	27·44	11·09	12·50	14·45	1·74	"
97559	28–30	" "	Reward	32·72	12·01	12·98	15·01	1·74	"
97572	28–45	Experimental Station, Rosthern	Marquis	39·91	12·53	16·04	18·55	1·63	"
97579	28–53	" "	Garnet	35·05	12·43	13·08	15·12	1·53	"
97580	28–54	" "	Reward	38·57	12·44	15·96	18·45	1·75	"
97586	28–6	" Swift Current	Marquis	35·40	11·78	15·12	17·49	2·03	After corn.
97583	28–3	" "	Garnet	29·48	11·81	13·51	15·62	1·52	On summer-fallow.
97589	28–9	" "	Reward	34·86	12·14	16·47	19·04	1·93	"
97601	28–72	" Scott	Marquis	34·51	10·89	15·04	17·40	1·55	"
97598	28–69	" "	Garnet	31·39	11·42	13·95	16·14	1·51	"
97606	28–77	" "	Reward	35·18	11·05	17·18	19·86	1·59	"
		Alberta							
97616	28–87	Experimental Station, Lethbridge	Marquis	33·83	11·15	12·60	14·56	2·00	"
97614	28–85	" "	Garnet	28·44	11·06	10·39	12·00	1·87	"
97617	28–88	" "	Reward	28·67	11·00	15·87	18·35	1·70	"
97638	28–109	" Beaverlodge	Marquis	31·66	12·01	14·11	16·32	1·41	"
97637	28–108	" "	Garnet	25·61	12·40	13·41	15·50	1·53	"
97642	28–113	" "	Reward	31·21	11·39	15·63	18·09	1·47	"
97646	28–117	" "	Marquis	31·56	11·04	15·22	17·59	1·91	"
97643	28–114	" Fort Vermilion	Garnet	27·23	11·66	16·80	19·42	1·87	"
97651	28–122	" "	Reward	29·54	12·33	18·11	20·93	1·72	After potatoes.

Summarizing these results, as in the case of 1927, table No. 18, showing maxima, minima and averages for the three varieties, as grown in the three provinces, has been prepared.

TABLE 18.—MARQUIS, GARNET AND REWARD WHEATS GROWN ON EXPERIMENTAL FARMS ANS STATIONS IN MANITOBA, SASKATCHEWAN AND ALBERTA. PROTEIN DATA (WATER-FREE BASIS)—CROP OF 1928

Variety	Man., Sask., Alta. 9 groups of three			Manitoba 2 groups of three			Saskatchewan 4 groups of three			Alberta 3 groups of three		
	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Marquis	18·55	14·56	16·93	18·36	16·63	17·50	18·55	15·48	17·23	17·59	14·56	16·16
Garnet	19·42	12·00	14·90	13·53	12·30	12·92	16·14	14·45	15·33	19·42	12·00	15·64
Reward	20·93	15·01	18·70	19·33	19·25	19·29	19·86	15·01	18·09	20·93	18·09	19·12

With respect to Marquis, the protein averages for Manitoba and Saskatchewan are practically equal, with that for Alberta approximately one per cent lower.

The protein averages for Garnet are essentially the same for Saskatchewan and Alberta and approximately 2·5 per cent higher than the average for Manitoba.

In the case of Reward, Manitoba and Alberta give the highest averages, being practically equal, with the Saskatchewan average about 1 per cent lower.

As with the 1927 crop, Reward has the highest protein average in all three provinces, with Marquis second and Garnet third.

The average protein content of the three varieties as grown in the three provinces in 1927 and 1928 may be presented as follows:—

—	Manitoba	Saskatchewan	Alberta
	p.c.	p.c.	p.c.
1927	14·04	16·38	16·34
1928	16·57	16·88	16·97

MARQUIS, GARNET AND REWARD WHEATS, WITH FLOURS, GROWN AT POINTS IN MANITOBA, SASKATCHEWAN AND ALBERTA CROP OF 1928

Wheats

This series, submitted by the Cereal Division, contains 123 samples, which fall into a number of groups grown and collected at 41 points—15 in Manitoba, 15 in Saskatchewan and 11 in Alberta. Each group consists of a sample each of Marquis, Garnet and Reward.

TABLE 19.—MARQUIS, GARNET AND REWARD WHEATS GROWN AT POINTS IN MANITOBA, SASKATCHEWAN AND ALBERTA—CROP OF 1928

Lab'y No.	Name of grower	Locality	Variety	Weight of 1,000 kernels	Moisture content	Protein		Ash on water-free basis	Remarks
						On 13·5% moisture basis	On water-free basis		
				gms.	p.c.	p.c.	p.c.	p.c.	
	Manitoba								
96092	P. E. Bredt	Kerney	Marquis	30·78	10·80	12·75	14·74	1·60	On summer-fallow.
96093	"	"	Garnet	25·49	10·28	11·63	13·44	1·59	"
96094	"	"	Reward	34·31	9·77	13·11	15·16	1·94	Off 1927 corn land.
96095	"	"	Ceres	31·28	10·27	13·87	16·03	1·73	On summer-fallow.
96096	M. P. Mountain	Solsgirth	Marquis	31·78	10·71	11·89	13·74	1·55	
96097	"	"	Garnet	29·40	11·08	12·77	14·79	1·62	On summer fallow.
96098	"	"	Reward	35·78	10·64	14·94	17·28	1·61	"
96099	A. Schamp	Cypress River	Marquis	30·89	10·33	14·26	16·48	1·63	After Marquis.
96100	"	"	Garnet	30·63	9·99	11·32	13·08	1·67	"
96101	"	"	Reward	33·27	10·04	15·62	18·05	1·62	On summer-fallow.
96102	L. G. Davidson	Goose Isle	Marquis	34·46	9·48	11·65	13·47	1·83	"
96103	"	"	Garnet	28·62	10·06	12·77	14·77	1·43	"
96104	"	"	Reward	33·28	10·55	13·96	16·14	1·41	"
96105	W. G. Ward	Dauphin	Marquis	39·99	10·11	15·41	17·82	1·94	After barley.
96106	"	"	Garnet	29·73	9·96	9·06	10·47	1·92	
96107	"	"	Reward	36·16	10·53	16·02	18·51	1·60	On summer-fallow.
96108	F. W. Hicks	Minnedosa	Marquis	36·05	10·35	11·59	13·40	1·86	On breaking.
96109	"	"	Garnet	28·48	10·69	11·93	13·80	1·42	On summer-fallow.
96110	"	"	Reward	36·56	9·88	13·14	15·19	1·69	On breaking.
96111	H. W. Hodginson	Neepawa	Marquis	33·25	9·81	12·47	14·42	1·83	After sweet clover pasture.
96112	"	"	Garnet	29·70	10·59	11·73	13·56	1·78	After barley.
96113	"	"	Reward	31·19	10·91	11·50	13·29	1·91	After sweet clover pasture.
96114	J. S. McCartney	Macdonald	Marquis	34·61	10·09	12·40	14·33	1·70	On summer-fallow.
96115	"	"	Garnet	31·74	10·58	10·31	11·92	2·01	"
96116	"	"	Reward	35·33	10·87	12·14	14·03	2·14	On timothy sod.
96117	W. Keith	Morden	Marquis	31·43	10·57	11·71	13·54	2·05	On summer-fallow.
96118	Stevenson Bros	"	Garnet	25·20	10·19	9·03	10·43	1·93	
96119	W. Keith	"	Reward	35·34	9·79	13·14	15·19	2·13	On summer-fallow.
96120	A. Anderson	Swan River	Marquis	36·69	11·03	10·16	11·74	1·99	"
96121	"	"	Garnet	34·07	10·05	9·49	10·97	1·87	Timothy sod.
96122	"	"	Reward	37·85	10·39	12·53	14·49	2·11	On summer-fallow.
96123	J. R. Rankin	Oakner	Marquis	35·23	9·96	12·81	14·82	1·91	
96124	"	"	Garnet	30·43	9·98	12·88	14·89	1·48	
96125	J. R. Rankin	"	Reward	39·14	10·38	14·32	16·56	1·71	
96126	W. Minty	Thornhill	Marquis	31·94	10·71	12·43	14·36	2·13	On summer-fallow.
96127	"	"	Garnet	31·28	10·75	10·96	12·68	1·93	After wheat.
96128	"	"	Reward	35·73	10·41	12·99	15·03	2·15	On summer-fallow.
96129	R. K. Smith	Oak Lake	Marquis	35·06	9·53	13·66	15·79	1·82	"
96130	"	"	Garnet	29·42	9·51	13·13	15·13	1·71	After sweet clover.
96131	"	"	Reward	36·10	9·76	15·12	17·49	1·86	After corn.
96132	J. W. Wasnif	Melrose	Marquis	39·18	9·46	11·58	13·39	2·08	

TABLE 19.—MARQUIS, GARNET AND REWARD WHEATS GROWN AT POINTS IN MANITOBA, SASKATCHEWAN AND ALBERTA—CROP OF 1928—*Concluded*

Lab'y No.	Name of grower	Locality	Variety	Weight of 1,000 kernels	Moisture content	Protein		Ash on water-free basis	Remarks
						On 13·5% moisture basis	On water-free basis		
				gms.	p.c.	p.c.	p.c.	p.c.	
	Manitoba—Conc.								
96133	J. B. Mitchell	E. Selkirk	Garnet	29·97	10·14	11·47	13·26	1·76	On summer-fallow.
96134	J. R. Oastler	"	Reward	31·14	8·67	10·53	12·17	1·93	After breaking.
96135	W. Broadbent	Treherne	Marquis	30·88	9·34	10·30	11·91	2·13	From S. F. wheat second year.
96136	"	"	Garnet	28·79	9·25	10·74	12·41	1·50	Sheaf feed.
96137	"	"	Reward	33·24	10·17	12·03	13·92	1·65	On summer-fallow.
96138	J. Barker	Katrine	Marquis	28·62	9·59	11·78	13·40	1·46	"
96139	"	"	Garnet	27·77	10·19	11·94	13·80	1·49	"
96140	"	"	Reward	29·11	10·17	12·66	14·63	1·50	"
	Saskatchewan								
96141	P. Luck	Baring	Marquis	34·52	10·24	12·98	15·01	1·68	On summer-fallow.
96142	"	"	Garnet	29·76	9·82	11·19	12·93	1·66	After breaking.
96143	"	"	Reward	33·88	9·97	14·17	16·38	1·66	"
96144	F. W. Henry	Mayfield	Marquis	32·24	9·94	12·41	14·35	1·65	
96145	"	"	Garnet	27·59	9·83	12·17	14·07	1·51	
96146	"	"	Reward	35·37	9·63	14·54	16·81	1·68	
96147	G. Lincoln	Wawota	Marquis	30·65	10·42	11·48	13·26	1·77	On summer-fallow.
96148	"	"	Garnet	28·16	9·81	12·24	14·16	1·69	"
96149	"	"	Reward	34·27	10·07	14·62	16·90	1·69	"
96150	J. D. MacFarlane	Carlea	Marquis	33·97	10·12	9·60	11·10	1·77	After oats.
96151	"	"	Garnet	32·39	10·21	11·34	13·11	1·60	
96152	"	"	Reward	34·42	10·28	12·99	15·02	1·76	After breaking.
96153	F. Distel	Marysburg	Marquis	29·47	9·88	11·50	13·29	1·92	After oats.
96154	"	"	Garnet	30·56	10·48	12·25	14·16	1·62	On summer-fallow.
96155	"	"	Reward	34·94	10·42	12·22	14·16	1·92	"
96156	K. D. Kirklam	Saltcoats	Marquis	31·00	9·61	10·50	12·14	1·75	
96157	"	"	Garnet	29·01	10·93	11·14	12·87	1·55	After garnet.
96158	"	"	Reward	34·37	10·77	15·25	17·63	1·52	On summer-fallow.
96159	George Avery	Kelso	Marquis	32·58	9·75	13·83	15·99	1·66	"
96160	"	"	Garnet	26·65	11·58	12·17	14·07	1·26	After corn.
96161	"	"	Reward	32·31	10·36	13·13	15·18	1·67	"
96162	H. Mitchell	Birch Hills	Marquis	34·56	10·81	12·59	14·54	1·53	On summer-fallow.
96163	"	"	Garnet	26·01	9·37	11·00	12·72	1·76	After breaking.
96164	"	"	Reward	34·60	10·53	15·16	17·53	1·58	On summer-fallow.
96165	W. Eunis	Tisdale	Marquis	33·36	9·90	11·00	12·72	2·03	After breaking.
96166	J. B. Eunis	"	Garnet	30·74	9·83	10·32	11·93	1·82	New breaking.
96167	"	"	Reward	33·21	10·56	10·54	12·19	1·97	"
96168	J. B. Layson	Corinne	Marquis	29·74	10·30	13·45	15·55	1·86	No crop.
96169	"	"	Garnet	29·45	10·54	11·01	12·73	1·62	After Marquis.
96170	"	"	Reward	33·96	9·90	16·86	19·49	2·00	No. crop
96171	G. Patrick	Esterhazy	Marquis	29·54	8·75	11·23	12·98	1·83	"
96172	"	"	Garnet	27·46	10·95	11·81	13·66	1·51	On summer-fallow.
96173	"	"	Reward	32·68	10·24	11·85	13·71	1·84	After Marquis.
96174	J. M. Thornton	Maidstone	Marquis	33·69	10·15	12·38	14·32	1·37	After breaking.

96175	S. H. Powlin	"	Garnet	24·58	10·63	11·08	12·80	1·64	After 1st crop breaking.
96176	"	"	Reward	30·87	10·38	12·60	14·56	1·75	"
96177	N. Grist	Watrous	Marquis	33·18	10·41	12·42	14·35	1·52	After breaking.
96178	"	"	Garnet	29·42	10·87	11·62	12·85	1·63	After Garnet.
96179	"	"	Reward	32·37	10·82	13·87	16·03	1·72	After breaking.
96180	A. W. Patterson	Wolseley	Marquis	31·60	10·40	12·11	14·00	1·85	On summer-fallow.
96181	"	"	Garnet	28·07	10·03	12·75	14·73	1·56	"
96182	"	"	Reward	34·40	9·98	15·07	17·42	1·87	"
96183	J. D. Boyes	Kelvington	Marquis	34·96	10·03	10·72	13·90	1·63	After breaking.
96184	"	"	Garnet	31·18	11·16	12·22	14·13	1·54	On summer-fallow.
96185	"	"	Reward	33·06	10·89	13·12	15·17	1·78	After breaking.
96799	Geo. Caulfield	Wild Rose	Marquis	37·99	11·02	13·86	16·02	1·42	
96800	"	"	Garnet	36·09	11·13	11·16	12·90	1·72	
	Alberta								
96186	J. B. Laplace	Wembley	Marquis	32·76	10·94	12·30	14·22	1·67	On summer-fallow.
96187	"	"	Garnet	32·54	10·65	8·61	9·95	1·78	After Garnet.
96188	"	"	Reward	41·51	10·29	16·51	19·09	1·90	After potatoes.
96189	P. Rock	Moirin	Marquis	33·18	10·27	14·02	16·21	1·84	On summer-fallow.
96190	"	"	Garnet	24·65	10·12	11·30	13·06	1·72	On stubble, low land cut green.
96191	"	"	Reward	32·87	11·10	16·12	18·63	1·82	On summer-fallow.
96192	M. J. Cochlin	Wembley	Marquis	30·22	11·03	11·53	13·34	1·66	
96193	"	"	Garnet	30·12	10·74	10·82	12·52	1·70	
96194	"	"	Reward	33·08	10·32	12·18	14·08	1·89	
96195	R. H. Hancox	Rochfort Bridge	Marquis	36·12	10·59	9·34	10·80	1·92	On summer-fallow.
96196	"	"	Garnet	30·03	10·65	10·42	12·04	1·86	After breaking scrub land.
96197	"	"	Reward	33·63	10·49	12·21	14·11	1·94	" "
96198	A. Laing	Harcourt	Marquis	33·43	10·43	9·86	11·40	1·74	
96199	Geo. Grimmett	"	Garnet	29·02	11·79	11·38	13·15	1·78	
69200	"	"	Reward	31·79	10·16	11·99	13·87	1·91	
96201	Grimm	Spirit River	Marquis	32·00	10·38	12·31	14·24	1·69	
96202	"	"	Garnet	27·73	10·37	11·50	13·30	1·61	
96203	F. C. Keith	"	Reward	28·69	9·88	15·66	18·11	1·42	
96204	"	"	Marquis	27·40	9·96	14·50	16·76	1·49	
96205	"	"	Garnet	31·02	10·45	13·79	15·95	1·39	
96206	A. McGill	Grande Prairie	Reward	33·60	9·62	12·93	14·95	1·65	
96207	"	"	Marquis	33·46	10·55	12·62	14·59	1·55	
96208	"	"	Garnet	28·49	9·55	11·40	13·11	1·64	
96209	"	"	Reward	29·91	10·73	10·84	12·53	1·64	
96210	"	"	Marquis	34·96	10·71	13·50	15·61	1·67	
96211	J. C. Featherstonhaugh	Ft. Saskatchewan	Garnet	33·48	10·48	11·82	13·67	1·70	On summer-fallow.
96212	"	"	Reward	33·05	10·16	12·57	14·53	1·54	"
96213	"	"	Marquis	32·12	9·57	15·71	18·17	1·64	"
96214	J. MacLaren	Sedgwick	Garnet	29·19	9·45	13·01	15·04	1·88	"
96215	A. Moir	"	Reward	30·25	10·96	13·35	15·43	1·24	"
96216	"	"	Marquis	33·22	10·17	15·95	18·44	1·66	"
96217	G. F. Spence	Athabaska	Garnet	34·32	10·79	9·15	10·58	2·02	"
96218	"	"	Reward	31·20	10·17	8·51	9·84	1·80	After potatoes.
96219	"	"	Marquis	34·73	10·10	10·76	12·45	1·91	On summer-fallow.
96220	Jazzard Bros	Buffalo Lake	Garnet	33·78	10·66	12·76	14·76	1·70	
96221	"	"	Reward	33·99	10·88	12·14	14·03	1·47	
96222	"	"	Marquis	35·86	10·83	15·68	18·13	1·70	
96801	Nels Linden	Wetaskiwin	Garnet	35·31	9·56	12·00	13·88	1·68	On summer-fallow.
96802	"	"	Reward	31·71	10·03	12·23	14·14	1·55	"

From the data of table 19 maxima, minima and averages of the protein content have been calculated for the three varieties as grown in the three provinces. These are presented in table 20?

TABLE 20.—MARQUIS, GARNET AND REWARD WHEAT GROWN AT POINTS IN MANITOBA, SASKATCHEWAN AND ALBERTA. PROTEIN DATA (WATER-FREE BASIS)—CROP 1928

Variety	Man., Sask., Alta. 41 groups of three			Manitoba 15 groups of three			Saskatchewan 15 groups of three			Alberta 11 groups of three		
	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Marquis	17·82	10·58	13·94	17·82	11·74	14·26	15·99	11·10	13·83	16·21	10·58	13·63
Garnet	15·43	9·84	13·12	15·18	10·43	13·08	14·73	11·93	13·39	15·43	9·84	12·79
Reward	19·49	12·19	15·95	18·05	13·29	15·66	19·49	12·19	15·88	19·09	12·45	16·43

Th averages for Marquis are fairly close, but there is a slight trend towards a lowering of the protein content from the East to the West across the prairies. In this respect these results agree fairly well with those from Experimental Farms and Stations for the same year (1928) presented in table No. 18.

The differences between the averages for Garnet are not large, but the average for Saskatchewan is highest, Manitoba next and Alberta last.

The protein average for Reward is highest in Alberta and lowest in Manitoba but the difference between these averages is less than 1 per cent.

Comparing the three varieties, Reward ranks highest in each province, Marquis second and Garnet third. These results are in complete accord with those of the crops of 1927 and 1928 from Experimental Farms and Stations.

The average protein content of the three varieties, as grown at the several points in the three provinces, are as follows:—

	p.c.
Manitoba	14·33
Saskatchewan	14·37
Alberta	14·28

It is interesting to note that the average protein content of these three varieties, as grown on the Experimental Farms and Stations in the same season is much higher—over 2 per cent (see page 24). It is also worthy of note that as in the case of the Experimental Farms and Stations the average protein content of this series for each of the three provinces shows but slight differences.

In the following table (No. 21) a summary of the data for the three series of Marquis, Garnet and Reward wheats, under consideration in this chapter, are presented. This tabulated statement emphasizes the comparative protein content of these three varieties and it is significant that in all the series these wheats fall into the same order; Reward with the highest average protein content, Marquis second and Garnet third.

TABLE 21.—MARQUIS, GARNET AND REWARD WHEATS, MANITOBA, SASKATCHEWAN AND ALBERTA. AVERAGE PROTEIN CONTENT (WATER-FREE BASIS)—1927 AND 1928

Variety	Crop 1927	Crop 1928	
	Grown on Experimental Farms and Stations	Grown on Experimental Farms and Stations	Grown at various points in the provinces
	10 groups (30 samples)	9 groups (27 samples)	41 groups (123 samples)
	p.c.	p.c.	p.c.
Marquis	15·40	16·93	13·94
Garnet	14·49	14·90	13·12
Reward	17·80	18·70	15·95

TABLE 22—FLOURS FROM MARQUIS AND GARNET WHEATS GROWN AT POINTS IN MANITOBA, SASKATCHEWAN AND ALBERTA—CROP OF 1928

Lab'y. No.	Milling No.	Locality	Variety	Moisture	Protein (N.x5·7)		Ash on water-free basis	Diastatic value	Gluten		Ratio moist gluten to dry gluten	Physical characteristics of gluten
					On 13·5% moisture	On water-free basis			Moist	Dry		
				p.c.	p.c.	p.c.	p.c.		p.c.	p.c.		
						Manitoba						
96954	322	MacDonald	Marquis	12·59	11·94	13·80	0·58	98	40·75	15·47	2·63	Elastic, fairly firm, good quality.
96955	323	"	Garnet	12·41	9·84	11·39	0·72	162	29·10	11·61	2·50	Fairly elastic, firm, fair quality.
96956	346	Katrine	Marquis	12·17	11·31	13·07	0·53	133	39·49	14·35	2·75	Elastic, fairly firm, good quality.
96957	347	"	Garnet	12·10	11·40	13·17	0·72	174	39·24	14·46	2·71	Fairly elastic, firm, fair quality.
						Saskatchewan						
96958	364	Saltcoats	Marquis	13·31	10·01	11·57	0·70	116	34·69	12·65	2·74	Fairly elastic, firm, fair quality.
96959	365	"	Garnet	12·17	10·22	11·80	0·73	161	36·83	12·70	2·90	Fairly elastic, firm, fair quality.
96960	385	Watrous	Reward	13·29	12·03	13·91	0·66	119	47·30	17·56	2·69	Elastic, fairly firm, good quality.
96961	386	"	Marquis	13·04	11·20	12·95	0·57	149	35·99	13·98	2·57	Fairly elastic, firm, fair quality.
96962	391	Kelvington	Garnet	12·00	10·40	12·03	0·58	121	37·61	13·09	2·87	Elastic, fairly firm, good quality.
96963	392	"	Reward	12·05	11·77	13·60	0·64	106	40·96	15·77	2·59	Fairly elastic, firm, fair quality.
96970	474	Wild Rose	Marquis	12·10	12·72	14·72	0·64	152	51·05	17·75	2·87	Quite elastic, very good quality.
96971	475	"	Garnet	12·57	10·07	11·64	0·63	180	36·38	14·11	2·57	Fairly elastic, fair quality.
						Alberta						
96964	403	Rockfort Bridge	Marquis	11·41	9·08	10·49	0·77	183	30·65	11·40	2·69	Elastic, fairly firm, good quality.
96965	404	" "	Garnet	11·81	9·66	11·17	0·59	203	33·09	12·43	2·66	Fairly elastic, fairly firm, fair quality.
96966	418	Ft. Saskatchewan	Marquis	11·90	11·77	13·60	0·68	150	47·46	17·00	2·79	Fairly elastic, fairly firm, fair quality.
96967	419	"	Garnet	12·01	11·92	13·77	0·65	163	45·48	16·75	2·71	Fairly elastic, good quality.
96968	420	Sedgwick	Marquis	12·21	12·75	14·73	0·60	116	48·80	16·71	2·92	Elastic, good quality.
96969	421	"	Garnet	12·59	12·79	14·79	0·56	192	44·84	16·97	2·64	Elastic, good quality.

Flours

This series of eighteen samples, in groups of two, consists of nine flours of Marquis and nine of Garnet, the wheats from which they were milled having been grown at points in Manitoba, Saskatchewan and Alberta. The data of these wheats appear in table 19. Two groups were from Manitoba, four from Saskatchewan and three from Alberta.

The data are presented in table 22. In addition to moisture protein and ash, results for diastatic value, gluten (moist and dry), and remarks on physical characteristics of the gluten, are given.

From the foregoing, a closer comparison of the two flours may be made by averaging their protein content (water-free basis) and gluten—moist and dry.

—	Protein (average)	Gluten (average)	
		Moist	Dry
	p.c.	p.c.	p.c.
Marquis	13·10	41·98	15·11
Garnet	12·70	37·99	14·30

Although the series contains two groups in which Garnet has the higher protein, these average results would indicate Marquis to be somewhat the superior flour in respect to "strength" and "absorptive capacity" and this deduction is supported by the physical characteristics of the gluten. The diastatic value of the Garnet flour is higher throughout the series, which possibly would be favourable to a larger loaf volume.

Although the milling process and results, using an experimental flour mill, are not strictly comparable to those of the larger commercial mills, it is of interest to compare the average protein data of the wheats in this series with those of the corresponding flours.

—	Marquis (average)	Garnet (average)
	p.c.	p.c.
Wheat	13·74	13·38
Flour	13·10	12·70

From the milling as carried out by the Cereal Division, it would appear that, considering these two varieties, there is a fairly uniform difference in protein content, namely, an average of between 0·6 and 0·7 per cent, the flour, almost invariably, having the lower percentage.

FLOURS BLENDED FROM MARQUIS AND GARNET WHEATS—CROP OF 1928

This series was prepared by the Cereal Division with the object of determining the relative baking or bread-making qualities of flours blended from Marquis and Garnet wheats. The several proportions of these flours are given in the following table (No. 23), together with data of moisture, protein and ash.

TABLE 23.—FLOURS—BLENDED FROM MARQUIS AND GARNET WHEATS—CROP OF 1928

Lab'y No.	Series No.	Designation	Moisture content as received	Protein (N x 5·7)		Ash on water-free basis
				On 13·5% moisture basis	On water-free basis	
			p.c.	p.c.	p.c.	p.c.
99066	I A	Marquis—Indian Head	13·55	12·70	14·68	0·61
67	"	Garnet—Wheat Pool	13·49	11·53	13·32	0·50
68	"	Marquis 75%, Garnet 25%	14·13	12·29	14·22	0·48
69	"	Marquis 50%, Garnet 50%	12·83	12·15	14·06	0·53
70	"	Marquis 25%, Garnet 75%	13·27	12·12	14·01	0·52
99071	II A	Marquis—Indian Head	13·05	12·90	14·91	0·66
72	"	Garnet—Wheat Pool	13·10	11·52	13·31	0·67
73	"	Marquis, 75%, Garnet 25%	12·44	12·42	14·35	0·57
74	"	Marquis 50%, Garnet 50%	12·56	12·13	14·03	0·51
75	"	Marquis 25%, Garnet 75%	12·32	11·96	13·82	0·51
99076	I B	Marquis—Indian Head	12·77	12·84	14·85	0·62
77	"	Garner—Wheat Pool	12·43	11·57	13·38	0·53
78	"	Marquis 75%, Garnet 25%	13·26	12·43	14·39	0·58
79	"	Marquis 50%, Garnet 50%	12·85	12·12	14·01	0·55
80	"	Marquis 25%, Garnet 75%	13·58	11·79	13·62	0·61
99081	II B	Marquis—Indian Head	13·32	12·69	14·65	0·63
82	"	Garnet—Wheat Pool	12·33	11·75	13·58	0·62
83	"	Marquis 75%, Garnet 25%	13·17	12·58	14·54	0·59
84	"	Marquis 50%, Garnet 50%	13·01	12·47	14·42	0·60
85	"	Marquis 25%, Garnet 75%	13·22	12·27	14·19	0·62
99086	.....	"Weak Flour"—used in blending experiment with flours in Series I and Series II..... Commercially milled: purchased June 1929.	11·46	10·28	11·88	0·55

Series 1A and 1B (duplicates) differ from series 2A and 2B (duplicates) in method of conditioning only: the wheats of 1A and 1B were conditioned for 20 hours before milling with two thirds of the water required for a 15 per cent moisture content; one hour before milling the remaining third was added. In the case of 2A and 2B the wheats were conditioned for seven days with sufficient water to give a moisture content of 13 per cent; one hour before milling the moisture content was raised to 15 per cent.

The baking results from this series are reported by the Cereal Division.

The protein content of the Marquis flour in all four groups is higher than that of the Garnet—varying between 1·0 and 1·5 per cent—and this difference is reflected in the several blends, the larger the proportion of Marquis the higher the percentage of protein.

The method of conditioning apparently did not materially affect the chemical data for protein.

HYBRID WHEATS FROM RUST-RESISTANT STRAINS

This series, submitted by the Cereal Division, consists of hybrid wheats from rust-resistant strains, produced by the Dominion Rust Research Laboratory, Winnipeg, Manitoba, in 1928. It includes grains of R2. Marquis and of R11, H-44-24, parents, and eight samples of hybrids from these wheats.

TABLE 24.—HYBRID WHEATS, RUST-RESISTANT STRAINS, 1928

Lab'y No.	Designation	Weight of 1,000 kernels	Moisture	Protein (N x 5·7)		Ash on water-free basis
				On 13·5% moisture basis	On water-free basis	
		gms.	p.c.	p.c.	p.c.	p.c.
97329	R. 2 Marquis	29·76	11·06	14·03	16·21	2·31
97331	R. 11 (H. 44·24)	30·64	11·32	14·99	17·34	2·41
97330	R. 49	30·46	11·30	14·51	16·90	2·30
97332	R. 63	31·11	11·32	14·40	16·64	2·37
97333	R. 79	31·14	10·70	14·62	16·90	2·52
97334	R. 56	30·77	11·26	14·80	17·12	2·51
97335	R. 105	30·53	10·74	13·09	15·13	2·34
97336	R. 99	31·96	10·98	15·52	17·95	2·52
97337	R. 93	29·13	11·54	15·50	17·92	2·62
97338	R. 117	30·08	11·01	14·46	16·73	2·46

The data for the parent wheats show that R11, H-44-24 is approximately 1·0 per cent higher in protein and slightly heavier in weight of kernel than R.2 Marquis. Both are high protein wheats. The range in protein of the hybrids is from 17·95 to 15·13 per cent with an average of 16·88 per cent. The mean of the parents is 16·78 per cent. With the exception of R.105 (15·13 per cent) all the wheats in this series are markedly rich in protein.

INFLUENCE OF LIGHT AND COD-LIVER OIL ON THE DEVELOPMENT OF BONES IN CHICKS

The therapeutic action of light from various sources has been studied by numerous investigators and it has been found not only effective in promoting normal calcification of bone but also in maintaining the normal calcium and phosphorus content of the blood. In as much as the addition to the ration of cod-liver oil—rich in fat—soluble vitamines—appears to assist in bone formation it has seemed desirable to compare bone development as influenced by light from various sources and by the addition to the meal ration of cod-liver oil.

In order to secure Canadian data on this question, the Poultry Division planned and carried out the following experiment in July 1928.

Eight pens of twenty-five Plymouth Rock chicks 36 to 48 hours old and the same number of pens of Leghorn chicks were placed under following conditions:—

Pen 2.—Subjected to Ultra-violet light (Hanovia lamp) for 20 minutes daily, at a distance of 3 feet; for the remainder of the 24 hours the chicks were in diffused light (windows covered with brown paper).

Pen 3.—The window of this pen was glazed with Cel-o-glass.

Pen 4.—The chicks in this pen were in diffused light, *i.e.*, the window was darkened with brown paper, and fed a mash irradiated for 30 minutes with Ultra-violet rays from an Hanovia lamp.

Pen 5.—The window of this pen was glazed with Vita glass.

Pen 6.—As in pen 4 the window was darkened by brown paper and the chicks were in a dull, dim light.

Pen 7.—The window of this pen was glazed with ordinary glass.

Pen 8.—The window of this pen was darkened with brown paper, making the light dull and dim. The chicks received a mash containing 32 ounces of cod-liver oil per 100 pounds of mash.

Pen 9.—The window was unglazed, merely covered with netting to prevent the escape of the chicks.

The chicks were fed the following mash: " Equal parts of shorts, middlings, yellow corn meal and oat flour to which was added 2 per cent each of bone meal, fish meal, powdered milk, 6 per cent of meat meal and 0·5 per cent of salt". The chicks received fresh cut clover daily. After the first week they were also fed a commercial scratch grain mixture.

At the age of six weeks two chicks in each pen were killed and the femur and the tibia-fibula (fused bone) from both legs dissected out and freed as far as possible from muscle and fat tissue. These bones were immediately sent to the laboratories for analysis.

TABLE 25.—INFLUENCE OF SUNLIGHT, ULTRA-VIOLET RAYS, ETC. ON THE DEVELOPMENT OF BONES IN SIX WEEKS OLD CHICKS 1928

Plymouth Rocks

Lab'y No.	Pen No.	Treatment	Femur			Tibia-Fibula			Total	
			Weight of green bones	Water	Weight of dry bones	Weight of green bones	Water	Weight of dry bones	Weight of green bones	Weight of dry bones
			grms.	p.c.	grms.	grms.	p.c.	grms.	p.c.	grms.
94626	2	Ultra-violet rays and diffused light.	9·16	49·80	4·59	13·13	49·65	6·61	22·29	11·20
94627	3	Sunlight through cel-o-glass.....	7·01	50·27	3·49	10·57	47·58	5·56	19·58	9·05
94628	4	Mash radiated—diffused light.....	6·08	58·76	2·51	8·64	55·87	3·81	14·72	6·32
94629	5	Sunlight through vita glass.....	8·09	46·70	4·31	12·46	45·53	6·79	20·55	11·10
94630	6	Diffused light, i.e. dull, dim.....	6·04	64·24	2·16	8·52	63·33	3·13	14·56	5·29
94631	7	Sunlight through common glass.....	7·61	61·72	2·91	10·86	60·96	4·24	18·47	7·15
94632	8	Cod liver oil supplement—diffused light.....	8·66	32·65	4·10	11·82	51·31	5·75	20·48	9·85
94633	9	Direct sunlight through open window	7·28	46·69	3·88	11·07	45·21	6·07	18·35	9·95

TABLE 26.—INFLUENCE OF SUNLIGHT, ULTRA-VIOLET RAYS, ETC., ON THE DEVELOPMENT OF BONES IN SIX-WEEKS OLD CHICKS 1928

Leghorns

Lab'y No.	Pen No.	Treatment	Femur			Tibia-Fibula			Total	
			Weight of green bones	Water	Weight of dry bones	Weight of green bones	Water	Weight of dry bones	Weight of green bones	Weight of dry bones
			grms.	p.c.	grms.	grms.	p.c.	grms.	grms.	grms.
94634	2	Ultra-violet rays and diffused light.	6·66	43·80	3·74	9·51	44·71	5·26	16·17	9·00
94635	3	Sunlight through celo-glass.....	6·25	44·71	3·58	8·67	42·69	4·97	14·92	8·55
94636	4	Mash, radiated—diffused light.....	6·56	43·57	3·70	9·11	43·46	5·15	15·67	8·85
94637	5	Sunlight through vita-glass.....	6·70	45·06	3·68	9·36	44·75	5·17	16·06	8·85
94638	6	Diffused light, i.e., dull, dim.....	4·98	59·96	1·99	6·96	60·03	2·78	11·94	4·77
94639	7	Sunlight through common glass....	5·51	53·83	2·54	7·59	53·81	3·51	13·10	6·05
94640	8	Cod liver oil supplement—diffused light.....	6·72	52·48	3·19	8·71	50·97	4·27	15·43	7·46
94641	9	Direct sunlight through open window	6·20	43·32	3·47	9·68	44·96	5·32	15·88	8·78

The data obtained comprised weight of green bone, percentage of water, nitrogen, fat, lime (CaO), phosphoric acid (P_2O_5), magnesia (MgO) and iron (Fe_2O_3). The tables also present the following ratios and calculations: dry to green bone, phosphoric acid to lime, bone phosphate as calculated from the phosphoric acid content and the same from the lime content.

This work is of the nature of a preliminary investigation. Such conclusions as may be reached from a consideration of the results should therefore be regarded as more or less tentative in character; further and confirmatory data should be obtained before regarding the conclusions as final.

Tables 25 and 26 present the following data: Weight of green bone, percentage of water in the bone and weight of dry (water-free) bone, in the six weeks' old chicks from the pens of Plymouth Rock and Leghorns, respectively.

LIGHT CONDITIONS AS INFLUENCING WATER CONTENT AND WEIGHT OF BONE

Using " weight of dry bone " as a measure of bone development, the chicks fall into two classes, as follows:—

TABLE 27.—WEIGHT OF DRY BONE (FEMUR + TIBIA-FIBULA)

Pen	Plymouth Rocks	White Leghorns
	grams	grams
Class I—		
Ultra-violet rays	11·20	9·00
Direct sunlight, open window	9·95	8·78
Sunlight through Vita-glass	11·10	8·85
Sunlight through Cel-o-glass	9·05	8·55
Cod-liver oil	9·85	
Mash irradiated	.....	8·85
Class II—		
Diffused light	5·29	4·77
Sunlight through common glass	7·15	6·05
Cod-liver oil	.....	7·46
Mash irradiated	6·32	

The birds in the first class, it will be observed, have a decidedly heavier weight of bone than those of the second class. No attempt however has been made to rank the pens within the classes, since the differences here may be within the limits of experimental error or may be considered as due to development peculiar to the individual chick. There are however significant differences between the first and second classes. The averages for Class I are 10·23 (Plymouth Rocks) and 8·81 (White Leghorns), and for Class II 6·26 (Plymouth Rocks) and 6.09. (White Leghorns).

The ratio of dry to green bone is a measure of the percentage of water in the bone. These ratios for both breeds are as follows:—

TABLE 28.—RATIO OF DRY TO GREEN BONE

Pen No.	Treatment	Plymouth Rocks	White Leghorns
2	Ultra-violet rays	1 : 1·99	1 : 1·79
3	Sunlight through Cel-o-glass	1 : 2·16	1 : 1·74
4	Mash irradiated	1 : 2·33	1 : 1·77
5	Sunlight through Vita-glass	1 : 1·85	1 : 1·93
6	Diffused light (dull, dim light)	1 : 2·75	1 : 2·50
7	Sunlight through common glass	1 : 2·58	1 : 2·16
8	Cod-liver oil	1 : 2·08	1 : 2·07
9	Direct sunlight through open window	1 : 1·84	1 : 1·81

TABLE 29.—INFLUENCE OF SUNLIGHT, ULTRA-VIOLET RAYS, ETC., ON THE DEVELOPMENT OF BONES IN SIX-WEEKS-OLD CHICKS

Plymouth Rocks, 1928

(Results calculated on Green Bone)

Lab'y No.	Pen No.	Treatment	Femur										Tibia-Fibula									
			Moisture	Fat	Nitrogen	CaO	P_2O_5	Ratio $\frac{P_2O_5}{CaO}$	$Ca_3(PO_4)_2$ Calculated from P_2O_5	$Ca_3(PO_4)_2$ Calculated from CaO	MgO	Fe_2O_3	Moisture	Fat	Nitrogen	CaO	P_2O_5	Ratio $\frac{P_2O_5}{CaO}$	$Ca_3(PO_4)_2$ Calculated from P_2O_5	$Ca_3(PO_4)_2$ Calculated from CaO	MgO	Fe_2O_3
			p.c.	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	pc	p.c.	p.c
					Theoretical			0·845														
94626	2	Ultra-violet rays and diffused light	49·89	11·53	3·53	8·15	6·48	0·795	14·13	15·04	0·50	0·92	49·65	12·79	2·89	8·07	6·62	0·822	14·45	14·89	0·36	0·29
94627	3	Sunlight through Cel-o-glass	50·27	10·41	3·47	8·58	6·70	0·781	14·64	15·83	0·38	1·00	47·58	13·66	3·40	6·67	5·53	0·829	12·05	12·30	0·27	0·11
94628	4	Mash radiated—diffused light	58·76	4·52	3·12	10·81	4·25	0·389	9·27	19·94	0·27	1·13	55·87	6·34	3·13	7·84	6·08	0·776	13·28	14·47	0·38	0·33
94629	5	Sunlight through Vita glass	46·70	12·59	3·03	9·07	7·15	0·788	15·62	16·73	0·48	1·07	45·53	13·39	2·74	8·26	6·69	0·810	14·60	15·23	0·30	0·27
94630	6	Diffused light i.e. dull, dim.	64·24	3·39	3·95	8·23	3·93	0·477	8·57	13·19	0·36	1·21	63·33	4·37	3·00	5·46	4·25	0·778	9·28	10·08	0·30	0·20
94631	7	Sunlight through common glass	61·72	3·31	3·70	6·01	4·65	0·774	10·16	11·08	0·50	1·14	60·96	4·98	3·41	5·52	4·78	0·865	10·43	10·19	0·33	0·16
94632	8	Cod liver oil supplement—diffused light	52·65	10·46	2·99	7·35	5·78	0·787	12·63	13·55	0·49	0·30	51·31	11·02	3·13	7·42	5·96	0·804	13·02	13·68	0·30	0·18
94633	9	Sunlight through open window	46·69	13·62	2·77	9·13	7·25	0·794	15·82	16·84	0·63	0·31	45·21	13·95	3·01	9·53	7·30	0·767	15·95	17·59	0·33	0·26

TABLE 30.—INFLUENCE OF SUNLIGHT, ULTRA-VIOLET RAYS, ETC., ON THE DEVELOPMENT OF BONES IN SIX-WEEKS-OLD CHICKS

Leghorns 1928

(Results calculated on Green Bone)

Lab'y No.	Pen No.	Treatment	Femur										Tibia-Fibula									
			Moisture	Fat	Nitrogen	CaO	P_2O_5	Ratio $\frac{P_2O_5}{CaO}$	$Ca_3(PO_4)_2$ Calculated from P_2O_5	$Ca_3(PO_4)_2$ Calculated from CaO	MgO	Fe_2O_3	Moisture	Fat	Nitrogen	CaO	P_2O_5	Ratio $\frac{P_2O_5}{CaO}$	$CaO(PO_4)_2$ Calculated from P_2O_5	$CaO(PO_4)_2$ Calculated from CaO	MgO	Fe_2O_3
			p.c.	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c	p.c.	pc.	p.c.	p.c.
94634	2	Ultra-violet rays and diffused light	43·80	13·91	3·72	9·67	7·41	0·767	16·95	17·84	0·60	0·48	44·71	15·16	3·21	8·29	6·59	0·795	14·39	15·30	0·32	0·47
94635	3	Sunlight through Cel-o-glass	44·71	15·13	3·57	9·75	7·85	0·805	17·14	17·99	0·48	0·73	42·69	17·30	3·02	9·02	7·16	0·794	15·64	16·63	0·43	0·31
94636	4	Mash radiated—diffused light	43·57	11·53	4·01	10·97	8·64	0·787	18·87	20·27	1·00	1·50	43·46	11·81	3·39	8·22	7·41	0·804	16·18	17·00	0·41	0·27
94637	5	Sunlight through Vita glass	45·06	13·02	3·69	10·01	7·94	0·790	17·34	18·55	0·79	0·33	44·75	14·32	3·28	8·35	6·85	0·820	14·95	15·40	0·25	0·28
94638	6	Diffused light, i.e., dull, dim	59·96	4·36	2·97	7·04	5·64	0·802	12·32	12·98	0·24	0·83	60·03	4·51	3·61	6·60	5·39	0·817	11·78	12·17	0·12	0·74
94639	7	Sunlight through common glass	53·83	5·57	3·13	8·80	7·32	0·831	15·98	16·23	0·58	0·95	53·81	6·61	3·22	8·17	6·52	0·799	14·24	15·07	0·09	0·44
94640	8	Cod liver oil supplement—diffused light	52·48	8·17	3·00	8·05	6·46	0·803	14·12	14·85	0·38	0·57	50·97	10·18	3·31	7·64	6·41	0·839	13·99	14·09	0·44	0·19
94641	9	Sunlight through open window	43·32	15·88	3·03	9·79	7·82	0·798	17·06	18·07	0·41	0·49	44·96	15·65	3·19	8·92	7·27	0·815	15·88	16·45	0·30	0·27

The wider the ratio the higher the water content of the bone and vice versa, the closer the ratio the lower the percentage of water. For example, in Pen No. 6 (Diffused light) the ratios are 1: 2·75 and 1: 2·50 with water content ranging between 60 and 64 per cent, whereas in Pen No. 2 (Ultra-violet ray) with ratios 1: 1·99 and 1: 1·79 the water content ranges from 44 to 50 per cent.

A further relationship is to be noted: the wider the ratio the lower the weight of bone. Thus Pen No. 6 (Diffused light) with its widest ratio has the lowest weight of bone, and Pen No. 2 (Ultra-violet ray) with its narrow ratio has the highest weight of bone.

From these findings it is clear that light or poor development is associated with a higher water content and a lower percentage of organic and mineral matter than bone which is developing normally.

LIGHT CONDITIONS AS INFLUENCING THE ORGANIC AND MINERAL CONTENT OF BONE

Detailed analytical data of the bones of the two breeds of chicks—Plymouth Rocks and Leghorns—are presented in tables 29 and 30. These comprise for femur and tibia-fibula respectively, water, fat, nitrogen, lime, magnesia, iron and phosphoric acid. The ratio, phosphoric acid (P_2O_5) to lime (CaO) is also given and the phosphate of lime is presented as calculated first from the phosphoric acid and second from the lime.

Attention may be directed to one or two of the more noteworthy inferences to be drawn from a general survey of these results.

Considering the composition of the leg bones, both femur and tibia-fibula, it is evident in both Plymouth Rocks and Leghorns that high water content (poor bone development) is associated with low fat and low phosphate of lime. Contrariwise, good bone development is associated with high percentage of fat and phosphate of lime but here again there can be no ranking of the pens within the class.

It is evident from a study of the data of this experiment that there is not sufficient justification to rank the several "light conditions" in an exact or regular order of merit, but the results would apparently permit the following grouping of pens—group I giving the best bone development and group III the poorest:—

Group I.—Direct sunlight through open window.

Group II.—Ultra-violet ray treatment.
Sunlight through Vita-glass.
Sunlight through Cel-o-glass.
Irradiated mash (Leghorns).
Cod-liver oil supplement (Plymouth Rocks).

Group III.—Sunlight through common glass.
Diffused sunlight (dull, dim light).
Irradiated mash (Plymouth Rocks).
Cod-liver oil supplement (Leghorns).

IODINE IN "IODIZED" SALT, FISH MEAL AND SEA WEED

The iodine content of the daily ration of live stock has been, of late, receiving more and more attention not only by agricultural investigators but also by the stock feeders themselves. The practical importance of iodine is, of course, in the prevention of goitre—a malady which has been reported as occurring in many parts of Canada. With the exception of a few localities, however, this occurrence has not assumed very serious proportions.

Iodized Salt.—Since the normal, daily ration contains, generally, very little iodine, it has been recommended that small amounts of this element should be supplied in the form of an iodide. This may be easily accomplished by the use of "iodized" salt, that is, salt to which potassium iodide has been added by the manufacturer. The following table presents some determinations made by the Division of Chemistry of the iodine content of various salts.

TABLE 31—IODINE CONTENT OF "IODIZED" SALT

Lab. No.	Source	Description	Iodine per cent
80508	Canadian Salt Co., Windsor, Ont.	Pressed Block	0·0003
80509	Canadian Salt Co., Windsor, Ont.	Granular	0·0003
91426	Century Salt		0·0074
91427	Century Salt		0·0034
91428	Dominion Salt Co., Sarnia		0·0120
91429			0·0038
91661	Canadian Salt Co., Windsor, Ont.		0·0007
93070	Windsor Salt Co.	Crescent Brand	0·0001 (approximately)

In the manufacture of "iodized salt" for live stock, sufficient iodide is added to give, theoretically, 0·02 per cent of potassium iodide (0·0152 per cent of iodine) in the finished product. The figures of the above table show that there is considerable variation in this percentage. This may be due in part to loss of iodine from the "iodized" salt during storage and in part to the difficulty in the process of manufacture of obtaining a uniform percentage of iodine throughout the whole product. A sample from one part of a shipment may contain only traces while that from another part may contain a fairly high percentage of this element. In the above table, for instance, the samples reported under lab. Nos. 91426 and 91428 contain amounts which approach the order of the theoretical. On the other hand, the iodine content of the samples reported under lab. Nos. 80508, 80509, 91661 and 93070 is extremely low.

Fish Meal.—Besides "iodized" salt, fish meal may, also, be used to supply iodine to the daily ration. This concentrate is produced in considerable quantity on the Atlantic and Pacific coasts from fish and fish wastes. The whole fresh fish and fish wastes are subjected to a process of reduction by steam cooking, the larger proportion of the oil is skimmed off and the residue is dried and ground. Among the fish used are mackerel, pilchard, cod and dog fish. Some attempt has been made, also, to utilize the salmon and salmon wastes from the canning industry in British Columbia.

In a bulletin of the Division of Chemistry (*), a number of chemical analyses of fish meals are reported; the following table presents the determinations of iodine in certain of these fish meals.

*Meat and Bone By-Products. Bulletin No. 49—New Series.

TABLE 32—IODINE CONTENT OF FISH MEALS

Lab. No.	Source	Description	Iodine in parts per hundred thousand
67443	Todd's Cannery, Esquimalt, B.C.		0·07
80594	W. R. Beatty & Co., Vancouver, B.C.	Hiuskookum meal	0·37
80595	Marine Products, Prince Rupert, B.C.	Salmon meal	0·15
95396	National Fish Co., Halifax, N.S.	Fish meal	0·90
95397	City Renderer's, Montreal	Fish meal	0·84
98272	Magdalen Islands	Cod's head and bones	1·22
98273	" "	Mackerel meal	0·56
98408	" "	Seal meat and bones	0·04
98409	" "	Seal meat	0·03
101215	City Renderer's, Montreal	Fish meal	1·30

These figures show that there is a distinct variation in the iodine content of different fish meals depending upon the nature of the materials used and, probably, upon the process of manufacture. The samples reported under laboratory Nos. 80595, 95396, 95397, 98272, 98273 and 101215 contain sufficient iodine to make them comparable to "iodized" salt as a source of iodine for live stock. For example, one pound of the fish meal reported under laboratory No. 95396 would furnish the same quantity of iodine as one-tenth of a pound of an "iodized" salt containing 0·009 per cent of iodine. One pound of fish meal and one-tenth of a pound of salt are approximately the quantities which would be fed in the ration per animal per day. The one sample listed under laboratory No. 67443 is low in iodine and must be considered as an exception, rather than the general rule. The samples reported under laboratory Nos. 98408-9 are produced from seal meat and must not, therefore, be classified as fish meals proper.

Fish meal is a valuable concentrate not only on account of its high protein content but also because of its calcium and phosphorus content. It may possess an additional value as a source of iodine. In co-operation with the Division of Animal Husbandry some experimental work preliminary to a more complete investigation of the subject has been conducted wherein fish meal was fed to milch cows in the concentrate ration at the rate of one pound per animal per day. During the period in which the fish meal was fed, the "iodized" salt generally furnished to the cattle was replaced by ordinary stock salt containing no iodine. The Division of Chemistry took the opportunity of determining the iodine content of the milk after the feeding of "iodized" salt and after the feeding of fish meal. The results are summarized in the following table.

TABLE 33—IODINE CONTENT OF MILK AFTER FEEDING "IODIZED" SALT AND AFTER FEEDING FISH MEAL

Source of Iodine	Per cent iodine	Pounds fed per animal per day	Grams iodine furnished	Iodine in milk, parts per billion (10^9)
Iodized Salt	0·009	0·1	0·0041	40
Fish Meal	0·0009	1·0	0·0041	55

The apparent difference in the iodine content of the two milks is not significant since the amounts are extremely small. Milk from herds not receiving any additional iodine in the ration has been reported as containing iodine to the

order of ten parts per billion. The feeding of " iodized " salt tends to raise the level of the iodine content of the milk. The feeding of fish meal will maintain the iodine content at approximately the same level as the feeding of " iodized " salt.

The results of this preliminary experiment, together with the analyses reported of fish meals, suggest that fish meal, already recognized as a valuable protein concentrate, may occupy a place of still greater importance in the daily ration.

Sea Weed.—The suggestion has been advanced that sea weed might be added to or incorporated in the concentrate ration to furnish iodine. Certainly sea weeds are very high, comparatively speaking, in iodine as the table below will reveal.

TABLE 34—IODINE CONTENT OF SEA WEEDS

Kind of sea weed	Iodine per cent
Fucus vesiculosus and nodosus	0·070
Fucus vesiculosus	0·013
Potwrack	0·050
*Laminaria	0·175
*Costaria	0·029
*Alaria	0·027

*Furnished by Dr. A. T. Cameron of the University of Manitoba who has made an extensive survey of the idodine content of sea weeds.

Whether or not a high iodine ration is beneficial or desirable is debatable. It has been shown that the small quantity of iodine in "iodized" salt has been sufficient to prevent the occurrence of goitre in regions where this malady has not assumed too serious proportions. In regions, however, where goitre is serious it is possible that the amount of iodine in salt may not prove sufficient and a supplemental addition of sea weed might, in this case, be indicated.

INVESTIGATIONAL WORK WITH FERTILIZERS

The work of the division in connection with the use of manures and fertilizers was continued during the past year at the greater number of the branch farms and stations.

In Eastern Canada, and particularly in the Maritime Provinces, experiments dealing with the use of nitrogenous fertilizers have shown that the newer and more highly concentrated forms of nitrogen are giving quite satisfactory results. Further evidence of the beneficial influence of lime on crop growth has been obtained.

At the branch stations of Kapuskasing, Northern Ontario, and La Ferme, Northern Quebec, further data on the use of fertilizers for general field crops on heavy clay lands have been recorded.

In Western Canada the experiments in progress at Rosthern, Sask., Beaverlodge, Alta., Lethbridge, Alta., Summerland, Invermere, Agassiz and Sidney, B.C., have been continued. In general, the influence of fertilizers at certain of these points has not been as great as in districts of Eastern Canada, due partly to the fact that the average soils of the western Prairie Provinces are richer than those of Eastern Canada, and also, in some measure, to dry seasonal conditions.

In this report it was thought desirable to present in brief form the results obtained during the past few years from the application of various phosphoric acid carriers.

SOURCES OF PHOSPHORIC ACID

CHARLOTTETOWN, P.E.I.

An experiment commenced in 1923, included the application of fortified (Sydney) basic slag, Bessemer basic slag, open hearth slag, superphosphate and ground Florida rock phosphate. These materials were applied in amounts to furnish phosphoric acid at two rates per acre, viz., 70 and 140 pounds. In 1923 the whole area, including check plots, received in addition to the phosphoric acid, an application of 100 pounds nitrate of soda and 50 pounds muriate of potash per acre. The crop in 1923 was barley, followed by clover hay in 1924 and timothy hay in 1925. In 1926 the plots were sown with turnips for which no further application of phosphoric acid was made but the whole area received a uniform application of 150 pounds nitrate of soda and 50 pounds muriate of potash per acre. In 1927 the crop was potatoes fertilized with nitrate of soda 130 pounds, sulphate of ammonia 300 pounds, and muriate of potash 300 pounds per acre; no further dressings of phosphoric acid were made for this crop, the chief reason being that fortified slag and open hearth slag were not procurable. Fortified slag is a mixture of open hearth slag and ground rock phosphate.

The crop yields obtained in 1923, 1924, 1926 and 1927 are given in table No. 35. The timothy hay yields of 1925 were not recorded.

TABLE 35—SOURCES OF PHOSPHORIC ACID—CHARLOTTETOWN, P.E.I.—1923-27

Source of phosphoric acid applied in 1923	Pounds of phosphoric acid (P_2O_5) applied per acre	Average Yields per Acre			
		1923 Barley	1924 Clover Hay	1926 Turnips	1927 Potatoes
		bush.	tons	tons	bush.
Fortified Slag (Sydney)	70	42·4	0·894	4·365	66·6
Bessemer Slag (Belgian)	70	47·9	1·120	4·820	82·7
Open Hearth Slag (Sydney)	70	38·1	0·661	4·646	47·0
Ground Rock Phosphate (Florida)	70	40·9	0·646	3·572	41·5
Superphosphate	70	45·7	1·167	3·136	64·0
Fortified Slag (Sydney)	140	41·6	1·046	8·131	70·3
Bessemer Slag (Belgian)	140	40·0	1·465	6·098	67·3
Open Hearth Slag (Sydney)	140	45·9	0·922	7·115	90·9
Ground Rock Phosphate (Florida)	140	34·0	1·129	4·850	35·4
Superphosphate	140	48·7	1·532	9·002	67·9
Checks (no phosphoric acid)	.....	45·0	0·804	1·707	53·3

The data in table No. 35 may be briefly summarized as follows:—

Grain, 1923.—The application of phosphoric acid did not result in any appreciable increase in yields over the check plots which received no phosphatic fertilizer.

Clover Hay, 1924.—At the smaller rate of application Bessemer slag and superphosphate gave fair returns. At the larger rate, all five sources of phosphoric acid proved effective in increasing the yields but the superiority of Bessemer slag and superphosphate over the other forms used is marked by much greater increases in yield,

Turnips, 1926.—The yields of this crop were comparatively low in most instances. However, all the forms of phosphoric acid gave very large increases over the check plot. The yields show that the larger rate of application of phos-

phoric acid (140 pounds P_2O_5) applied in 1923 was much more effective than the smaller rate (70 pounds P_2O_5). This is particularly noticeable on the superphosphate plots; apparently this form of phosphoric acid at the smaller rate was not sufficient to prove satisfactorily effective on the fourth crop removed from the date of application.

Potatoes, 1927.—The low yields of potatoes are no doubt due to the absence of phosphoric acid in the fertilizer treatment since for this crop nitrogen and potash were applied in fairly liberal amounts. Under these circumstances, comparisons of the various forms of phosphoric acid applied in 1923 would scarcely be justified.

NAPPAN, N.S.

An experiment similar in outline to that at Charlottetown was commenced in 1923 at Nappan, N.S. The phosphatic fertilizers were applied for the grain crop in a three-year rotation of grain, clover hay and timothy hay. Two separate areas were used in this experiment, one commenced in 1923 and the other in 1924. Owing to the presence of couch grass the first area was ploughed following the clover hay crop of 1924 and fertilized and seeded to grain in 1925.

The crop yields obtained from 1923 to 1927 are given in table No. 36.

TABLE 36—SOURCES OF PHOSPHORIC ACID—NAPPAN, N.S., 1923-27

Source of phosphoric acid applied for the grain crop	Pounds of phosphoric acid (P_2O_5) applied per acre	Yields per acre		
		Oats average for three years 1923, 1924, 1925	Clover hay average for three years 1924, 1925, 1926	Timothy hay average for two years 1926, 1927
		bush.	tons	tons
Fortified Slag (Sydney)	70	55·7	1·564	1·646
Bessemer Slag (Belgian)	70	58·2	1·645	1·602
Open Hearth Slag (Sydney)	70	54·6	1·547	1·635
Ground Rock Phosphate (Florida)	70	52·9	1·263	1·100
Superphosphate	70	55·7	1·527	0·950
Fortified Slag (Sydney)	140	57·1	1·709	1·743
Bessemer Slag (Belgian)	140	59·0	1·923	1·757
Open Hearth Slag (Sydney)	140	54·8	1·657	1·630
Ground Rock Phosphate (Florida)	140	56·4	1·407	1·043
Superphosphate	140	55·6	1·660	1·097
Checks (no phosphoric acid)	.....	53·6	1·333	1·330

The data in table No. 36 may be briefly summarized as follows:—

Grain, 1923-25.—The average results for the three crops of oats show that the application of phosphoric acid did not give very large increases in yields. The highest yield of the series was from the plot treated with Bessemer slag.

Clover Hay, 1924-26.—Small increases in yield were obtained from practically all the treatments. Bessemer slag proved somewhat superior to the other sources of phosphoric acid employed.

Timothy Hay, 1926-27.—For this crop the yields from all slag plots were practically equal and considerably larger than those from the plots treated with rock phosphate and superphosphate.

FREDERICTON, N.B.

At this Station, an experiment dealing with sources of phosphoric acid was commenced in 1926. The following phosphatic fertilizers were employed to furnish phosphoric acid at the rate of 140 pounds per acre, viz., fortified slag,

Bessemer slag, ground Florida rock phosphate, Ephos rock phosphate and superphosphate. These materials were applied alone and also in conjunction with a dressing of nitrate of soda at the rate of 100 pounds per acre and muriate of potash at 50 pounds per acre. The applications were made to the grain crop in a three-year rotation of oats, clover hay, timothy hay on quadruplicate plots of 1/320 acre area. The crop yields obtained during the years 1926 to 1928 are presented in table No. 37.

TABLE 37—SOURCES OF PHOSPHORIC ACID—FREDERICTON, N.B., 1926-28

Source of phosphoric acid applied for the grain crop	Pounds of phosphoric acid (P_2O_5) applied per acre	Average yields per acre		
		Oats 1926	Clover hay 1927	Timothy hay 1928
		bush.	tons	tons
(Without Nitrogen or Potash)				
Fortified Slag (Sydney)	140	44·8	1·734	1·641
Bessemer Slag (Belgian)	140	48·5	1·950	1·760
Ground Florida Rock Phosphate	140	48·5	1·360	1·466
Ephos (Egyptian Rock Phosphate)	140	46·7	1·677	1·780
Superphosphate	140	51·7	1·800	1·672
Check (no phosphoric acid)		51·6	1·332	1·496
(With 100 lb. Nitrate of Soda and 50 lb. Muriate of Potash)				
Fortified Slag (Sydney)	140	47·6	1·774	1·757
Bessemer Slag (Belgian)	140	55·0	2·199	1·912
Ground Florida Rock Phosphate	140	52·5	1·277	1·770
Ephos (Egyptian Rock Phosphate)	140	48·1	1·525	1·839
Superphosphate	140	60·3	1·699	1·795
Check (no phosphoric acid)		54·8	1·492	1·750

The increases in yield resulting from the application of phosphoric acid as outlined in table No. 37 are not large. Although Bessemer slag and superphosphate gave somewhat better returns than the other sources of phosphoric acid used, the value of the increased yield in each instance was not sufficient to pay for the cost of the fertilizer applied.

KENTVILLE, N.S.

BASIC SLAG EXPERIMENT.—At this Station an experiment planned chiefly to compare fortified (Sydney) slag and Bessemer (Belgian) slag as sources of phosphoric acid for a three-year rotation of grain, clover hay and timothy hay, was commenced in 1926. The slags were applied alone and also in conjunction with a dressing of nitrate of soda at 100 pounds and muriate of potash at 50 pounds per acre. Two rates of application of the slags were employed to furnish 140 and 70 pounds of phosphoric acid per acre. In addition, a plot receiving superphosphate alone at the larger rate of application was included. The work was conducted in quadruplicate on plots of 1/320 acre area. The following crop yields were obtained (table No. 38).

TABLE 38—SOURCES OF PHOSPHORIC ACID (BASIC SLAG EXPERIMENT)
KENTVILLE, N.S., 1926-28

Source of phosphoric acid applied for the grain crop	Pounds of phosphoric acid (P_2O_5) applied per acre	Average yields per acre		
		Oats 1926	Clover hay 1927	Timothy hay 1928
		bush.	tons	tons
(Without Nitrogen or Potash)				
Fortified Slag (Sydney)	70	50·59	1·06	2·16
Bessemer Slag (Belgian)	70	47·18	1·45	2·51
Fortified Slag (Sydney)	140	52·94	1·08	2·46
Bessemer Slag (Belgian)	140	54·11	1·94	2·99
Superphosphate	140	46·47	1·30	2·73
(With 100 lb. Nitrate of Soda and 50 lb. Muriate of Potash)				
Fortified Slag (Sydney)	70	56·47	0·80	2·11
Bessemer Slag (Belgian)	70	58·23	1·32	2·24
Fortified Slag (Sydney)	140	54·11	0·99	2·48
Bessemer Slag (Belgian)	140	60·59	1·90	3·37
Checks (Average) no fertilizer	.....	45·49	0·46	1·55

DISCUSSION OF THE DATA OF TABLE NO. 38

Grain, 1926.—Both types of slag gave fair increases in yield of oats over the check plot, Bessemer slag proving somewhat superior to the fortified slag. It is difficult to account for the relatively poor returns of the grain crop from the superphosphate plot. The addition of the nitrate of soda and muriate of potash to the slag treatment resulted in significant increases in yield.

Clover Hay, 1927.—The comparatively low yields of clover hay may be accounted for by the fact that the clover plants suffered severely through heaving in the spring of 1927. In this connection it was noted that the clover plants on the Bessemer slag plots were more vigorous in the fall of 1926 than those on

Nitrate of soda on second year hay, on the Experimental Station, Fredericton, N.B.
Left—nitrate of soda, right—no nitrate of soda.

the fortified slag plots and that they were not affected to as great an extent by the adverse spring weather conditions. This observation is borne out by the distinctly superior yields of clover hay from the plots treated with Bessemer slag. The superphosphate plot also gave a markedly superior yield to that of the fortified slag plots. There is no evidence of any beneficial influence on the clover hay crop from the nitrogenous and potassic fertilizer applied for the grain crop in 1926. The exceptionally low yield on the untreated check plot may be noted.

Timothy Hay, 1928.—All treatments resulted in substantial increases of timothy hay over the untreated check plot, with both the Bessemer slag and superphosphate plots giving distinctly superior yields to the fortified slag plots. As in the case of the clover hay crop, the application of the nitrogenous and potassic fertilizers in 1926 did not materially improve the yields of timothy hay in 1928. The results from the smaller dressing of phosphoric acid were equally as good as those from the larger dressing of this element of plant food.

Fertilizers and Ground Limestone Experiment.—An experiment with fertilizers and ground limestone was commenced in 1914 at Kentville, N.S., the plan of which permitted of a comparison between superphosphate, basic slag and bone meal as sources of phosphoric acid on limed and unlimed areas. From 1914 to 1925, inclusive, the above fertilizers were applied in conjunction with a nitrogenous and potassic fertilizer to the potato crop of a three-year rotation of potatoes, grain and clover hay, the resulting application in each case being equivalent, approximately, to 600 pounds of a 4-8-8 mixture per acre. On the limed section, ground limestone at the rate of 2 tons per acre was applied every three years at the beginning of the rotation. The soil—a light sandy loam—was, at the commencement of the experiment, low in fertility and deficient in lime. The results for the period 1914-25 (four complete rotations) are presented in the following table (No. 39).

Table 39.—Sources of Phosphoric Acid (Fertilizer and Ground Limestone Experiment) Kentville, N.S., 1914–1925

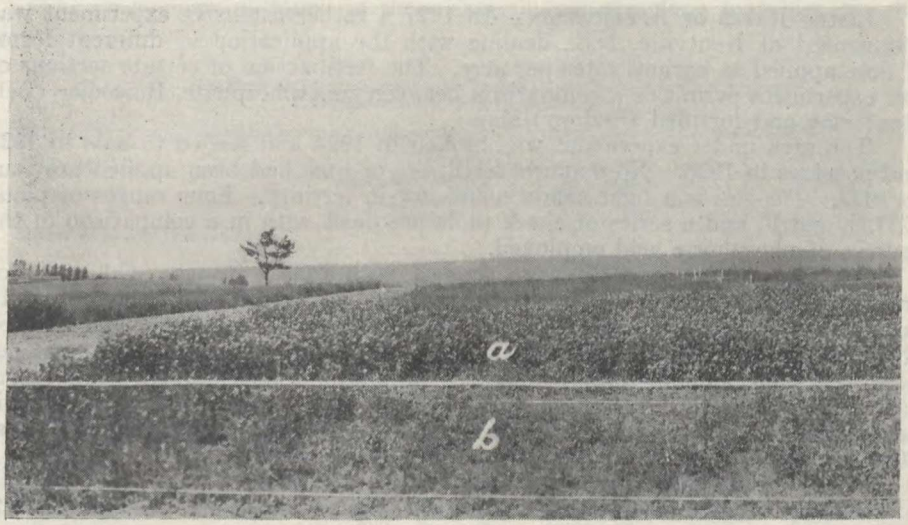
Source of phosphoric acid used in the fertilizer mixture	Yields per acre							
	Potatoes, average yields for 4 years, 1914, 17, 20, 23		Wheat, average yields for 2 years, 1918, 1921		Oats, average yields for 2 years, 1915, 1924		Clover hay, average yields for 4 years, 1916, 19, 22, 25	
	With lime	Without lime	With lime	Without lime	With lime	Without lime	With lime	Without lime
	bush.	bush.	bush.	bush.	bush.	bush.	tons	tons
Superphosphate	197·1	183·5	22·6	15·8	37·1	29·2	1·521	0·715
Basic slag	204·8	184·6	24·3	17·2	40·1	29·9	1·656	0·780
Bone meal	198·0	175·5	22·6	17·7	40·2	32·9	1·560	0·761
Check (No phosphoric acid)	163·1	139·4	21·0	14·2	33·1	28·6	1·160	0·685

In the spring of 1926 it was thought desirable to increase the amount of plant food supplied for the hoed crop and the application of fertilizers to each treated plot was changed to the equivalent of 1,600 pounds per acre of a 4-9-6. At the same time, mangels were substituted for potatoes as the first crop of the rotation. This change was necessitated by the fact that the soil of the limed section had become badly infested with the potato-scab organism, the crop in 1923 being practically unmarketable. In addition to the foregoing changes the application of ground limestone was discontinued.

The crop yields for the fifth rotation period 1926-28 are given as follows (table No. 40).

TABLE 40.—SOURCES OF PHOSPHORIC ACID (FERTILIZERS AND GROUND LIMESTONE EXPERIMENT) KENTVILLE, N.S., 1926–1928

Source of phosphoric acid used in the fertilizer mixture	Yields per acre					
	Mangels, 1926		Wheat, 1927		Clover hay, 1928	
	Formerly limed	No lime	Formerly limed	No lime	Formerly limed	No lime
	bush.	bush.	bush.	bush.	tons	tons
Superphosphate	445·0	251·8	27·7	17·3	1·780	0·480
Basic slag	511·0	417·8	28·0	17·8	2·040	0·755
Bone meal	421·2	117·2	22·7	17·8	1·890	0·550
Check (No phosphoric acid)	101·2	1·0	19·5	11·2	0·975	0·430



Effect of liming—clover crop, Experimental Station, Fredericton, N.B. (a) ground limestone, 3 tons per acre, (b) check (no ground limestone).

The outstanding feature of the results tabulated in tables No. 39 and 40, covering the five rotations recorded is the marked increase in all crops from the application of ground limestone. This is particularly noticeable in the grain, hay and mangel crops. It will also be noted that very satisfactory increases were obtained from the fertilizers employed.

To compare the relative effectiveness of the three sources of phosphoric acid used in this experiment, the value of the crops produced during the fifteen year period 1914 to 1928 have been calculated using the following values: potatoes 60 cents per bushel, wheat $1 per bushel, oats 70 cents per bushel, mangels 8 cents per bushel, clover hay $10 per ton and straw $6 per ton. The results are tabulated in table No. 41.

TABLE 41.—SOURCES OF PHOSPHORIC ACID (FERTILIZERS AND GROUND LIMESTONE EXPERIMENT) KENTVILLE, N.S., VALUE OF CROPS PRODUCED, 1914-1928

Source of phosphoric acid used in the fertilizer mixture	With lime			Without lime		
	Total value of crops produced	Increases over check	Per-centage increase	Total value of crops produced	Increases over check	Per-centage increase
	$	$		$	$	
Superphosphate	740 12	154 34	26·3	603 92	138 93	29·9
Basic slag	780 39	194 61	33·2	671 01	206 02	44·3
Bone meal	743 16	157 38	26·9	587 49	122 50	26·3
Check (No phosphoric acid)	585 78			464 99		

The data in table No. 41 show that in this experiment basic slag has proved the most effective source of phosphoric acid in the fertilizer mixture on both the limed and unlimed areas and that superphosphate and bone meal gave about equal returns. It is significant to note the decidedly higher "total value" of the crops on the plots on which the fertilizer was associated with lime.

LIME—RATES OF APPLICATION.—In 1927 a rather extensive experiment was commenced at Kentville, N.S., dealing with the application of different forms of lime applied at various rates per acre. The fertilization of certain sections of this experiment permit of a comparison between superphosphate, Bessemer (Belgian) slag and fortified (Sydney) slag.

The area under experiment was broken in 1924 and seeded to oats in 1925 and potatoes in 1926. No manure, fertilizers or lime had been applied previous to 1927. The soil is a light sandy loam, low in fertility. Four ranges of plots, C.D.E. and F. and a series of check plots are dealt with in a comparison of the sources of phosphoric acid employed.

All four ranges in 1927 were dressed with lime. Range "C" was not treated with any phosphatic fertilizer. Range "D" received 800 pounds of 16 per cent Bessemer slag, Range "E" received 900 pounds of 14 per cent fortified slag and Range "F" received 800 pounds of 16 per cent superphosphate, per acre, the same amount (approximately) of phosphoric acid being supplied to each range. The series of check plots did not receive either lime or phosphoric acid. The whole area under experimentation was treated with nitrate of soda at 200 pounds and muriate of potash at 100 pounds per acre.

The average yields of grain and clover hay per acre of all the plots in each of the four ranges and on the series of check plots are given in table No. 42.

TABLE 42.—SOURCES OF PHOSPHORIC ACID (LIME AT DIFFERENT RATES EXPERIMENT) KENTVILLE, N.S., 1927-28

Range	Fertilizers applied per acre in 1927 (In addition to the uniform application of nitrogen and potash)	Average yields per acre	
		Oats, 1927	Clover hay, 1928
		bush.	tons
	Check plots (no phosphoric acid or lime)	21·9	0·51
C	Lime only	27·2	1·10
D	800 lb. Bessemer Slag (16% P_2O_5)+lime	33·5	1·76
E	900 lb. Fortified Slag (14% P_2O_5)+lime	27·6	1·41
F	800 lb. Superphosphate (16% P_2O_5)+lime	36·1	1·70

It is evident from the data of table No. 42 that the soil responded well to applications of phosphoric acid and lime. Superphosphate gave slightly better returns than the Bessemer slag and both of these sources of phosphoric acid were

much more effective on the grain and hay crops than the fortified Sydney slag. It is worthy of note to observe that in the case of both oats and clover hay the limed areas without fertilizers gave marked increases over the check (unlimed) plots.

EPHOS BASIC PHOSPATE EXPERIMENTS

An experiment to compare Ephos Basic Phosphate, superphosphate and Bessemer basic slag as sources of phosphoric acid was commenced in 1925 at the branch farms at Nappan and Kentville, N.S., and Charlottetown, P.E.I. Each of these fertilizers was applied singly in amounts to furnish 80 pounds of phosphoric acid per acre, and also in conjunction with a nitrogenous and potassic fertilizer (nitrate of soda, 150 pounds and muriate of potash, 100 pounds per acre.) At Charlottetown and Nappan the fertilizers were applied for the turnip crop, followed by grain and hay; at Kentville mangels and turnips were used to measure the effect of the phosphatic fertilizers in the year of their application, the following crops being grain and hay. Ephos basic phosphate is ground Egyptian rock phosphate containing 28 per cent of phosphoric acid in the form of tricalcic phosphate.

The crop yields obtained in these experiments are given in tables No. 43, 44 and 45.

TABLE 43.—SOURCES OF PHOSPHORIC ACID (EPHOS BASIC PHOSPHATE EXPERIMENT) CHARLOTTETOWN, P.E.I., 1925–1927

Source of phosphoric acid used	Plant food supplied in pounds per acre			Crop yields per acre, experiment commenced in 1925			Crop yields per acre, experiment commenced in 1926	
	N	P_2O_5	K_2O	1925 turnips	1926 oats	1927 clover hay	1926 turnips	1927 barley
				tons	bush.	tons	tons	bush.
Without Nitrogen and Potash—								
Check (no phosphoric acid).....	....	....	....	5·83	31·6	0·778	7·73	13·2
Ephos Basic Phosphate.....	....	80	....	10·28	28·1	0·670	7·82	14·7
Superphosphate.....	....	80	.....	12·52	25·9	0·624	12·08	13·7
Bessemer Slag.....	....	80	.....	8·60	29·2	0·681	7·64	13·3
With Nitrogen and Potash—								
Check (no phosphoric acid).....	24	....	50	5·56	28·8	0·609	7·20	14·0
Ephos Basic Phosphate.....	24	80	50	12·32	29·1	0·699	10·72	14·0
Superphosphate.....	24	80	50	15·64	34·5	0·773	10·92	16·0
Bessemer Slag.....	24	80	50	8·56	29·1	0·942	8·48	16·1

At Charlottetown, very marked increases in the yield of turnips were obtained in 1925 from the application of all three forms of phosphoric acid, superphosphate proving the most effective source of this element followed by Ephos basic phosphate and basic slag in the order named. In 1926, superphosphate was the only phosphatic fertilizer which proved effective where each source was applied alone; when applied with nitrogen and potash, superphosphate and Ephos basic phosphate gave practically equal and very substantial increases in yield. On the grain and hay crops with the exception of basic slag on clover hay and superphosphate on oats, the effect of the fertilizers was not significant.

TABLE 44.—SOURCES OF PHOSPHORIC ACID (EPHOS BASIC PHOSPHATE EXPERIMENT) NAPPAN, N.S., 1925–1928

Source of phosphoric acid used	Plant food supplied in pounds per acre			Crop yields per acre			
	N	P_2O_5	K_2O	1925 Turnips	1926 Oats	1927 Clover hay	1928 Timothy hay
				tons	bush.	tons	tons
Without Nitrogen and Potash—							
Check (no phosphoric acid)	.....	.....	.....	7·44	46·4	0·75	1·05
Ephos Basic Phosphate	.....	80	.....	12·00	40·0	0·81	1·01
Superphosphate	.....	80	.....	14·12	47·1	1·11	1·20
Bessemer Slag	.....	80	.....	14·08	54·1	1·02	1·14
With Nitrogen and Potash—							
Check (no phosphoric acid)	24	.....	50	9·48	47·1	0·80	1·23
Ephos Basic Phosphate	24	80	50	16·64	54·1	1·03	1·26
Superphosphate	24	80	50	15·60	54·1	1·08	1·09
Bessemer Slag	24	.....	50	16·72	49·4	0·87	1·11

At Nappan, large increases in the yield of turnips resulted from the application of phosphoric acid, and all three forms of this element gave fairly close returns. Slight increases are to be noticed from the application of phosphoric acid, in the clover hay crop of 1927.

TABLE 45.—SOURCES OF PHOSPHORIC ACID (EPHOS BASIC PHOSPHATE EXPERIMENT) KENTVILLE, N.S., 1925–1928

Source of phosphoric acid used	Plant food supplied in pounds per acre			Crop yields per acre				
	N	P_2O_5	K_2O	1925 Mangels	1925 Turnips	1926 Oats	1927 Clover hay	1928 Timothy hay
				tons	tons	bush.	tons	tons
Without Nitrogen and Potash—								
Check (no phosphoric acid)	.....	.....	.....	2·00	6·34	32·0	0·64	2·08
Ephos Basic Phosphate	.....	80	.....	1·68	7·72	32·9	0·65	2·17
Superphosphate	.....	80	.....	4·12	7·68	34·7	0·51	2·25
Bessemer Slag	.....	80	.....	4·56	7·04	34·1	0·73	2·73
With Nitrogen and Potash—								
Check (no phosphoric acid)	24	.....	50	3·09	7·84	32·3	0·79	2·40
Ephos Basic Phosphate	24	80	50	2·76	8·16	31·2	0·60	2·32
Superphosphate	24	80	50	6·35	9·48	33·5	0·84	2·27
Bessemer slag	24	80	50	6·96	9·72	34·1	0·79	2·40

The yields of the hoed crops and particularly that of mangels are much below the average for this crop at Kentville, through the soil having grown heavy crops of corn and oats in 1923 and 1924, respectively, and in consequence being somewhat low in fertility. The low yields of clover hay may be attributed to injury of the plants from heaving during adverse seasonal conditions in the spring of 1927.

Turnips.—Applications of phosphoric acid alone gave small increases; all three forms of this element appear to have been equally effective. Used in conjunction with nitrogen and potash the increases are larger with superphosphate and slag about equal and Ephos a close third.

Mangels.—Superphosphate and basic slag when used alone gave very fair increases in yield and still larger increases in conjunction with nitrogen and potash. Ephos has not proved an effective fertilizer in this experiment for the

mangel crop, no increase in yield having resulted from its use either alone or with nitrogen and potash.

The residual effect of the fertilizers on the grain and hay crops was not significant.

SUGAR BEETS FOR FACTORY PURPOSES

The investigational work with sugar beets begun in 1902 has two main objects: (1) to ascertain the suitability of various districts in the Dominion, in respect to soil and season, for the growing of beets for sugar extraction, and (2) to determine the relative value for factory purposes of the several special strains or varieties of sugar beets bred for high sugar content, chiefly in France, Russia and Germany. In addition to the above, the comparative value of beets from foreign and Canadian grown seed has been studied.

Seed of the following varieties was used in this investigation during the past season: Buszczynski, Dippe and Fredericksen, from the Dominion Sugar Company, Chatham, Ont., Ramon, Kalnik and Niemertche, from the Amtorg Trading Company, New York City, and a number of others, chiefly of Russian origin, which had been sent direct to several of the branch farms and stations.

The beets were grown on twenty-four Farms, Stations and Substations of the Experimental Farms System as follows: Prince Edward Island, Charlottetown; Nova Scotia, Kentville and Nappan; New Brunswick—Fredericton; Quebec—Lennoxville, Cap Rouge, and Ste. Anne de la Pocatière; Ontario—Ottawa, Harrow and Kapuskasing; Manitoba—Brandon and Morden; Saskatchewan—Rosthern, Scott, Indian Head and Swift Current; Alberta—Fort Vermilion, Lacombe, Lethbridge and Beaverlodge; British Columbia—Agassiz, Sidney, Summerland, and Invermere. The data are presented in table 46.

Co-operative experiments were carried on in Nova Scotia and Prince Edward Island, using the variety of Dippe.

Charlottetown, P.E.I.—Soil: sandy loam, overlying a gravelly clay. Manured in the spring of 1927, ten tons per acre, followed by a grain crop (barley). Manured in 1928 with twelve tons per acre. Sown June 5, pulled November 14.

—	Mean temperature	Rainfall
	degrees F.	inches
May	50·1	2·4
June	57·3	2·82
July	66·8	3·48
August	65·6	3·88
September	56·6	4·39
October	47·5	2·49

The beets were medium to large in size, very well shaped with no forking.

These results are quite satisfactory in regard to both sugar content and purity. They indicate a crop that would be quite suitable for sugar extraction; the analyses of the ten varieties showing great uniformity in respect to good percentages of sugar and high purity.

The beets grown at this Station have usually been of excellent quality.

Kentville, N.S.—Soil: sandy loam, 9 to 12 inches, overlying a gravelly subsoil. Manured at the rate of 15 tons per acre in the season of 1927. In the spring of 1928 another dressing of manure at the rate of 15 tons and 600 pounds of a 10-4-7 fertilizer was applied. The crop of the previous season had been turnips for seed production. Sown May 9, pulled October 8.

Spring: rainfall for May was 1·26° above normal. Temperature was 2 degrees above normal; in June the rain fall was 1·31 inch below normal and the temperature was normal.

Summer: the temperature during July and August was two degrees above normal for both months, and the precipitation in July was 1·51 inch above normal and in August 2·17 inches below normal.

Autumn: the rainfall during September was about normal, while the temperature was slightly cooler. The temperature during October was about normal with 0·85 inch of rain.

Though satisfactory as to quality—sugar and purity, these beets were "rooty," too small and irregular as to shape, considered as a crop suitable for factory purposes. The evidence would indicate poor cultivation rather than a season unfavorable to beet culture.

Nappan, N.S.—Medium clay loam 15 inches deep overlying a heavy clay. Manured at the rate of 20 tons of manure in the spring of 1928. Crop of previous season: oats, peas and vetch for silage.

—	Average mean temperature	Total precipitation
	degrees F.	inches
March	27·56	2·22
April	40·17	2·82
May	51·97	2·38
June	57·98	2·08
July	65·39	2·78
August	64·81	1·92
September	54·28	5·59

The data as to sugar and purity are quite satisfactory, indicating a quality of roots suitable for sugar extraction.

From the crop standpoint the series were a rather mixed lot, ranging from very small to one or two quite large roots. Further, they were irregular in shape, with a tendency to forking. Evidently there had been insufficient attention given to the proper growing of these beets.

Fredericton, N.B.—Soil: Sandy loam 1 foot, overlying sand, to a depth of 3 feet where it changes to a very dense hard pan. Manured in the spring of 1928 with 15 tons barnyard manure and a dressing of 400 pounds 2-12-5 home-mixed fertilizer. Crop of previous season was clover. Sowed May 28, pulled October 1.

—	Average mean temperature	Total precipitation
	degrees F.	inches
April	39·05	3·69
May	53·27	2·44
June	58·8	3·77
July	66·7	4·45
August	65·2	6·34
September	53·84	3·02

These beets were of medium size, well formed, with no forking.

The results indicate a crop which would be quite satisfactory for factory purposes, the sugar content being decidedly above the average and the purity exceptionally good.

Lennoxville, P.Q.—Soil: Sandy loam to a depth of 6 inches, overlying sand and gravel. Manured in 1927 with 250 pounds per acre of a 4-8-4 commercial fertilizer and in 1928 with 14 tons per acre of barnyard manure. Crop of previous season oats. Sowed May 11, pulled October 12.

—	Average mean temperature	Precipitation
	degrees F.	inches
May	51·64	4·23
June	59·73	3·45
July	67·43	4·30
August	68·00	4·72
September	54·35	4·43

These results, both as to sugar and purity, may be considered as fair; beets of higher quality have been grown this past season at a number of points in the Dominion.

The roots were of good shape, medium to large in size, with no forking. The crop as to both yield and quality must be regarded, from the factory standpoint, as quite fair.

Cap Rouge, P.Q.—Naturally drained sandy loam from 15 to 20 inches deep overlying shale. Twenty tons rotted manure per acre were applied in the autumn of 1927. Crop of previous season—barley. Sowed June 5, pulled October 11. May and June were colder, dryer and duller than the average, July was colder, much wetter and brighter. August was warmer, dryer and duller while September was colder much dryer and duller than the average.

In respect to quality—sugar and purity—these beets are quite satisfactory. The roots were small to medium in size, of good shape and free from forking.

Ste. Anne de la Pocatière, P.Q.—Soil: a heavy clay overlying blue clay. Manured in 1927 at the rate of 20 tons per acre of barnyard manure. Crop of previous season: peas. Sowed May 15, pulled October 29.

The spring was fair at the beginning but very wet at the end. Maximum temperature 56·1° and minimum 36·6°. Summer, precipitation 3·45. During the last 11 days of May, i.e., very soon after the seeding 5 inches of rain fell which flooded the larger part of the area sown with roots. The temperature was not very favourable for growth. The weather was too cloudy and not warm enough. October, temperature, maximum 52·3 minimum 38·7, precipitation 2·67. September and the first part of October being rather dry and cold, the growth of roots was not very significant hence the low yield reported.

These beets were small to medium in size, which explains in a large measure the somewhat low yields recorded. They were of good shape, with little tendency to forking.

The data for sugar and purity are good and the beets in respect to quality must be regarded as quite suitable for factory purposes.

Ottawa, Ont.—Soil: medium to light sandy loam. Subsoil: sandy. The precipitation for the spring months of March, April and May was 7·91 inches; for June, July and August 15·23 inches; September had a precipitation of 4·35. The mean temperature of July was 68·°, of August 68·2° and of September 53·30°.

The larger number of these beets were distinctly small, which would most probably make the yields too light for profitable culture.

In both sugar content and purity the results are distinctly higher than usual at this point and indicate a quality quite suitable for sugar extraction.

Harrow, Ont.—Soil: Black sandy loam 1 foot in depth, overlying sand. Ploughed and manured with 10 tons of barnyard manure in the fall of 1927. In 1928, dressed with 500 pounds per acre commercial 4-8-4 fertilizer. Crop of previous year Alfalfa. Sowed May 3rd, pulled October 12. Total rainfall for March, April and May—3·08 inches with an average temperature of 44·59°. June, July and August had a total rainfall of 6·10 inches with an average temperature of 70·09°. September and October (1st-12th) had a rainfall of ·87 inch with an average temperature of 46·40°.

The results as to sugar and purity are quite satisfactory, indicating a crop which would be quite suitable for sugar extraction.

The roots varied as to size, the larger number being somewhat small for a good yield. They were of good shape, with no indication of forking.

Kapuskasing, Ont.—Soil: a fairly heavy clay 6 inches to 8 inches in depth overlying a heavy clay, stratified and somewhat impervious to water. Manured in 1928 with sixteen tons of barnyard manure. Hay had been the crop of the previous season. Sown June 1, pulled October 4. The precipitation for the springs months of March, April and May was 6·76; for June, July and August it was 13·44, for September 3·25 inches. The mean temperature of July was 63·00°; for August 62·50° and for September 48·50°.

Considering the very high quality of the varieties tested (as evidenced by the results obtained at many widely distant points in the Dominion) the data from this Station are not very satisfactory—much higher results, both as to sugar and purity, have been obtained at many other stations of the system. Further, the beets were very small, indicating too light a yield for profit.

Brandon, Man.—Soil: a clay loam of 9 inches overlying a clay. The crop of the previous year had been wheat. Sowed May 18, pulled September 24. Spring mild and dry, June and July very wet with a very dry September.

These were large and well formed roots, with practically no forking—and received in good condition.

These beets were of very fair quality, both as to sugar and purity and of much higher quality than has usually been produced at this point. Evidently, the weather conditions in the Autumn were favourable to the ripening of the beet and the production of sugar.

Morden, Man.—Soil: Medium heavy loam 7 inches deep over heavy loam. Crop of previous season had been brome grass. Sown May 18, pulled October 3. Spring warm and very dry, summer moderately warm and very wet (May 25-August 5); Autumn warm and very dry.

In respect to richness in sugar these beets are quite satisfactory; in purity they are only fair. The roots were medium to large and well formed, with no forking. The reported yields are quite high. The autumn weather generally has been described as "warm and very dry" and these conditions, the beets having made good growth during the summer, were conducive to sugar production.

Rosthern, Sask.—Soil: sandy loam 6 inches deep overlying clay and below that, sand. The land had lain fallow in 1927. Sowed May 16, pulled September 28. Spring—very dry in April and May, moderate temperatures. Summer—sufficient moisture in June and July, August dry with about average heat and sunshine. Autumn very dry: quite warm most of September but severe frosts September 23, 24 and 25 which froze tops on sugar beets.

These roots were quite small, averaging less than one pound, but showed no forking. The sugar content is fair only; the results for purity are distinctly low. The data indicate a root of somewhat inferior quality—poorer than is usually considered necessary for satisfactory sugar extraction.

Scott, Sask.—Soil: a dark brown sandy loam for 5 to 7 inches over clay loam. Manure applied at the rate of 12 tons per acre in the fall of 1926; ploughed under 6 inches deep in June 1927, Land summer-fallowed in 1927. Sown May 30, Pulled October 1. Spring slightly warmer than usual. Precipitation much below average with considerable high windy weather. Summer moderately warm, good distribution of rainfall and favourable growing weather. Autumn very dry, moderately warm clear weather.

These beets were decidedly small, indicating too low a yield for profitable culture.

The data for sugar and purity are distinctly low, and the beets must be considered of inferior quality; seed from the same stock sown at many other points in the Dominion furnished roots of decidedly higher results.

Swift Current, Sask.—Soil: a sandy clay loam 6 inches in depth over a clay loam. Land summer-fallowed in 1927. Sown May 4, pulled October 1. The temperature in the spring was normal with the exception of a period between May 20 to 27 when it ranged between 80-93°. Precipitation April and May ·96 inch. Normal temperature in June. Hot winds in July. Rainfall in June—4·76 inches—July 2·17 inches. Hot winds during the first part of August. 6° frost on August 22. September variable temperature—Rainfall in August 3·2 inches—practically no rain from August 15 to October 1.

These beets were of medium size, well formed and sound.

The results for both sugar and purity are distinctly low. Seasonal conditions at this point have not proved favourable for sugar production.

Fort Vermilion, Alta.—Soil: a dark loam about 2 feet deep overlying a gravelly subsoil. Fifteen wagon loads of manure, per acre, applied in summer of 1927. Land summer-fallowed in 1927. Sown May 11, pulled September 19. Spring, temperature cool, precipitation light. Summer, warm with light precipitation. Autumn cool with light precipitation.

The data for both sugar content and purity, like those of the preceding season indicate a beet which would be quite satisfactory for sugar extraction. Previous to 1927 it was only occasionally that beets of high quality were obtained at this Station.

The season of 1928 appeared to have been exceptionally dry and this no doubt accounts in a large measure for the small size of the root—a feature which is usually indicative of a comparatively high sugar content.

Considering the beets were only small to medium size, the yields per acre recorded appear to be very high.

Beaverlodge, Alta.—Soil: a black loam to 4 or 5 inches overlying a grey silt subsurface: subsoil chocolate clay. In 1927 the land was in summer-fallow. Sown May 10, pulled October 12-13. Spring, May hot ·95 inch precipitation. June normal temperature with frequent showers. Precipitation totalling 2·26 inches. July hot; precipitation 2·16 inches. August normal; precipitation 1·48 inch, rather windy. September—rather windy and dry. Precipitation ·84 inch. October rather windy and dry with no precipitation.

These beets were small to medium in size, uniform as to type with no forking. As received, they were slightly wilted, which would have the effect of raising somwhat their sugar content. The data show a high percentage of sugar with a fair purity. The results from this Station in the past have not as a rule been those of beets suitable for factory purposes.

Lacombe, Alta.—Soil: a black loam over subsoil of clay loam. Crop of previous year—cereal plots. Sown May 19, pulled October 4. Spring very dry, summer cool and wet, autumn very dry and warm.

These beets are of inferior quality; the sugar content and purity are decidedly low and in consequence the roots must be considered as unsuitable for factory purposes. The beets were small and the yield light, confirming the opinion from the analysis of the beets that beet culture for sugar extraction in this district would not prove profitable. The results of previous seasons in this enquiry agree in the main with those now recorded, indicating that seasonal conditions in this district are not favourable to the proper development of the sugar beet.

Lethbridge, Alta.—(Irrigated) Soil: sandy clay with fair amount of humus, depth about one foot: subsoil also sandy clay. Crop of previous season—beans. Sown April 27, pulled October 6.

(Non-irrigated) Soil: a sandy clay with very little humus, depth about one foot overlying a sandy clay subsoil. Summer-fallowed in 1927. Sown May 19, pulled October 9.

Spring—warm with little late frost, many high winds and very little precipitation. Summer warm with abundant moisture, especially all through June and the early part of July. Autumn a few early frosts but the weather almost throughout the fall was fine with very few storms.

These beets (irrigated) were fairly well formed, with little inclination to "forking". They were not uniform as to size, varying from "very large" to medium. Though the sugar content is fair, the results as a whole are not quite satisfactory; seed from the same stock having given this year at a number of points decidedly higher results, both as to richness and purity.

The roots from the dry land plots were small to medium but generally undersized; there was little tendency to forking and in shape or type, long and slender—free from rootlets and quite firm. As a series the sugar content is slightly lower than that of the irrigated beets—which is difficult to understand—especially as the roots were decidedly smaller than those from the irrigated area.

Agassiz, B.C.—Soil: a sandy loam 6-8 inches in depth overlying a sandy gravel. Manured in 1928 with barnyard manure, 10 tons per acre and 500 pounds commercial fertilizers. Crop of previous year—roots. Sown May 14, pulled October 15.

—	Maximum temperature	Minimum temperature	Precipi-
	degrees F.	degrees F.	inches
Spring	74	32	4·84
Summer	93	43	4·25
Autumn	87	33	11·75

The data for sugar content are decidedly low and those for purity are only fair; the beets therefore cannot be regarded as satisfactory for factory purposes. Beets of excellent quality have been grown at this point and the present poor results must be attributed to the exceedingly wet and cool autumn, these conditions preventing the proper ripening of the beet. The roots varied in size from medium to very large, showing that good growth had been made. The yields per acre were quite good.

Sidney, B.C.—Soil: a peaty silt overlying a clay. The crop of previous season—corn. Sown May 19 pulled October 23. Spring cool, rains more abundant than usual, summer dry. Autumn—no frosts with rain about average.

These beets were well formed and exceptionally large; they arrived in good condition. The percentage of sugar is only fair but the purity is high—and especially so considering the size of the beets. A high yield per acre was recorded.

Invermere, B.C.—Soil: a fine silty loam over a gravel mixed with hard pan. In the spring of 1928, 100 pounds nitrate of soda, 400 pounds superphosphate and 200 pounds muriate of potash were applied. The land had lain fallow in 1927. Sown May 11, pulled October 20. The mean temperature of the spring months, March, April and May was 43·13°, the precipitation—1·03 inch. For summer —June, July and August, 60·58°, and 5·63 inches of rain. Autumn—September had a mean temperature of 52·19 and a precipitation of 0·33 inch of rain.

Though the results for sugar and purity are decidedly high the yield per acre was altogether too small to make the crop a profitable one. The beets were quite small short and thick set and rooty with slight forking, indicating a shallow and unsuitable soil from the physical standpoint.

Summerland, B.C.—Soil: a medium clay loam 6 inches in depth over clay loam and clay. Tomatoes had been the crop in 1927. Sown April 21, pulled October 27. Spring cold to May 5, warm in May, Summer more than usual rain up to July 4, July very hot and dry, August warm and dry. Autumn fine weather, moderate temperatures, no rain.

		inch.
Precipitation:	April	1·57
	May	1·16
	June	1·48
	July	1·65
	August	0·23
	September	0·01
	October	0·39

These beets were exceptionally large; there was no forking and the roots were well formed, but with distinctly hollow crowns. The fairly high percentage of sugar may be regarded as satisfactory, considering the large size of the roots, but the purity is low—a factor which militates somewhat against profitable sugar extraction.

TABLE No. 46.—SUGAR BEETS GROWN ON THE DOMINION EXPERIMENTAL FARMS, 1928

Variety	Locality where grown	Percentage of sugar in juice	Coefficient of purity	Average weight of one root		Yield per acre	
			p.c.	lb.	oz.	tons	lb.
Buszczynski	Charlottetown, P.E.I.	19·28	88·41	1	14	11	1,871
	Kentville, N.S.	20·74	90·33	1	1	10	1,120
	Nappan, N.S.	21·01	89·13	..	14	11	504
	Fredericton, N.B.	19·93	88·74	1	4	13	906
	Lennoxville, Que.	17·39	87·06	1	14	10	300
	Cap Rouge, Que.	19·06	87·34	1	..	9	1,948
	Ste. Anne de la Pocatière, Que.	21·60	88·14	..	12	7	1,644
	Ottawa, Ont.	19·29	90·57	..	14	..	..
	Harrow, Ont.	19·28	89·00	1	2	11	23
	Kapuskasing, Ont.	16·69	82·00	..	10	3	1,680
	Brandon, Man.	19·05	87·56	1	15	12	1,806
	Morden, Man.	20·26	84·78	2	2	20	1,600
	Rosthern, Sask.	18·89	83·73	..	14	11	1,179
	Scott, Sask.	17·56	79·45	..	10	5	1,641
	Indian Head, Sask.	20·90	84·45	1	2	6	1,480
	Swift Current, Sask.	15·86	81·77	1	12	12	500
	Fort Vermilion, Alta.	20·65	85·96	1	1	9	1,440
	Lacombe, Alta.	13·73	74·49	8	12	7	430
	Lethbridge, Alta. (irrigated)	18·80	83·30	1	4	12	360
	Lethbridge, Alta. (non-irrigated)	17·71	84·76	..	14	5	1,280
	Agassiz, B.C.	16·37	84·63	2	8	16	256
	Sidney, B.C.	16·25	91·03	2	12	17	1,420
	Invermere, B.C.	23·31	89·56	..	13	..	1,505
	Summerland, B.C.	19·30	83·07	4	..	23	827
Dippe	Charlottetown, P.E.I.	18·65	88·12	2	..	14	227
	Kentville, N.S.	18·98	87·74	..	15	8	896
	Nappan, N.S.	19·22	87·74	..	15	14	301
	Fredericton, N.B.	19·93	88·74	1	4	15	521
	Lennoxville, Que.	17·06	85·41	2	1	12	..
	Cap Rouge, Que.	18·86	86·38	..	15	9	1,171
	Ste. Anne de la Pocatière, Que.	21·44	87·08	1	2	8	1,972
	Ottawa, Ont.	19·09	88·89	1	..	..	..
	Harrow, Ont.	18·80	92·04	1	1	11	599
	Kapuskasing, Ont.	17·25	82·92	..	8	3	640
	Brandon, Man.	18·28	86·64	2	6	14	682
	Morden, Man.	19·72	84·67	1	15	13	250
	Rosthern, Sask.	16·55	80·00	1	4	12	288
	Scott, Sask.	17·81	81·45	1	..	5	324
	Indian Head, Sask.	21·66	85·78	1	..	7	520
	Swift Current, Sask.	16·62	80·52	1	10	6	1,330
	Fort Vermilion, Alta.	20·92	85·53	1	3	13	280
	Beaverlodge, Alta.	21·35	81·19	1	2	6	625
	Lacombe, Alta.	15·28	77·80	..	15	7	430
	Lethbridge, Alta. (irrigated)	17·51	83·64	1	12	21	980
	Lethbridge, Alta. (non-irrigated)	16·85	82·19	..	13	5	500
	Agassiz, B.C.	16·41	84·84	2	4	15	555
	Sidney, B.C.	17·73	89·56	3	7	14	1,720
	Invermere, B.C.	22·82	89·04	1	0	..	1,715
	Summerland, B.C.	18·91	84·22	6	0	31	1,162
Fredericksen	Charlottetown, P.E.I.	18·55	87·06	1	13	12	1,265
	Kentville, N.S.	18·45	89·54	1	..	10	1,912
	Nappan, N.S.	19·14	89·19	1	..	14	301
	Fredericton, N.B.	19·00	90·05	1	4	15	243
	Lennoxville, Que.	17·16	84·39	1	12	10	200
	Cap Rouge, Que.	18·41	87·56	1	..	9	1,539
	Ste. Anne de la Pocatière, Que.	20·53	84·98	1	3	8	1,972
	Ottawa, Ont.	18·57	89·59	..	14	..	..
	Harrow, Ont.	18·05	88·39	1	3	13	933
	Kapuskasing, Ont.	16·54	82·94	..	10	3	1,040
	Brandon, Man.	18·14	86·84	2	5	14	1,480
	Morden, Man.	18·28	81·87	2	5	25	100
	Rosthern, Sask.	16·74	83·03	1	..	12	763
	Scott, Sask.	16·66	78·21	1	1	5	1,512
	Indian Head, Sask.	20·99	84·47	1	3	8	1,780
	Swift Current, Sask.	15·84	80·81	1	11	13	207
	Fort Vermilion, Alta.	20·84	86·06	1	3	11	1,400
	Beaverlodge, Alta.	22·52	83·70	1	..	5	1,861
	Lacombe, Alta.	15·64	77·32	..	11	6	1,390
	Lethbridge, Alta. (irrigated)	17·03	81·36	2	..	15	480
	Lethbridge, Alta. (non-irrigated)	16·75	81·72	..	13	5	600
	Agassiz, B.C.	16·74	86·58	1	13	11	491
	Sidney, B.C.	16·49	87·70	3	13	17	320
	Invermere, B.C.	22·60	88·90	1	..	..	1,920
	Summerland, B.C.	19·27	82·92	4	5	28	265

TABLE No. 46.—SUGAR BEETS GROWN ON THE DOMINION EXPERIMENTAL FARMS, 1928—*Concluded*

Variety	Locality where grown	Percentage of sugar in juice	Coefficient of purity	Average weight of one root		Yield per acre	
			p.c.	lb.	oz.	tons	lb.
Bielotzerkov	Charlottetown, P.E.I.	18·67	86·62	2	..	12	394
	Ste. Anne de la Pocatière, Que.	20·71	85·94	1	..	8	1,460
	Rosthern, Sask.	18·35	80·89	..	11	13	1,720
Kalnik	Charlottetown, P.E.I.	18·76	86·86	2	..	13	1,356
	Rosthern, Sask.	19·32	83·68	..	11	11	1,375
	Lethbridge, Alta. (irrigated)	18·17	83·10	1	14	11	1,860
	Lethbridge, Alta. (non-irrigated)	17·78	82·96	..	12	6	1,020
	Agassiz, B.C.	16·21	85·59	1	15	9	585
Kalnik, Z. No. 8	Charlottetown, P.E.I.	18·79	87·16	1	14	10	1,257
	Ste. Anne de la Pocatière, Que.	21·02	77·71	..	14	7	434
	Ottawa, Ont.	19·16	89·37	..	15	..	..
Niemertche	Charlottetown, P.E.I.	18·62	87·98	2	.	13	1,007
	Ottawa, Ont.	19·02	89·09	..	14		
	Lethbridge, Alta. (irrigated)	18·64	83·73	1	10	11	1,080
	Lethbridge, Alta. (non-irrigated)	17·65	83·14	..	13	5	1,700
	Agassiz, B.C.	15·84	83·66	1	15	9	522
Ramon	Charlottetown, P.E.I.	17·95	86·30	2	..	14	1,969
	Ottawa, Ont.	18·38	89·10	..	15		
	Lethbridge, Alta. (irrigated)	17·14	81·41	2	5	8	400
	Lethbridge Alta. (non-irrigated)	16·87	83·37	1	2	7	1,080
	Agassiz, B.C.	15·59	84·10	2	4	14	476
Vierchniatchka	Charlottetown, P.E.I.	18·54	87·32	2	5	12	916
	Brandon, Man.	17·94	85·11	2	10	13	757
	Rosthern, Sask.	19·16	83·01	..	13	12	420
Uladovka	Charlottetown, P.E.I.	18·07	86·18	2	..	13	1,007
	Ste. Anne de la Pocatière, Que.	20·92	88·55	1	3	9	65
	Rosthern, Sask.	18·55	81·77	..	12	14	1,568
Russian E. 10	Kentville, N.S.	17·39	85·41	..	11	4	1,768
Russian E. 28	Kentville, N.S.	19·31	89·97	1	1	7	1,048
7 E. 10	Nappan, N.S.	20·25	89·37	..	13	13	141
7 E.*	Lethbridge, Alta. (irrigated)	17·97	82·17	1	3	10	1,800
	Lethbridge, Alta. (non-irrigated)	16·97	82·28	1	4	7	580
4 No. 3	Nappan, N.S.	19·13	88·28	1	1	12	1,397
5 Z. 8	Nappan, N.S.	20·00	90·51	..	14	12	594
6 E. 4	Nappan, N.S.	19·41	91·22	1	4	14	224
9 N (Yaltoushkov)	Lethbridge, Alta. (irrigated)	18·95	84·31	1	1	15	380
	Lethbridge, Alta. (non-irrigated)	17·07	82·73	1	5	7	900
Sakharotrest No. 3	Kentville, N.S.	19·06	89·66	1	..	4	1,088
"	Brandon, Man.	18·80	86·40	2	..	13	180
" No. 4	Kentville, N.S.	18·26	87·36	..	6	5	560
"	Brandon, Man.	18·61	85·74	2	5	13	317
" No. 8	Brnadon, Man.	18·93	86·68	2	.	11	1,193
" No. 10	Brandon, Man.	18·37	85·51	2	5	13	1,912
Vladovsk	Brandon, Man.	16·96	83·33	2	7	13	1,720
Belatzebar	Brandon, Man.	17·59	85·49	2	..	14	1,645
Ivanosk	Brandon, Man.	19·54	87·24	2	2	12	1,118
Horning	Brandon, Man.	18·17	86·52	2	4	14	682
	Fort Vermilion, Alta.	20·17	84·61	..	11		
Home Grown	Brandon, Man.	18·52	88·20	1	2	13	757
	Fort Vermilion, Alta.	19·97	85·25	..	11		
	Beaverlodge, Alta.	22·97	87·34	..	14	5	1,940
Schreiber & Sons	Brandon, Man.	18·75	88·16	2	2	13	1,142
	Fort Vermilion, Alta.	20·58	84·94	..	13		
	Beaverlodge, Alta.	22·11	84·72	..	15	6	1,150
Raymond Seed	Lethbridge, Alta. (irrigated)	17·70	80·97	1	13	17	640
	Lethbridge, Alta. (non-irrigated)	17·03	81·89	1	2	6	100

Averages of "sugar in juice" and "coefficient of purity" of the three varieties—Dippe, Buszczynski and Fredericksen—as grown on the twenty-four Farms and Stations in this investigation in 1928 are presented in table No. 47.

TABLE 47—SUGAR BEETS: SUGAR IN JUICE AND COEFFICIENT OF PURITY: AVERAGES FROM THE SEVERAL VARIETIES GROWN ON 24 EXPERIMENTAL FARMS AND STATIONS THROUGHOUT THE DOMINION, 1928

Variety	Sugar in juice	Coefficient of purity
	p.c.	p.c.
Buszcyynski	18·87	80·80
Dippe	18·70	82·48
Fredericksen	18·35	79·80

The averages for sugar are distinctly higher than for the previous season, the data for coefficient of purity are, however, lower. The results indicate that the varieties sown are of high factory quality. It is perhaps significant that the beets from all three sources of seed were practically of equal quality.

The results in the following table (No. 48) present the average percentage of sugar in juice from beets grown from 1920 to 1928 inclusive at the several Farms and Stations of the Experimental Farm System. They permit a comparison of the quality of the beets as grown at a large number of points in the Dominion and indicate the variation which may take place from year to year at these points, due largely to changing seasonal conditions.

TABLE 48—AVERAGE PERCENTAGE OF SUGAR IN JUICE IN SUGAR BEETS GROWN ON DOMINION EXPERIMENTAL FARMS 1920–1928

Locality	1920	1921	1922	1923	1924	1925	1926	1927	1928
Charlottetown, P.E.I.	16·44	16·40	.....	18·67	19·23	19·30	17·80	17·91	18·82
Kentville, N.S.	18·36	18·06	18·72	20·43	24·71	18·08	20·33	18·66	19·39
Nappan, N.S.	18·01	18·08	18·45	17·61	16·98	19·49	18·41	.....	19·79
Fredericton, N.B.	18·34	18·09	16·61	15·60	21·42	19·19	15·48	17·86	19·62
Lennoxville, Que.	14·55	16·01	15·12	15·99	17·51	17·29	17·15	18·49	17·20
Cap Rouge, Que.	16·69	17·04	21·27	18·61	.....	20·17	19·11	22·80	18·77
Ste. Anne de la Pocatière, Que.	13·24	17·31	17·69	15·30	19·72	19·80	18·18	20·01	21·19
La Ferme, Que.	.....	.....	.....	.....	.....	.....	.....	16·65	.....
Ottawa, Ont.	15·04	15·61	16·44	16·16	16·36	15·57	16·92	17·08	18·98
Kapuskasing, Ont.	.....	.....	.....	.....	.....	.....	15·73	16·52	16·82
Harrow, Ont.	.....	.....	.....	.....	.....	.....	.....	18·99	18·71
Brandon, Man.	15·24	16·82	14·14	12·19	13·36	.....	13·16	14·51	18·49
Morden, Man.	.....	.....	.....	.....	.....	.....	9·44	14·17	19·42
Rosthern, Sask.	14·15	13·56	17·27	13·13	14·19	14·27	17·95	14·37	17·72
Scott, Sask.	15·74	15·79	17·25	19·21	15·71	14·18	12·58	12·92	17·34
Indian Head, Sask.	20·24	.....	19·70	20·12	17·10	16·52	15·73	12·54	21·18
Swift Current, Sask.	.....	.....	.....	.....	.....	.....	16·05	18·06	16·10
Fort Vermilion, Alta.	.....	14·47	16·00	14·32	13·01	16·11	12·28	19·74	20·80
Beaverlodge, Alta.	.....	15·77	.....	19·16	.....	.....	13·45	13·70	.....
Lacombe, Alta.	12·86	13·84	15·77	.....	.....	12·25	9·26	15·13	14·88
Lethbridge, Alta. (Irrigated)	18·34	17·99	17·04	17·21	18·85	17·28	15·34	17·86	17·78
Lethbridge, Alta. (non-irrigated)	19·35	16·63	17·57	15·92	.....	15·04	15·23	20·50	17·10
Agassiz, B.C.	16·46	15·78	16·67	17·62	16·75	.....	14·94	15·44	16·50
Sidney, B.C.	14·29	.....	.....	16·67	14·90	18·74	16·38	17·22	16·82
Invermere, B.C.	19·26	15·78	17·56	20·02	17·44	21·96	15·84	.....	22·91
Summerland, B.C.	16·85	20·03	17·36	16·92	20·08	21·33	14·96	20·49	19·16

CO-OPERATIVE WORK WITH SUGAR BEETS

PRINCE EDWARD ISLAND, 1928

Field tests with sugar beets were carried out on six of the Illustration Stations of Prince Edward Island during the past season, the work being under the direction of the Superintendent, Experimental Station, Charlottetown. One variety of seed—Dippe—was used and was from the same stock as that used on Experimental Farms and Stations. The results are presented in table No. 49. The soil generally was sandy loam overlying a gravelly brick clay.

TABLE 49—SUGAR BEETS GROWN IN CO-OPERATION WITH ILLUSTRATION STATIONS, P.E.I., 1928—VARIETY: DIPPE

Grower	Locality	Percentage of sugar in juice	Coefficient of purity	Average weight of one root	
			p.c.	lb.	oz.
S. P.	Palmer Road	19·32	86·32	1	3
A. G.	Glenwood	18·36	83·28	–	11
M. M.	Rose Valley	18·79	87·32	–	14
C. M.	St. Peters	18·05	89·71	–	4
F. M.	Montague	19·25	89·54	–	13
A. M.	Wood Islands	18·86	89·25	–	4

These beets were very small, indicating too light a yield for profitable culture. Further, they were poorly grown, being variable as to size and forked.

The data for sugar and purity are in very fair accord with those from the beets grown on the Experimental Station, Charlottetown, and indicate that, as far as these factors are concerned, the beets are of good quality.

SACKVILLE, N.B., AND AMHERST, N.S., DISTRICTS

In 1928 a small co-operative experiment in the growing of sugar beets was carried out by seven farmers living in the Sackville and Amherst districts. One variety of seed—Dippe—was tried out.

The soil generally was medium to light clay loam with gravel subsoil for those grown in the Sackville district. The seed was sown in the first week in June and the crop harvested the last week in October and the first week in November.

TABLE 50—SUGAR BEETS GROWN IN CO-OPERATION WITH FARMERS IN SACKVILLE AND AMHERST DISTRICTS, 1928

VARIETY: DIPPE

Grower	Locality	Percentage of sugar in juice	Coefficient of purity	Average weight of one root	
			p.c.	lb.	oz.
E. M. S.	Cumberland, N.S.	19·63	89·23	1	15
H. M.	Sackville, N.B. district	18·79	86·58	2	1
J. W. O.	" "	19·60	89·52	1	–
C. I.	" "	19·47	90·57	–	8
Ed. M.	" "	19·23	86·88	1	10
H. A.	" "	22·39	89·91	1	–
R. S.	" "	20·14	91·85	–	11

The large number of the roots were of good size and shape; a few were forked and had hollow crowns.

One sample (E.M.S.) was slightly soft and wilted; this would raise the sugar content somewhat.

The sample H.A. was very soft; the wilting was reflected in the very high percentage of sugar obtained.

Apparently many of the co-operators held their beets too long after digging under conditions that resulted in wilting.

The beets of R.S. were very hard and firm.

Considered as a series the results indicate an excellent quality of beets, both as to sugar and purity. The seasonal conditions evidently were favourable to good growth and the proper ripening of the beet.

INSECTICIDES AND FUNGICIDES

The investigations under this heading are carried on partly in the laboratory of the Division of Chemistry at Ottawa and partly in co-operation with the Entomological Branch of the Department of Agriculture, chiefly through their various Branch Stations.

At the Entomological Branch Station at Annapolis Royal, N.S., the work included further researches on the combined lime sulphur-aluminium sulphate spray for the purpose of broadening our data in connection with the use of this spray under adverse weather conditions; investigations on Bordeaux Oil Emulsions and studies on the adherence of sulphur to apple foliage and arsenic to forest foliage. These latter experiments were conducted to ascertain the "spread" of the dusting and to determine arsenical residues remaining from the aerial dusting of forests in Northern Ontario.

In co-operation with the officer in charge of the Entomological Station at Vineland Station, Ont., various experiments were undertaken to increase the suspension and adherence of siliceous earths, such as talc, china clay, infusorial earth, bentonite and diatomite to be used in control measures against the Oriental Peach Moth.

In co-operation with the Pollination Committee special experiments were conducted in the orchards of the Annapolis Valley to obtain information respecting non-set of fruit. Of the large number of problems under review those dealing with the effect of the poison spray and dusts on the mortality of the honey bee and wild bee were the most interesting. In the orchard of the Experimental Station at Kentville some sixteen cages were erected over apple trees which had been treated with practicable combinations of spray and dust insecticides and fungicides. A hive of bees was placed in each cage, the bees then liberated and allowed to work the treated bloom. Daily records of the dead and dying bees were taken and the bees later analyzed with a view to shedding light on which sprays or dusts were the most poisonous or repellent. This problem is still under review.

Chemical and physical examinations of many of the materials used in the field work were undertaken, a number of which are discussed briefly as follows:—

ARSENATE OF LIME

Lab'y Nos. 93346-47 and 96804.—Three samples of arsenate of lime were analyzed and found to satisfactorily meet their guarantee; when admixed with Bordeaux mixture they liberated only a trace of soluble arsenic. They are well made and stable preparations.

ANALYSIS OF ARSENATES OF LIME, 1928-29

Lab'y No.	Source of sample (manufacturer)	Vendor or submitter	Relative density	Arsenic as metallic As		Moisture
				Total	Water Soluble	
			cu. in. per lb.	p.c.	p.c.	p.c.
93346	Deloro Chemical Co., Deloro, Ont.	Associate Dominion Entomologist, Ottawa.	87	27·22	0·04	1·73
93347	John Cowan, Chemical Co., Montreal.	"	54	28·50	0·10	1·29
96804	Lucas Kil-Tone Co., Vineland, N.J.	Entomologist-in-charge, Vineland Station, Ont.	52	27·64	0·33	.....

ARSENATE OF LEAD

Lab'y No. 96309.—One sample was analyzed; it was well prepared and met its guarantee.

Lab'y No.	Manufacturer	Vendor or submitter	Arsenic as metallic As		Lead Oxide (PbO)	Moisture
			Total	Water soluble		
			p.c.	p.c.	p.c.	p.c.
96309	General Chemical Co., San Francisco, Cal.	British Columbia Orchards, Ltd., Kelowna, B.C.	20·61	0·04	63·99	0·13

SULPHUR PREPARATIONS

Lab'y Nos. 93428-30.—Three samples were submitted to analysis; sample No. 93430 was a clear solution while in samples Nos. 93428 and 93429 one-fifth and one-fourth respectively of the samples was sediment.

ANALYSIS OF LIME SULPHUR CONCENTRATES, 1928-29

Lab'y No.	Manufacturer	Vendor	Total sulphur	Sulphide sulphur	Degrees Beaumé
			p.c.	p.c.	(at 20° C.)
93428	Fruit Growers' Association, Ste. Hilaire, Que.	Provincial Entomologist, Province of Quebec.	20·20	16·28	30·2°
93429	" "	" " "	20·06	16·27	30·2°
93430	Niagara Brand Spray Co., Burlington.	" " "	25·18	23·69	32·1°

SULPHUR POWDER

Lab'y No. 96555.—Sulphur mixture, stated to be extracted from liners in a rubber factory. This sample was a greyish yellow, somewhat "tacky", fine powder containing a rather large amount of cotton fibre. The numerous small fibres in the preparation would render it unsuitable for use in spray or dust apparatus, but for small scale plots the sulphur could be dusted on the foliage by sifting through a canvas sack.

ANALYSIS

	p.c.
Sulphur (free)	82·80

NICOTINE PREPARATIONS

Lab'y Nos. 93959-93960.—Solutions of Nicotine Sulphate and Free Nicotine manufactured respectively by The Tobacco By-Products and Chemical Corporation, Inc., Louisville, Ky., and Nicotine Manufacturing Co., St. Louis; submitted by The International Tobacco Co. of Canada, Toronto. The samples were up to guarantee.

ANALYSIS

	Lab'y No. 93959 (Black Leaf 40)	Lab'y No. 93960 (Nikoteen)
	p.c.	p.c.
Nicotine (as alkaloid)	40·11	31·97

Nicotine Extract

Lab'y No. 97257.—A nicotine extract received from the Cooper Leaf Tobacco Company, Wallaceburg, Ont.

ANALYSIS

Specific gravity (at 20° C.)	1·201
Nicotine (as alkaloid)	4·06 per cent

Nicotine Dust

Lab'y No. 97393.—Nicotine Dust, submitted by H. K. Bentley, Lakeville Fruit Co., Centreville, N.S. to ascertain if it were up to strength.

ANALYSIS

Nicotine (alkaloid)	1·56 per cent

The analysis indicated the dust to be below strength (2 per cent). It was fortified for use by mixing with the required quantity of "Black Leaf 40" to again bring it to a 2 per cent nicotine strength.

TOBACCO WASTE

Lab'y Nos. 96890-91.—Medium quality tobacco and tobacco trash respectively, received from a grower in Oliver, B.C., to ascertain if the waste tobacco could be used in the preparation of tobacco extracts for spray purposes.

ANALYSIS

	Lab'y No. 96890	Lab'y No. 96891
	p.c.	p.c.
Nicotine (alkaloid)	2·14	1·59
Moisture	7·45	6·82

The ground "tobaccos" were added to warm water at the rate of 1 pound to 2 gallons of water, agitated and allowed to stand for four hours. Nicotine found in the filtrate was 0·108 and 0·068 per cent respectively. The nicotine content is within the range desired for spray purposes. The preparation of extracts of this nature are suitable for small scale operations; for large scale operations the time necessary for their preparation would offset any monetary advantages. The extracts would have to be freshly prepared as fermentation takes place in several days time resulting in a lowering of the nicotine content.

OILS

Lab'y Nos. 96362-96742.—Oils to be used in the preparation of sprays, submitted by the officer in charge, Vineland Entomological Station, Ont. The oils were to be used in the preparation of dormant and delayed dormant sprays for the control of various insects. Data with respect to volatility and oil constants are presented on Tables 51 and 52.

TABLE 51.—OIL VOLATILITY

Lab'y No.	Brand	Volatility on asbestos sheets 3 inches square								
		First day	Second day	Third day	Fourth day	Fifth day	Sixth day	Seventh day	Tenth day	4 hours at 100°C
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
96362	Imperial Junior Red	10·13	16·53	21·75	23·97	25·46	31·64	33·07	38·54	0·06
96363	Imperial Solar Red	6·86	10·78	12·07	15·60	17·63	22·23	23·81	29·48	0·05
96364	Imperial Diamond Paraffin	36·54	53·62	62·32	67·53	69·79	74·07	75·53	79·88	0·36
96398	Enarco Spray Paraffin	12·51	20·81	25·77	29·46	32·86	41·59	42·49	47·18	0·01
96655	Transport Spray Soluble	33·98	41·56	45·34	49·24	50·04	51·27	53·73	53·73	1·95
96656	Transport Spray Oil A	10·78	15·76	20·05	24·67	26·65	29·46	31·24	33·72	0·14
96657	Transport Spray Oil B	21·72	33·01	40·00	46·02	50·77	55·99	60·84	61·80	0·38
96741	Sun Golden XCII	27·37	33·68	40·78	46·72	49·63	53·30	56·01	56·81	0·58
96742	Sun Golden XCIII	18·84	26·88	32·74	38·53	40·63	44·79	47·95	48·48	0·24

This table expresses percentage volatility by two different methods—the percentage loss when the oil is heated at a constant temperature of 100-105° C. for four hours (the former method of expressing volatility) and the daily percentage loss by the new method when ± ·5 gram of the oil is heated at 100° C. This latter method tends to a much finer differentiation.

TABLE 52.—OIL CONSTANTS OTHER THAN VOLATILITY

Lab'y No.	Producer	Reaction (to litmus)	Specific gravity at 20° C.	A.P.I. at 20° C.	Sulphonation-per cent oil unsulphonated	Viscosity (Saybolt at 100° F.)
					p.c.	seconds
96362	Imperial Oil Co. Ltd., Sarnia	Neutral	0·907	25·0	76·0	251
96363	" "	"	0·907	24·8	72·0	321
96364	" "	"	0·891	28·0	74·0	96
96398	Canadian Oil Co., Ltd	Acid	0·899	26·5	84·0	208
96655	Transport Oil Co., Toronto	Alkaline	0·953	17·5	59·0	1,950
96656	" "	Neutral	0·895	27·0	79·0	189
96657	" "	"	0·883	29·0	83·0	101
96741	Sun Oil Co., Toronto	Acid	0·926	21·5	87·5	226
96742	" "	"	0·932	20·5	84·0	309

HARBAS

Lab'y No. 93404.—Harbas (red spraying oil): Submitted by the Dominion Entomologist and the product of Messrs. R. A. Harris & Co., Sydney, N.S.W.

This product was advertised as "a self-emulsifying oil; mixes with cold water; keeps fruit trees healthy."

ANALYSIS

	per cent.
Water (Xylene method)	17·3
Oils*	79·7
Ash	3·2

*Oils comprise:—

	per cent
Hydrocarbons (rosin, oil, tar oil, etc.)	55·8
Phenols (cresols and higher homologues)	4·3
Fatty and rosin acids	19·5

A red coloured, practically clear oil emulsion, strongly alkaline, comprising oils, cresols and potassium carbonate. It dilutes readily with cold water giving a miscible oil emulsion.

LITHOL

Lab'y No. 96581.—A product of the Lithol Company, London, Ontario, and received from the Seed Branch, Ottawa. "To be applied to the heel and back of cattle to keep insects away," stated however that it would not kill flies.

As received it was a dark coloured liquid, readily separating into two layers and analysis showed it to be crude oil, water, and Oil of Mirbane. No blistering occurred when young heifers were given a practical application as recommended.

BAITS

Lab'y No. 95460.—Bran and Sodium Fluoride, placed in soil May 29, taken out of soil October 18. Lab'y Nos. 95459, 96475, Bran and Sodium Fluosilicate, placed in soil May 29, taken out of soil October 18. Lab'y No. 96476: Bran and Sodium Fluosilicate, part of original mixture before placing in ground. These samples were received from the Entomological Branch Station at Vernon, B.C. and comprised material used in experiments toward cutworm control. The recovered bran-sodium fluosilicate bait was still toxic to white grubs after having been in the soil for 4½ months.

ANALYSIS

Lab'y No.	—	—	Sodium fluoride (NaF)	Sodium fluosilicate (Na_2SiF_6)
			per cent	per cent
95460	Bran and sodium fluoride	Recovered bait	1·30	.....
95459	Bran and sodium fluosilicate	Recovered bait	.....	3·71
95475	Bran and sodium fluosilicate	Recovered bait	.....	4·11
95476	Bran and sodium fluosilicate	Unused bait	.....	5·39

PULVEX

Lab'y No. 95213.—Submitted by the Canadian Co-operative Wool Growers Association Toronto and manufactured by Wm. Cooper, Nephews Co.

As received, a whitish coloured impalpable powder, slightly alkaline to litmus, slight effervescence with acid. It is a mixture of powdered derris and a siliceous earth.

COPPER-SULPHUR-TOBACCO DUST

Lab'y No. 97533.—Submitted by the Senior Pathologist in Charge, St. Catharines, Ont., and a product of the Hammond Slug Shot Works, Beacon, N.Y.

Reported to be superior to the usual copper-sulphur dusts, and particularly recommended for grape and rose mildew.

ANALYSIS

	per cent
Sulphur (free)	66·15
Copper (as metallic Cu)	0·40
Arsenic (as metallic As)	0·04
Water Soluble arsenic (as metallic As)	trace
Nicotine (as alkaloid)	0·078

It is a mixture of finely ground tobacco, sulphur and copper sulphate with lime.

ALUMINIUM SULPHATE

Lab'y No. 97530.—Sample submitted by W. J. Tawse, Montreal and a product of Dillons, Ltd., Montreal.

ANALYSIS

	Found per cent	Guaranteed per cent
Aluminium oxide (Al_2O_3)	16·5	17
Sulphur trioxide (SO_3)	38·7	.....

The sample was a very fine powder and as guaranteed. When aluminium sulphate is so finely ground that it is of the nature of an impalpable powder, it has a tendency to cake thus retarding solution. Later work has shown that aluminium sulphate dissolves readily when not too finely ground.

FEEDING STUFFS

During the year 100 samples of feeding stuffs have been submitted to analysis. These comprise feed wheats, brans, shorts, middlings, feed flours, oats and oat products, barley and barley products, corn and corn products, Purina feeds, poultry feeds, oil cake meals, meat and fish products, hay meals, and a number of milling and industrial by-products and compounded feeds of a miscellaneous character. The analytical data of these feeds are presented in table 53, and in the following text a brief report of each sample as to quality, etc., is given.

FEED WHEAT

Lab'y No. 93323.—From the C. L. Milling Co., St. Chrysostôme, Que. Received as a fine meal; sweet and wholesome. The fibre is somewhat high, indicating the presence of a certain small amount of chaff or similar material. Otherwise the data are in accord with those of wheat of fair quality.

Lab'y No. 95758.—Grown on Experimental Station, Rosthern, Saskatchewan. This "feed" wheat is an uncleaned sample, containing a considerable amount of chaff and broken straw, and in consequence has a high fibre content. It has an excellent protein content but is somewhat low in fat.

Lab'y Nos. 96026-7.—From C. R. V. & Co., Toronto, per Animal Husbandry Division, Grade No. 6. The submitted sample (96027) is a good-coloured, clean, fairly plump wheat with traces only of foreign matter, oats, chaff, etc. The sample collected from car as purchased (96026) is much darker in colour (greenish, indicating immaturity), less uniform as to berry containing a larger proportion of shrivelled kernels and the percentage of foreign matter (chiefly oats) is very slight but appreciably higher than in the submitted sample. The protein data indicate that the sample as taken from the car is somewhat the superior of the sample submitted.

Lab'y No. 96352.—Grade No. 5, A. A. H., Kemptville, Ont. Of fair quality; if price were satisfactory this ground wheat could be advantageously used in the meal ration of home grown "chop" to bring up the protein ratio.

Lab'y Nos. 96424-5.—"Feed" wheat (No. 96424) and grade No. 6 (96425). Crop of 1928. The "Feed" sample contained 9·07 per cent of chaff; No. 6 contained 1·54 per cent. This chaff content is reflected in the analysis, the No. 6 grade wheat being the superior by reason of higher protein and lower fibre.

Lab'y Nos. 96434-5.—These two samples—whole and ground—were stated to be from the same stock of "feed" wheat. The analyses are sufficiently close to support this statement. They are those of average quality wheat of this grade.

BRAN

Lab'y No. 93156.—This sample, stated to be the product of the Robin Hood Mills Co. was thought by the correspondent to be of inferior quality. It practically meets the standards in protein and is quite satisfactory as to fat and fibre. Examination however showed that it was made from improperly cleaned wheat.

Lab'y No. 95620.—This sample is too low in protein and too high in fibre to meet the requirement of the standards.

Lab'y No. 96698.—Of good quality, meeting the standards satisfactorily; although a trifle low in protein it is better than the requirements in respect to fat and fibre.

SHORTS

Lab'y No. 93455.—Possibly made from winter wheat as it is somewhat low in protein. It is quite satisfactory as to fat and fibre.

Lab'y No. 95615.—A little low in protein (possibly due to being made from winter wheat) but fully meeting the standards in respect to fat and fibre.

MIDDLINGS

Lab'y No. 95108.—These middlings very fully meet the requirements of the Act in respect to protein and fat but are a little too high in fibre.

Lab'y No. 95109.—A good quality of middlings but not quite meeting the standards in respect to protein and fibre.

FEED FLOUR

Lab'y No. 93344.—A very finely ground floury meal; yellowish white; sweet and sound. Somewhat below the average in protein for feed flours but otherwise quite satisfactory.

OATS AND OAT PRODUCTS

Lab'y No. 93150.—From stock used in feeding experiments by the Animal Husbandry Division. Agrees very well with the average data for Grade No. 1 feed oats.

Lab'y No. 94511.—This sample is of special interest, being chop from hulless oats (Laurel). It differs from the chop of ordinary oats in having a much higher protein content and only about one-third the fibre.

Lab'y No. 95612.—Oats grown on Experimental Farm, Ottawa. The data indicate that these oats are of fair quality only; the protein is somewhat low and the fibre (hull) high for the best grade.

Lab'y No. 96468.—A botanical examination of these "oat scalpings" showed it to consist of

	per cent
Wild oats	88
Cultivated oats	8
Barley	2
Wheat	1
Traces of Ergot and chaff	1
	100

In protein and fat these scalpings compare well with oat chop but are much higher in fibre and therefore have a decidedly lower nutritive value. The amount of ergot present is not sufficient to impart any injurious quality to the feed.

Lab'y No. 96699.—This sample of ground oats is of fair grade only; it is too low in protein and high in fibre for oats of the highest quality.

BARLEY AND BARLEY PRODUCTS

Lab'y No. 94512.—But few analyses of hulless barley are on record; this sample (Himalayan) was grown at Rosthern, Saskatchewan, of the crop of 1927; it is a more nutritious feed than ordinary barley, being from 2 to 3 per cent higher in protein and about 2·5 per cent lower in fibre.

Lab'y No. 95613.—Barley grown on Experimental Farm, Ottawa, crop of 1928. It is a good sample, the percentage of protein being decidedly above the average for this cereal.

Lab'y No. 95759.—This sample of "feed" barley, from Saskatchewan, was found on examination to be a mixture of barley and shrivelled wheat, with a small percentage of chaff, etc. The wheat present has raised the percentage of protein and thus given the sample a somewhat higher nutritive value than barley alone. The percentage of fibre is high, due to the presence of a small amount of chaff and straw.

CORN AND CORN PRODUCTS

Lab'y Nos. 93527-531.—These five corns (American and Argentine) were submitted by the Poultry Division, to ascertain their relative nutritive value. In addition to the chemical analysis the weight of kernel was taken.

Lab'y No.	Variety	Weight of 1,000 kernels in grams.
93527	North Dakota white flint	283·8
93528	Minnesota No. 13 yellow dent	251·0
93529	Disco, 90 days white dent	284·1
93530	Longfellow—grown in Wisconsin—Yellow Flint	264·0
93531	Argentine	245·4

With respect to protein content the variety Disco, 90 days white dent, is the richest with the Argentine grown corn ranking second. The remaining three, North Dakota, Minnesota No. 13, and Longfellow, fall into a third class—all being practically equal.

In oil or fat North Dakota and Argentine contain somewhat higher percentages than the remainder of the series—between the members of which the differences in oil content are practically negligible.

It is doubtful if the differences in fibre are significant but Disco is somewhat the highest in this constituent, which presumably might be interpreted as indicative of a slightly thicker integument or skin.

In weight of kernel North Dakota and Disco (equal) are the heaviest, Longfellow second, with Minnesota No. 13 and Argentine the lightest.

Lab'y No. 93189.—The results of this analysis indicate that the Hominy Feed is of fair quality. Microscopical examination shows that this sample contains traces of wheat, oats and weed seeds; also a considerable amount of germ tissue—which accounts for the high fat content.

Hominy feed is a palatable, wholesome feed, fairly rich in protein and with a high fat content. It is much relished by stock and has been used extensively and satisfactorily in the United States in the feeding of dairy cows and swine.

Lab'y No. 96697.—This analysis is in accord with that of ground corn of good average quality.

PURINA PRODUCTS

Feeds on the market bearing the brand "Purina" are the product of the Ralston Purina Company of Canada, Ltd. of Woodstock, Ontario.

Lab'y No. 93148.—Bulky-Las, a coarse bulky cow feed, said to contain bran, dried beet pulp, molasses, alfalfa meal and iodized salt. This is a low-protein product, and though probably a palatable feed it is distinctly inferior to

ground oats (the chief ingredient of the farm-grown "chop") compared with which it is lower in protein and fat and higher in fibre. It satisfactorily meets its guarantee, which calls for protein 8·5 per cent, fat 1·0 per cent and fibre 16·0 per cent.

Lab'y Nos. 93149, 93324, 95484.—These are samples of the product Omcline and from stock used in feeding experiments by the Animal Husbandry Division.

This is a horse feed to be used in the place of oats and stated to be composed of oats, corn, alfalfa meal, linseed meal, molasses and salt. It carries a guarantee of protein 9·7 per cent fat 3·2 per cent and fibre 10 per cent. In all three samples the guarantee is very fully and satisfactorily met.

Lab'y No. 93269.—Purina Chick Startena Feed. Although a trifle low in protein, it otherwise meets its guarantee—protein 19 per cent, fat 4·0, fibre 7·0—very satisfactorily.

Lab'y Nos. 93345, 95485, 93410.—Purina Pig Chow Feed. A high protein concentrate, with a desirable percentage of fat and a comparatively low fibre content. Both these samples satisfactorily meet their guarantee.

Lab'y No. 95212.—Purina Chicken Powder. This is a high protein feed. Though a little high in fibre it may be said to satisfactorily meet its guarantee—protein 19 per cent, fat 3·0 per cent, fibre 8·0 per cent.

POULTRY FEEDS

Lab'y No. 93191.—This "Chick starter" is characterized by good percentages of protein and fat; the low fibre content is also in its favour.

Microscopical examination showed it to be composed of bran, shorts, ground corn, oat groats, meat meal, bone meal, powdered milk, ground wheat and salt.

Lab'y No. 93393.—A finely ground, rather greyish coloured meal, apparently sweet and wholesome. It is fairly high in protein and fat, with a comparatively low fibre content. The ash (mineral) content seems to be somewhat higher than desirable for very young chicks.

The microscopical examination shows corn meal, ground oat groats, feed flour, alfalfa meal, fish meal, bone meal, buttermilk, finely ground shell, charcoal and salt.

Lab'y No. 93797.—This "egg mash" consists of bran, shorts, ground oats, ground barley, corn meal, alfalfa meal, beef meal, bone meal, charcoal and salt. Though the percentage of fibre is somewhat high for a poultry feed, it is probably a nutritious feed, as the percentages of protein and fat are quite satisfactory. It carries a guarantee of protein 17 per cent, fat 4·0 per cent, fibre 7·5 per cent; this it very well meets except in regard to protein, which is almost 1·00 too low.

Lab'y No. 93798.—This "chick starter" mash fairly well meets its guarantee, though a trifle low in protein. It is stated to consist of corn meal, middlings, powdered milk, bone meal, pearl grit and salt.

It may be noted that this feed differs from most of the brands of "chick mash" on the market, in a lower protein content presumably due to the absence of a meat product. The most desirable proportion of protein in a mash for very young chicks is as yet undetermined. The very low percentage of fibre in this feed is undoubtedly a commendable feature.

Lab'y No. 94335-36.—The chick "starting" mash is of excellent quality and very well meets its guarantee. The "Growing" mash is considerably below its guarantee in protein, but is otherwise quite satisfactory.

Lab'y Nos. 94863-4.—These are two brands of "Laying Mash," respecting which we were unable to procure information from our correspondent as to the manufacturer. In chemical composition these two mashes do not greatly differ: No. 94863 is however somewhat the better, by reason of a slightly higher protein content and a lower percentage of fibre. They are both high protein feeds and of excellent quality.

Lab'y No. 94982.—This "Laying Mash" was made up according to the following formula: Bran 300 pounds, shorts 200 pounds, corn meal 200 pounds, ground oats 100 pounds, middlings 100 pounds, beef scrap 100 pounds, fish meal 100 pounds, ground alfalfa 50 pounds, linseed 20 pounds, charcoal 25 pounds, salt 7 pounds, sulphate of iron 2 pounds.

On submitting this analysis and formula to the Poultry Division, the comment was made that the percentage of fibre was too high for an ideal mash. It was suggested that middlings be substituted for shorts and the proportion of bran might be advantageously reduced. With these changes and using a "scratch mash" of low fibre content, this formula would make a very satisfactory mash. It is preferable to feed granulated charcoal and any other constituent in large particles, in separate hoppers.

Lab'y No. 95211.—This "Sunbeam" laying mash is quite similar in composition to Lab'y No. 94982. It is a trifle high in fibre but otherwise meets its guarantee.

Lab'y No. 96510.—The guarantee of this laying mash is protein 18·0 per cent, fat 4 per cent, and fibre 4·5 per cent. Our analysis shows that it very satisfactorily meets its guarantee.

Lab'y No. 96511.—This home-mixed laying mash was made up as follows: ground corn 700 pounds, ground wheat 200 pounds, fish meal 100 pounds, beef scrap 50 pounds, charcoal 25 pounds, cod liver meal 30 pounds, alfalfa meal 46 pounds, iodized salt 18 pounds, carbonate of lime 30 pounds. The analysis indicates a mash of good average quality; it is however a little lower in protein than many of the brands on the market.

Lab'y No. 97072.—This is also a home-mixed laying mash. It is made up as follows: ground oats 200 pounds, bran 200 pounds, middlings 200 pounds, ground corn, 200 pounds, and beef scrap 100 pounds. This is an excellent mash, with very fair percentages of protein and fat and a comparatively low fibre. The beef scrap, in addition to furnishing animal protein contributes about 6 per cent of bone phosphate—a useful constituent.

OIL CAKE MEALS

Lab'y No. 95618.—The guarantee for this brand is protein 35·0 per cent, fat 6·5 per cent, fibre 7·5 per cent. It meets this guarantee very well in all particulars.

Lab'y No. 96456.—This sample though of the same brand as No. 95618 is not quite so high in protein and further, contains a slightly higher percentage of fibre.

Lab'y No. 96467.—Although genuine and sound this sample is distinctly low in oil—the constituent in oil cake meal which imparts to this concentrate a highly valued quality, especially when used in calf feeding.

Lab'y No. 96700.—This sample is scarcely equal to the average for this concentrate; it is distinctly low in protein and oil and high in fibre, when compared with the best brands on the market.

MEAT AND FISH PRODUCTS

Lab'y No. 95616.—" Tankage 45 per cent." The guarantee of this brand is protein 45 per cent, fat 6·0 per cent. It greatly exceeds its guarantee in protein and is well above the requirement in fat. It contains 17·86 per cent bone phosphate.

Lab'y No. 85617.—" Tankage 60 per cent." This brand well meets its guarantee in protein and fat and contains approximately 14·0 per cent bone phosphate. Guarantee: protein 60 per cent, fat 6·0 per cent.

Lab'y. No. 95757.—The guarantee of this brand is protein 50 per cent, fat 6·0 per cent. It exceeds this guarantee in respect to protein by 17 per cent. It contains 8·78 per cent bone phosphate.

Lab'y No. 96834.—Guarantee: protein 50 per cent, fat 6·0 per cent. This sample is slightly below its guarantee in protein; in fat it is very high, containing more than double the amount called for by the guarantee. Of bone phosphate—an important constituent in feeds of this character—it contains 23·48 per cent.

Lab'y No. 96835.—Guarantee: protein 50 per cent. This sample exceeds its guarantee by 6·65 per cent. It has a high fat content and contains 18·20 per cent bone phosphate.

Lab'y No. 96873.—A fish meal of excellent quality, rich in protein (nearly 70 per cent) and in bone phosphate (11·49 per cent). It has a comparatively low fat content, a favourable factor towards good keeping qualities.

HAY MEALS

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

Lab'y No. 94125.—This hay meal was from alfalfa (whole plant), first cut, in full bloom; dried immediately and ground. It has a bright green colour, which indicated a crop in good condition, well cured.

These data are those of an alfalfa meal of first class quality; the protein ranks with the highest recorded and the fibre is by no means excessive. The ash, 8·51 per cent, contains potash (K_2O) 2·51 per cent, phosphoric acid (P_2O_5) ·82 per cent and lime (CaO) 2·18 per cent.

Lab'y No. 95619.—This is not among the good grades of alfalfa meal, though it might be considered of fair quality; the protein is too low and the fibre too high.

Lab'y No. 95680.—This clover meal is of a poor, coarse, fibrous quality, very low in nutritive properties. For use in poultry feeding this must be considered as unsuitable and practically useless.

Lab'y No. 97073.—This is a brown, finely ground meal. The analysis indicates that it is of very poor quality. The " ash " 29·43 per cent contains 23·56 per cent of sand.

MISCELLANEOUS

Lab'y No. 93188.—This is an American "dog food" (Ken-L-Ration) put on the Canadian market as suitable for fox feeding. It appeared to be a mixture of meal and biscuit or bread. This is a low protein food, moist (the percentage of water is practically that of meat), free from preservatives, apparently sound and wholesome.

Lab'y No. 94434.—This dog biscuit of the brand "National" was forwarded for analysis by Officer Commanding G. Division R.C.M.P., Edmonton, Alta. A dark brown biscuit with a fairly thick crust and on fracture showing meat fragments. The biscuits are of good quality, sound and wholesome.

Lab'y No. 93192 and 93395.—These are samples of dried pomace from the manufacture of cider. This material is a coarse mixture of the skins, seeds, cores, stems, etc., of apple waste. Odour, not unpleasant; no trace of mould or fermentation and apparently wholesome. Attention may be called to the variable moisture content.

Apple pomace is a low protein high fibre feed and the fact must not be overlooked that it contains skins, seeds and cores which are largely indigestible and which for the most part must pass through the animal unattacked.

Lab'y No. 94600.—This sample of distiller's dried grains from corn is rather lower in protein than many of the samples previously analysed in these laboratories.

Lab'y No. 97239.—A somewhat richer sample of corn grains than No. 94600, being roughly 2 per cent richer in protein and 1 per cent in fat.

Lab'y No. 96457-8.—Palm kernel products from the British Oil and Cake Mills Ltd., England. Both satisfactorily meet their guarantee. The "meal" differs from the "cake" in a higher protein and a lower fat content. Though little known as a feeding stuff in Canada, it has a good reputation in Europe as a palatable and fairly digestible cattle feed.

Lab'y Nos. 96904 and 97262.—Whole and ground samples of Sweet Clover Seed. These were from old seed which had lost its germinating power and in consequence was put on the market (ground) as a feeding stuff. The data for the two analyses are practically identical and indicate that this material may be regarded as a high protein concentrate, with moderate percentages of fat and fibre. The coumarin content was 0·50 per cent, an amount not likely to affect the palatability of the seed as a feeding stuff. A preliminary feeding trial by the Animal Husbandry Division using the ground seed to the extent of 10 per cent of the meal ration, was made with satisfactory results.

Lab'y Nos. 94665 and 95216.—Samples of weed seeds from thresher from neighbourhood of Kemptville, Ont. The botanical separation of these samples is as follows:—

—	No. 94665	No. 95216
	p.c.	p.c.
Yellow Foxtail (Setaria g.)	50·0	20·0
Wild mustard (Brassica a.)	3·0	50·0
Barnyard Grass (Echn. Crus-galli)	30·0	2·0
Lambs' Quarters (Chen. Alb.)	8·0	4·0
Lady's thumb (Polycynum per.)	5·0	2·0
Wild buckwheat (Polyg. convol.)	1·0	.....
Black Medick (Midicago lup.)	.....	10·0
Green Foxtail (Staria vis)	3·0	10·0
Canada thistle (Cir. arv.)	.....	2·0
Bladder campion		
Rag Weed		

Sample No. 94665, thoroughly ground, though somewhat high in fibre, should make a fairly nutritious, palatable feeding stuff.

Sample No. 95216, by reason of its 50 per cent wild mustard seed, is quite unfit for feeding purposes; it would be found unpalatable and probably injurious.

Lab'y No. 93266.—Caplin fish, cooked for 75 minutes under a pressure of 10 pounds in an autoclave. It was found free from preservatives and apparently sound and wholesome. On a 10 per cent moisture basis this would make a fish meal containing protein 60·0 per cent, fat 17·0 per cent, and ash 13·0 per cent. The caplin is an oily fish and for the preparation of a first-class fish meal with good keeping qualities a certain proportion of the oil should be removed.

Lab'y No. 93657.—This "pig feed" was composed 3 parts feed flour and 5 parts ground provender (oats and barley). This should prove an excellent feed for young pigs, especially if supplemented by a little tankage or meat and bone meal, to supply animal protein and minerals.

Lab'y No. 93724.—This meal was made by mixing 2 parts each of bran, ground barley and gluten feed with 1 part of ground oats. The exceedingly high ash content (20·36 per cent) was found on further analysis to consist of 16·0 per cent common salt. On inquiry it was learned that 1½ pounds salt had been added per 100 pounds of meal mixture; evidently the ingredients had not been thoroughly mixed.

Lab'y No. 94153.—This "tonic food" for swine, sold under the name of "Baconrite," contains barley, soy bean, oats, rye, wheat and some weed seeds, common salt, epsom salts and resin, all ground to a fine powder. It does not contain any iodide of potassium or added phosphate of lime.

Apart from alleged medicinal properties, this preparation has a certain food value, since it contains 15·73 per cent protein and 4·69 per cent fat.

Lab'y No. 94160.—This calf meal contains Oil Cake meal, wheat middlings, oat flour and soya bean meal. This is a high-grade meal, with a specially high protein content. It very fully meets its guarantee, which is protein 24 per cent, fat 6·0 per cent, and fibre 6·0 per cent.

Lab'y No. 94855.—This is a by-product from the manufacture of the breakfast food "grape nuts." This material was apparently broken and partially powdered "grape-nuts," of a light reddish brown colour and pleasant odour of dried bread. The inquiry was as to its suitability as a poultry feed.

This by-product has a composition somewhat similar to that of low-protein wheat, though no doubt in the process of manufacture some of the starch has been converted into dextrin. It cannot be regarded as a protein concentrate, but its low fibre content may give it a special value in feed mixtures for poultry.

Lab'y No. 95323.—This important bone flour is on the market as a source of phosphorus and calcium in animal feeding. It is in the form of an exceedingly fine, white, odourless powder. Its analysis gave the following data:—

Phosphoric acid (P_2O_5) 34·38 per cent, equivalent to 75·07 per cent bone phosphate.

Nitrogen 0·575 per cent, equivalent to 3·59 per cent protein.

Ether Extract (fat) 0·36 per cent.

From its analysis, fine state of division and evident purity this material must be adjudged a bone meal of excellent quality and one eminently suitable for supplying phosphorus and lime in cattle and swine feeding, when the ration is deficient in these elements.

Lab'y No. 95343.—This sample of so-called peanut "sprouts" is a by-product from the manufacture of peanut butter; it is free from shell and the amount of "skin" present is very small.

This product is characterized by high percentages of protein and fat—especially of the latter. Such a high proportion of fat not only makes safe feeding of the product difficult but also endangers its keeping qualities. Peanut by-products are palatable and nutritious but must be judiciously used if the best and safest results are to follow. Their employment in swine feeding is undesirable, since the tendency would be to cause too soft and too oily a fat.

Lab'y No. 95621.—This " provender " consisted of ground " oats and barley " 50 per cent and ground weed seeds from thresher (Lab'y No. 94665) 50 per cent.

Compared with a provender or chop from mixed oats and barley, this feed is approximately 2·5 per cent richer in protein and about 1·75 per cent richer in fat, making it a more nutritive feed for cattle. It is, however, between 4 and 5 per cent higher in fibre, which makes it less desirable for pig feeding than the chop from grain only.

Lab'y No. 95827.—This brand of fox biscuit does not contain any meat or other animal tissue; it has in consequence a low protein content. The larger number of brands on the market contain from 18 to 23 per cent of protein. These biscuits were sweet and wholesome.

Lab'y No. 96250.—This meal, in common with molasses products in general, depends practically entirely on its sugar content (35·24 per cent) for its nutritive value.

Lab'y No. 96433.—This is a well-proportioned concentrate—a nutritious feed which would be useful in the ration of milch cows.

Lab'y No. 96701.—This meal mixture, compounded at the Experimental Station, Kapuskasing, Ont., was made of bran, corn and oats, each 4 parts, oil cake meal one part. This is a medium-protein feed, nutritious and of excellent quality.

Lab'y No. 96803.—A chop or provender of fair feeding value.

Lab'y No. 96993.—This ground feed was bought as 50 per cent wheat and 50 per cent barley. Though a little high in fibre for this mixture—indicating that the cereals were not of the highest quality—the analysis indicates that for a feed of this kind it is of excellent quality.

Lab'y No. 96976.—This is a concentrate of high quality, characterized by excellent percentages of protein and fat. The very low fibre content would greatly contribute towards high digestibility.

TABLE 53.—ANALYSIS OF FEEDING STUFFS

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
	Feed Wheat						
93323	C. L. & M. Co., St. Chrysostome, Que.	12·40	13·43	3·34	64·02	4·28	2·53
95758	Experimental Station, Rosthern, Sask.	10·30	14·42	1·74	66·80	4·93	2·81
96026	C.R.V. & Co., Toronto, Animal Husbandry Div., C.E.F.	10·71	14·63	2·53	68·10	2·51	1·52
96027	" " "	8·40	14·19	2·45	70·90	2·41	1·65
96352	A. A. H., Kemptville, Ont.	11·87	13·91	2·52	67·12	2·46	2·01
96424	Dominion Linseed Oil Co., Toronto, Ont.	10·94	13·66	3·03	65·79	4·35	2·23
96425	" "	10·73	13·95	2·60	67·68	3·27	1·77
96434	R. B., Caledonia Springs, Ont.	10·49	13·53	2·87	67·39	3·79	1·93
96435	" "	9·74	13·86	2·86	68·38	3·22	1·94
	Bran						
93156	Robin Hood Mills—J. B. R., North Hatley, Que.	8·42	14·96	5·77	54·96	10·51	5·38
95620	Lake of the Woods Milling Co., Animal Husbandry Division, C.E.F.	9·39	14·32	5·47	62·68	12·04	6·10
96698	Western Canada Flour Mills, Experimental Station, Kapuskasing, Ont.	8·94	14·94	5·89	53·71	10·87	5·65

TABLE 53.—ANALYSIS OF FEEDING STUFFS—*Continued*

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
	Shorts						
93455	Wolverton Flour Mills, St. Mary's, C.C.V., East Fairfield, Ont.	8·99	15·39	5·25	58·87	7·41	4·09
95615	Maple Leaf Milling Co., Animal Husbandry Division, C.E.F....	11·40	15·37	6·03	55·50	7·29	4·41
	Middlings						
95108	O'Dairy, Ogilvy Flour Mills, Animal Husbandry Division, C.E.F.	11·98	16·59	6·01	56·94	5·33	3·15
95109	White Middlings—Maple Leaf Milling Co.	12·71	16·10	5·32	57·48	5·52	2·87
	Feed Flour						
93344	Spiller's Canadian Mlg. Co., Calgary, Alta., A.A.H., Kemptville, Ont.	12·52	15·05	3·39	65·14	1·65	2·25
	Oats and Oat Products						
93150	No. 1 Feed Oats—Animal Husbandry Division, C.E.F.	13·61	11·13	4·42	56·83	10·82	3·19
94511	Hulless Oat Chop—Experimental Station, Rosthern, Sask.	11·49	15·49	7·20	60·65	3·06	2·11
95612	Oats, Animal Husbandry Division, C.E.F.	9·97	10·15	4·91	60·22	11·62	3·13
96468	Oat Scalpings, F.F., Terrace, B.C.	9·34	11·24	6·87	55·33	13·40	3·82
96699	Ground Oats, Western Canada Flour Mills, Experimental Station, Kapuskasing, Ont.	8·54	10·57	5·88	60·44	11·63	2·94
	Barley and Barley Products						
94512	Hulless Barley Chop, Experimental Station, Rosthern Sask.	12·86	13·48	1·84	67·51	2·18	2·13
95613	Barley—Animal Husbandry Division, C.E.F.	11·99	12·73	2·30	65·19	5·00	2·79
95759	Feed Barley, Saskatchewan	9·86	12·77	2·03	67·07	5·86	2·41
	Corn and Corn Products						
93527	Corn, North Dakota White Flint, Poultry Division, C.F.E.	11·27	9·40	5·62	70·71	1·60	1·40
93528	" Minnesota No. 13, Yellow Dent, Poultry Division, C.E.F.	12·28	9·54	4·28	70·87	1·74	1·29
93529	" Disco, 90 days, White Dent, Poultry Division, C.E.F.	9·22	10·63	4·92	71·35	1·91	1·97
93530	" Longfellow, Wisconsin, Yellow Flint, Poultry Division C.E.F.	11·22	9·49	4·69	71·18	1·72	1·70
93531	" Argentine, Maple Leaf Milling Co., Poultry Division, C.E.F.	9·52	10·19	5·48	71·58	1·74	1·49
93189	Hominy Feed, Ogilvy Flour Mills, Mrs. A. T., Neepawa, Man.	9·45	10·48	7·56	65·78	3·88	2·85
96697	Ground Corn, Western Canada Flour Mills, Experimental Station, Kapuskasing, Ont.	11·62	9·37	3·84	71·78	2·13	1·26
	Purina Products, Manufactured by Ralston Purina Co., Woodstock, Ont.						
93148	Bulky Las, Cattle Feed, Animal Husbandry Division, C.E.F.	11·35	9·10	1·97	56·27	13·45	7·86
93149	Omeline, Horse Feed, " " " ...	10·91	10·80	4·47	62·07	7·30	4·45
93324	" " " " " ...	14·12	9·84	4·08	60·76	7·78	3·47
95484	" " " " " ...	6·10	11·12	4·36	65·18	9·17	4·07
93289	Startena Chick Feed, F. H., Norwich, Ont.	7·67	18·78	7·47	49·62	5·55	10·91
93345	Pig Chow, A.A.H., Kemptville, Ont.	11·33	19·31	4·35	50·52	6·24	8·25
95485	" Animal Husbandry Division, C.E.F.	10·49	20·29	5·01	49·84	6·65	7·72
93410	" " " " ...	8·89	20·26	4·13	51·23	6·60	8·89
95212	Chicken Chowder, O.C., Hagersville, Ont.	9·08	20·01	4·07	48·68	8·39	9·77
	Poultry Feeds						
93191	Chick Starter, Buttermilk Mash, Brackman-Ker Milling Co., Vancouver, B.C., J.Y., Pearse Is., B.C.	8·38	15·08	5·17	62·49	2·12	6·76
93393	Mar-Mil Chick Starter, D. N. Reesor & Sons, Markham, Ont., W.J.J., Meaford, Ont.	9·55	16·00	4·90	56·68	3·09	9·78
93797	Sterling Egg Mash, Toronto Heights Poultry Supply Co., C.T., Cooksville, Ont.	11·36	16·18	5·12	54·01	5·79	7·54
93798	Sterling Chick Starter Mash, Toronto Heights Poultry Supply Co., C.T., Cooksville, Ont.	11·30	11·28	3·44	64·00	1·83	8·15
94335	Thrivo Chick Starting Mash, Brackman Ker Milling Co., Vancouver, B.C.	10·78	15·11	6·13	59·04	2·73	6·21
94336	Thrivo Chick Growing Mash, Brackman Ker Milling Co., Vancouver, B.C.	11·42	14·55	5·13	59·74	3·18	5·98
94863	Laying Mash, No. 1, W.R.D.B., Vancouver, B.C.	10·73	22·47	6·13	48·57	4·89	7·21
94864	" No. 2, " " " ...	9·94	21·18	5·93	48·51	6·33	8·11
94982	" F.W.A., Mission City, B.C.	9·96	20·00	6·49	56·05	9·64	7·86
95211	Sunbeam Laying Mash, Standard Milling Co., Toronto, O.C., Hagersville, Ont.	10·21	20·48	4·13	49·82	7·97	7·39
96510	Mar-Milk Laying Mash, F.N.R., Markham, Ont.	8·59	18·65	5·07	51·55	4·76	11·38
96511	Laying Mash, Beaufort Farm, Freeman, Ont.	8·71	17·78	4·15	55·27	5·52	8·57
97972	Poultry Mash, A.A.H., Kemptville, Ont.	9·94	18·41	5·35	54·45	5·79	7·06
	Oil Cake Meals						
95618	Sherwin Williams Co., Animal Husbandry Division, C.E.F.	9·27	36·48	9·05	33·55	6·90	4·75
96456	" " " " " ...	9·90	34·36	9·25	34·05	7·41	5·03
96457	" " T.J.D., Brockville, Ont.	10·45	36·89	5·06	35·09	7·63	4·88
96700	Western Canada Flour Mills, Experimental Station, Kapuskasing, Ont.	8·85	33·85	6·21	37·41	8·51	5·17

TABLE 53.—ANALYSIS OF FEEDING STUFFS—*Concluded*

Lab'y No.	Particulars	Moisture	Protein	Fat	Carbohydrates	Fibre	Ash
		p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
	Meat and Fish Products						
95616	Tankage, City Renderers Ltd., Montreal, Animal Husbandry Division, C.E.F.	8·42	57·83	10·44	.....	.....	21·16
95617	Tankage, City Renderers Ltd., Montreal, Animal Husbandry Division, C.E.F.	8·36	61·62	10·00	.....	.....	17·87
95757	Red Ribbon Digester Tankage, Swift's Canadian Co., Ltd., Edmonton, Alta., Experimental Station, Rosthern, Alta.	8·10	67·24	7·23	.....	.....	11·10
96834	Meat Meal, Egg-em-on, City Renderers Ltd., Montreal, l'Association Agricole, Montmagny, Que.	5·23	47·30	15·01	.....	.....	28·65
96835	Laymore Meat Scrap, Swift's Canadian Co., l'Association Agricole, Montmagny, Qué.	4·29	56·65	15·40	.....	.....	21·30
96873	Fish Meal, Experimental Station, Scott, Sask.	7·31	69·25	10·84	.....	.....	11·85
	Hay Meals						
94125	Alfalfa Meal, Division of Forage Plants, C.E.F.	7·16	20·46	3·72	36·60	23·55	8·51
95619	Alfalfa Meal, Beaver Valley Alfalfa Meal Co., Thornbury, Ont., Animal Husbandry Division, C.E.F.	9·87	12·48	2·08	39·64	29·03	6·90
95680	Clover Meal, N.C.H., Montmagny, Que.	8·29	11·32	3·78	33·28	35·50	7·83
97073	Ground Hay, H.B., Victoriaville, Que.	8·89	9·66	4·30	34·04	13·68	29·43
	Miscellaneous						
93188	Dog Food, Ken-L-Ration, W.K.R., Charlottetown, P.E.I.	72·66	11·54	5·46	8·94	.....	1·22
94434	Dog Biscuit, National, R.C.M.P., Edmonton, Alta.	11·64	16·31	6·88	61·90	0·79	2·48
93192	Dried Apple Pomace, Oliver Chemical Co., Penticton, B.C., Experimental Station, Summerland, B.C.	10·08	5·88	6·65	56·03	17·43	3·93
93395	Dried Apple Pomace, Oliver Chemical Co., Penticton, B.C., Experimental Station, Summerland, B.C.	23·13	4·35	5·89	51·15	13·01	2·47
94600	Distillers' Grains (Corn), Can. Industrial Alcohol Co., Toronto, Ont.	6·77	27·29	11·94	40·90	9·85	3·25
97239	Distillers' Grains (Corn), Kelly Feed & Seed Co., Toronto, Ont.	7·99	29·12	12·84	36·99	10·68	2·38
96457	Palm Kernel Meal (extracted), British Oil & Cake Mills, Hull, England, Animal Husbandry Division, C.E.F.	9·95	20·68	1·16	51·08	12·67	4·46
96458	Palm Kernel Cake, British Oil & Cake Mills, Hull, England, Animal Husbandry Division, C.E.F.	5·85	16·68	5·48	57·23	10·95	3·81
96904	Sweet Clover Seed, Eddy Seed Cleaners, Ltd., Toronto, Ont.	9·65	34·74	4·70	36·72	10·42	3·77
97262	" " Meal, Animal Husbandry Division, C.E.F.	9·69	33·78	4·67	38·19	9·83	3·84
94665	Weed Seeds from thresher, A.D., Kemptville, Ont.	13·09	15·71	3·78	44·61	16·91	5·90
95216	" " " "	10·91	18·63	5·02	39·06	17·58	8·80
93266	Fish, P.L.D., Pont Rouge, Que.	81·88	11·97	3·39	.....	.....	2·49
93657	Pig Feed, A.A.H., Kemptville, Ont.	13·78	11·66	3·80	61·87	6·59	2·30
93724	Meal, Experimental Station, Ste. Anne de la Pocatière, Qué.	8·35	14·22	2·86	48·41	5·80	20·36
94153	Baconrite, Thriftonic Foods, Toronto, Ont.	9·37	15·73	4·69	60·59	5·89	3·73
94160	Calf Meal, "Grow or Bust", F.B., Spencerville, Ont.	11·89	25·36	6·52	45·85	6·49	3·89
94855	Grape Nuts, J.R.R., Maidstone, Ont.	7·13	11·47	1·37	75·82	1·87	2·34
95323	Feeding Bone Flour, "Churn Brand", Sterilized, British Glues and Chemicals	.....	3·59	0·36	.....	.....	.....
95343	Peanut Sprouts, G.E.B., St. John, N.B.	3·16	28·88	46·93	15·43	3·07	2·53
95621	Provender, A.A.H., Kemptville, Ont.	9·65	13·17	4·89	51·94	14·85	5·50
95827	Fox Biscuit, Acton Biscuit Co., Acton Vale, Que.	13·27	10·77	2·76	70·22	1·13	1·85
96250	Molassine Feeding Meal, Molassine Co., Ltd., Greenwich, England, E.J.S., Kitchener, Ont.	20·18	8·50	.....	.....	.....	7·67
96433	Ideal Dairy Ration, Pembroke Milling Co., Pembroke, Ont.	7·59	21·68	4·70	57·19	5·54	3·30
96701	Meal Mixture, Experimental Station, Kapuskasing, Ont.	9·34	14·18	5·10	58·02	7·54	5·82
96803	Feed, P.M.T., St. Norbert, Man.	9·26	12·47	3·29	65·80	6·17	3·01
96993	Feed, Q.V., Glen Robertson, Ont.	9·67	12·66	2·91	66·28	5·55	2·93
96976	Dairy Feed, Germ Middlings, Wm. McE., Ormstown, Ont.	7·36	22·44	8·46	56·01	2·28	3·47

WELL WATERS FROM FARM HOMESTEADS

The Division of Chemistry has taken a practical interest in farm water supplies since the earliest days in the history of the Experimental Farm System. During the past forty years it has analysed and reported on several thousands of samples from farm wells throughout the Dominion and in this work an important service has been rendered the farming community.

An ample supply of pure water is one of the essentials towards successful farming; its importance to the good health of the farmer and his family can scarcely be over-emphasized. Further, it has been proved that thrift in the live stock and first-class wholesome dairy products are largely dependent on a plentiful supply of good water.

During the past year 159 samples of well waters from Canadian farms have been submitted to analysis. The results have been reported in full to the sender, together with suggestions and advice with respect to the improvement or aban-

donment of the supply, where such was deemed desirable. It may therefore suffice to present here the following summary:—

	per cent
Pure and wholesome	39
Suspicious and probably dangerous	29
Seriously polluted	21
Saline (non-potable)	11

The proportion of good waters is usually about 25 per cent, so the results of this year's work may be considered as distinctly encouraging.

If the water is to be kept free from contamination by drainage of excretal or other objectionable matter, the location of the farm well is a matter of importance. The danger from pollution from the barnyard, stables, privy, etc., must not be overlooked. Information on this subject has been issued in leaflet form, obtainable on application. Those intending to select a site for a new well should write for a copy.

Farmers suspicious of the purity of their supply should avail themselves of the privilege of a free examination, first writing to the division for a copy of the directions to be followed in the collection and shipment of the sample to Ottawa. In too many instances, owing to the small quantity sent or to the water being forwarded in a dirty container, it has been impossible to make an analysis on which a report as to the quality of the water could be based.

WATERS FROM FISH HATCHERIES

For a number of years past this division has undertaken the examination of the waters of the fish hatcheries of the Dominion. During the year waters from eight hatcheries, chiefly in Alberta and British Columbia, have been analysed, detailed reports having been submitted to the Fisheries Branch, Department of Marine and Fisheries, at the instance of which this work has been accepted.

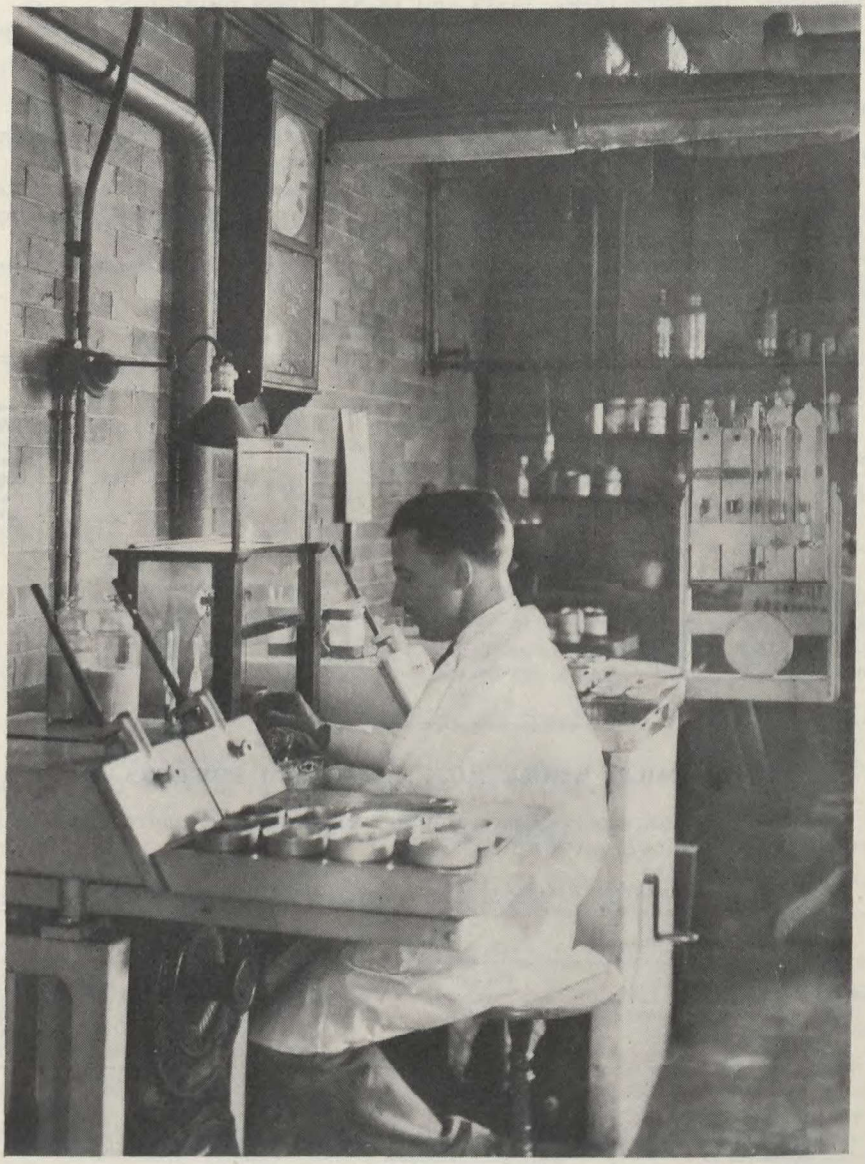
The importance of pure water for hatchery purposes is obvious, but beyond its immediate use the record of this series has a national value, for these waters are drawn from lakes, rivers, creeks and springs and are representative of natural waters in various parts of the Dominion.

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

During the year 1,627 samples were examined. This report gives a brief summary of the analytical results obtained for each class of product.

CLASSIFIED LIST OF SAMPLES EXAMINED DURING THE YEAR, 1928–1929

Condensed and evaporated milks	362
Milk and cream powders	193
Evaporated apples	150
Colours and inks	22
Salts and preservatives	4
Spices and condiments	154
Denaturing oils	67
Lards, lard compounds, edible oils and fats	54
Canned and preserved fruits and vegetables	219
Mincemeats	28
Tomato products	45
Sausages, potted and preserved meats and fish pastes	201
Pickled pork and bacon and pickling solutions	24
Miscellaneous	104
	1,627



Mojonnier equipment for analysis of milk by Roesse-Gottleib method.

CONDENSED AND EVAPORATED MILKS

Three hundred and sixty-two samples were examined under this heading.

The average, maximum and minimum net weights of thirty-two samples of condensed milk were 13·97, 14·13 and 13·85 ounces respectively.

The average, maximum and minimum percentages of fat of thirteen samples of condensed milk were 9·06, 9·33 and 8·81 respectively.

The average, maximum and minimum percentages of fat of twenty-five samples of condensed milk were 8·12, 8·27 and 7·89 respectively.

This year no samples of condensed milk were found to have " sugar down "; that is, a deposit of milk sugar at the bottom of the can.

Three samples of skimmed condensed milk were examined. The percentage fats were 0·34, 0·34 and 0·52 respectively. The percentage total solids were 71·59, 72·33 and 73·28 respectively.

Three hundred and twenty-one samples of evaporated milk were examined. A summary of results is given in table 54.

TABLE 54—SUMMARY OF RESULTS OF ANALYSES OF EVAPORATED MILKS

Net Weight			Total Solids			Fat		
Number of samples	Net weight	Per cent number under weight	Number of samples	Total solids	Per cent number below standard (25·5%)	Number of samples	Fat	Per cent number below standard (7·8%)
	oz.			p.c.			p.c.	
	Ave. 6·37			Ave. 26·16			Ave. 7·91	
51	Max. 6·6	4	64	Max. 28·28	nil	64	Max. 8·16	8
	Min. 5·86			Min. 25·80			Min. 7·77	
	Ave. 16·53			Ave. 31·74			Ave 9·16	
270	Max. 16·90	4	257	Max. 32·21		257	Max. 9·3	
	Min. 15·71			Min. 31·4			Min. 8·8	

SKIM-MILK, WHOLE MILK AND CREAM POWDERS

One hundred and ninety-three samples were examined under this heading. A summary of results is given in table 55.

TABLE 55—SUMMARY OF RESULTS OF ANALYSES OF MILK AND CREAM POWDERS

	Moisture		Ash	Fat	
Number of Samples	Moisture	Per cent number above standard (5%)	Ash	Fat	Per cent number below standard (26%)
	p.c.		p.c.	p.c.	
131	Skimmed milk powder	8			
	Ave. 3·18		Ave. 8·12		
	Max. 8·38		Max. 8·53		
	Min. 1·51		Min. 7·68		
56	Whole Milk Powder	3			
	Ave. 6·14		Ave. 5·80	Ave. 27·36	3
	Max. 2·16		Max. 6·34	Max. 28·38	
	Min. 0·4		Min. 5·04	Min. 23·9	
6	Cream Powder				
	Ave. 1·29		Ave. 2·36	Ave. 69·6	
	Max. 2·48		Max. 2·52	Max. 70·5	
	Min. 0·4		Min. 2·23	Min. 66·9	

All samples of milk powders were found to be free from borates and carbonates.

One sample of buttermilk powder contained 3·94 per cent moisture, 8·92 per cent ash and 1·33 per cent fat.

Two samples of ice-cream mix powder contained respectively 1·38 and 0·58 per cent moisture, 3·91 and 4·52 per cent ash and 39·17 and 45·38 per cent fat.

EVAPORATED APPLES

One hundred and fifty samples were examined for water content.

Table 56 gives a comparison of results for the past five years.

TABLE 56—WATER CONTENT OF EVAPORATED APPLES

Year	Number of samples	Water per cent			Number of samples containing water in excess of standard (25 p.c.)	Per cent number containing water in excess of standard
		average	maximum	minimum		
1924–25	412	21·8	31·3	4·8	56	14
1925–26	561	21·7	34·4	3·9	72	13
1926–27	204	22·2	27·7	4·2	28	14
1927–28	196	21·9	29·8	13·2	27	14
1928–29	150	21·1	31·2	4·8	17	11

COLOURS AND INKS

Twenty-two samples were examined. Sixteen samples of branding inks were found to be free from arsenic. Six samples of food colours were examined. One sample of imported colour contained a non-permissible coal tar dye mixed with ponceau 3 R (S & J 56). All were free from arsenic.

SALTS AND PRESERVATIVES

Three samples of common salt and one sample of sodium nitrite were examined and found to be free from harmful ingredients.

SPICES AND CONDIMENTS

One hundred and fifty-four samples were examined. Two samples of mace contained foreign starch and one was coloured with turmeric.

DENATURING OILS

Sixty-seven samples were examined. A summary of results is given in table 57.

TABLE 57—NUMBER AND PERCENTAGE NUMBER OF DENATURING OILS WHICH SATISFY THE VARIOUS STANDARD TESTS

Tests	Standards required	Satisfy requirements	
		number	per cent number
All		45	67
Flash point	Not below 75°C. (167°F.)	67	100
Boiling Point	Not below 205°C. (401°F.)	62	92
Specific Gravity	Not below 0·819	67	100
Taste	Easily recognized when present in the proportion of 1 part oil to 1,000 parts fat.	47	70

LARD, LARD COMPOUNDS AND EDIBLE OILS AND FATS

Fifty-four samples were examined. One sample of lard gave a positive test for rancidity. One sample of cocoa butter was coloured with butter yellow (S & J 16).

CANNED AND PRESERVED FRUITS AND VEGETABLES

Two hundred and nineteen samples were examined under this heading. These included thirty-six samples of jams and marmalades prepared in Canada, forty-five samples of imported jams, marmalades and jellies, fifty-seven samples of glace and maraschino cherries, and thirty-one samples of canned fruits and vegetables.

Thirteen samples of pure Canadian jams contained benzoates and one salicylate, all within the limits allowed by the regulations.

Five samples of pure Canadian jams were coloured with permissible coal tar colours.

All samples of imported jams and jellies were free from preservatives. Six samples contained coal tar colour. In three samples a non-permissible colour was found.

Sixteen samples of pure strawberry jam and twelve samples of pure raspberry jam were examined for total solids, water insoluble solids, pectin and ash contents.

The results of these analyses are given in table 58.

TABLE 58—SUMMARY OF RESULTS OF ANALYSES OF PURE STRAWBERRY AND RASPBERRY JAMS MADE IN CANADA

Fruit		Total Solids	Water insoluble solids	Pectin (calcium pectate)	Ash
		p.c.	p.c.	p.c.	p.c.
Strawberry	Ave.	73·92	1·12	0·28	0·22
	Max.	77·82	1·66	0·33	0·28
	Min.	64·42	0·69	0·23	0·15
Raspberry	Ave.	75·42	1·98	0·27	0·19
	Max.	78·93	2·98	0·33	0·30
	Min.	68·69	1·02	0·21	0·13

The average, maximum and minimum percentages of glucose in thirty-seven samples of glace cherries were 48·1, 72·1 and 22·5 respectively.

One sample of canned peaches, which was intended for use as a diabetic food, was found to contain 20 per cent of sucrose and 11 per cent of invert sugar.

One sample of apple juice imported from Holland contained 2·68 parts per 2,000 of sulphur dioxide.

MINCEMEATS

Twenty-eight samples were examined for glucose and preservatives.

Nineteen samples, sixty-eight per cent, contained benzoates, all in amounts less than the maximum allowed by the regulations. Six samples, twenty-one per cent, were found to contain glucose.

TOMATO PRODUCTS

Forty-five samples of tomato pastes, catsups, pulps and sauces were examined.

The average, maximum and minimum percentages of total solids in thirteen samples of tomato pastes were 29·9, 38·6 and 14·8 respectively.

Seventeen samples, fifty-three per cent, of tomato catsup were coloured with ponceau 3R (S & J 56), a permissible coal tar colour.

Twenty-two samples—sixty-nine per cent—of tomato catsup contained preservative (benzoates or salicylates). Seven of these samples contained preservatives in excess of the maximum amounts allowed by the rgulations.

SAUSAGE, POTTED AND PRESERVED MEATS AND FISH PASTES

Two hundred and one samples were examined under this heading.

Summaries of results of analyses of twenty-six samples of pork sausage and fifteen samples of bologna are given in tables 59 and 60.

TABLE 59—SUMMARY OF RESULTS OF ANALYSES OF SAUSAGES

——		Water	Protein (N x 6·25)	Water protein ratio	Cereal starch
		p.c.	p.c.		p.c.
Pork Sausages	Ave.	53·7	10·7	4·9	3·6
	Max.	61·5	13·3	6·4	8·7
	Min.	44·9	8·6	3·6	0·4
Bologna	Ave.	62·2	14·1	4·4	4·7
	Max.	65·0	18·1	5·4	7·7
	Min.	57·0	11·3	3·5	0·3

TABLE 60—NUMBER AND PERCENTAGE NUMBER OF BOLOGNA AND PORK SAUSAGES, WHICH CONTAIN WATER AND STARCH IN EXCESS OF MAXIMUM AMOUNTS ALLOWED BY THE REGULATIONS AND SUMMARY OF WATER: PROTEIN RATIOS

——	Samples containing more than 60 per cent water		Samples containing more than 5 per cent starch	Samples having water: protein ratios				
				above 5	above 4·5	above 4	above 3·6	below 3·6
Pork sausages	per cent.	Number - 1	6	11	17	23	26	0
		Number - 4	23	42	65	88	100	0
Bologna	per cent.	Number -12	7	2	7	11	13	2
		Number -80	47	13	47	73	87	13

Seventy samples of imported fish pastes were examined. Four were artificially coloured, three with rhodamine (S & J 505) and one with ponceau 3R (S & J 56). No preservatives were found.

Sixty-five samples of imported meat pastes were examined. All were free from added colour and preservatives.

The average, maximum and minimum percentages of cereal starch in sixty-three samples of fish paste were 3·4, 8·8 and nil respectively.

The average, maximum and minimum percentages of cereal starch in fifty-six samples of meat pastes were 3·1, 5·7 and 0·4 respectively.

The average percentage of cereal starch in five samples of meat loaf was 9·0.

PICKLED PORK, BACON AND PICKLING SOLUTIONS

Twenty-two samples of pickled pork and bacon were examined for nitrite content. Five samples, twenty-three per cent, contained more than the maximum allowed by the regulations (200 parts per million as sodium nitrite).

MISCELLANEOUS

One hundred and four samples were examined under this heading including flours, starches, sugars, purifiers and decolourizers, gelatines, vinegars, pickles, sauces, mayonnaise, sausage casings, plating solution and solder.

COLLABORATIVE WORK ON THE DETERMINATION OF CHLORINE IN BLEACHED FLOUR

An investigation is being carried out by the Food Research Division of the Bureau of Chemistry and Soils, Washington, D.C. to find a reliable method for the determination of chlorine in bleached flour. This Division has co-operated in the investigation during the past year by making analyses of several samples of bleached and unbleached flour, using a new method of analysis.

CHEMICAL STUDY OF " BREAK DOWN " IN CANNED TOMATOES

With a view to determining the causes of " break down ", which has occurred in several cans of tomatoes from British Columbia, an investigation was made of the chemical constituents of " normal " canned tomatoes and canned tomatoes in which " break down " had taken place.

No very definite results have as yet been obtained, but it is thought that the change in pectin content may have some significance.

THE " BOILING " QUALITY OF PEAS

It has been found that peas ordinarily suitable for soup making when grown in different districts may exhibit various degrees of hardness on boiling; in many cases the peas remain so hard as to be quite unsuitable for the making of soup.

At the instance of the Cereal Division an investigation was undertaken by this division to ascertain the cause of this refusal to soften on boiling.

Several samples of peas of various degrees of " boiling hardness " were analysed in these laboratories for water, protein and ash content. While no relation was found between the length of time to boil soft and the water or the protein content, it appears that " good " quality *i.e.*, readiness to boil soft is associated with high ash content. This suggests that fertilizers in which potash predominates might prove effective towards the production of " good boiling " peas, and a series of experiments towards that end will be instituted at a number of points during the coming season.

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