The following Annual Reports for 1930 have not been published:—

Director of Experimental Farms
Division of Chemistry
Division of Animal Husbandry
Division of Forage Plants

Progress reports of the Division of Chemistry and the Division of Forage Plants covering the years 1930 to 1933, inclusive, have since been published but are not included in this present series.

EXPERIMENTAL FARMS REPORTS

1930-1938

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Summary Report

For the Period April 1, 1930 to December 31, 1936

G. W. MUIR
DOMINION ANIMAL HUSBANDMAN

Group of five Clydesdale stallions. Imported in 1934 by Dominion Department of Agriculture.

Published by Authority of the Hon. J. G. Gardiner, Minister of Agriculture, Ottawa, 1939.

DOMINION EXPERIMENTAL FARMS

E. S. ARCHIBALD, B.A., B.S.A., LL.D., D.Sc., Director

DIVISION OF ANIMAL HUSBANDRY

G. W. MUIR, B.S.A., Dominion Animal Husbandman.

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P. E. SYLVESTRE, B.A., B.S.A., M.S., Animal Husbandman in charge of Beef Cattle, Sheep, and Pasture Studies.

ALAN DEAKIN, B.S.A., Ph.D., Animal Geneticist.

C. D. MACKENZIE, B.S.A., M.S.A., Ph.D., Animal Husbandman in charge of Dairy Cattle, and Dairying.

R. L. CUNNINGHAM, Assistant Animal Husbandman.

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DIVISION OF ANIMAL HUSBANDRY

Summary Report
For the period April 1, 1930 to December 31, 1936

INTRODUCTION

Due to the financial stress in the years from 1931 onwards it was not found possible to publish the regular yearly divisional reports, which accounts for this summary report of the division being issued at this time. During this period a number of changes have occurred in the staff of the division which it seems well to record here.

Early in 1931 Mr. G. B. Rothwell, B.S.A., who had been Dominion Animal Husbandman from 1919, was called upon to assume the duties of Dominion Live Stock Commissioner in charge of the Live Stock Branch of the Department of Agriculture. This was a severe loss to the division, particularly coming as it did in such trying times, as Mr. Rothwell had given excellent guidance and leadership to the division during his term of office. Mr. G. W. Muir, B.S.A., took over the duties of Dominion Animal Husbandman in an acting capacity and was later appointed to the position.

The position of Animal Geneticist was created in 1931 and Alan Deakin, B.S.A., Ph.D., was appointed thereto to conduct investigations along genetical lines, a feature of the work with larger animals that had been more or less neglected.

An additional position of Animal Husbandman was created in 1936 and C. D. MacKenzie, B.S.A., M.S.A., Ph.D., was appointed thereto in October of that year to have direct charge of all phases of dairy cattle work and dairying.

In addition to the regular members of the staff already enumerated, the division has had the services of Messrs. V. S. Logan, J. G. Stothart and S. B. Williams as graduate and student assistants. They have been responsible for the collection and compilation of much of the data of the various experiments.

The Animal Husbandry Division, which embraces all work with live stock on the Central Experimental Farm and directs and supervises similar work on the branch farms in various sections of Canada, is primarily concerned with the finding and trying out of improved methods of breeding, feeding, and management practices for live stock. For this purpose herds of various breeds are kept, breeding studies are conducted, and quality breeding stock is distributed to breeders and farmers. The animals in the studs, herds, and flocks are used in experiments, the objectives being to find improved breeding and production methods, the most economical feeds and feed mixtures to use, and the resultant effect of these factors on the finished market animal or animal product. Management practices and methods of housing are also given attention in order that those engaged in agriculture may be advised on the most suitable methods of live stock production. Information thus obtained and advice on live stock problems is provided to farmers and those interested in this phase of agriculture through the medium of correspondence, press articles, technical and farmers' bulletins, lectures and demonstrations.

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BEEF CATTLE

A breeding herd of some 40 head of grade Shorthorns has been maintained at the Central Experimental Farm since the fall of 1930. It is kept mainly to provide uniform, healthy animals for experimental purposes such as digestion trials, pasture investigations, and winter feeding experiments, but practical observations are also made on housing and management and the amount and kind of feed used is recorded. The maintenance of the herd is made possible through the use of the Connaught Rifle Range at South March, Ont., where adequate cheap pasturage is available.

Winter Housing of the Beef Herd

In commercial beef production the capital invested in buildings must be kept as low as possible. Too often, due to the cold climate, one is inclined to think that snug, warm, expensive buildings are necessary. That this is not the case has been conclusively proved in the five years during which this herd has been maintained. The cows bred to calve in March are kept during the winter in a shed opening into a yard with a southern exposure. Feeding racks for hay constitute the partitions between the yards and a feeding trough for silage and grain runs across the south end of each yard. Fresh water is provided in tanks and kept from freezing by a small immersion electric heater. The cows are allowed to go in and out of the sheds and feed at will on roughage. Under this method not only has the cost of housing been reduced, but the herd has been kept in excellent health. Calving takes place in the shed in March and April and no calves have been lost due to low temperatures or tramping. Cleaning is done twice a year only and provided the shed is well bedded, the cows keep clean. Under this system one man with one horse has been able to care for upwards of a hundred head during the winter months.

Advantages of Early Calving

During the first year it was arranged to have the calving take place on grass. However, due to the large amount of milk secreted by these Shorthorn cows and the inability of the young calves to consume it all, udder trouble

Part of the Shorthorn herd, and their calves, on pasture at Connaught Rifle Range.

developed with all the difficulties connected therewith. The following year the cows were bred to calve in March and April. No grain whatsoever was fed either before or after calving. Under these conditions the initial milk flow was

not in excess of the requirements of the calves and very little udder trouble was experienced. When finally the animals are put on pasture the increased milk secretion is easily taken care of by the calves.

Early calving has many other advantages in addition to the above mentioned. By the time the cows go to pasture, milk production has started to decline but the stimulus of the new grass tends to offset this drop in production. Being older, the calves are better able to take advantage of the nutritious herbage of the early summer. Due to their additional age in the fall the calves can be weaned more easily and wintered more economically, while in addition, the cows go into winter quarters in better condition. Lastly, such early calves would lend themselves very well to finishing as "fed calves."

In order that this method of handling a herd under eastern conditions may be profitable, it is essential that an abundance of cheap pasture and cheap winter roughage be available. In addition, when beef prices are low it may be more profitable to have one cow nurse two calves, the other cow to be milked by hand, and the milk or cream sold to provide additional revenue.

Maintenance Costs of Beef Cows

For three winters—1933, 1934 and 1935—all the feed fed to the breeding herd was recorded. The ration consisted of corn silage, hay and straw. The cows received an average of 15 pounds of hay and 23 pounds of silage per head daily. For the winter period of 169 days or 5½ months, each cow received 2,657 pounds of hay and 3,950 pounds of corn silage. The proportion of hay to silage was fairly high. This is due to the fact that an abundance of low grade hay, coarse oat hay and straw was available. Probably a good third of this material was not eaten, but nevertheless served as bedding.

On this ration the cows have wintered well, produced good calves and gone back to pasture in good condition. On the basis of these results it is safe to assume that with corn silage, a feed of hay and a feed of straw daily is sufficient to maintain pregnant beef cows. Valuing the roughage at $5 a ton and corn silage at $3.25, the total feed cost of wintering a cow for approximately 5½ months was $13.05. It is very necessary that such a low winter feeding cost be attained to make this system of raising beef profitable.

Wintering of Beef Calves

The logical procedure to follow with early spring calves is to keep them coming along for finishing as "fed calves" or baby beeves. That this can be done fairly economically is shown by their fall and spring weights. For instance, on December 11, 1934, 16 calves after weaning averaged 564 pounds and on May 2, after being wintered on a ration of hay and corn silage plus 2 pounds of grain per head daily, they averaged 749 pounds. Had they been fed a fattening ration they would certainly have reached marketable weights by this time. However, as these animals were needed for other experimental work their finishing as fed calves was not feasible. The object therefore was to winter them as economically as possible. They entered their winter quarters around the first of December and from then on were fed a ration suitable for normal growth, consisting of mixed clover and timothy hay, corn silage plus 2 pounds of a grain mixture made up of barley, oats and oilmeal.

The average feed consumption for three years shows that the calves consumed 9 pounds of hay, 13 pounds of silage and 2 pounds of grain per head daily. Over a period of 159 days each calf consumed 1,566 pounds of hay, 2,118 pounds of silage and 348 pounds of grain. On such a ration they made an average daily gain of 1·25 pounds or 199 pounds during the winter period. Valuing the hay at $8.25 a ton, the silage at $3.25 and the meal at $24.40 a ton, the cost of wintering a calf was $14.15.

In the spring these calves were well grown, healthy, and in good condition. Ninety-seven calves wintered in this manner averaged in the spring 688 pounds each. On pasture they continued to gain and in the fall with proper feeding could have been finished for the Christmas market, had they not been needed for other work.

Feeding Value of Potatoes for Fattening Steers

With the object of determining the feeding value of raw potatoes, soaked dried potatoes, and potato meal, 16 steers were divided into four groups of four steers each. One group received a standard ration consisting of mixed hay, corn silage and a grain mixture composed of 400 pounds of barley, 200 pounds of oats, 100 pounds of bran, 100 pounds of linseed oilmeal and 8 pounds of salt. A second group was fed the same ration except for the barley, which was replaced by potato meal pound for pound. The third group was given raw potatoes in place of corn silage and the fourth group, soaked dried potatoes. The steers were stall-fed and the individual feed consumption recorded.

Comparing barley meal with potato meal, the results show that the latter gave somewhat superior results. The daily gain was higher, as also was the gain per 100 pounds of dry matter consumed. The steers on potato meal made 8·88 pounds of gain for each 100 pounds of dry matter while those on barley meal made 7·98 pounds. While the difference is not very great, it may be said that potato meal can successfully replace barley in the grain mixture.

Comparing the three succulent feeds, namely, corn silage, raw potatoes and soaked dried potatoes, the latter gave the best results, with corn silage next and raw potatoes last. Here again the differences are not large. The average daily gain was 1·65 pounds for the soaked dried potatoes group, 1·43 pounds for the corn silage group and 1·40 pounds for the steers fed raw potatoes. Some difficulty was experienced in feeding raw potatoes in that increases in the amount fed resulted in digestive disturbances. It would appear that from 20 to 25 pounds per day is the limit for a 1,000-pound steer. Dried potatoes (soaked) proved very palatable and were eaten with relish. These results are for one year only, and the experiment will have to be repeated before a definite report can be given.

Digestibility Studies

A study of the digestibility of Canadian feeds has been under way for quite a few years. So far the digestibilities of mixed hay, corn silage, "Vim" oat feed, oats, barley, and oilmeal have been determined. The associative digestibility of these different feeds has also been studied together with the effect of the plane of nutrition.

This work is being carried on as a co-operative project of the Chemistry and Animal Husbandry Divisions, completed work being published in the form of joint papers.

Pasture Investigations

Since 1931, pasture grazing experiments with steers have been conducted in co-operation with the Field Husbandry Division. The economy of different fertilizer treatments on the production of pasture herbage, light and heavy grazing, mixed grazing, and the value of a cultivated pasture rotation are some of the projects now under way. The results are reported in the pasture section of this report.

DAIRY CATTLE

Introduction

During the period covered by this report the herds of Ayrshire and Holstein cattle have continued to make progress. The period covered coincides fairly closely with the period of reduced appropriations, consequently some of the experimental activities had to be reduced. It was possible, however, to maintain the herds at a fairly high level, and breeding studies constituted the major activities. Table I gives the inventories for the respective years at the periods taken:—

TABLE 1.—DAIRY CATTLE AT CENTRAL EXPERIMENTAL FARM MARCH 31, 1931 TO DECEMBER 31, 1936

Date	Ayrshires					Holsteins				
	Females		Males			Females		Males		
	3 years and over	Under 3 years	2 years and over	Under 2 years	Total	3 years and over	Under 3 years	2 years and over	Under 2 years	Total
March 31, 1931	45	43	1	13	102	26	34	2	5	67
March 31, 1932	39	34	2	3	78	30	34	2	10	76
March 31, 1933	32	47	1	5	85	23	35	2	8	68
March 31, 1934	31	57	2	5	95	26	24	2	10	62
March 31, 1935	36	43	2	11	92	24	29	1	7	61
December 31, 1935	36	46	2	9	93	24	31	2	4	61
December 31, 1936	30	46	2	3	81	19	31	0	5	55

Breeding and Management Policy

The breeding policy being followed is to maintain the two pure-bred herds of dairy cattle up to a good standard of type and an economical standard of production, the latter being obtained under conditions of management and feeding that can be followed by any progressive dairy farmer. Handled in this manner, the dairy cattle yield data that are applicable to conditions in the district. All two-year-old heifers are given an opportunity to prove their productive ability in their first lactations which are usually extended to 365 days to give the heifers a chance to develop properly before their next calving. The heifers outstanding in type and production are maintained in the herd as breeding replacements. Those of a medium calibre are maintained for another test or as needed for experimental work while the poor producers are culled immediately. Any suitable surplus females are disposed of for breeding purposes. Surplus males are developed for disposal to branch farms and stations and to breeders. Unless a bull calf is backed by creditable R.O.P. records on the part of the dam, it is generally disposed of at birth.

As already intimated, practical economical production is the objective. The cows are liberally but not extravagantly fed, and they are milked only twice daily except when a cow is producing exceptionally heavily and it becomes an absolute necessity to milk her three times daily.

The experimental work includes studies in breeding, feeding, management, and disease prevention and eradication. These features are discussed elsewhere in this report.

Sires Used

In the following paragraphs a few brief notes are given on the herd sires used in the breeding work during the period under review.

Ayrshires

Dunlop Reflection (Imp.) —110286—, a Royal Winter Fair Champion, but failed to make the showing in the herd that his show reputation would lead one to expect of him.

Ottawa Supreme 12th —92925—. This bull left a number of good producing daughters but lowered the average butterfat test rather seriously.

Bois de la Roche Radium —134051—, a big strong bull of fair type. He left a few good daughters in the herd.

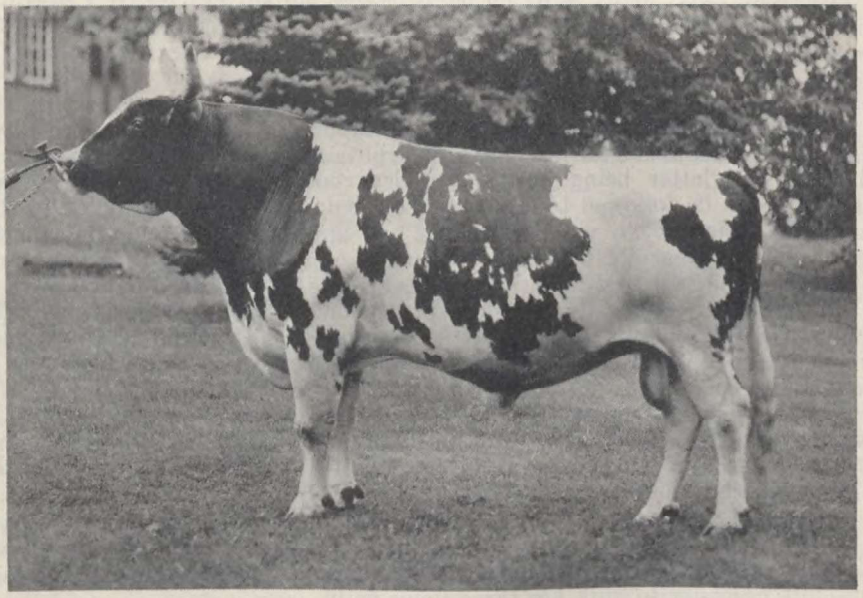
Ottawa Reflection 2nd —134685—. Though a very typey, well-bred bull he left poor producing daughters.

Kirkcudbright Legend (Imp.) —155136—. Of very good type but left rather low producing daughters not up to the standard of their sire in type and quality.

Netherhall Old Times (Imp.) —157090.— Of good type and well bred for production. His progeny were promising as calves but have not proved outstanding producers.

Kapuskasing Beauty Supreme —163887—. A bull with exceptionally good milk and fat backing. He grew up to be upstanding and long and was only used lightly pending the development of his heifers.

Lessnessock Electra (Imp.) —177014—, the present herd sire, was imported in 1934 as a three-year-old. He is of excellent dairy type and is exceptionally well bred, being by one of the most noted proven sires in Scotland and out of



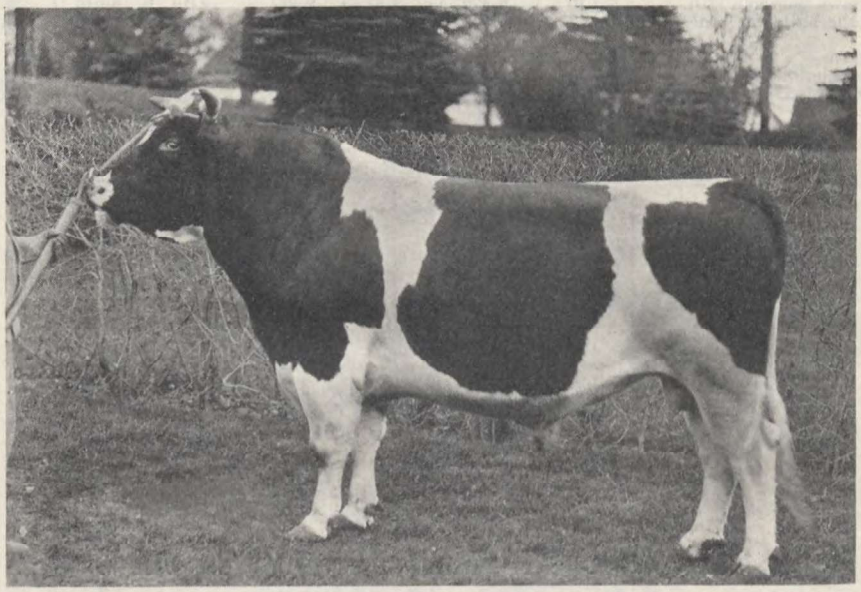
Ayrshire bull "Lessnessock Electra (Imp.)—177014—". Class AA in Advanced Registry. Imported from Scotland in 1934, and now senior herd sire at the Central Experimental Farm, Ottawa.

a cow with five records averaging 11,120 pounds of milk testing 4·07 per cent fat in 298 days. His daughters are developing very nicely, showing considerably more dairy form than those of the bulls used previously.

Holsteins

In the case of Holsteins, during the early part of the period a pair of Brookholm Inka bred sires were used. These two bulls left some fairly heavy producing cows but they were not of desirable type, being upstanding, and inclined to have pendulous udders.

Abegweit Hiemke Francy 70109, was secured in the spring of 1931 and was used continuously until December, 1935, with the result that a large part of the herd is now made up of his daughters and granddaughters. He has left



Holstein bull "Abegweit Hiemke Francy 70109". Class XX in Selective Registration. R.O.P. No. 956. Late senior Holstein herd sire at Central Experimental Farm, Ottawa.

his influence on the herd by improving the type, particularly the udders, and also, by preserving a fairly high level of production.

King Posch Tidy 77713, was also used during this period in a limited way but proved a breeder of poor type animals and was discarded.

Paul Echo Colanthus 49444, a 12-year-old bull of good type and proved breeding ability, was used for a period of three months in 1934, while on his way through to the Fredericton Station, with quite satisfactory results, the six heifers he sired being rather outstanding as a group.

King Jewel Posch 99344 was used during the 1935 season on the daughters of Abegweit Hiemke Francy. As he was of much the same line of breeding, the results were very satisfactory. He left a nice group of both bull and heifer calves.

The final determination of the value of these bulls can best be made by comparing daughter and dam records, from which bull indexes are calculated as outlined in the Animal Genetics section of this report. A summary of the indexes of bulls used early in the period covered by this report is shown in table II.

TABLE II.—DAUGHTER-DAM PRODUCTION RECORDS AND SIRE INDEXES OF BULLS WITH FIVE OR MORE DAUGHTERS WITH RECORDS

Sire's name	Records (Mature Equivalent, 305 days)						
	Number Pairs	Daughters		Dams		Sire Index	
		Milk	Per cent fat	Milk	Per cent fat	Milk	Per cent fat
		lb.		lb.		lb.	
Ayrshires—							
Dunlop Reflection	10	10,377	3·72	9,744	4·00	11,010	3·44
Ottawa Supreme 12th	10	9,472	3·53	8,884	4·10	10,940	2·96
Netherhall Old Times	7	10,210	3·97	10,351	3·86	10,069	4·08
Holsteins—							
Brookholm Inka 25th	7	14,492	3·48	14,292	3·41	14,692	3·55
Abegweit Hiemke Francy	14	12,854	3·31	12,770	3·53	12,938	3·09

Table III shows the service and calving records of the sires used.

TABLE III.—BREEDING RECORD OF C.E.F. HERD SIRES, APRIL 1, 1930 TO DECEMBER 31, 1936

—	Number of cows served	Number of services	Number of conceptions	Services per conception	Number of calves dropped	Number of males	Number of females	Number of normal calves	Number of abortions	Number of deformed calves	Number of calves died at or shortly after birth	Number of cows retaining afterbirth
Ayrshires—												
Dunlop Reflection	17	22	17	1·29	17	8	9	16	0	1	0	7
Ottawa Supreme 12th	37	46	35	1·31	38	19	19	35	2	0	1	2
Bois de la Roche Radium	13	14	11	1·27	12	6	6	11	0	0	1	1
Ottawa Reflection 2nd	20	28	18	1·56	21	11	10	17	0	0	4	6
Kirkcudbright Legend	18	27	18	1·50	19	7	12	19	0	0	0	2
Netherhall Old Times	82	132	79	1·67	81	43	38	74	1	0	6	12
Kapuskasing Beauty Supreme	23	33	22	1·50	22	11	11	22	0	0	0	3
Lessnessock Electra	35	44	34	1·29	34	14	20	32	0	0	2	8
Total	245	346	234	1·48	244	119	125	226	3	1	14	41
olsteins—												
Brookholm Inka 25th	33	41	33	1·24	34	15	19	28	1	0	5	2
Brookholm Inka 31st	13	21	12	1·75	12	3	9	12	0	0	0	1
Abegweit Hiemke Francy	90	176	82	2·15	85	49	36	75	3	1	7	19
King Posch Tidy	15	25	12	2·08	13	8	5	8	3	1	1	3
Paul Echo Colanthus	13	17	9	1·89	9	3	6	9	0	0	0	0
ng Jewel Posch	8	10	8	1·25	8	5	3	8	0	0	0	3
Total	172	290	156	1·86	161	83	78	140	7	2	13	28
Total for both breeds	417	636	390	1·63	405	202	203	366	10	3	27	69

The foregoing table serves to show the health of the herd from a breeding and genital standpoint. It will be seen that the average number of services per conception is relatively low, indicating a comparatively healthy breeding herd. The figures for sexes of the calves are interesting in that it is shown that if sufficient numbers are used, the sex ratio is about equal. The proportion of normal to abnormal calves is also very satisfactory and another indication of a healthy herd. The abortions in most cases were not the result of Bang's disease infection but resulted from other causes. The proportion of retained afterbirths was high in spite of the relatively healthy condition of the herd early in the period covered by this review, but there was considerable improvement in the latter part of the period. Considerable improvement in the general and genital health of the herd is attributed to the culling out of chronically diseased cows, but some of the improvement is undoubtedly due to the more natural conditions of management, including a long pasture season.

Production Records

The average yearly production of the cows that have completed lactation periods during each year for the two breeds maintained has been compiled and is set forth in table IV.

TABLE IV.—AVERAGE YEARLY PRODUCTION OF COWS WITH COMPLETED LACTATIONS DURING PERIOD 1930-36

Calendar Year	Number of cows	Age	Days in milk	Milk	Fat	Per cent fat
		yr. mos.		lb.	lb.	
Ayrshires—						
1930*	30	4 7	326	8,087	326·4	4·04
1931	25	4 1	322	7,884	322·1	4·09
1932	32	4 8	321	8,742	330·6	3·78
1933	29	5 0	305	8,177	296·7	3·63
1934	28	6 8	327	8,503	311·5	3·66
1935	38	5 2	311	7,879	289·2	3·67
1936	29	5 2	310	7,990	295·5	3·70
Holsteins—						
1930*	13	5 4	368	11,142	394·4	3·54
1931	21	4 0	377	11,890	434·5	3·65
1932	25	4 4	385	13,174	455·2	3·45
1933	21	4 11	355	12,161	413·7	3·40
1934	20	5 1	342	11,787	418·7	3·55
1935	24	4 6	353	11,640	411·1	3·53
1936	22	5 0	330	11,452	387·4	3·38

* April 1 to December 31.

From an examination of table IV it will be seen that the Ayrshire milking herd was slightly higher in numbers throughout the period than was the Holstein herd. Although there were variations in the number of individual cows in each breed from year to year, an attempt was made to keep these at as constant a figure as possible. In calculating the average age of the cows in the respective years, the age of each cow was taken at the beginning of each lactation period. It will be noted that over the period the average ages range from 4 years 1 month and 4 years to 6 years 8 months and 5 years 4 months for the Ayrshires and Holsteins respectivily. With the exception of the average age in 1934 for Ayrshires, these figures do not show any great variation. An examination of the trend of the figures showing the number of days in milk for each breed during each year is of interest. With minor exceptions there has been a gradual decline in the number of days in milk for both of the breeds from the beginning to the end of the period being reported. This may be attributed in

part to improved herd management, and in addition is another indication of improved genital health of the cows referred to previously. It is good management practice to breed cows to freshen annually, allowing at the same time a six- to eight-week dry period. It will be noted from table IV that the average lactation period for the milking herd of Ayrshires was shorter than that of the Holsteins.

Ayrshire cow "Relief Lucy (Imp.)—83933—". A cow of excellent quality and type, and a profitable producer and reproducer. She has eleven R.O.P. records totalling 134,721 lb. milk, 5,120 lb. fat in 3,620 days, largely on twice-a-day milking.

The milk production has remained fairly constant for each of the two breeds over the total period under review, especially when consideration is given to the gradual decrease in the length of lactation. Comparatively, the standard of production of the Ayrshires is considerably lower than that of the Holsteins. These data, however, cannot be taken as a just comparison of the relative producing ability of the two breeds, for the Ayrshire herd had suffered from the use of a series of highly rated herd sires which did not measure up to expectations. On the other hand, the Holstein sires used were of a quality to maintain a fairly high standard of production.

Considering the system of management, which has been maintained on a comparatively uniform basis throughout the period, with twice-a-day milking and no forced feeding, it is felt that the production as shown is quite creditable and is an indication of the standard of milk production from year to year. Concerning the average butterfat test for each breed, the trend shows a slight decline, especially in that of the Ayrshire breed. This is an illustration of the fact that when a fairly high average level of milk and fat production is attained it takes a good breeding bull to maintain this level and an outstanding bull to improve it.

Sales of Breeding Stock

The sales of breeding stock have constituted one of the phases of the work with dairy cattle. During the period of this report sales have consisted largely of young breeding bulls to farmers and breeders in the district surrounding the Central Experimental Farm and to those in outlying districts. In addition, a number of breeding bulls have been supplied to various branch experimental

stations not only for testing purposes but as herd sires, thus carrying out the policy of supplying necessary new blood from within the Experimental Farms System, and at the same time making possible the testing of bulls and the carrying on of a planned line-breeding policy. During the period covered by this report, 63 Holstein and 61 Ayrshire bulls were distributed, including 3 Holsteins and 6 Ayrshires to branch stations. In addition, a limited number of female breeding animals have been sold, and a number of shipments made to experimental stations, notably to Fredericton, N.B., and Ste. Anne de la Pocatière and Farnham, Que.

Advanced Registration and Selective Registration

The Advanced and Selective Registration of Ayrshires and Holsteins, respectively, has been followed up since its inception, and each year all eligible animals have been inspected. Both herds have made creditable showings in this regard during the period. However, it may be mentioned that while all assistance, co-operation and encouragement possible have been given to the

Holstein cow "Ottawa Hiemke Lena 271016". A "Gold Medal" cow in Selective Registration, with a two-year-old R.O.P. record of 11,212 lb. milk, 397 lb. fat testing 3.54 per cent in 339 days on twice-a-day milking.

development of this phase of the work, it has been considered of secondary value only and supplementary to the testing of the animals both from a breeding and production standpoint. One obstacle encountered in this registration of young bulls has been that owing to lack of space for holding these animals, and to the desire of many breeders and farmers to obtain comparatively young bulls, a rather large number have been sold at less than eight months of age, and thus were not eligible for registration.

Record of Performance

The cows in the Central Experimental Farm herds have always been entered in the Record of Performance test. The purpose of this procedure, where even more complete private production records were also being kept, was to have official records on the cows through which to have their male progeny qualified for Advanced and Selective Registration. It also serves to let the

public know how the herds compare with other herds of the same breeds. Table V gives a summary of the R.O.P. work with the two herds for the years 1931 to 1936 inclusive.

TABLE V.—NUMBER OF COWS QUALIFYING IN RECORD OF PERFORMANCE

—	Number entered	Number qualified	Per cent qualified
Ayrshires—			
1931	30	8	27
1932	33	13	39
1933	34	12	35
1934	37	16	43
1935	36	13	36
1936	36	11	31
Total	206	73	35
Holsteins—			
1931	27	17	63
1932	28	21	75
1933	23	11	48
1934	19	16	84
1935	22	17	77
1936	22	15	68
Total	141	97	69

This table shows that the highest percentage of cows in each breed qualifying was obtained in the year 1934, with some slight drop for the years 1935 and 1936. This table again brings out the fact that the standard of production in the Ayrshire herd has suffered from the quality of sires used, but it also must be kept in mind that this was a comparatively large herd and every animal in it was put on test, this being the policy that is now followed in the "Herd Test Plan" sponsored by the Canadian Ayrshire Breeders Association. Additional information concerning R.O.P. trends in the Ayrshire and Holstein breeds will be found in the Animal Genetics section of this report.

Feed Cost of Milk Production

With the increasing demand for information concerning the cost of producing milk in Canada, it was decided in 1932 to compile the records for the Experimental Farm herds in a form that the feed cost of 100 pounds of milk and of one pound of butterfat could be ascertained promptly from month to month. Accordingly, that year tentative forms were drawn up, itemized in such a way that the milk and butterfat produced, the feed consumed, together with the various governing factors such as number of days in milk, age of cow, etc., could be recorded for individual cows each month. The record includes all cows, milking and dry, and all heifers from four to eight weeks previous to their first freshening. Using the current market price for purchased feeds and the cost of production figure for home-grown feeds, a feed cost figure for producing 100 pounds of milk and 1 pound of butterfat was calculated. A further calculation made possible the determination of the amount of each type of feed, i.e., roughage, concentrates and succulent feeds required to produce 100 pounds of milk.

Table VI entitled "Average Feed Cost of Milk Production per Cow" consists of a summary of the figures from the combined Ayrshire and Holstein milking herds at the Central Experimental Farm for the four-year period 1933 to 1936 inclusive. The table has been set up in two parts. Part A shows the four-year average on a per cow basis by months while part B gives the average per cow on a monthly basis for each of the four years that these records have been collected.

TABLE VI.—AVERAGE FEED COST OF MILK PRODUCTION PER COW—AYRSHIRE AND HOLSTEIN MILKING HERD

Month	Number of cows		Age of cows		Number of days since freshening (cows in milk)	Total cow-days		Total milk for period	Daily average yield of milk	Average per cent fat	Fat produced in period	Meal eaten	Ensilage eaten	Hay eaten	Roots eaten	Green-feed eaten	Pasture	Total cost of feed for period	Feed cost per.....		Feed consumed per 100 lb. milk					
	In milk	Dry				Milking	Dry												100 lb. milk	1 lb. butter-fat	Meal	Ensilage	Hay	Roots	Green-feed	Pasture
			years	mos.	days	days	days	lb.	lb.	%	lb.	lb.	lb.	lb.	lb.	lb.	days	$	$	$	lb.	lb.	lb.	lb.	lb.	days
PART A: Average age of each month throughout the four-year period 1933-1936.																										
January	56	9	5	4	179	24·0	7·0	635	20·5	3·69	23·4	208	936	283	748	.....	.....	5.30	0.84	0.23	32·8	147·4	44·5	117·7	.....	.....
February	51	12	5	4	171	20·0	8·0	617	22·0	3·65	22·5	193	847	260	621	.....	.....	4.81	0.78	0.21	31·3	137·2	42·2	100·7	.....	.....
March	50	14	5	4	149	22·0	9·0	697	22·5	3·58	24·9	216	929	283	553	.....	.....	5.23	0.75	0.21	31·0	133·3	40·6	79·3	.....	.....
April	56	7	5	4	141·5	24·0	6·0	805	26·8	3·61	29·1	240	837	279	715	.....	.....	5.14	0.64	0.18	29·7	103·9	34·7	51·5	.....	.....
May	58	5	5	5	151	27·0	4·0	937	30·2	3·58	33·5	236	664	228	.....	.....	4·8	4.66	0.50	0.14	25·2	70·9	24·3	.....	.....	0·5
June	59	4	5	5	165	27·0	3·0	901	30·0	3·54	31·9	135	149	72	.....	.....	26·0	3·76	0.42	0 12	15·0	16·6	8·0	.....	.....	2·9
July	59	6	5	5	180	27·0	4·0	837	27·0	3·44	28·8	155	234	70	.....	.....	27·0	4.11	0.49	0.14	18·5	27·9	8·4	.....	.....	3·2
August	59	7	5	5	190	26·0	5·0	747	24·1	3·48	26·0	151	165	68	.....	.....	27·0	4.09	0.55	0.16	20·2	22·1	9·1	.....	.....	3·6
September	58	8	5	5	174	24·0	6·0	672	22·4	3·50	23·5	153	224	76	.....	.....	26·0	4.23	0.63	0.18	22·8	33·4	11·3	.....	.....	3·9
October	57	11	5	4	197	25·0	6·0	633	20·4	3·54	22·4	180	612	183	36	.....	18·0	4.50	0.71	0.20	28·5	96·8	29·0	5·6	.....	2·8
November	55	8	5	5	193	24·0	6·0	592	19·7	3·62	21·4	189	903	264	671	.....	.....	4.77	0.81	0.22	31·9	152·7	44·7	113·3	.....	.....
December	54	9	5	3	187	24·0	7·0	613	19·8	3·71	22·7	198	940	279	714	.....	.....	5.04	0.82	0.22	32·3	153·4	45·5	116·5	.....	.....
PART B: Monthly average for each year 1933-1936 inclusive.																										
1933	54	7	5	5	173	24·6	5·8	738	24·3	3·60	26·6	215	702	222	374	.....	10·1	5.14	0.70	0.19	29·1	95·0	30·1	50·7	.....	1·4
1934	53	9	5	5	185	24·5	5·9	716	23·5	3·63	26·0	173	622	218	286	.....	10·0	4.32	0.60	0.17	24·1	87·0	30·5	40·0	.....	1·4
1935	61	9	5	3	177	24·4	6·0	697	22·9	3·56	24·8	182	624	200	333	.....	9·6	4.55	0.65	0.18	26·1	89·5	28·7	47·8	.....	1·4
1936	54	8	5	4	168	24·8	5·7	747	24·5	3·49	26·1	182	520	137	242	.....	13·9	4.55	0 61	0.17	24·3	69·7	18·4	32·4	.....	1·9

The figures in table VI A are self-explanatory and show the seasonal variation in production and the corresponding feed cost. It will be noted that there is a considerable variation in the production and economy of production from one season of the year to another. A number of factors influence this such as time of freshening, stage of lactation, comparative numbers of milking and dry cows in the herd, age of cows, and variations in the price of purchased feeds. This table illustrates the comparative economy in the production of milk during the summer months through the utilization of pasture, the most economical feed produced on the farm.

In an examination of table VI B it will be noted that there was only a slight variation from one year to another in the average feed cost of milk production. The slightly higher relative feed cost per 100 pounds of milk in 1933 was due to the increased cost of producing hay, resulting from a poorer crop than the average and to a relatively higher consumption of concentrate feeds. In view of the herd management practised in obtaining these results, the figures shown in table VI B may be used as a standard for comparative purposes in estimating the cost of producing milk. From the quantities of each type of feed required to produce 100 pounds of milk as shown in the table, it is possible by applying current local prices to these feed constituents, to estimate this feed cost in any specific locality. In addition, in order to arrive at a figure representing the total cost of producing milk, it is known that the feed item constitutes in the neighbourhood of 50 per cent of the total cost. Although the ratio will vary to some extent in different seasons and in different localities a fair estimate of the total cost can be arrived at by doubling the feed cost figure.

Experimental Feeding

During the period being reported a number of feeding trials were carried out with the milking herd and the results of these are briefly summarized as follows:—

1931-35: The Boutflour System of Feeding Dairy Cattle

The essential differences between the Boutflour system and that used in general practice in Eastern Canada are that in the former system the feeding of succulent feeds such as roots and ensilage is eliminated entirely and the total bulk of a dry ration is controlled within definite limits. The Boutflour system is based upon a definite amount of feed (hay and concentrates) being fed according to the weight of the cow, the proportion of hay and concentrates in the ration being increased or decreased to provide the required bulk and nutrients according to the milk production of each individual animal. The amount of total dry feed taken as necessary is slightly less than 3 pounds for each 100 pounds of live weight and of this the amount of concentrates is slightly less than 3·5 pounds for each 10 pounds of milk produced. Thus a 1,200-pound dairy cow producing 30 pounds of milk a day would receive 22·5 pounds of hay and 10·5 pounds of concentrates.

During the years 1931 and 1932 a series of double reversal trials was carried out comparing the Boutflour system with that commonly practised at the Central Experimental Farm, which system is similar to general eastern Canadian practices where meal and hay together with either or both ensilage and roots are used. In this latter system the rate of feeding per day is based upon 1 pound of meal for each 3·5 pounds of milk produced, and 3·5 pounds of ensilage and 1 pound of hay for each 100 pounds of live weight. In 1931 the tests using nine Holsteins and ten Ayrshires consisted of four periods each of one month duration, while in 1932 the tests using eleven Holsteins and ten Ayrshires ran for three periods each of one month duration. In all cases the animals used were comparable and were producing well. Only data from the final fourteen days of each period were used for comparative purposes. The

results of these comparatively short-time tests were similar for both years and although showing no marked differences in the milk or butterfat yields, indicated slightly more economic production of milk under the Boutflour system. However, to more thoroughly test this system in order to try to find whether or not it would maintain production and health and at the same time be of more economic value over a longer period, it was decided to continue this study and carry out an experiment during the succeeding year in which pairs of cows, one of each pair being under the respective systems, were carried throughout their complete lactations.

In the 1933 trial six Holstein cows and six Ayrshire cows were allotted and paired as closely as possible, taking into consideration chiefly age, weight, and past and predicted milking performance, thus making three pairs of two individuals of each breed. Of these six pairs, one animal in each pair was placed under the Boutflour system and one animal under the Central Experimental Farm system. Through no fault of the feeding experiment, normal results for the whole period were obtained only upon three pairs of animals, one pair of Holsteins and two pairs of Ayrshires. These results for complete lactation periods contradicted the apparent slightly favourable showing of the Boutflour system for economic milk production in the short-time tests conducted during the previous two years. For these animals over the longer period the average feed cost to produce 100 pounds of milk was found to be $0.88 on the Central Experimental Farm system as compared to $1.02 on the Boutflour system.

During the succeeding two years 1934 and 1935 this work was continued, using twelve animals (seven Ayrshire cows and five Holstein cows) over an experimental period of 40 weeks during each year. Feeding for various lengths of time on each system was tested with different and the same animals, varying from 12 weeks as the shortest time on one system up to the full 40 weeks. Further, with other animals the reversal system was tried out. The data obtained from these trials over these two years did not show that the Boutflour system had any advantage over the Central Experimental Farm system in that persistency of milk production was slightly improved and the condition of the animals was more satisfactory under the Central Experimental Farm system.

1933: A COMPARISON OF THE RELATIVE VALUE OF LINSEED OIL MEAL AND SOYBEAN OIL MEAL FOR MILKING DAIRY COWS.

The double reversal system was used in this test with two lots of dairy cows (seven Ayrshires and eleven Holsteins), each lot being carried on for three periods of four weeks each and only the data of the latter two weeks of each period were used. One lot of cows was started on the check meal mixture consisting of bran 300 pounds, ground oats 400 pounds, ground barley 200 pounds, linseed oil meal 300 pounds, minerals 36 pounds, with corn ensilage, roots and chopped mixed clover hay in addition, while the other lot was started on the experimental ration which was identical to the check ration except that the linseed oil meal content in the meal mixture was replaced by 256 pounds of soybean oil meal. In each trial the average data of periods one and three were compared with those of period two. The average feed cost to produce 100 pounds of milk was $0.75 on the linseed oil meal ration and $0.76 on the soybean oil meal ration. No appreciable difference could be detected in the general condition and health of the animals or in their milk and butterfat yields that could be attributed to the different rations fed. Butter made from cream produced by the cows when fed the ration containing the linseed oil meal was slightly superior to that from the cows when fed the ration containing the soybean oil meal.

1934: LINSEED OIL MEAL VS. SOYBEAN OIL MEAL VS. PEA MEAL AS A PROTEIN SUPPLEMENT FOR MILKING DAIRY COWS

In a trial similar to that reported immediately above, using the single reversal system during five periods with a group of ten Ayrshire milking cows with the same check ration containing 300 pounds of linseed oil meal in periods one, three and five, 256 pounds of soybean oil meal and 300 pounds of pea meal replaced the linseed oil meal in the basal ration in periods two and four respectively. Comparisons were made of periods one, two and three with ten animals and of periods three, four and five with nine animals. As the previous experiment reported, no difference was noted in the appearance or general condition of the animals that was caused by or related to the different protein supplements used. The essential results as shown in table VII demonstrate no very great difference from the use of these feeds in the yield of milk or in the economy of production.

TABLE VII.—LINSEED OIL MEAL vs. SOYBEAN OIL MEAL vs. PEA MEAL

—	Average of periods 1 and 3 Linseed Oil Meal	Period 2 Soybean Oil Meal	Average of periods 3 and 5 Linseed Oil Meal	Period 4 Pea Meal
Total milk produced.....lb.	3,786	3,855	3,080	2,955
Total fat produced.....lb.	135	136	108	103
Meal consumed per 100 lb. milk.....lb.	32·7	33·0	34·0	34·3
Feed cost per 100 lb. of milk.....$	0·69	0·69	0·73	0·76

1935: THE PALATABILITY OF COD OIL IN THE GRAIN RATION OF DAIRY COWS

Short-time palatability trials were carried out to determine the amount of cod oil which could be added to ground wheat to be included in the grain mixture of milking dairy cows without adversely affecting the ration and without affecting the quality of the butter produced. These trials were made in an attempt to alter the milling qualities of wheat without lowering its feeding value. Fed in the concentrate mixture at the rates of 1 to 2,000 and 1 to 4,000 parts by weight with different lots of cows over varying periods, the results indicated that the smaller proportion of oil fed was more palatable to dairy cows and that neither proportion of cod oil used caused any taint in the butter of the cows so fed.

1934, 1935 AND 1936: PASTURE TRIALS WITH MILKING DAIRY COWS

Studies were carried on concerning the relative value of mineral and complete fertilizers for permanent pastures using dairy cattle as the grazing animals. This experiment is reported in the section of this report dealing with pasture investigations.

DISEASE ERADICATION

The main features in disease eradication are the elimination of tuberculosis, Bang's disease, and mastitis. In so far as tuberculosis is concerned all animals are tested annually by the Health of Animals Branch under their Accredited Herd Plan and the whole herd has been almost entirely free of reactions throughout this report period. An occasional animal has given a suspicious or definite reaction but nothing in the nature of an epidemic has occurred since 1927. In the case of Bang's disease a similar practice is followed, the herd being blood tested regularly under the Supervised Herd Plan of the Health of Animals Branch. Here again, the results have been highly satisfactory, in that there have been very few reactions and fewer abortions. The abortions that did

occur could not be traced by means of subsequent blood tests to infection with *Brucella abortus*, the causative agent of Bang's disease, therefore such abortions must have been due to other incidental causes. This assertion is borne out by the fact that no epidemics of this disease followed the occasional abortion where no reaction to the blood test had occurred. From the foregoing results it is quite evident that the tests applied and procedure now being followed are highly efficient. One result has been a much more rapid building up of the herds than was possible when they were being periodically decimated by outbreaks of tuberculosis and abortion. This in turn has allowed for more severe culling and at the same time provided sufficient animals for the carrying on of experimental work.

Unfortunately the elimination of these two diseases has not entirely solved the problem of herd wastage. The incidence of infections from mastitis is unduly high and has accounted for much of the wastage in the herds in recent years. Steps are being taken with the co-operation of the Division of Bacteriology to determine the best method of eliminating this disease from the herd. To date, however, the tests and procedure for detecting and eliminating this disease are not so clearly defined and efficient as those for the handling of tuberculosis and Bang's disease, with the result that further study will still have to be given to the problem.

The Dairy

The Farm dairy during the period covered by this report has been maintained and operated in the intermediate capacity of that of a comparatively large farm dairy and that of a small creamery. The work carried on has consisted chiefly of the handling of all milk produced by the two dairy herds, its processing, the marketing of all dairy products thus manufactured, and studies and experimental work relating thereto. Financial limitations and the lack of suitable equipment have of necessity curtailed this latter work to a marked degree.

All milk handled in the dairy, amounting to approximately 1,200 pounds daily, is pasteurized by the "holding" method. A portion is sold as whole milk, a limited amount is used for calf feeding and in cheesemaking, while the bulk is separated into cream and skim-milk. The cream is manufactured into farm butter while the skim-milk is used for calf, pig and poultry feeding and various experimental feeding studies. Although high-class dairy butter is the chief product manufactured, several types of cheese are made, principally Cheddar and Cheshire cheese.

Through the co-operation of the Division of Bacteriology, the milk and various products are periodically checked and bacterial counts made, and the production of these is maintained at a high standard.

Additional work in the dairy has taken the form of the frequent testing of milk from individual cows in the Experimental Farm herds, the testing of a large number of milk samples for farmers, and of assistance and advice given concerning various phases of dairy production.

HORSES

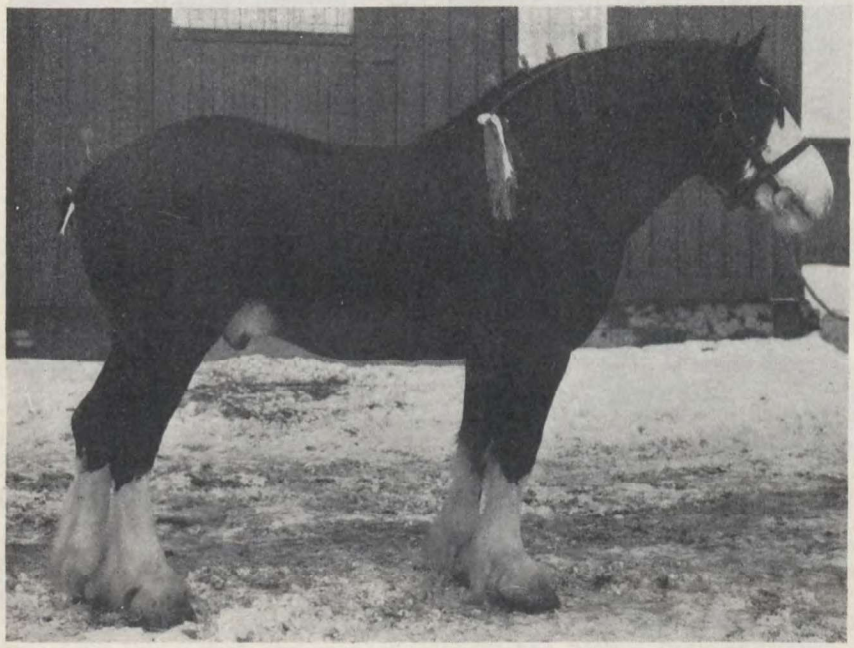
Development of Clydesdale Stud

For a number of years just previous to 1930, due to the comparatively successful times, high price of grain, and low price for horses, interest in horse breeding fell off considerably and it was not until the second or third year covered by this report that the economy of the horse as compared with the tractor, in hard times, was realized. From 1933 on, however, there has been a renewed interest in horse breeding and this division has endeavoured to foster this interest as much as possible.

The breeding of Clydesdale horses for the twofold purpose of producing breeding stock for distribution and supplying horse-power for work on the farm has been one of the main projects for a number of years. The foundations for this work were laid in 1916 with the purchase of two imported Clydesdale mares. These two mares came from a breeding establishment in Scotland noted for its good breeding mares. Further purchases were made in 1919—of one imported and one Canadian-bred mare, and again in 1925 of three Canadian-bred mares. The original selection, however, proved the most satisfactory and one of these mares is the foundation mare of the majority of the females in the breeding stud as at December, 1936.

Stallions Used

Up to and including the breeding season of 1924 no stallion was kept at the Central Experimental Farm, the mares either being shipped out to some Clydesdale breeder's establishment to be bred, or they were bred to one of the good horses standing in the district. In the fall of 1924 Sir James Calder

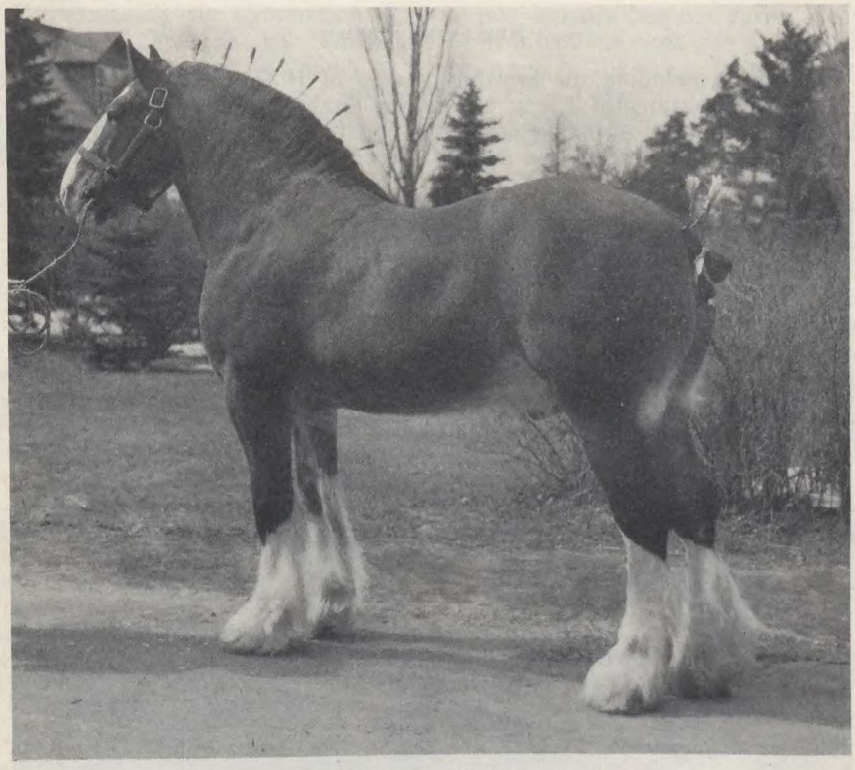


Clydesdale stallion "Sandy Mac (Imp.) [24318]."

of Scotland presented the Dominion Government with the three-year-old Clydesdale stallion "Sandy Mac (Imp.) [24318]." This horse, a splendid type of Clydesdale, as indicated by the accompanying photograph, stood for service at the Central Experimental Farm for the following four breeding seasons, after which he was transferred to the Lennoxville Experimental Station. He left a number of excellent foals, both on the Farms and in the surrounding districts. His female progeny were particularly good and developed into excellent brood mares.

During the breeding seasons of 1929, 1930, and 1931 there was no stallion standing at the Central Experimental Farm and the breeding work suffered as a consequence. In the spring of 1932 the imported stallion "Precedence [24623]" was purchased. This was a well preserved typey horse 12 years of age, and a

proven breeder of numerous and good type offspring. The accompanying photograph, taken at 12 years, shows this horse to be of a very desirable type, with a short, strong back, deep bodied, well muscled on the quarters, and good strong, clean, hard bone. He stood at the Farm in 1932, 1933 and 1934 with very satisfactory results. Bred to daughters of "Sandy Mac" he left very uniform, smooth progeny. There are, as at December, 1936, fourteen of his progeny on hand. Five of these are three-year-old fillies, all of which give promise of being good brood mares. Two colts of the same age were shipped to the experimental stations at Lennoxville, Que., and Charlottetown, P.E.I., respectively, in 1936 as breeding

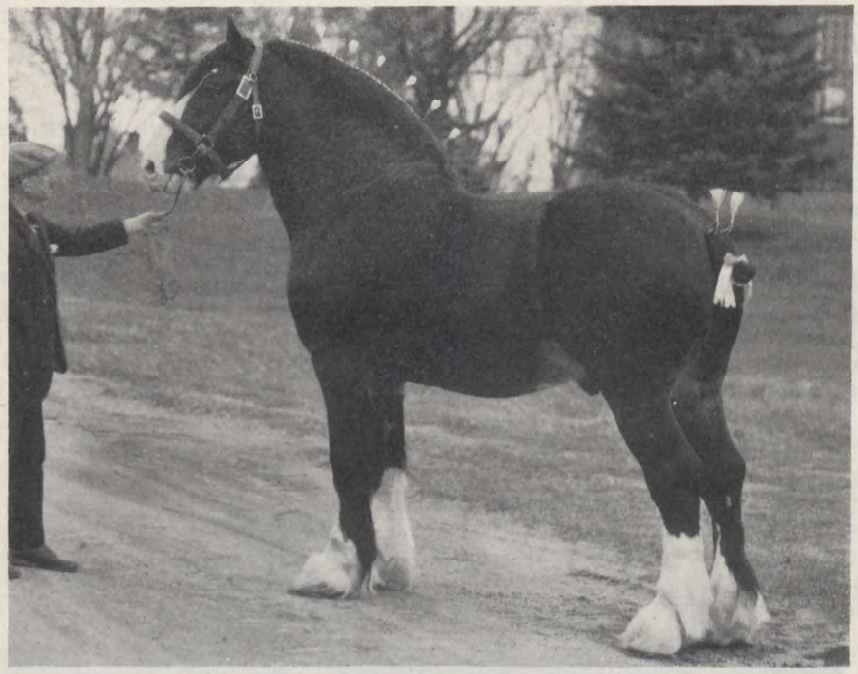


Clydesdale stallion "Precedence (Imp.) [24623]."

stallions. The 1934 and 1935 foal crops were not so large but there are some promising individuals. This stallion "Precedence" was shipped in the fall of 1934 along with two home-bred mares, to the experimental farm at Nappan, N.S., where he is continuing his successful career as a breeder of good type Clydesdales.

In the fall of 1934, recognizing the need for some assistance to horse breeding, the Department of Agriculture imported five Clydesdale stallions,—one aged horse, three two-year-olds, and one yearling. The two-year-olds were placed at the Brandon, Indian Head, and Lacombe Experimental Farms, while the aged horse and the yearling were retained at Ottawa, the former as a stud horse and the latter for further development, the yearling finally being shipped to Brandon to replace the other horse which died in 1935 from encephalomyelitis.

The aged horse was "Windlaw Gayman [26992]" born in 1929. He is by "Dunbritton Sensation" and out of a "Baron of Buchlyvie" dam. Close up in his pedigree are to be found the names of such noted horses as "Hiawatha", "Dunure Footprint", "Everlasting", "Baron's Pride", "Baden Powell", and "Sir Everard." In addition to being well bred he is a good individual with plenty of size, strength and substance, good strong clean bone, and bold straight action. He stood for service at Ottawa and Brampton, Ontario during 1935, and at Ottawa in 1936 under a Premium Mare Policy. This Policy gave special consideration and assistance to owners of high-class pure-bred mares likely to produce colts that would in time be useful as sires for the general improvement



Clydesdale stallion "Windlaw Gayman (Imp.) [26992]."

of the breed. This same Policy was put in operation at each of the other stations where stallions were maintained and should in the course of time, have a desirable effect on the type of draft horse in the districts concerned.

The average number of horses maintained per year during the period covered by this report has been 46. There has been a decided change, however, in the proportion of work horses to breeding horses, the numbers of the former falling off and of the latter, increasing. This is in keeping with the renewed interest in horse breeding throughout the country. The shortage of horse labour available was made up for by the greater use of tractors in the large field work where the latter can be used to good advantage.

SHEEP

The sheep flock numbers about 400 breeding ewes of which grade Shropshire and cross-breds form the greater part. The grade flock owes its origin to the purchase in 1928 of 72 ewes of mixed breeding. By successive matings with pure-bred Shropshire rams and judicious selection these sheep have taken on all the characteristics of this breed. The flock is most uniform and is very well

suited for experimental purposes. The cross-breds are the result of crossing Leicester rams on Shropshire ewes. These sheep are heavy, compact, vigorous, and very good grazers. They are mostly used for the production of market lambs and for experimental grazing purposes.

For the purpose of furnishing rams for breeding operations, two small flocks of pure-bred Shropshires and Leicesters are also maintained. Being highly selected as to wool qualities and mutton conformation, they are very useful for the grading up and cross-breeding program which is followed. They are also used as demonstration flocks at field days. Occasionally a few rams of good conformation are sold to farmers at reasonable prices.

Three main lines of experimental work are being carried on at the present time, namely, cross-breeding for the production of market lambs, winter feeding of the breeding ewes, and pasture grazing studies. Each of these will be discussed in turn.

Cross-breeding

During the past five years, the cross-breeding of Shropshire and Leicester sheep has been carried on almost continuously. The procedure consists in mating Shropshire to Leicester or vice versa. The female progeny of the first generation is raised and as yearlings bred back to Shropshire rams. The resulting lamb crop is entirely disposed of as market lamb.

Although no valid comparison can be made due to the fact that most of these ewes and lambs had to be used for pasture experimental work, certain observations however, have been made. The first-cross lambs are very hardy and grow rapidly. Given an abundance of feed throughout the summer they will develop into very satisfactory market lambs. If, on the other hand, the feed is scarce the lambs will keep on growing and their finishing within the required

Spring lambs being finished on alfalfa aftermath. September, 1935.

market weight will be difficult. The female progeny is of particular interest from the standpoint of conformation and breeding qualities. These sheep average 150 pounds, have excellent constitution, are long lived and easily wintered. Their prolificacy is above the two parents' breeds and being excellent milkers, the cross-breds are well suited for the raising of lambs on grass. The wool although a little shorter than that of the Leicester, is abundant, bright, and strong. In fineness it grades low medium staple.

The second cross lambs are almost ideal from the market standpoint. Being early maturing they are ready earlier than the lambs of most of the straight breeds and furthermore they furnish a most desirable carcass, as they are low-set, blocky and particularly full at the loin and legs.

Such a system of cross-breeding is of value in the production of market lambs and should be practised more extensively in certain districts. It has, however, its limitation. Cross-breds do not breed true, consequently, no animals of the second generation and especially no ram of either cross should be kept for breeding. This system necessitates the keeping of two breeds or the purchase of rams of another breed, a feature which involves expenditure and is possible only in fairly large flocks.

Western Range Ewes vs. Eastern Ewes for the Production of Cross-bred Lambs

In the fall of 1936, 40 aged range Rambouillet and 40 Corriedale × Rambouillet ewes which were used in cross-breeding experiments at Manyberries and Lethbridge were shipped to the Central Experimental Farm, Ottawa. Bought under contract, payment is to be made on the basis of poundage of lambs produced the following two seasons according to the age of the ewes. These sheep are to be mated to Shropshire rams and compared with sheep of eastern origin. The purpose of this work is to determine whether western range ewes, old but otherwise sound and healthy, could be brought east and used for the production of market lambs. The experiment is now under way but no report is available as yet.

Roughages for Wintering Breeding Ewes

In 1930, an experiment was undertaken to determine the relative value of timothy hay, mixed hay, and alfalfa hay for feeding ewes during pregnancy and during the period after lambing when they are still barn fed, or until the lambs are four weeks of age. Accordingly, the following experiment was devised and carried on for four years. Each year 108 ewes were divided into six lots of eighteen ewes each. During the gestation period the various lots received the following rations: Lots I, II and III, timothy, mixed, and alfalfa hay respectively, while lots IV, V and VI all received a standard ration of alfalfa hay and corn silage along with enough grain to maintain the ewes in good condition, although in only one of the four years was any grain fed before lambing.

After lambing, each lot was subdivided into two groups, A and B. In each case, the A group continued on the same ration as it had received up until lambing. In the case of lots I, II and III, the B group was changed to the standard ration while lots IV B, V B and VI B received timothy, mixed and alfalfa hay respectively. Thus the three different types of hay and the standard ration can be compared as follows:—

(1) When fed throughout the gestation period and the four weeks of nursing.

(2) When fed up until lambing and then followed by a standard ration for the nursing period.

(3) When fed during the nursing period after the feeding of a standard ration during the gestation period.

Complete individual weight records of all ewes were kept along with their feed consumption by lots. In addition to this, as a measure of the effect of the various treatments on milk production, all lambs were weighed at birth and when 7, 14, 21 and 28 days old. Post-mortem examinations of all mortalities were conducted and the mortality figures reported refer only to those

lambs that died from causes that might be attributable to the treatment and do not include accidental deaths.

In all, 394 ewes lambed while on this experiment, giving a total of 616 lambs. The results are conclusively in favour of alfalfa as a roughage for pregnant ewes whether fed alone or supplemented with silage and grain as compared with mixed or timothy hay. Comparing the lots on the basis of their weights at allotment and immediately after lambing, those receiving the standard ration and those on alfalfa alone maintained their weight while the sheep of the mixed hay lot lost 9 per cent of their original body weight and the timothy lot 19 per cent. This difference is also carried through in the average birth weight of the lambs as the average ranged from 7·3 pounds for the timothy lot to 8·6 pounds for the lot receiving the standard ration.

Perhaps one of the most significant measures of the value of the various rations shows up in the grading of the lambs at birth and the percentage mortality occurring in the various lots. In the timothy lot 16 per cent of the lambs were stillborn, and only 32 per cent graded "good," while the mortality up to four weeks of age, including those stillborn, was 33 per cent. The mixed hay lot gave some reduction over this, the figures being 11 per cent stillborn, 58 per cent "good," and a mortality of 22 per cent. Alfalfa alone gave the best results of all, being even lower in percentage mortality than was the standard lot; thus it would appear that the addition of silage to an alfalfa ration reduced the vitality of the lambs. There were less than 1 per cent stillborn in the alfalfa lot as compared with 3 per cent in the standard, and in both lots 81 per cent of the lambs graded "good." The mortality was 7 per cent for the alfalfa lot and 13 per cent for the standard lot.

After lambing the results were essentially the same, those ewes receiving timothy and mixed hay continued to lose weight, while those on the standard ration maintained their weight. During the first four weeks, the former lost 12·5 pounds and the latter 8·5 pounds per head. It would seem also that grain at this point is necessary with alfalfa as during the same period this lot lost 6 pounds per head. This difference in the feeds is also reflected in the milk production of the ewes as measured by the growth of the lambs during the first four weeks. Those from ewes receiving timothy gained at the rate of 0·34 pound per head per day; those in the mixed hay lot, 0·38 pound; alfalfa lot, 0·45 pound; and the standard lot 0·52 pound per head per day.

Another point coming out of this experiment is that even though ewes have been fed a poor ration during gestation, the losses in body weight can be stopped by the feeding of an adequate ration during the nursing period and the lamb gains can be increased, although they do not reach the level of the gains of lambs from ewes fed the standard ration throughout the winter. The average daily gains of the lambs for the various lots were as follows: Timothy up to lambing, standard ration after, 0·49 pound; mixed hay up to lambing, standard ration after, 0·44 pound; alfalfa up to lambing, standard ration after, 0·47 pound; standard ration throughout, 0·52 pound. The comparatively high value for the first of these can be explained on the basis of selective mortality, that is to say the mortality was so high in this lot that only the very superior lambs remained.

The effects of feeding the various roughages alone for the nursing period following the feeding of the standard ration during gestation is brought out by lots IV B, V B, and VI B. Since the results obtained, although inferior to those found when a high-grade ration was fed throughout gestation and nursing, are decidedly better than those obtained when the low-grade roughages were fed during the entire period, the necessity for the adequate nourishment of pregnant ewes is clearly demonstrated. When timothy alone was fed, an average loss in body weight of the ewes of 11·7 pounds was experienced, and lamb gains dropped to 0·42 pound per head per day. The mixed hay lot as

usual was intermediate, with a ewe loss of 8·4 pounds and a lamb average daily gain of 0·47 pound. The alfalfa hay lot lost slightly in body weight, but the lamb gains were as high as those in the standard lot.

The results of the entire experiment may be summarized as follows:—

(1) Timothy hay, unsupplemented, is not a suitable feed for wintering pregnant ewes in that there is a heavy loss in body weight of the ewes, a high percentage of stillborn lambs, a low percentage of good lambs and a high subsequent lamb mortality. It also has a depressing effect on the milk yield of ewes that have been well wintered. The changing of timothy-fed ewes to an adequate ration of alfalfa, silage, and grain after lambing brings about a decided improvement in the condition of the ewes and the rate of gain of their lambs.

(2) Alfalfa hay when fed alone throughout the gestation and nursing period gave results only slightly inferior to the standard rations. Up until the time of lambing even slightly better results were obtained as the corn silage seemed to increase lamb mortality. After lambing, however, alfalfa alone did not maintain the ewes' body weight and the lamb gains were somewhat inferior to the standard ration. When alfalfa was fed after lambing to ewes that had received an adequate ration throughout the winter this drop did not occur.

(3) Mixed hay is intermediate in all respects to timothy and alfalfa.

(4) If low-grade roughage has to be fed to breeding ewes it should be fed during the pregnancy period and the better hay saved for the nursing period.

Mixed Hay for Wintering Pregnant Ewes

Since the preceding experiment had proved conclusively that alfalfa gives excellent results whether alone or supplemented, in 1934, it was discontinued and another experiment was designed to determine the best way of supplementing a ration based on mixed hay as this hay is most prevalent in Eastern Canada.

This trial consisted of five lots of 20 ewes each. Lot V being the check received a ration of alfalfa hay and silage, supplemented with grain for four weeks before lambing. Lots I to IV all received mixed hay with Lots III and IV being fed silage throughout the winter and Lots II and IV receiving in addition grain from four weeks before lambing. After lambing, all lots were subdivided into two groups, A and B. Lots I A, II A, III A, and IV B continued on the same ration as they had received before lambing. Lots I B and III B had grain added and Lot II B silage. Lot IV A was the same as before lambing except that the grain allowance was removed. Lot V was not split and continued on the same ration. All ewes were kept on the various treatments until their lambs were four weeks of age and from then on the lots all received the same treatment, being grazed in the same flock all summer. Much the same records were kept as in the previous experiment except that in this case the weight records of the ewes and lambs were kept throughout the pasture season. This experiment was discontinued in the fall of 1936 and two years' results are available.

None of the treatments were effective in preventing the loss of weight of the ewes from breeding to after lambing when mixed hay was used, while in the alfalfa lot a slight gain was shown. Corn silage and grain, however, did reduce this loss.

The birth weight and vigour of the lambs were affected markedly by the ration fed, the average birth weight of the mixed hay alone lot being 7·7 pounds and the mortality 17 per cent. The addition of grain, or silage and grain increased birth weight and reduced the mortality to 10 per cent. The addition of silage alone, however, proved decidedly detrimental, as in this lot the average birth weight was only 7·3 pounds and the mortality was 24 per cent.

From lambing until the lambs were four weeks of age the ewe loss in body weight was sharply reduced by the addition of grain, silage or both to the mixed hay. As measured by the lamb gains, corn silage and mixed hay gave the poorest results, with the hay and grain lots coming next, the combination of all three gave almost as satisfactory results as did alfalfa, silage and grain. One rather peculiar point brought out was that ewes that had been wintered on an adequate ration and lambed in good condition did not seem to require grain during the nursing period in that the lamb gains were high even though the ewes lost some weight themselves.

Throughout the pasture season, the differences between treatments seemed to even out with the exception that the gains of the lambs from ewes fed mixed hay and silage throughout the winter did not reach the same level as the other lots. In addition the recovery of the ewes in condition during the pasture season did not seem to be affected by the ration fed during the preceding winter.

Summary

(1) Mixed hay supplemented with corn silage and grain gave almost as good results as alfalfa hay, corn silage and grain.

(2) Silage had a depressing effect on the birth weights and vigour of lambs, particularly when supplementing mixed hay. While there was some evidence that this was also true in the case of a hay-grain ration, the data were inconclusive.

(3) The addition of grain to a hay, or hay-silage ration after lambing reduced the losses in ewe weight for the nursing period.

(4) A mixed hay-silage ration appeared to lower lamb gains throughout the ensuing pasture season. The ration fed during the winter, however, did not seem to affect the recovery of the ewes while on pasture.

Protein Supplement for Fattening Lambs

In order to determine the value of a protein concentrate such as linseed oil meal when fed in a ration made up of alfalfa hay and home-grown grain, 60 lambs were divided in three groups of 20 each. All groups were fed the same basal ration of alfalfa hay and a grain mixture of barley and oats in equal parts. In addition, 14 per cent of linseed oil meal was added to the grain mixture of group II and 28 per cent to that of group III. The digestible crude protein of the three rations was as follows: 9·4 per cent for group I, 12·2 per cent for group II and 15·1 per cent for group III. The lambs were fed for 58 days and the feed consumption was held at the same level.

The addition of 14 per cent of linseed oil meal gave an increased daily gain of 34 per cent over the straight grain ration and the addition of 28 per cent of linseed oil meal resulted in an increase of 83 per cent. The feed required per pound of gain decreased with the increase in the quantity of the protein supplement. Group I required 7·7 pounds of hay and 9·5 pounds of grain per pound of gain. Group II required 5·1 pounds of hay and 7·0 pounds of grain, and group III, 3·7 pounds of hay and 5·1 pounds of grain.

The dressing percentage was 48·3 per cent for the straight grain ration, 47·8 per cent for group II and 47·9 per cent for group III. The diminution in dressing percentage may be explained by the fact that the wool of the lambs fed the oil meal seemed to contain more grease or yolk than that of the check, which may account for the pelts being heavier. Although the experiment was of short duration and needs to be repeated in order to arrive at a definite conclusion, the results seem to show that a protein supplement may be beneficial when fed in a mixture with home-grown grain for grass lambs being finished quickly.

Fattening of Western Feeder Lambs

In connection with a cross-breeding project now under way at Lethbridge and Manyberries stations for the improvement of wool and mutton qualities of the range sheep, an experiment was undertaken at Ottawa in the fattening of western feeder lambs.

Forty range Rambouillet, forty Corriedale × Rambouillet and forty Romney Marsh × Rambouillet feeder lambs were brought down to the Central Farm to be fattened. Data on their fattening ability, and the quality of their carcasses will be recorded and compared in order to obtain information on the value of these crosses. As the experiment is still in progress, these data will of necessity be held for the next report.

Pasture Investigations

Each summer some 200 ewes and their lambs have been used for carrying on pasture grazing experiments. Commercial fertilizers versus no fertilizer, manure versus no manure, and mixed grazing versus single grazing are some of the projects which are being investigated and a discussion of the results will be found in the pasture section of this report.

PASTURE INVESTIGATIONS

In 1929 the first pasture experiment at the Central Experimental Farm was started, and consisted of a simple layout designed to obtain information on the comparative value for sheep of fertilized pastures rotationally grazed as compared with fertilized pastures continuously grazed, and non-fertilized pastures continuously grazed. Since that time the pasture work has increased both in volume and complexity, and at present the various projects occupy about 85 acres of land, and dairy cattle, beef cattle, and sheep, the latter two both singly and in combination, are used as the grazing animals.

These experiments are carried out co-operatively, the divisions involved being, Animal Husbandry, Field Husbandry, Forage Crops, Botany, and Chemistry. Since this division is particularly interested in the effect of the various treatments on the productive power of the pastures as measured by the health and production of the animals, this report will deal only with these phases of the results.

All data have been calculated on the basis of total digestible nutrients (T.D.N.) produced, by the reverse use of feeding standards. By this method it is assumed that an animal of a given weight requires a certain amount of total digestible nutrients per day for maintenance and an additional amount for each pound of production, whether it be gain or milk. Thus, the total T.D.N. required for the maintenance and gain of all animals on the plot approximates the actual production of the pasture if it is closely grazed. This total T.D.N. is then converted to animal units per acre per day by dividing it by 2,400, which is the number of pounds of T.D.N. required to support a 1,000-pound dairy cow producing 25 pounds of 4 per cent milk per day over a grazing season of 150 days.

Where an economic value has been placed on the pastures, the actual gains have been corrected by use of "Standard Animals" in order to eliminate such factors as density of grazing, rate of gain, age and species of animal, and milk of different fat contents.

Dairy Cattle

Mineral versus complete fertilizer

In 1933 an experiment was laid down which was designed to test the effect of mineral fertilizers alone, and with nitrogen, on different pasture mixtures and their subsequent value for dairy cattle. Grazing was started in 1934 and three years' results are available.

No advantage appeared to be derived from the addition of nitrogen to a mineral fertilizer; in fact, minerals alone gave slightly better results than did the complete fertilizer. In the three-year average both fertilizer lots showed some increase over the check, amounting to 20 per cent in the case of the mineral fertilizer, and 10 per cent in the case of the complete fertilizer, although these increases were somewhat less than might be expected, possibly due to the fact that the land was in a reasonably high state of fertility at the commencement of the experiment. There was some evidence to indicate that complete fertilizer should be used at the start in laying down a permanent pasture, this to be followed by applications of mineral fertilizers only.

Steers

QUANTITY OF FERTILIZER

With the object in view of determining the most economical amount of fertilizer necessary to rejuvenate old permanent pastures, in 1931 four fields of four acres each were laid out. Field 1 received no fertilizer; field 2, a light application; field 3, a medium application; and field 4, a heavy application, each of complete fertilizer. In 1935, however, the treatment of field 2 was changed to an application of 600 pounds of superphosphate every four years so that while there are six years' results available for fields 1, 3, and 4, there are only four years' results for the light application of a complete fertilizer, and two years for the superphosphate alone treatment.

Group of yearling Shorthorn steers on experimental pasture.

All fields showed a marked increase in total digestible nutrient yields over the check lot, with the superphosphate alone giving excellent results. The yields of the treated plots increased directly with the increases in amounts of fertilizer, but in the case of the heavy application, this increase in production was not enough to cover the cost of the additional fertilizer. From the standpoint of return per acre over cost of fertilizer, superphosphate alone proved most satisfactory, with the medium application of the complete fertilizer, namely, 100 pounds of ammonium sulphate annually, and 300 pounds of superphosphate plus 75 pounds of muriate of potash every four years coming next in order of merit, followed by the light, and then by the heavy application.

MOWING AND HARROWING

At the same time as the above trial was started, two other fields were laid out to determine whether mowing and harrowing had any effect on the productivity of old pasture. Both fields were treated with a medium application of a complete fertilizer, and were lightly grazed. Field 5, however, was harrowed and mowed, while field 6 was left untouched. Six years' results would indicate that for the conditions of this experiment it is advantageous to leave the old grass standing in the pasture for cover. Field 6 gave superior results as measured by total digestible nutrient yield, carrying capacity, and return over cost of fertilizer. It might also be pointed out that this area seems to be improving from year to year.

LIGHT VS. HEAVY GRAZING

As the two experiments are located in the same block, light vs. heavy grazing can be compared by using the data from fields 3 and 5. The results show that heavy grazing has given slightly better yields and returns but indications are that the lightly grazed field is improving in carrying capacity throughout the years.

CULTIVATED PASTURES

In 1936 an experiment was started to determine whether a rotated, cultivated pasture was superior to continuously-grazed permanent pasture. The cultivated pasture consisted of a three-year rotation as follows: first year, oats and sudan grass seeded down; second year, clover; third year, timothy. This was compared to fields 1 and 3 of the experiment previously reported. The first year's results are distinctly in favour of the cultivated pasture, the carrying capacity was doubled over the non-fertilized permanent pasture, and showed a 65 per cent increase over the fertilized permanent pasture. In monetary returns per acre the cultivated pasture gave a 25 per cent net increase over the fertilized permanent pasture in spite of the rather heavy cost of cultivation and seeding.

SHEEP AND STEERS

MIXED GRAZING

Since rather widespread interest was evidenced in the value of mixed grazing, an experiment designed to obtain information on this point was laid out in 1933. One field was grazed with two-year-old steers along with ewes and their lambs, in the proportion of one steer to every five or six ewes; the other was grazed with sheep alone. Both fields were fertilized with 10 tons of manure per acre, applied every four years. The results obtained show rather conclusively that there is benefit to be derived from mixed grazing in that both carrying capacity and returns were 30 per cent higher in the lot grazed with sheep and steers. This increase appears to be due to the fact that the field was more evenly grazed, the steers eating the longer grass while the sheep chose the more succulent, shorter herbage, thus producing a more desirable type of sward.

MANURE VERSUS COMMERCIAL FERTILIZER

At the same time as the above experiment was started, an adjacent lot was laid out with a view to determining the relative value of farmyard manure and commercial fertilizer for permanent pastures. This lot was also grazed with sheep and steers and was fertilized with a medium application of a complete fertilizer. Over four years the commercial fertilizer area has been about 20 per cent better than the barnyard manure area, but by comparison with the check lot which received no fertilizer, it would appear that the farmer who has a good supply of manure would be well advised to apply some of it to his permanent pastures.

Sheep

Fertilized versus non-fertilized and continuous versus rotational grazing

As has been previously stated, the first experiment started by the Central Experimental Farm was one to determine the value of commercial fertilizer on permanent pastures, and the effect of continuous and rotational grazing on the quantity and quality of the grass as measured by the carrying capacity and live weight gains of sheep. In 1929 three fields of four acres each were laid out, one of which remained unfertilized and one received a medium application of a complete fertilizer. The other field was subdivided into three lots which were rotationally grazed. This field received the same fertilizer treatment as did the second one. The seven years' average shows an increase in the carrying capacity of the fertilized field over that receiving no treatment of 66 per cent, but gave an increased return over fertilizer cost of only 7 per cent.

The rotational grazing showed a small but constant increase over the continuous grazing. It is doubtful, however, if this would pay for the extra fencing and labour involved. From the results of this experiment rotational grazing can only be recommended when little extra labour is required for extra fencing and the supplying of water.

Pasture Management Experiments

In 1933, twelve small quarter-acre fields were fenced off and several experiments started to obtain information on day and night grazing, the effect of resting pastures for various periods, and the effect of giving pastures rests of a month duration at different times throughout the season. Yearling ewes were used as the grazing animals. These experiments were not very successful due to the small size of the plots which sometimes led to conflicting results from year to year.

Day versus night grazing

In the day and night experiment the " day " animals were on pasture from 6 a.m. to 6 p.m. and the " night " lot from 6 p.m. to 6 a.m. When not on the plots the animals were kept in a small corral and received no feed. A check lot was grazed continuously. It was noted that the " day " animals grazed but little during the warm weather except for a short period in the morning. This was borne out by the experimental data in that lower carrying capacity was obtained for the " day " lot. The " night " lot gave results superior to both the " day " and " continuously grazed " lots.

Weekly rest periods

The experiment to determine the effect of resting a pasture for various periods consisted of three fields. Field 1 was grazed one week, and rested the next; field 2 was grazed one week, and rested for two; while field 3 was rested for three weeks after each week of grazing. When not on experiment the animals were kept in an adjoining field as nearly similar to the experimental plots as possible. The results vary from year to year due to weather conditions, but on the average the carrying capacity of the fields increased as the length of the rest period became shorter. In other words, one week's rest gave the most economical results.

Monthly rest periods

Six fields comprised the monthly rest experiment. Fields 1 to 5 were each given consecutive four-week rest periods, commencing with field 1 in the spring season and finishing with field 5 in the fall season. Field 6 was the check and was grazed continuously throughout the summer. The results are rather inconclusive but it would seem that a rest period, to be of the most value, should be in midsummer, not in the spring or the fall.

CULTIVATED PASTURES

In 1935, five fields, each seven-tenths of an acre in area, were laid out and seeded to a pasture mixture in order to determine the value of various fertilizers for seeded pastures. Lot 1 received a complete fertilizer; Lot II, nitrogen and phosphorus only; Lot III, no treatment; Lot IV, phosphorus only; and Lot V, nitrogen only. As this has run only one year and an unseasonably late frost in early June may have interfered somewhat with the results, little comment can be made. However, the carrying capacity throughout was high as compared with permanent pasture receiving the same fertilizer. The average daily gain of the lambs on these plots was excellent and all lambs were fat and of market weight early in the season.

General Conclusions

1. Applications of a complete commercial fertilizer will increase the productivity of permanent pastures, the amount of increase being proportionate to the amount applied. However, it is possible that large applications will not prove economical. The most satisfactory general fertilizer mixture, as determined by these experiments, was 100 pounds of sulphate of ammonia annually plus 300 pounds of superphosphate and 75 pounds of muriate of potash every four years.

2. Superphosphate alone gave very good results and appeared to encourage the growth of legumes when applied to permanent blue grass sod.

3. Rotational grazing always gave slightly better results than did continuous grazing, but the increases were not large enough to pay for the additional cost.

4. Mixed grazing of sheep and steers was superior to the grazing of either class of stock alone.

5. Farmyard manure will increase the production of permanent blue grass pasture but possibly not so effectively as commercial fertilizers.

6. The mowing and harrowing of pasture has not proved to be an economical procedure.

7. No treatment of old blue grass sods, whether by fertilizer or management, has given as satisfactory results as have cultivated pastures, although the results for the latter are for one year only. It would appear that in the Ottawa valley, for best results permanent pastures fully grazed in the spring must be supplemented by annual pastures and aftermath for the midsummer months. However, in the case of the rotated, cultivated pasture experiment the same number of stock was carried throughout the entire pasture season.

For a complete report of all experiments, including data and discussions of the management of the live stock on the experimental pastures, the reader is referred to the bulletin entitled "Pasture Improvement in Eastern Canada," Publication 602 of the Dominion of Canada, Department of Agriculture.

SWINE

The swine herd at the Central Experimental Farm is maintained for two main purposes; first, to produce feeder stock for comparative tests on the relative value of feeds, feed combinations and feeding practices; and second, to conduct breeding experiments and supply breeding stock to other Dominion Experimental Farms and to breeders and farmers in the district.

In 1930, the swine herd consisted of Yorkshires and Berkshires, these being two of the more popular breeds in Canada. However, due to the increasing demand for Yorkshire breeding stock, the falling off in demand for Berkshires in this district, and the limited facilities for conducting experimental work, it was decided to disperse the Berkshire herd. This was done in 1933, and thus the swine herd consisted only of Yorkshires until the spring of 1935.

In November, 1933, a group of Large White (Yorkshire) boars was imported by the Dominion Live Stock Branch from Great Britain. One of these was placed as a herd sire at this farm, but, unfortunately, died in the fall of 1934.

In February, 1935, the group of Landrace boars and sows imported from Sweden by the Dominion Department of Agriculture was brought to the Central Experimental Farm. The importation was undertaken in order to try out this breed of pigs under Canadian conditions, but since the project will involve the testing of several generations of these pigs, the results of the first two years' work will not be presented in this report.

The plan being followed in testing the Landrace pigs includes the collection of complete data similar to that being taken on swine at the various experimental farms. The farrowing and weaning records are compiled, including the number of pigs born in each litter, number at 21st day, number weaned, and the weight of the litter at birth and at the 21st day. After weaning, each litter is fed up to market weight and the feed and gain data recorded. The carcass measurements taken to determine the suitability of this breed to produce quality bacon are similar to those recorded under the Advanced Registry Policy for Swine. These latter are obtained through the co-operation of the Dominion Live Stock Branch.

While intense interest is being manifested in the Landrace pigs, their distribution is not contemplated unless warranted by the results of the tests.

At the time of the Landrace importation, a group of Swedish Large White (Yorkshire) boars was imported. One of these was retained at Ottawa and the rest placed on various Dominion Experimental Farms at representative breeding centres. The offspring of these boars is being tested in much the same manner as the Landrace. At the same time, breeding stock from these boars is being sold to breeders and farmers to introduce new blood lines into Canadian Yorkshire herds.

Farrowing and Weaning Records

Records on the number of pigs farrowed and weaned in each litter have been kept as a means of establishing average farrowing and weaning records, and to cull out unproductive individuals in the herd. In addition, further records have been accumulated since 1932 on the average weight of the pigs at birth, and at three weeks of age. A sumary of these records is shown in table VIII.

TABLE VIII.—FARROWING AND WEANING RECORDS

Year	Number litters farrowed	Average number born alive per litter	Average weight at birth per pig	Number alive at 21st day	Average weight at 21st day per pig	Average number weaned
			lb.		lb.	
Yorkshires—						
1930	38	10·08	.....	.....	.....	6·30
1931	35	11·23	.....	.....	.....	7·97
1932	37	10·03	2·57	8·08	11·08	7·78
1933	44	10·50	2·52	8·48	10·37	7·57
1934	33	9·42	2·55	7·76	10·89	7·39
1935	17	10·59	2·48	8·47	10·93	7·94
1936	22	9·86	2·60	8·50	11·66	7·41
Berkshires—						
1930	8	8·12	.....	.....	.....	4·63
1931	6	8·17	.....	.....	.....	6·67
1932	10	6·70	2·81	5·20	12·13	4·78
1933	4	10·50	3·17	8·75	12·40	8·00

A study of the litter data on Yorkshires from all Dominion Experimental Farms was published in the March, 1935, issue of "Scientific Agriculture" (Volume XV, No. 7).

Advanced Registry Policy for Swine

The 1929 and 1930 reports contain outlines of the Advanced Registry Policy for swine. In those years the policy was in its experimental stage, and the Dominion Experimental Farms co-operated with the Dominion Live Stock Branch by testing sows in order to establish standards. During the past seven years, the experimental farms have continued this co-operation, and in addition to testing sows under the Advanced Registry Policy, which became standardized in 1930, have collected certain records on feed consumption and cost of gains.

Since 1933, when the Advanced Registry Board was considering the use of feeding stations in order to eliminate as far as possible differences in the results of testing which were due to different feeding and management practices, special feeding trials have been conducted on the farms to ascertain the most satisfactory meal mixtures and system of management which might be used in feeding stations in all parts of the Dominion.

Over the seven-year period covered by this report, the pigs from 29 sows were tested in Advanced Registry by the Central Farm. In addition to the production, maturity index, and carcass scores under the policy, records were compiled on the rate of gain, feed requirements, and cost of gain. The average daily gain per litter ranged from 1·07 pound to 1·56 pound, the general average being 1·36 pound per pig per day. The pigs of 16 litters fed a ration of meal and milk consumed on an average 235 pounds of meal and 559 pounds of milk for 100 pounds gain, while those of eight litters fed meal alone, i.e., a mixture of grains balanced with protein supplements, required an average of 362 pounds meal per 100 pounds gain.

At prevailing feed prices during the period, the feed cost of 100 pounds gain for 12 litters ranged from $3.89 to $5.38, the average being $4.58.

With the exception of one gilt, all the sows tested weaned the required eight or more pigs per litter; 26 of the 29 exceeded the minimum standard rate of growth expressed by the maturity index; while 11 passed the slaughter test. These latter also passed in the other parts of the test and thus were qualified in Advanced Registry. Testing sows under the Advanced Registry Policy not only establishes their relative excellence and economy for the production of bacon pigs, but the records are of such nature that individuals prepotent in certain characteristics may be selected to improve a particular strain.

Experimental Feeding Trials

TAVID

In co-operation with the Ontario Department of Agriculture, an experiment was undertaken in 1930 to determine the vermicidal and tonic value of a preparation called "Tavid." The formula of this preparation was designed by Dr. L. Stevenson, with the view of combining a tonic and a vermicide for pigs, a large dose having vermicidal properties and a small dose acting as a prophylactic and tonic.

Vermicidal Value

"Tavid" was fed in vermicidal doses to a number of young sows which had not been wormed for several months. The remedy proved effective in that it was the means of expelling a number of round worms from the sows. "Tavid" did not seem to irritate the sows, or have any ulterior effect on them.

Tonic Value

The tonic value of "Tavid" was determined with pigs approximately two and one-half months old. One lot of pigs was fed the tonic for four weeks and compared with a check lot which received similar treatment except that no tonic was fed. The lot which did not receive "Tavid" made faster and cheaper

gains than that fed "Tavid." While the differences between the two lots were small, the value of "Tavid" as a tonic would not seem to justify the added expense.

PROVENDINE

"Provendine," a tonic supplement in swine feeding, has been tested several times and the results reported. The first test showed "Provendine" to be worth 37 cents per pound in the swine ration; the second, 11 cents; and the third, 13 cents. Due to the variation in the results, a further experiment was carried out during 1930 with two groups of ten pigs each, one of which was fed "Provendine," and the other a check ration without "Provendine," from ten weeks of age up to market weight. The Provendine-fed pigs gained somewhat faster—1·41 pound per pig per day as compared to 1·35 pound for the check lot. The two lots required approximately the same amount of feed to produce 100 pounds gain. The cost of "Provendine," however, reduced the net profit of the lot which received the tonic considerably below the check lot. Although the "Provendine" cost $1.50 per package of 3¼ pounds, the results of this final experiment showed it to be worth only 34 cents per package, or 10 cents per pound.

COMMERCIAL WINDOW GLASS

The value of certain types of commercial window glass in allowing the passage of health-promoting sun's rays for the prevention of rickets or crippling in winter-fed pigs was investigated.

An experiment was conducted in the winter of 1930, and repeated in 1931, in which five lots of uniform pigs were fed a complete ration under conditions where the admittance of sunlight was the only variable factor. Three of the pens were glazed with special commercial glass carrying the trade names of "Vitalite Glass," "Vitaglass" and "Vioray." The fourth pen was glazed with common window glass, while the fifth had an opening similar to a window, covered with a wire screen. In addition to the complete feed and gain records collected, the haemoglobin content of the blood of the pigs in all groups was taken at the beginning and end of the test.

There was no evidence of rickets in any of the groups, and only a few slight cases of stiffness noted. The gains and cost of gains of the various lots were practically equal, and the haemoglobin content of the blood of the pigs did not vary a great deal.

The results of this experiment indicate that there is little difference between the value of the various kinds of commercial window glass tested and common window glass, or a wire screen, when used for the admittance of light to growing and fattening pigs in winter.

COD LIVER OIL AND PILCHARD OIL

The supply of essential vitamins is an important problem to pig raisers in Canada, and particularly to those producing bacon pigs during the winter months. Feeding trials at other experimental farms indicated cod liver oil to be an efficient source of vitamins for swine feeding, particularly in certain northern sections.

As a cheaper fish oil called pilchard oil was being produced in considerable quantities on the Pacific Coast, the relative nutritional value of these oils seemed to warrant investigation. An experiment was, therefore, undertaken at Ottawa and at a number of the other Dominion Experimental Farms to determine the value of cod liver oil and pilchard oil in the winter feeding of pigs.

In the Ottawa experiment, where cod liver oil cost 95 cents per gallon, the results showed it to be worth 79 cents, while pilchard oil, which cost 68 cents, returned a value of 52 cents per gallon.

The results of all the tests conducted are reported in full in Pamphlet No. 163, N.S. "Fish Meals and Oils," the following general conclusions being drawn:—

1. The fish oils improved the rate of gain in growing swine, and lowered the meal requirement per unit gain.

2. The prevailing price of these oils prohibits their use when economy, as in growing market hogs, must be considered.

3. Cooking tests indicated that it is necessary to discontinue the feeding of these fish oils to market hogs 30 days before slaughtering, to prevent a fishy flavour in the meat.

OAT GROATS

An experiment was conducted in 1931 to determine the value of oat groats (dehulled wild oats) in the ration of growing and fattening hogs. Four lots of seven pigs each were used, the first lot being fed a check ration composed of ground oats, ground barley, shorts, bone meal, and buttermilk; in the second and third lots, ground oat groats replaced the oats and shorts respectively; while in the fourth lot, oat groats replaced half the oats and half the shorts of the check lot. The pigs were started on test at about 75 pounds and fed for 84 days.

The results indicate that where ground oat groats replaced the ground oats, as in Lot II, and half the oats and half the shorts, as in Lot IV, the pigs made slightly faster gains and consumed a little less meal per 100 pounds gain than those in the check lot. However, due to the higher cost of the oat groats, these lots showed no advantage over the check lot in economy of gain. Lot III, in which oat groats replaced the shorts in the ration, was found to be approximately equal to the check lot. An inspection of the carcasses produced in all lots did not reveal any outstanding differences.

CORN VERSUS BARLEY

To determine the feeding value of barley in comparison with corn in the ration of growing and fattening hogs, an experiment was conducted in 1931 in which four lots of seven pigs each were fed. Two duplicate lots were fed corn, and the other two lots were fed barley in a complete ration. The pigs were fed from an initial weight of 84 pounds to market weight.

There was little difference between the corn and barley lots in the rate of gain, both averaging over one and one-half pounds per pig per day. The average amount of meal consumed per 100 pounds gain for the corn and barley fed lots was exactly the same. As corn was somewhat more expensive than barley at the time, the barley-fed lots were slightly lower than the corn-fed lots in feed cost per 100 pounds gain. It would seem, therefore, from the results of this experiment, that pound for pound, barley is equal to corn for growing and fattening pigs, and the feed to be used will be determined largely by the relative cost and availability of the two feeds.

LACTIC FERMENT

An experiment was undertaken in the summer of 1932 to determine the value of skim-milk soured with a lactic ferment (Dr. Heuberger) for the feeding of growing and fattening swine. Three groups of six pigs each were fed a meal mixture consisting of barley, oats, middlings, shorts, and bone meal, to which was added sweet skim-milk in the first lot, skim-milk soured with Dr. Heuberger's lactic ferment in the second lot, and skim-milk soured with buttermilk in the third lot.

The pigs fed sweet skim-milk made somewhat slower gains than those fed skim-milk which had been soured by the lactic ferment or buttermilk, the rate of gain of the latter two lots being about the same. In feed required per 100 pounds of gain the buttermilk soured lot was lowest, the lactic ferment lot next, and the sweet skim-milk lot highest. However, in economy of gain based on feed cost per 100 pounds gain, the added cost of the prepared lactic ferment made that lot the most expensive of the three. The sweet skim-milk lot was slightly lower than the lactic ferment lot, while the buttermilk-soured lot was easily the cheapest.

The experiment indicated that skim-milk soured with a lactic ferment or with buttermilk was superior to sweet skim-milk in producing rapid gains. Due to its cost, however, the use of the lactic ferment was not warranted, as buttermilk-soured skim-milk proved equally as efficient and considerably more economical.

MIN-O-VITE

In 1933, a commercial mixture of iodized mineral salts called "Min-O-Vite" was tested against a mineral mixture composed of ground limestone, 40 pounds; bone meal, 40 pounds; and iodized salt, 20 pounds, to determine the comparative value of the two mineral supplements for growing and fattening pigs. In addition to the iodized minerals, the "Min-O-Vite" contained malt and cod liver oil.

Two lots of five pigs each were fed identical rations up to market weight, with the exception that one lot received the home-mixed mineral supplement at the rate of one ounce per pig twice a day, while the other lot received "Min-O-Vite" at the same rate.

The pigs fed "Min-O-Vite" did not gain as rapidly or produce as economical gains as did those fed home-mixed mineral supplement.

INTERVAL LOWERING OF THE PROTEIN LEVEL WITH DIFFERENT PERCENTAGES OF TANKAGE

As a sequel of the tankage-protein experiment reported in 1928, a further experiment was designed to show the effect, if any, of different percentages of tankage in the ration of growing and fattening hogs, and to gain some knowledge of an optimum range of protein levels for bacon hogs from weaning to market weight. This experiment was conducted in the summer of 1932 with six lots of six pigs each, and was repeated in the winter of 1932-33, using five pigs per lot.

As in all comparative feeding trials carried out on the Dominion Experimental Farms, the pigs were allotted so that all lots were as nearly equal as possible in weight, age in days, condition, distribution of sexes, variety of ancestry, and probable outcome.

The basal meal mixture for this experiment consisted of ground oats, 200 pounds; ground barley, 100 pounds; ground corn, 100 pounds; shorts, 100 pounds; middlings, 100 pounds; bone meal, 10 pounds; and iodized salt, 5 pounds. This was supplemented during the 30-day periods in which the trial was divided, with the amounts of tankage required to bring the level of crude protein for the various lots up to the desired percentages. The 18·9 per cent crude protein level required the addition of 84 pounds of 60 per cent protein tankage to the 615 pounds of basal meal mixture; the 17·1 per cent level, 54 pounds; the 15·1 per cent level, 26 pounds; and at the 13·3 per cent level no tankage was used. The protein levels of the lots during the various feeding periods and the essential results of the two tests are shown in table IX.

TABLE IX.—INTERVAL LOWERING OF THE PROTEIN LEVEL WITH DIFFERENT PERCENTAGES OF TANKAGE

——	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Crude protein, 1st 30 days..... %	18·9	18·9	18·9	18·9	18·9	13·3
Crude protein, 2nd 30 days..... %	18·9	17·1	17·1	15·1	15·1	13·3
Crude protein, remainder of test.... %	17·1	17·1	15·1	15·1	13·3	13·3
Summer, 1932—						
Number pigs in lot.....No.	6	6	6	6	6	6
Average initial weight..... lb.	68·2	68·2	68·2	68·2	68·2	68·2
Average finish weight..... lb.	203·3	215·2	203·2	210·7	203·0	171·2
Average daily gain..... lb.	1·33	1·48	1·39	1·43	1·33	0·99
Meal per 100 lb. gain..... lb.	356·0	330·0	337·0	307·0	347·0	386·0
Cost per 100 lb. gain..... $	4.75	4.35	4.44	4.02	4.53	4.98
Winter, 1932-33—						
Number pigs in lot.....No.	5	5	5	5	5	4
Average initial weight..... lb.	96·0	95·8	95·6	95·8	95·6	96·0
Average finish weight..... lb.	210·0	208·0	204·0	209·0	203·4	192·5
Average daily gain..... lb.	1·52	1·50	1·45	1·51	1·44	1·29
Meal per 100 lb. gain..... lb.	367·0	374·0	371·0	359·0	381·0	409·0
Cost per 100 lb. gain..... $	4.79	4.84	4.78	4.60	4.87	5.10

The summer test was conducted over a period of 104 days, but as individual pigs were removed when they reached market weight, lot VI was the only group which had to be fed intact for the entire period. The winter-fed pigs were started on test at heavier weights and the feeding period was only 75 days.

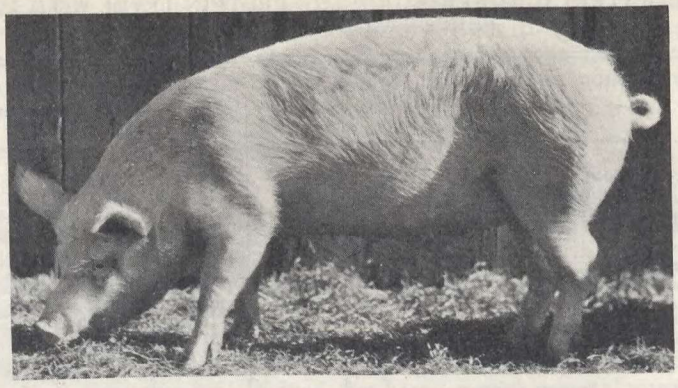
It is interesting to note that the results of all treatments, except lot I, in the first test were confirmed with relative results in the second test. Lot I stood fourth in rate of gain in the summer test, whereas in the winter test the pigs gained most rapidly on the high protein feeding. From a survey of the data, lot IV produced the best results. In this lot the level of protein was high for the first 30 days, and reduced to 15·1 per cent for the remainder of the test. The pigs did not make the most rapid gains, however, standing second in both tests, but they were the most economical, producing gain at $4.02 and $4.60 per 100 pounds as compared with lot VI, the poorest lot, which received the basal meal mixture without tankage, and in which the gain cost $4.98 and $5.10 per 100 pounds.

While the results of these two tests cannot be taken as conclusive, they do indicate that pigs not only produce satisfactory gains where the level of protein is reduced as the pigs develop, but that the gains are more economical when such practice is followed.

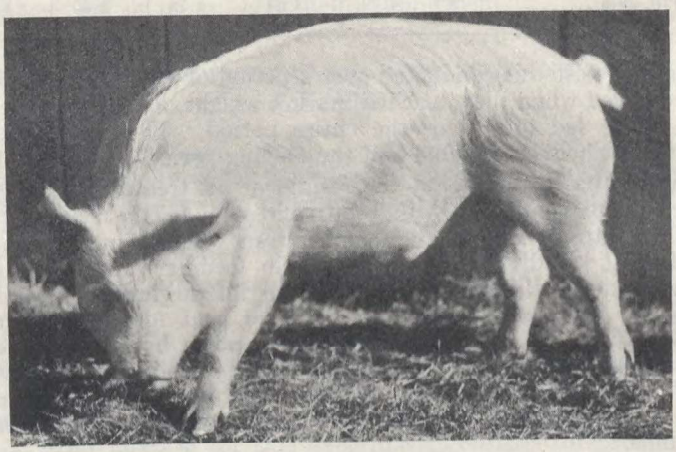
MEAL MIXTURES FOR WEANLING PIGS

It is recognized that one of the most critical stages of a pig's life is the transition period when pigs are weaned from sow's milk and started on feed. In order to compare and test the suitability of a number of meal mixtures for weanling pigs, and further, to determine the value of skim-milk powder in such mixtures, an experiment was undertaken during the winter season of 1933-34.

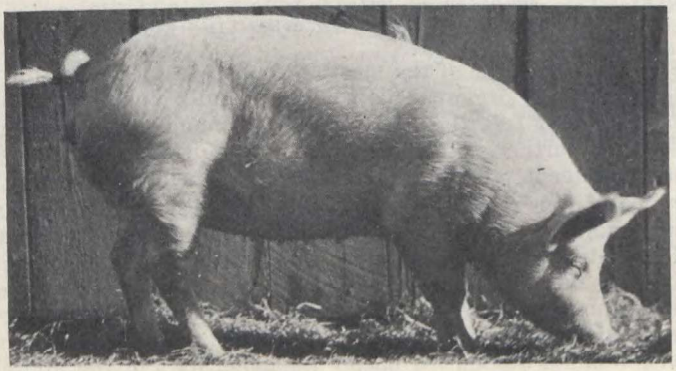
Ten groups of four pigs each were started on test immediately after weaning at eight weeks of age, and were fed different weanling pig mixtures for six weeks. All the lots were then put on growing mixtures for six weeks, and subsequently, finishing mixtures for six weeks, or until the pigs reached a market weight of 200 pounds. In the weanling period, ground oats with the hulls sifted out was the basal feed used in all lots. Middlings was added in lots 1, 4, 5, 8, 9 and 10, with a small amount of barley replacing part of the middlings in lots 9 and 10. In place of the middlings fed the above lots, shorts was added in



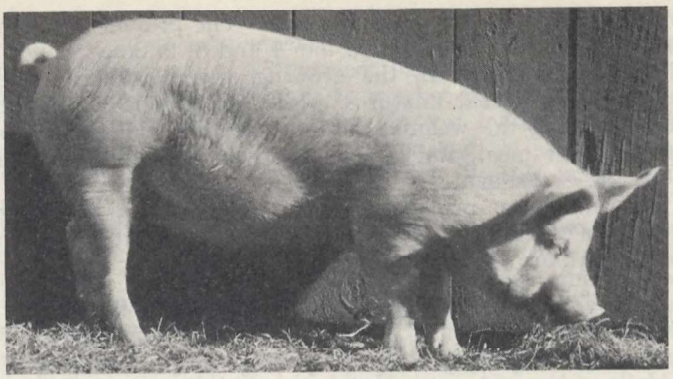
Lot 1



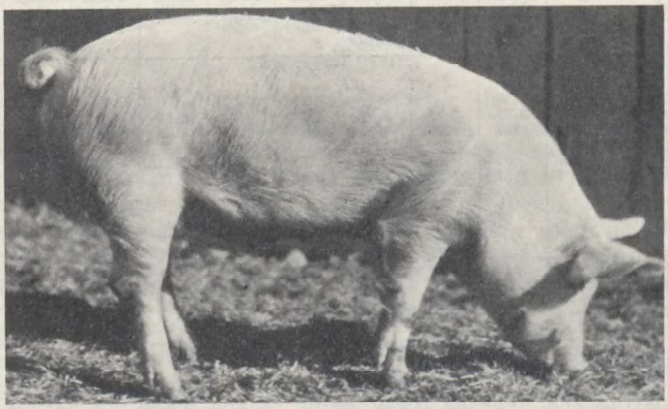
Lot 2



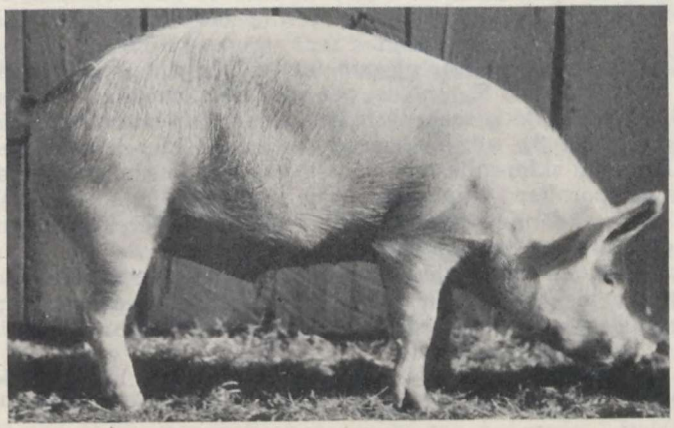
Lot 3



Lot 4



Lot 5



Lot 6

Representative pigs from the lots of the 1932 summer experiment, "Interval Lowering of the Protein Level with Different Percentages of Tankage".

lots 2 and 6, and rolled wheat in lots 3 and 7. The protein supplement in lots 1, 2, 3 and 9 was skim-milk powder; in lots 4 and 8, tankage; and in lots 5, 6, 7 and 10, liquid skim-milk. In the growing and finishing periods, all lots received the same basal meal mixtures, while the protein supplement of each lot was that fed during the weaning period. A mineral mixture consisting of ground limestone, bone meal, and iodized salt was included in the ration of all lots throughout the experiment.

As this experiment was primarily designed to test meal mixtures for weanling pigs, the results of the first six weeks' test, in addition to the essential results for the complete trial, are shown in table X.

TABLE X.—MEAL MIXTURES FOR WEANLING PIGS

Lot	1	2	3	4	5	6	7	8	9	10
Feeds fed during weanling period	Oats middlings skim-milk powder	Oats shorts skim-milk powder	Oats rolled wheat skim-milk powder	Oats middlings tankage (high)	Oats middlings skim-milk	Oats shorts skim-milk	Oats rolled wheat skim-milk	Oats middlings tankage (low)	Oats middlings barley skim-milk powder	Oats middlings barley skim-milk
Weanling period (1st 6 weeks)										
Average daily gain..... lb.	0·77	0·77	0·94	0·76	1·00	0·85	1·06	0·41	0·68	1·13
Pounds meal per 100 lb. gain.. lb.	139	125	190	220	162	162	135	389	160	155
Pounds supplement per 100 lb. gain..... lb.	36	32	49	33	417	421	393	39	42	396
Feed cost per 100 lb. gain.... $	3.87	3.29	5.68	3.45	2.96	2.76	2.88	5.64	4.44	2.82
Complete Feeding Trial										
Average daily gain..... lb.	1·17	1·22	1·30	1·16	1·28	1·26	1·25	1·04	1·11	1·18
Pounds meal per 100 lb. gain.. lb.	274	249	251	338	242	238	235	332	289	275
Pounds supplement per 100 lb. gain..... lb.	47	42	45	34	354	345	359	19	49	401
Feed cost per 100 lb. gain.... $	6.17	5.56	5.90	4.98	3.82	3.70	3.85	4.53	6.50	4.34

Basal meal mixture same for all lots in growing and finishing periods.
Supplement fed during weanling period continued throughout trial.

In comparing the average daily gains of the weanling period, it will be noted that four of the five highest lots were fed liquid skim-milk. In economy of gain, or costs per hundred pounds gain, the lots stood: 6, 10, 7, 5, 2, 4, 1, 9, 8 and 3. In this latter respect, the liquid skim-milk lots were again to the fore, and were considerably cheaper than any of the lots which received other supplements.

The order of the lots in rate of gain for the complete trial was as follows: 3, 5, 6, 7, 2, 10, 1, 4, 9 and 8. In cost per hundred pounds gain it was: 6, 5, 7, 10, 8, 4, 2, 3, 1 and 9. It is seen, therefore, that while in rate of gain over the full test, one lot (lot 3) which received powdered skim-milk made the most rapid gain, the liquid skim-milk lots and the tankage lots were more economical than the lots fed powdered skim-milk. The inclusion of middlings, shorts, and rolled wheat in the weanling ration resulted in little apparent difference in rate or economy of gain over the complete test.

This experiment indicated that skim-milk powder was a satisfactory source of protein in the pig ration. In comparison with other protein supplements, however, the high cost of this product limits its general use.

COMPARISON OF PROTEIN SUPPLEMENT LEVELS, AND HAND- VERSUS SELF-FEEDING FOR BACON HOGS (ADVANCED REGISTRY BOARD FEED COMMITTEE TEST)

In conjunction with a number of agricultural colleges, and other experimental farms, a comparative feeding trial was conducted during 1936 to compare certain protein supplement levels of the Advanced Registry ration, and hand- versus self-feeding for bacon hogs.

Three lots of five pigs each completed the test, two of which were hand-fed different levels of protein supplement, lot I being fed from weaning to 100-110 pounds a mixture composed of 85 per cent basal grains and 15 per cent protein supplement and from 100-110 pounds to market weight, 90 per cent basal and 10 per cent protein supplement, while lot III was fed 88 per cent basal and 12 per cent protein supplement for the first period, and 94 per cent basal and 6 per cent protein supplement in the finishing period. Lot II was self-fed the same ration as lot I.

Complete records of the gains made and the feed consumed were collected in addition to carcass measurements of the pigs, following the Advanced Registry procedure. It was noted that lot II, in which the pigs were self-fed the higher level of protein supplement, showed an advantage both in rapidity of gain and economy of feed consumption. The differences between the lots, however, were not great, as was also the case in the average carcass measurements of the lots, where the pigs in lot II again showed a slight superiority. Between the hand-fed lots, the difference in protein supplement level produced little variation in the results.

ANIMAL GENETICS

Introduction

The subject of animal genetics deals with the inherited differences of offspring compared with their parents. Stated in another way, it aims at correctly rating parents on their transmitting ability through the progeny test. While animal genetics is new as a science, it is old as a practice. The early pioneer breeders and the progressive breeders of to-day make sure that their sires are transmitting desirable characteristics to their offspring before giving them heavy breeding service. The way many breeders accomplish this is to use a young sire for a while and then loan him, until his progeny prove him to be good, bad, or indifferent. This raises the problem of evaluating or rating sires. Breeders for the most part use their judgment in rating sires, and they are successful just in proportion as their judgment of their breeding stock is sound. Judgment of progeny by inspection is more suitable for beef cattle, as their economic worth can be seen. With other classes of live stock, and particularly dairy cattle, there are several characteristics affecting economical production which cannot be readily seen. To aid the judgment, therefore, in rating sires, the necessary records should be kept so that the progeny of sires can be rated by comparing them with their dams. It is with the problems of rating sires with the aid of records that animal genetics deals. In the following passages the methods of applying the progeny test, and the economical characteristics sought in the different classes of animals are outlined. When outstanding sires are thus discovered it is desirable to obtain as many offspring from them as possible and, hence, the possibilities of artificial insemination are being tried out.

Progeny Test in Dairy Cattle and the Sire Index

In dairy cattle, as with all animals, the sire and dam contribute equally to the hereditary potentialities of their offspring. The production worth of a cow as a parent, however, can be determined by weighing the milk she gives over a number of years, and testing it for butterfat. No such direct estimate of a bull's worth can be made, so indirect methods of measuring a bull's potential capacity have to be used. This is done through the progeny test. By comparing a bull's daughters' average yields with those of their dams, an estimate of the bull's transmitting capacity can be made. Before any just comparison can be made between dams' and daughters' yields, a certain amount of adjustment of the records is necessary. Thus, the dams will have several records by the time their daughters have one record and, hence, the dams'

records will need to be averaged, also, yields on an average increase with age until the cow is seven or eight years old, thus necessitating all yields being adjusted to a mature equivalent. The first, or two-year-old records of both dams and daughters could be used, but they are not always available and, therefore, it is better to adjust all records to a mature equivalent. Adjustments are necessary for the length of lactation, as it would be unfair to compare, say, 305-day records of daughters with 365-day records of their dams. Lastly, records have to be adjusted to a uniform milking basis, that is, two, three, or four times-a-day milking.

When the records of both dams and daughters have been adjusted, they can then be averaged and the differences between them noted. From their average records a sire index can be calculated. A sire index represents the yield a bull would have given had he been a cow. Milk yields and butterfat percentages are found from crossbreeding experiments to be of a blending type of inheritance and, therefore, when the yields of a bull's daughters are known and those of their dams, the bull's potential yields, or his transmitting capacity, can be calculated. Thus, if the daughters' average yields were 10,000 pounds milk and 3·5 per cent fat, and the dam's 9,000 pounds milk and 4 per cent fat, the sire index would be 11,000 pounds milk and 3·0 per cent fat. In other words, to state the method backwards, the daughters are placed mid-way between the dam's yields and the bull's potential capacity.

In order to test the value of rating sires on the basis of indexes, the necessary conversion tables for milk records, blank forms for the daughters' and dams' records, and instruction sheets were prepared in 1932, and indexes were calculated on all dairy bulls used on the experimental farms. As was to be expected, the various bulls differed tremendously in their transmitting capacity; some improved the herd by raising the production of the daughters over that of their dams; others maintained the herd level; while others lowered it. In many herds a good bull was followed by a poor one, thus wiping out the advances made by the good bull. Pedigree was not always a reliable guide as to the transmitting capacity of a bull. The records of two half-brothers, for example, showed the daughters of one to be about 2,000 pounds milk higher than their dam's yields, and the other bull's daughters were 2,000 pounds lower than their dam's yields, the fat percentages remaining about the same.

Some breed associations in other countries now publish lists of sires, together with their indexes, because of the valuable information they give to breeders. Thus, if a breeder knows the average production of his herd he can then select a sire of proved ancestry having a production index which will improve his herd. However, some organization and co-operation among breeders is necessary in the matter of testing cows and exchanging bulls. A sire index, to be reliable, should be based upon all daughters' records, or an unselected sample of daughters, and not on just a few of the best daughters. This requires that breeders put all cows in the herd on test. Moreover, since a bull is about six years of age before his daughters have their first lactation records, it is necessary for breeders, except large breeders, to exchange bulls in order to keep them alive until their transmitting capacity is known. Also, aged bulls require proper attention, and should be housed in well-built safety pens.

The sire index should be used only as a guide, but a valuable guide in planning matings or purchases, and not as an absolute value of a bull's potential capacity. The reliability of a bull's index can be gauged by learning something about the conditions under which the daughters' and their dams' records were made. If the daughters were forced more than their dams, or if only the best daughters' records were used, then the index would not be reliable. Moreover, an index should be based upon at least five daughter-dam pairs, but the more pairs there are the more reliable will be the index. In the absence of dams' records, an index can be obtained by simply averaging the daughters' records, and correcting to a uniform standard.

For the building up of a profitable and economical herd, other characteristics are important and supplemental to production records and sire indexes. For example, longevity and reproductive vitality in dairy cattle are very important. The best procedure to ensure these characteristics being bred into the herd is to select for proving, bulls whose ancestors were long lived and regular producers. Cows that have to be culled on account of poor production, broken-down udders and disease infection after only one or two lactation periods, are very unprofitable. Other important characteristics are good underpinning, good constitution, large body capacity and good digestion, so that large amounts of roughages can be efficiently digested rather than having to heavily feed expensive concentrates. Records can be taken on conformation and feeding efficiency, and the daughters thus compared with their dams as in production records. In the absence of records, the breeder has to use his judgment on the breeding and production value of his animals, but the formulation of a judgment based upon records is much more reliable than one that is not based upon any records.

Publications: Dairy Cattle Improvement Scheme; Blank forms and Instructions for Calculating Bull Indexes.

Progeny Test of Swine

The inherited characteristics sought for in the economical production of bacon hogs are good nursing capacity, litters of ten to fourteen thrifty pigs, rapid and economical gains, and desirable market carcasses. While these are inherited characteristics, the kind of feeding, housing and management practices determine how they will be developed. The determination of the hereditary differences in the strains of pigs requires that feeding, housing, and management practices be as nearly as possible the same for all pigs. These conditions are largely met on the experimental farms and, therefore, the several herds of swine offer good experimental material for determining the differences in transmitting capacity of boars and sows. Hence, detailed breeding records are kept on all pigs. The farrowing records kept on sows are the number of functioning mammae, number of dead and live pigs at birth, weight of dead and live pigs at birth, and weight and number of live pigs at three weeks of age. From these records, the sows are rated on their nursing capacity, and the boars on their capacity as sires. The value of this method of progeny testing parents for the purpose of selecting prolific strains of swine is being worked out. Records are kept on the other important characteristics, namely, rapidity and economy of gains, and carcass values, and used in co-operation with the Advanced Registry and Pig Testing Station Policies.

Publications: Fecundity and Nursing Capacity of Large Yorkshire Sows. Scientific Agriculture, Vol. 15, pp. 458-462, 1934.

Progeny Test of Sheep

The inherited characteristics sought for in economical sheep husbandry are good nursing capacity, a large percentage of twinning, rapid and economical gains (depending on the breed) and good fleeces representative of the breed. That individual ewes vary in their nursing capacity is known to all familiar with sheep, and is doubtless an inherited trait. The other traits mentioned above are also inherited, since they represent largely breed characteristics. The object in progeny testing sheep is to determine the differences in the transmitting capacity of rams and thus single out the best rams for extended use. Complete breeding records are, therefore, kept and the data used to determine the value of the progeny test in selecting economical strains of sheep.

Crossbreeding Sheep

The various breeds of sheep have been developed for their suitability to particular climatic and topographical conditions. None of the conditions are exactly the same as those found in the western ranch country. The desirability of developing strains through crossbreeding the more suitable breeds has been considered for some time, and some experimental work has been done in this direction. In more recent years, the crossbreeding work has been extended. At the Lethbridge Experimental Station a few Corriedales were imported from New Zealand and the United States, and are being developed. Canadian Corriedales are being developed also from crosses of Lincoln and Rambouillet, and their suitability is being determined by co-operation with some sheep ranchers. At the Manyberries station, crossbreeding is being conducted with Romney Marsh and Rambouillet. The Experimental Farms Service is also co-operating in this crossbreeding work with the College of Agriculture, University of Saskatchewan, Saskatoon, Sask.

Buffalo-Domestic Cattle Crosses

The hybridization experiment, conducted at Buffalo National Park, Wainwright, Alta., between American buffalo or bison and domestic cattle is being continued. The first cross male hybrids have been proved to be definitely sterile, while the female hybrids will conceive either to bison males or domestic bulls. The policy is to breed them to domestic bulls in order to obtain fertile males with a larger percentage of domestic blood in them than bison blood. None of the three-quarter cattle hybrid males bred at Wainwright have proved to be fertile, though it appears possible that some three-quarter males could be fertile. The seven-eighth hybrid males, obtained by crossing a three-quarter female to a domestic bull, should be fertile, though one such male bred at Wainwright did not leave any offspring. The males are now given semen tests to determine whether they are fertile, thus avoiding loss through barrenness of females mated with sterile males. The females have a tendency to become overfat and thus shy breeders unless steps are taken to prevent over-condition. Owing to the results of this experiment having been recently published in bulletin form, details are not given here.

Publication: Hybridization of Domestic Cattle, Bison and Yak. Technical Bulletin No. 2.

Artificial Insemination

The technique of artificial insemination, also called artificial impregnation and artificial breeding, has in it the possibilities of enormously increasing the number of offspring from a sire. Thus, instead of the services of a bull being confined to one herd, semen can be collected from him and a number of herds serviced with it through the agency of an operator transporting the semen and inseminating with it, cows that are in season. The practice of artificial insemination fits in well with the progeny test and proven sire policy. Thus, the few good sires which have proved their superiority through the desirable characteristics transmitted to their offspring can be used extensively and a large number of offspring obtained from them. While artificial insemination has been spasmodically practised with more or less indifferent success for a long time, the modern improved methods are much more reliable and certain.

In 1934, the improved types of equipment used in other countries, especially England and the Union of Soviet Socialist Republics, were purchased. Experiments were begun, mostly with dairy cattle, but also with horses, with the following objects in view:—

1. Studies on the various methods of obtaining semen from sires for artificial insemination purposes, and their effect upon the sires.

2. Methods of inseminating cows, and the most effective time during the heat period.

3. The most effective methods for sterilizing equipment to prevent the spread of disease, and without injury to the semen.

4. Testing out the best methods of storing semen, such as the best temperature conditions, and the effect of dilutions with various kinds of fluids.

The experiments are in progress and will be reported at a later date.

Statistical Analysis of Milk Yields

A few studies were made on the statistical analysis of milk yields. These include trends in R.O.P. records for both Holstein-Friesians and Ayrshires, daughter-dam R.O.P. comparisons of 14 Ayrshire sires, and the analysis of two experimental farm Shorthorn herds.

HOLSTEIN-FRIESIAN R.O.P. TRENDS

For this study R.O.P. records were averaged for each class, beginning with those published in R.O.P. report No. 3, and then every fourth report up to and including report No. 23. No. 3 report was for the year 1911 and contained 75 records; the No. 23 report was for 1931 and contained 1,651 records. Up to and including report No. 12 (1920) there was only one division; later reports have the two divisions, namely, 305- and 365-day divisions. In order to determine the trend in production the records had to be corrected to a common basis. It was found that the average milk yields had increased slightly during the years 1911 to 1931, while the number qualifying increased from 75 to 1,651. The fat percentages gradually increased during the same period from 3·31 to 3·52 per cent. There was a large increase in the proportion of cows milked four and three times daily up to report 15 (1923) and a considerable decrease in later reports. The average production of the different age classes of reports 15, 19 and 23 is 29·4 per cent higher than the required production in the 305-day division, and 36·8 per cent higher for the 365-day division. More cows qualify in the 365-day division than in the 305-day divison.

AYRSHIRE R.O.P. TRENDS

For this study only the two-year-old records were used, beginning with report No. 3 and then every third report up to and including No. 24, that is, from 1911 to 1932. Report No. 3 contained 23 two-year-old records, and report No. 24 had 350 records in the 305-day division and 257 in the 365-day division. There was little difference in milk yield of the old yearly division and the later 305-day division. The yields of the new 365-day division are much higher. All of the average yields for the various reports and divisions were approximately 20 per cent above required production. The average fat percentages as a whole, although they fluctuate a little between the different reports, do not show much change. The average for the old yearly division was 4·16; for the 305-day division, 4·18; and for the new 365-day division, 4·19. With regard to the number of daily milkings, in 1923 an average cow was milked three times daily for 40 days in the 305-day division and 86 days in the 365-day division. In 1932 the three-times-a-day milkings had dropped to 18 and 29 days, respectively.

AYRSHIRE SIRES

For this study the R.O.P. records of the progeny of 14 Ayrshire sires and those of the dams of the progeny were used. Those sires were chosen that had at least ten daughters with R.O.P. records. The sires were ones, therefore, that had been used extensively. The records of each group of daughters and their dams were averaged and corrected. It was found that of the 14 sires, two of

them had raised the daughters' milk records over that of their dams by at least 1,000 pounds of milk, and two of them had lowered the daughters' records by the same amounts. The average records of the remainder of the groups of daughters fluctuated within 1,000 pounds of their dams' records. With regard to the test, two sires raised their daughters' tests by at least two-tenths of one per cent over that of their dams and one sire reduced his daughters' test by the same amount.

TWO SHORTHORN HERDS

For this study the production records of two experimental farm dual-purpose Shorthorn herds, covering a period of about 20 years, were used. The object was to see what influence the various sires used had upon the herd. In one herd 13 sires had been used, and in the other 12 sires. The records were averaged and corrected for each group of daughters and their dams. The fat percentages of the two herds remained about the same, one being slightly over 4·00 per cent, and the other slightly under. In milk yields there was a tremendous difference between the various groups of daughters compared with their dams. One sire reduced his daughters' yields by as much as 40 per cent below that of their dams. Conversely, other sires materially increased their daughters' yields. Taking the herds as a whole, the sires of one herd reduced their daughters' milk yields by 3 per cent below that of the dams, and in the other herd by 8 per cent. In other words, the sires used were a little more of the beef type. The milk production of the two herds had been maintained by selecting the best producing daughters of each sire. Some of the groups of daughters had the beef-cattle characteristic of short lactation periods.

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