A STUDY OF

THE OPERATION OF SELECTION

FOR PRODUCTION

IN A NEW ZEALAND DAIRY HERD.

Being the Thesis submitted by "BONUS" for the ANIMAL HUSBANDRY SECTION of the M.AGR.SC. Examination, 1940.

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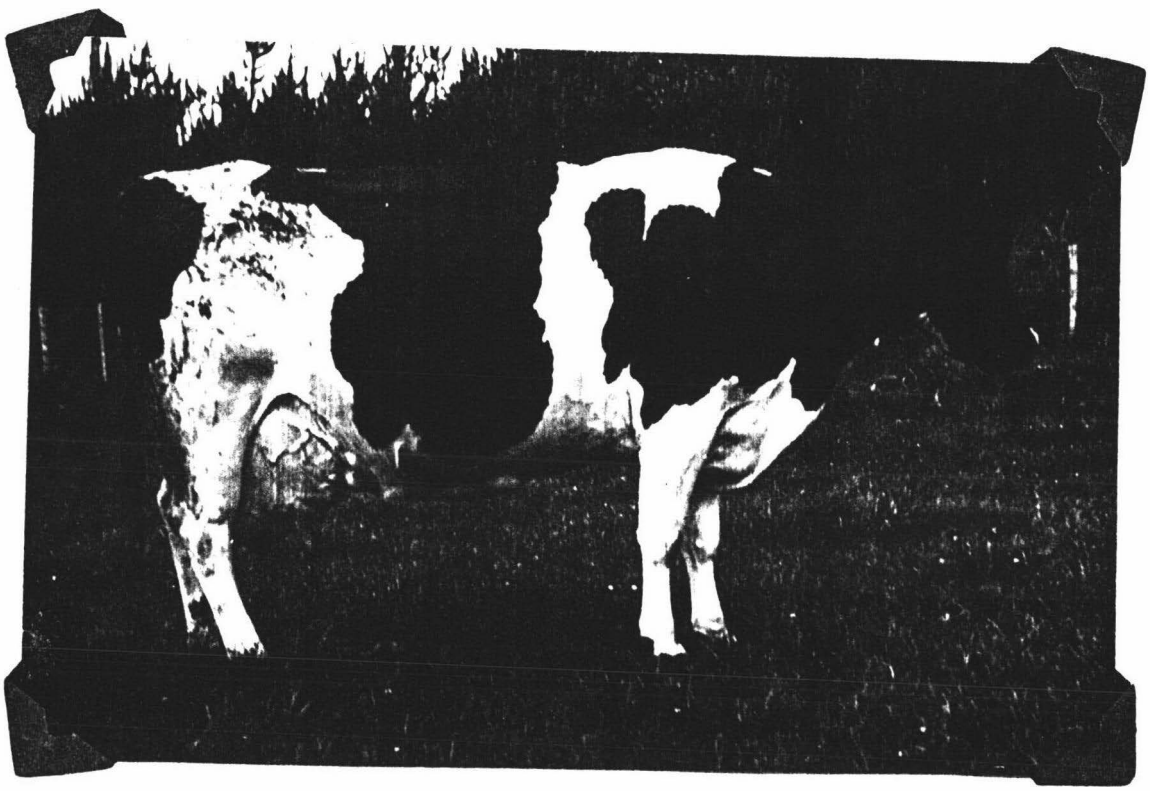
26591 Massey Renown Heterodyne V.H.C.

Bred & Owned

Massey Agricultural College.

Born 6th July, 1930.



Natural Photograph 30th Nov. 1940.

Production Records.

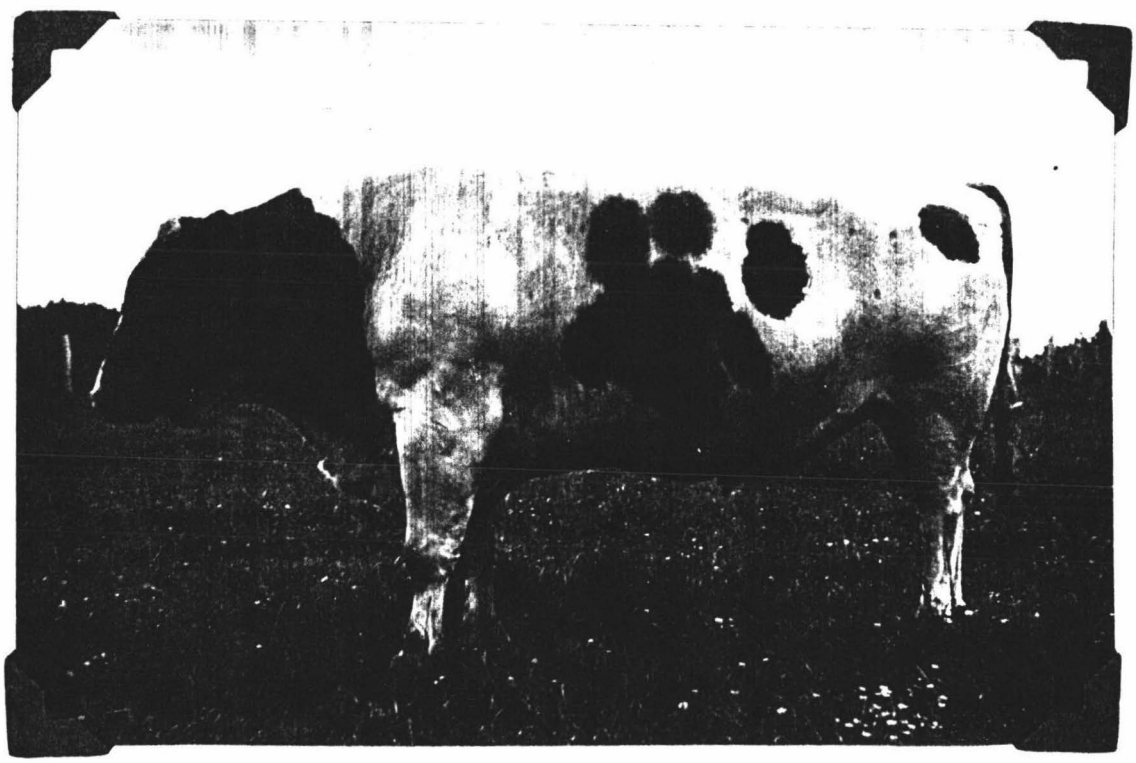
Age	Calving Date	Milk lbs.	Test %	Fat lbs.	Days.
2 yrs. 50 days	25/8/32	9,117	4.2	397	339
3 " 74 "	18/9/33	16,098	4.4	709	466
4 " 341 "	13/6/35	14,610	4.1	600	318
5 " 347 "	18/6/36	15,450	4.2	660	343
7 " 65 "	10/9/37	21,435	4.4	934	530
8 " 312 "	14/5/39	18,420	4.02	740	348

7555 Totara Netherland Renown.

Born 10th February 1928.

Breeder: Piri Land Co., Auckland.

Owner: Massey Agricultural College, Palmerston North.



Natural Photograph 30th November, 1940.

SECTION 1.

INTRODUCTION.

It may be argued that a dairy farmer who is testing his cows every year and breeding his own replacement heifers, sired by pedigree dairy bulls with reasonable butterfat backing, should by a programme of intelligent culling, be able to establish and maintain a herd consisting mainly of mature cows of high producing ability. This is the point that this study endeavours to answer. Can a farmer purchase foundation stock in an open market and hope by continued testing and selection, to establish and maintain a high producing herd substantially in advance of the average Dominion herd? What is the progress in his selection, and how do the progeny of successive bulls fare? What are the difficulties encountered in the operation of vigorous selection? These and numerous allied questions arise and an endeavour is made to throw some light on them from a study of the changes and events that have taken place over the last thirteen years in a herd where the managerial policy has closely followed the recognized methods of herd improvement.

The New Zealand dairy farmer is a specialist in that he relies far more upon the produce from his animals, as a sole source of revenue, than do his overseas competitors. Consequently, the quality of his stock, the maintenance of his herd, the selection of his bulls, the feeding and general management of his animals are factors of vital importance. His dairy herd is a moving population of but short-lived individuals and he is concerned not with averages of large populations but with individuals. Each animal, male or female, in a herd, makes a specific contribution to herd achievement

and must, therefore, be given individual consideration. In consequence, the following study resolves itself very much into a study of individuals, as averages, which are a function of a much wider population as may be represented in Herd Improvement data, are not particularly applicable to a herd of only forty cows such as that selected for the study. Should there appear to be undue emphasis placed upon records of individuals or small groups of individuals, it must be remembered that this study endeavours to consider the farmers' problems and not those of the statisticians.

Over the past twenty years, herd testing has been ~~the~~ a most valuable guide to ~~the~~ farmers in improving the general standard of herd production and in bringing the average level of production closer to that attained by the more efficient producers. But that does not necessarily mean that all farmers availed themselves of its services. Herd testing as such, has its limitations, and furthermore the application of the lessons of herd testing may be restricted, due to the repercussions of other confronting problems, in the nature of stock losses, disease and herd maintenance, or perhaps certain economic influences. Though herd testing association figures are not specific enough to indicate the more numerous problems of the farmers, they are indicative of the final outcome of the operation of selection for increased production. Such figures for the Dominion, reveal the very disturbing fact, that despite the substantial improvements recorded in production up till the initial years of this decade, the average level of production has remained relatively stationary over the past several seasons.

Broadly speaking, this static nature of herd production may be accounted for by two sets of factors, environment and heredity. Over the past ten years there have been no radical changes in farm management, such as those that characterized

the previous ten years, when there was a revolutionary change in grass-land management. Phosphatic topdressing, the use of improved certified pasture strains, the closer subdivision of land into smaller grazing units, the conservation of surplus pasture as silage, not only led to heavier stocking but also found expression in a higher plane of nutrition for all dairy stock, reflected in increased production.

By the continued use of pedigree sires of the specialized dairy breeds, notably the Jersey, progressive grading-up and genetic improvement of the earlier foundation stock, which were mainly of Shorthorn origin carrying blood of beef strains, were effected. Though there is no measure of the difference in producing ability between the ordinary grade commercial herds and the pedigree herds from which the sires were drawn during this period, it is probable that the difference was substantially in favour of the pedigree herds. This is not the case today. The apparent tendency of the average herd sire at present in use, is to cause, in his female offspring, a regression or a progression to a production level of about 280 lbs. of butterfat per annum. As further evidence on this point, the average production of pure-bred cows under C.O.R. test has not increased over the past fifteen years to anything like the same degree as the production level of commercial stock. The position now exists, where the average farmer, buying the average bull at a spring fair, cannot hope to improve substantially on the level of his herd production, while still maintaining the same plane of herd management and nutrition.

This latter qualification is most important. It is reasonable to state that average production could be raised to a very high degree, merely by improvements in dairy stock nutrition. The reliance on pasture, with its virtues so far as costs of production are concerned, but with its short-

-comings so far as providing an adequate supply of nutriment to enable dairy stock to give full expression to their inherent capacity to produce milk and butterfat, has created the anomalous position, of seeking to increase the genetic capacity of the dairy stock while yet not utilizing to the full, that already there. But this is not all. As Gowan (1) expressed it, "the problem of breeding better dairy stock, is not so much to produce animals of higher production than we have today, as it is to be able to reproduce the best of our present dairy herd, uniformly and at will". Practically every crop of two-year old heifers that enters a dairy herd is characterized by a range of performance from outstanding individuals to absolute wasters. Any estimation of a young animal's worth as a producer later in life is still mainly speculative. Even the best bulls as revealed by sire surveys may produce indifferent daughters which are the progeny of high producing cows; yet on the whole, this class of bull is making substantial contributions to the industry. Great possibilities lie in the development of sire surveys and an artificial insemination service, but not only have the technical details of such a service to be evolved and perfected under New Zealand conditions, but also the average New Zealand farmer must be educated to its possibilities.

SECTION 11.

Source of Data.

The data on which the analyses and discussions presented in the following sections have been based, have been extracted from the records of the pedigree Friesian herd at Massey Agricultural College. These records contain a remarkably complete and accurate account of the herd since its establishment in 1927 and furnished unique material for an investigation into the operation of selection for production in a dairy herd.

Thirteen years is a long time when measured in terms of a cow's productive lifetime, but it is a relatively short time when considering the history of a herd. Though the data may suffer from this shortcoming, it is immensely valuable in other respects, particularly because very complete and accurate records have been kept. Furthermore, the herd is not so long established that those responsible for its management are unable to remember each individual animal clearly and are able to fill in those personal details of judgement that cannot be expressed in even the most complete records. Another fortunate feature of the herd is that it consists of pedigree animals, and as such, is the very class of herd from which the commercial dairy farmer draws his herd sires. In consequence, therefore, selection and its operation have a wider significance than the mere selection of females to enter the milking herd. Another important attribute is that group herd testing has been the only system of production recording used. Cows have not been forced to produce records out of proportion of their normal herd expectations, as a qualification for their continued existence in the herd as breeders of sale stock. Except in the case of a few foundation cows, each individual has had to justify its presence in the

herd by its continued productivity. Essentially, the herd has been a strictly commercial proposition, butterfat production being the dominating consideration.

It has been the policy in the recording of herd events to standardize the dairying season to cover the period July 1st - June 30th. In all, thirteen such seasons, extending from July 1st., 1927 - June 30th 1940 have been included in the investigation. Details of the current incomplete season are not included.

The study has been confined to pedigree members of the herd only. Though grade and cross-bred animals have played a minor part in the development of the herd, they are not included in data considered, unless specifically mentioned.

For the past five seasons an area of about thirty five (35) acres of the College farm, with an experimental herd averaging about twenty cows including a few Friesians, has been run as a separate unit. These Friesian animals have been included in the main College records.

Method.

For convenience in the handling of the data, a modified method of the card index system (2) was adopted. A sample of the particular type of card used is presented. Every animal that entered the milking herd was allotted a card, and by the slotting of specific punch hole, the cards (or animals) were classified according to the following plan:

Foundation stock,
Grade stock,
Season of birth,
Sire,
Family (relative to foundation dams.),
Disposals.

NAME CLASS'N

DATE OF BIRTH HERD BK. NO.

BREEDING INDEX BREED

PURCHASE DETAILS

DISPOSAL DETAILS

AGE	CALVING DATE	CONDITION AT CALVING	MILK	TEST	FAT	DAYS	REMARKS	SEX OF CALF	PROGENY REARED		
									TATTOO	NAME	SIRE

SECTION 111.

A BRIEF HISTORY OF THE HERD.

Establishment and Foundation Stock.

The College Friesian herd was established in July, 1927, by the private purchase of twenty-nine registered females from the New Zealand Government's Central Development Farm, Weraroa, which, at that time, possessed one of the best known Friesian studs in the Dominion. These foundation animals were not really selected, but were animals surplus to the needs at Weraroa and were made available to the College at book values. Only a few of the animals offered were rejected as the College had in a short time to build up a big herd. Further, they were viewed as good commercial animals which, available at the ordinary market rates for grade cows, could later be selected as decided. They did not represent the best of the Weraroa stock, but, fortuitously, they included members of the best Weraroa families. From the same source, a supplementary purchase of five females was made in July 1929, when the stud was dispersed by public auction. Of these Weraroa animals, only five had had one or more previous lactations, the remainder being young unproven stock, selected on type, pedigree, and performance of dams and other close relations.

Members of the New Zealand Friesian Breeders' Association, anxious that the foundation stock for the constitution of a herd at an Agricultural College, be worthy representatives of the breed, arranged for the presentation of several animals which they hoped would be effective foundation dams. In 1928, six such heifers were presented to the College through the courtesy of Sir Andrew Russell (Tunanui, Hastings), Major R.A. Wilson (Bulls), Estate T.O. Hodgson, (Tamahere), Messrs. J. Liggins (Tokomaru), W.A. Kyle (Otaki) and W.E.A. Gill (Bloomfield Farm Company, Wellington).

The age details of these forty foundation females at the time of their entry into the herd ~~was~~ WERE as follows:

4 mature and 1 four-year-old cow with previous lactations,

3 three-year-old heifers,

19 two-year-old heifers,

10 yearling heifers,

3 heifer calves

The high proportion of young stock in this group has been advantageous in at least one respect, namely, that many of the more outstanding animals have been retained in the herd for a long time. No further females have been brought into the herd from outside sources since July 1929, all subsequent stock for replacement or expansion purposes having been home-bred.

The purchase of the great majority of the foundation stock from the one stud has meant that there was a fairly close blood relationship among these original stock. The American-bred sire, Woodcrest Jo 334, figures prominently within three generations of thirty of the foundation cows, thirteen of which were line-bred to him. This particular bull, in spite of his very unprepossessing appearance, had a particularly good influence upon the production records of the Weraroa stud. As evidence of the futility of judging a bull merely on his appearance, it has been stated that the Weraroa herd manager was so unimpressed with the looks of the bull that he mated him mainly to the poorer cows. In spite of this, Woodcrest Jo left some of the highest producing stock in the Weraroa herd. A subsequent importation used at Weraroa, the American-bred Carnation King Matador Betty 5998, was the sire of fourteen of the foundation cows. The associate herd sire at Weraroa when the College purchases were made was the very recently imported Canadian bull Pioneer Snow Ormsby 8165. At the Weraroa dispersal sale in 1929 this bull was sold for three hundred (300) guineas. Some of the first calves born at the College, along with two of the

animals purchased in 1929, were sired by this bull. Longbeach blood was also represented in the original purchases, thirty animals tracing to Longbeach bred stock, within three or four generations, chiefly through the two sires, Longbeach Big Patch 515, Longbeach Primrose League 698 and several females. The concentration of Dutch blood, however, had become very diluted following the extensive use of, and line breeding to, the American blood. Woodcrest Jo left several sons which were used extensively in the herd. Weraroa also purchased some female importations, some of Australian origin, others American. Of these American animals, Dominion Mutual Mercedes of Rock 732, and Dominion Jessie Fobes Beets 734 figure extensively in the pedigrees of the College animals, Particularly close line-breeding resulted through the use of sons of these females, and of Woodcrest Jo. The blood of two other American cows, Woodcrest Daisy 726 and Dominion Lady Blanche Homestead 733 was also well represented in the foundation animals. Except for one animal, which was of direct Longbeach descent and by the Canadian sire Pioneer Snow Ormsby, all the College foundation females carried a high percentage of American blood. The close relationship of many animals to the bull, Carnation King Matador Betty, probably accounted for much of the size that characterized the original College herd, as this particular bull, ~~bull~~, himself was of heavy type and tended to hand that characteristic to his progeny. Many of the foundation stock were big round-boned animals. The size of these animals was not likely to be due to the Longbeach blood, since, as stated previously, this had been very much diluted. On the whole, though there were several animals of remarkably good type in the original herd, there was a lack of uniformity. This is a natural expectation when one considers the heterogeneity of blood lines represented in the succession of imported sires used at Weraroa and the mixing of these bloods with the original

Longbeach Dutch blood.

An examination of extended pedigrees reveals the fact that these thirty foundation animals from Weraroa, trace back through their female line of descent to only fourteen foundation dams (or families) as shown in the following summary:-

FAMILY.	ORIGIN.	NO. OF ANIMALS.
Domino 6.	Imported Dutch Friesian. J. Grigg Esq. "Longbeach"	3.
Chloe 862.	N.Z. Raised to stud. J. Grigg Esq. "Longbeach"	3.
Thelma 310.	" " " " " "	3.
Countess 711.	" " " " " "	2.
Manola 913.	N.Z. Raised to Stud. N.Z. Government, Weraroa.	2.
Spot IVth 314.	" " " " " "	1.
Johanna 894.	" " " " " "	1.
Jessie Fobes Beets 734.	Imported American Friesian. N.Z. Government, Weraroa.	4.
Lady Blanche de Kol Homestead 733.	" " " " " "	3.
Woodcrest de Kol Cornella 727.	" " " " " "	2.
Woodcrest Ida Fayne 729.	" " " " " "	1.
Woodcrest Daisy 726.	" " " " " "	1.
Mierlo 320.	Imported Australian Friesian. N.Z. Government, Weraroa.	6.
St. Gertrude 318.	" " " " " "	2.

Three of these fourteen families have entirely disappeared. Of the remainder, the Domino and the Chloe families only, have featured prominently in the development of the present-day herd, though, through the use of home-bred sires, the Jessie Fobes Beets

and Thelma families still figure extensively in pedigrees.

It is of interest that only nine descendants, five milking members and four young stock, of but three of the six presentation cows are present members of the herd. Disease and misfortunes, typical of the farmers' problems, were the major factors in reducing these family lines. Two of the gift animals died early in life from hoven. Under the circumstances, it is to be expected that the breeders concerned would have been especially careful in their selection to provide stock of very high quality, and so the unfortunate outcome of the animals concerned serves to emphasise the practical difficulties and limitations of selection as a means of dairy stock improvement. The College had an unfortunate experience with another presentation animal, a yearling bull, Hobson Ensign Zozo Acme 8004 (Hobson Ensign Acme 7281 - Hobson Zozo Pontiac 12478) donated to the College in 1927 through the courtesy of John Court Esq. (Hobson Farm Ltd., Wharepapa, Auckland.) Though, himself, extremely well-bred and possessed of excellent butterfat backing, Ensign's progeny were mediocre and few were retained in the herd.

Herd Sires.

During the thirteen seasons of the herd's existence, fourteen bulls, of which six were home-bred, have been used. One of these home-bred bulls was carried *in utero* from Weraroa and was by the imported sire, Pioneer Snow Ormsby; the remainder were out or College-bred cows by purchased bulls. No bulls of the second paternal generation of College breeding have yet had service in the herd, though a number of such animals have been sold as calves to other breeders.

The College herd-sires, have been drawn from a number of sources. One of the earliest, Hobson Ensign Zozo Acme,

has already been mentioned. This bull was line-bred to a recent American importation, Ensign Pontiac Valdessa Fayne 5586 which appears in the pedigree as both paternal and maternal grand-sire. The paternal grand-dam was Pauline Acme 3rd (imp.) 1642. His maternal grand-dam was that fine cow Zozo 2nd. of Ashlyn 2043. A contemporary herd sire, Fendalton Nazli Posch 2nd. was presented from the stud of Royds Brothers, Christchurch. Posch was line bred to that notable cow Burkeyje Sylvia Posch (imp.) 1276 and also carried some of the Longbeach Dutch blood. Both these bulls, therefore, had good butterfat backing, Ensign slightly better than Posch in that more was known of his sire, and his dam was a particularly good daughter of a proven cow. Ensign was delivered at the beginning of November 1927 and Posch later in the month after being exhibited as a yearling at the Royal Show at Christhcurch where he was placed third. They were quite different in type. Posch was finer in the bone, had a smaller head and a deeper body than Ensign, though he was, however, "very hammy". Ensign had better thighs. Ensign in the show-ring, gained, 1st Prize in the aged bull class, and Reserve championship at the Palmerston North Show, 1930.

These two bulls were given equal chances as yearlings. Ensign was turned out with the Weraroa two-year-old heifers, while Posch was mated to the cows in milk in 1927-28 season and also run with the yearlings. Posch was used exclusively during the winter and spring matings of 1928, Ensign being spelled. In 1929, yearling daughters of both Posch and Ensign had to be mated and it was therefore necessary to procure another bull to run with these young stock. Thus Totara Netherland Renown 9705 (Totara Netherland Supremacy 7555 - Totara K.P. Dorothea 13491) was purchased in September 1929 as a rising two-year-old, from the Piri Land Company, Auckland. He was chosen for his high testing ancestry in contrast to the low tests of the majority of the Weraroa foundation stock. He was

selected also because of his relationship to Westmere Princess Pietertje 469 and Netherland Princess 217, an established high testing strain. In common with the previous sire, his pedigree traced back to Burkeyje Sylvia Posch. He was mated to the heifers and a few very early cows.

Having used Posch in 1928, it was decided now to concentrate on the one bull Ensign, so that both bulls could be tried without risking too much by the wide use of either. The College was then keen, as now, on testing their sires, and as the heifers from these bulls were not yet in milk, and as it was not possible to keep the two mature bulls, Posch was loaned out to R.A. Wilson Esq., Bulls, for the period October 1929 - September 1931.

By the end of 1930-31 season it was learned that Ensign was a failure, and that Posch was a good sire. It was decided then to mate Posch again to all the foundation cows. Ensign was an outcross, and did not nick well with the College cows, and though mated to quite a large number of females, it was early learned from his first progeny that he was not a success and only five of his offspring entered the milking herd; four of these were culled for low production with 252 lbs. fat in 288 days as the highest individual record. The fifth animal was of quite outstanding merit and a grand-daughter from her is the only representative of the Ensign blood-line remaining in the present herd. Ensign himself was sold to the Longburn Freezing Works in 1931.

Posch's offspring, therefore, entered the herd in two separate groups, the first during 1930-31 -- 1931-32 seasons, and the second in 1934-35 season. Posch was a very successful sire and left a number of heavy milking cows, though characterized by somewhat low tests: Of his fourteen daughters which entered the milking herd, two still remain, but his blood is well distributed. In the milking herd of fourty-six animals during the 1939-40 season eighteen animals traced back

to him, some of them being as far removed as the fourth generation.

Meanwhile, in 1929, Massey Snow Ormsby Gambler 10386 (Pioneer Snow Ormsby (imp.) 8165 -- Dominion Mutual Mercedes Beets 9543) was born and kept for use in the herd. There was another promising bull born in this year (Pioneer Snow Ormsby-Dominion Krugersdorp 6584). It was elected, however, to sell the latter calf and keep Gambler because he was from an immediate daughter of Dominion Jessie Fobes Beets (imp.) 734 that had bred very well, at Weraroa in respect of both male and female progeny. Gambler, therefore, was related to quite a number of the original foundation stock, both through his sire and through his dam who was a grand--daughter of Woodcrest Jo (imp.) 334. In 1930, daughters of both Ensign and Posch were in the milking herd as two-year-olds, and there were yearlings sired by Posch. Renown was used at the shed with the milking cows in the spring and summer, and Gambler mated to the yearlings. In the following year, 1931, Gambler was used with the daughters of both Posch and Ensign. Another College bred bull, Massey Hotspur 11243 (Hobson Ensign Zozo Acme 8004 -- Dominion Mutual Mercedes Beets 9543) a half brother to Gambler was run with the heifers. This bull had only the one season of service and none of his progeny entered the milking herd. Having been disappointed in the one outcross breeding with Ensign, the College preferred to line breed with Gambler rather than risk another outcross, with Renown, and he was, therefore, loaned to E. Nielson Esq.,

By 1932, the Posch heifers were found to be characterized by a low percentage butterfat test and it was decided not to use him further. In preference to bringing back Renown, it was decided to use Gambler again, in the expectation that he would provide a better nick. Both Gambler and Renown at this

time were untested, but a chance of selling Renown was accepted, and he was finally disposed of in July 1932. On appearance as young stock the Renown heifers were ungainly and did not look particularly promising, and being the first of the second generation of College breeding, did much to discount his name. Forty-five successful matings with this bull resulted in twenty live females of which eleven were reared. Only six of these eventually entered the milking herd, but they proved that he possessed the ability to raise consistently the tests of his progeny above that of their dams, a feature for which the College had been striving. If for no other reason, Renown thoroughly justified his sojourn at the College through siring the outstanding producer in the herd, Massey Renown Heterodyne.

For the purpose of running with the heifers, a young bull Mahoe Donald 11637 (Bainfield Pietertje Topsy King 4932 -- Coldstream Pontiac Domino 7732) was borrowed from Major Wilson, Bulls, for the period November 1932 to September 1933. He was selected for his high butterfat test backing. He was used for the one season only and on a very few heifers, as the disposal of Ensign offspring had involved a large number of the calves born in 1930 and 1931, with the result that the home-bred replacements in 1932 and 1933 were very below normal requirements. Donald left two daughters which entered the milking herd, both outstanding producers in the present herd.

Posch was finally sold in October 1933, chiefly on account of the low test of his heifers. In this same year, Gambler's 1931 heifers were seen to have badly shaped "bottle-neck" teats, and he was not retained any longer. As mentioned previously, he had been used extensively on Posch and Renown animals, and also on several of the original gift animals. In one case, his female progeny

from matings with a Weraroa cow were reared but the blood relationship was not particularly close. In all, thirteen of his heifers entered the herd, but not many of his descendents have been retained. His breeding performance was variable. He improved test appreciably, but his progeny were not consistent, though some of his daughters as aged cows survive as very worthy members of the present herd. In the show-ring, Gambler was quite successful, gaining prizes as a yearling, two-year-old and three-year-old. He was finally sold in November 1933.

By 1933 Renown's daughters had completed their first milking season and his real value was being recognized. It was then decided to obtain another bull from a high testing strain and Totara Pontiac Invader 12166 (Bainfield Netherland King Pontiac 4187 -- Totara Sylvia Lulu 15533) was selected. As a Piri Land Company bred bull, he carried much the same blood-lines as did Totara Netherland Renown. He was a half-brother to Totara Veeman Lulu 22360, one of the highest testing Friesians under C.O.R. His paternal grand-dam was Westmere Netherland Princess from Westmere Princess Pietertje, the blood the College was particularly anxious to follow. He was also line bred to Burkeyje Sylvia Posch. Apart from high test qualities, these strains indicated longevity, both the dam and the grand-dam on the maternal side along with other close relatives being alive on the property at the time of Invader's selection. Invader was purchased in September 1933 as a two-year-old and mated to the milking cows and to some heifers. Massey Donald Lionheart 13260 (Mahoe Donald 11637 -- Dominion Domino Colantha 9540) was born at the College in 1933 and kept with the object of obtaining the Domino type along with the Donald high test. One daughter, later entered the herd and has since proved to be of good quality.

In 1934, Invader was again used at the milking shed,

and Lionheart mated to the heifers. Another College-born calf, Massey Invader Monarch 13897 (Totara Pontiac Invader 12166 -- Massey Ensign Honeysuckle 29033) born in October 1934, was kept with the object of improving the shape of the udders in the herd as his dam was outstanding in this respect, and also to infuse more Renown blood throughout the herd. His dam Honeysuckle was actually a daughter of Totara Netherland Renown, not of Ensign as the registered name indicates. His great-dam Dominion Krugersdorp 6584, was also proven in type, production and longevity. In 1935, Lionheart was exchanged for Tokaora Domino Asjes 13842 (Coldstream Domino Pontiac 7366 -- Tokaora Pontiac Vera 26401) bred by H.E. Johnson Esq., Tokaora, Hawera. Asjes came to the herd as a yearling in September 1935. Asjes was chosen because of the close-set, deep bodied type of his dam, associated with her high production and moderately high percentage test, since the Invader heifers tended to be rather leggy and lacking in depth. Through his sire, Asjes traced back to Magpie Domino 4206, a high testing blood-line. Asjes was mated to the heifers, while Invader and Monarch were used at the milking shed. In the following season 1936, the same programme of mating was followed, Asjes again running with the heifers. Monarch had a very limited period of service in the herd as he was sold as a two-year-old in November 1936, but, nevertheless, he was used with success. Two of his heifers, now approaching maturity, are among the best that have come into the herd. Altogether nine of his daughters were brought into the herd and six of these have been retained. One particular Monarch heifer, calving for the first time as a three-year-old in June 1939, produced 506 lbs. fat in the first 320 days of test. Monarch, in a number of cases, was mated to half-sisters, and three heifers resulting from such matings are at present in the herd. They have each completed

their two-year-old lactations, which, in all three instances were satisfactory, and they show every promise of development with maturity.

By the 1937 season, Invader's daughters had become very numerous in the herd and in July 1937 he was sold. His contribution to the herd has been far greater than that of any previous sire, twenty-nine offspring having entered the milking herd in the past three seasons. Fifteen of these are members of the herd in the present 1940-41 season. His relationship to high testing strains is reflected in the high percentage tests of his daughters, which show a substantial improvement over the previous test-level of the herd. The high wastage of his stock has been due mainly to disease, but in spite of his generally good breeding ability, four daughters have been culled for low production.

The high standard of production set by his progeny, has been substantially maintained in the second generation of his blood-line. Nine such females representing two sires, have entered the herd during the last two seasons, and all but one have qualified for entry into the 1940-41 herd.

Following the disposal of Invader, another purchase was Coldstream King Tilley Alcartra 15267 (Coldstream Matador 13245 -- Coldstream Joyce 15080) from G.A. Marchant & Sons, Cardiff, Stratford. Tilley carried some of the same blood as did Asjes. He was line-bred to the Magpie Domino 4206 strain, and traced back to Alcartra Clothilde Pietje 1165 and Westmere Princess Pietertje 469. His dam was an old cow. During the 1937 season, Tilley was mated to the daughters of Asjes. Massey Invader Quality 16494 (Totara Pontiac Invader 12166 -- Massey Renown Heterodyne 26591) born at the College in September 1937, was used along with Asjes on the milking herd in 1938. In this season Tilley was again run with the heifers.

Asjes was sold in July 1939. By this time his daughters

were numerous, and though somewhat low testing they are deep milkers, well-uddered, of good type and very promising, being an improvement in type on the rather leggy cows that Invader left in the herd. Eight daughters calved prior to June 30th 1940, eight more in the early part of the 1940-41 season, while others are amongst the present young female stock on the farm. Unfortunately, in this 1939 season, Quality proved nearly sterile and another bull Tokaora Colantha Marcus 16436 (Tokaora Colantha Victory 13423 -- Tokaora Melba 21610) had to be purchased. He came from the same stud as Asjes and, in common with this bull, carried the Magpie Domino blood, while he also traced back to Westmere Princess Pietertje, so that he was of very much the same blood as Tilley.

In July 1940 Tilley was loaned out and with the commencement of the 1940-41 dairying season, Renown has again returned to the College as a thirteen-year-old, but, both he and Quality have proved sterile, and so Marcus has to be used with the milking herd.

Two recent College bred bulls, Massey Asjes Refrain 17186 (Tokaora Domino Asjes - Massey Invader Mandolin 35580) born July 1938, and Massey Asjes Royalty (Tokaora Domino Asjes -- Massey Renown Heterodyne) born May 1939, have been used to a limited extent. Refrain ran with the heifers in 1939 and was also used at the shed for a few services. He was sold in August 1940. Royalty, in the present 1940 season, is running with the heifers.

Breeding Policy.

In brief, the breeding policy may be stated as follows:

(a) To breed animals that would produce and reproduce well.

(b) To develop high testing strains.

(c) To breed animals that would produce well under ordinary New Zealand grass farming conditions without special feed or care.

(d) To develop a herd of uniformly high producing cows,

each cow paying her way and no cow being kept purely for breeding purposes.

(e) To maintain and increase longevity of production.

(f) To maintain general breed type.

From the previous details of herd sires, it is seen that every consideration in the selection of these animals for purchase, has been given to furthering the aims of the herd breeding policy. Further, by controlled planned matings, every attempt has been made to use these sires to the best possible advantage.

Herd Policy.

The policy, over a number of years, has been to preserve a balance of numbers between the three dairy breeds, Jersey, Friesians and Ayrshires, kept at the College. Within the Friesian group of the total herd, there has been only a small number of non-pedigree stock, and these of little consequence. Four grade Friesians were purchased in the initial season and four heifers, the progeny of Friesian dams mated to Jersey bulls, were subsequently introduced into the herd. There has, therefore, been only a small residual of non-pedigree cows which could be replaced by pedigree stock. The dominance of pedigree Friesians is in strong contrast to the position obtaining in the companion Jersey herd maintained at the College, in which grades have been numerically more important than pedigrees. Within the limitations of stock available for replacement, a question which will be discussed in detail later, this has meant a greater latitude in selection of pedigree stock, than is usually the case in herds where, more often, pedigree expansion is made at the expense of a decreasing proportion of grades. It has been possible, therefore, for the College to adopt a policy of more stringent culling of pedigree stock than is characteristic of most pedigree herds in the early years of

establishment. This fact is of some importance in later discussions on the productive progress of the herd.

With the innovation of type classification by the Friesian Breeders' Association, a number of cows were submitted for classification, this last year. Six received the highest award, the V.H.C., four the H.C., and seven the C. certificate. In a herd where a fetish has not been made of type, which has been kept in its proper perspective, this is a very satisfactory result. Even more satisfying are the production levels attained by these cows, the seven mature animals which were classified averaging 528 lbs. of fat with an average lactation of 335 days.

In two respects the College herd has developed along lines which are not typical of the usual New Zealand herd. One is the practice of winter dairying for the provision of a milk supply for the milk-in-schools scheme, and for research and educational work in dairy manufactures. The other is the maintenance since 1937 under the segregation method of disease control, of two herds, respectively consisting of reactors and non-reactors to the abortion agglutination test. This latter development has now a special significance in the culling policy that is being pursued, animals in the reactor herd having a much severer standard to maintain in order to be retained in the herd.

In most other respects, the herd is very typical of the better North Island herds. There is the same reliance on grassland farming, while individual cows have to justify their place in the herd by their performances. Perhaps more than usual weight is now placed on the value of life-time production, but, with the heavy wastage toll characteristic of New Zealand herds, this criterion must inevitably achieve more general recognition.

Farm Policy.

A feature of some considerable importance in the history of the herd has been the improvement in husbandry conditions which has occurred over the past thirteen years. In its original state the dairy farm consisted of three large paddocks which had been down in pasture for some considerable time. Additionally, there was a considerable area of light accretion country, covered mainly in fescue, lupins, goat's rue, gorse and blackberry. Initial steps taken were the subdivision of paddocks into 6-7 acre units, and the regeneration of pasture by phosphatic top-dressing, since much of this, particularly on the lighter country, had deteriorated to a dominance of lower producing species such as brown-top and sweet vernal. Subsequently, much of the inferior pasture was broken up and resown with certified or pedigree seeds to establish pastures of very high quality, but with the lighter country the first response to improvement was very slow. Concurrently, the accretion country was progressively brought into production, and, though the majority of this land is still of low productivity, in conjunction with some of the lighter paddocks of the original farm, it serves a very useful function in that the heavier, high-producing country can be spelled at critical seasons. With much of the farm consisting of very light land, subject to drought, the volume and quality of feed have not always been ideal for high production, with resulting repercussions in stock returns.

Following subdivision, shelter belts have been established and an extensive watering system laid down.

In the absence of precise measurements, it is reasonable to state that there have been substantial improvements in respect of feed conservation for periods of deficient pasture growth. Advancement in both methods and facilities for the conservation of more and better quality hay and silage has been effected.

One important innovation is the saving of autumn-grown pasture for rationed grazing in the winter and early spring. No measure has been made of the efficacy of this practice but it is known to have a very substantial influence on production at that time of the year.

Throughout the whole period, the relationship between the herd and the farm has been very intimate. Firstly, the farm had to be improved while the herd was being improved. Secondly, the stock, through home breeding alone, had to be increased as the farm land was improved and the carrying capacity raised. Thirdly, it has at all times been necessary to get the greatest possible return from the farm as a commercial proposition. Consequently, high per acre production was a prime consideration, often at the expense of the production of the individual cows.

The net result of these improvements has been that the whole dairy farm is now able to carry many more milking stock than it would in the initial years of the period under review. More than this, the increased stock numbers are now maintained at a somewhat higher plane of nutrition.

Herd Numbers.

Table 1. gives the composition of the Friesian herd as at December 31st., for each of the thirteen diarying seasons in the full period under review 1927 -- 1939.

The first three seasons were characterized by rapid expansion and a high proportion of heifer calves were reared for entry into the milking herd. By 1931, a peak had been reached in herd numbers, both in respect of milking and total stock, that has not been exceeded in subsequent years. However, herd numbers showed a substantial decline in 1932 -33. This rise and decline in such quick succession was the result of several influencing factors. Firstly, there was the normal

TABLE 1.

COMPOSITION OF THE FRIESIAN HERD AS AT DECEMBER, 31st., 1927 - 1939.

Class of Stock	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	19
Cows and Heifers in Milk	10	29	31	40	43	34	34	33	32	39	38	42	41
Cows - dry	1	1	2	6	3	1	2	3	2	3	5	1	4
Heifers - 2 yr. old	10	-	2	2	1	-	1	3	-	-	-	4	-
Heifers - yearlings	6	6	13	8	13	11	8	8	13	11	11	10	14
Calves - heifers	4	10	10	10	12	7	7	15	11	11	12	12	19
Calves - bulls	-	-	1	-	1	1	2	1	1	-	1	1	1
Stock Bulls	2	2	2	4	4	2	1	2	3	2	2	3	4
Totals	33	48	61	70	77	56	55	65	62	66	69	73	79

trend of herd expansion during the earlier years of establishment. Secondly, in 1930 and 1931 stock prices were very low, as were dairy produce prices, thereby creating a temporary modification in herd policy, namely, the retention of stock in an endeavour to obtain greater gross output of dairy produce. Culling details show that no animals were culled from January 1930 until August 1931, a period of nineteen months. Thirdly, sex ratios of progeny born during the seasons 1928 to 1930 had been markedly in favour of heifers, of which a high proportion were retained. This increased stocking finally culminated in overstocking to the detriment of the herd. In the two seasons 1930-31 and 1931-32, though total production per acre may have increased, production per cow suffered, and in 1931-32 the number of abnormal records, mastital mainly, was proportionately higher than in any season since. As a consequence, disposals for 1931-32 were heavy, totalling fifteen milking stock and thirteen young stock: Lack of quality was the main factor determining the selection of these young stock for disposal. Only a few of the 1931-32 season's crop of female calves were saved. It was at this time that the ~~most~~ had been learned of Ensign, and these cullings include all his calves for that season, ten of his young stock and four of his milking daughters. The next two seasons, however, were characterized by unfavourable sex-ratios accompanied by a higher incidence of herd losses from deaths and disease. The net result was that in the seasons 1931-32 and 1932-33 total herd numbers record the lowest level for the whole period excepting the initial years of establishment. In 1934 when there were more favourable sex ratios, total stock numbers showed an appreciable increase due to the greater number of calves reared, and since that year numbers have had a higher tendency.

Throughout, the number of cows recorded as dry has been

small. This is to be expected since the great bulk of the herd are spring-calvers, while those cows which were freshening in the autumn would not in most cases be dried off till January and February. Two-year heifers, not in milk, were also few in number. These were mainly late calves, which were held back from service so that they would calve in the autumn at two and a half years. Yearling heifers and heifer calves, for the most part, represent stock reared for replacement purposes only, since surplus heifers were usually disposed of at birth. In the same way, the numbers of bull calves have been small as selected animals are also sold at birth in preference to service age. The considerable annual fluctuations in the numbers of yearling heifers and heifer calves will be explained in detail in a later section. On an average, after excluding the initial establishment years, the annual number of replacement heifers reared has been approximately eleven, which is equivalent to about thirty per cent of the average milking herd. Not all of these animals have gone into the herd. Deaths, breeding troubles, lack of promise, surplus sales and a variety of other reasons have reduced the annual herd entry numbers, but on the whole, the rate of replacement has been high.

Movements of stock entering and leaving the herd for the thirteen-year period are summarized in the following figures:

Purchased foundation females	40
Heifer calves saved for rearing	146
Heifers entering milking herd	93
Cows and heifers leaving milking herd	92
Bull calves sold at birth for dairying	59
Bull calves reared	7
Stock bulls used	14

All of the original foundation cows have passed from the herd, the last going at the end of the 1937-38 season, so now the whole complement of the milking herd is College-

bred. Only eighteen of these original cows are represented in the present herd which is now dominated by relatively few families. This has resulted not so much through objective family selection as from favourable sex ratios and other uncontrollable circumstances.

Milking stock numbers, as at any one date during a season, are not strictly indicative of the actual milking herd on account of irregularities in months of calving, length of lactations, length of dry periods and times of culling. These modifying influences make the assessment of annual milking herd numbers very difficult, and as a means of over-coming these difficulties the dates for the normal season have been altered to cover the period April 1st -- March 31st. Table 2. summarizes annual milking herd numbers, according to age groups. It is assumed also, that from the time an animal commences her first lactation, till the completion of her last lactation, she must be considered a member of the milking herd. Animals, which because of disease (abortion, sterility, or mastitis) have lost a full season's production, or aged animals retained for breeding purposes only, are not included in the total figures, but are indicated in brackets. In the drafting of stock for age groups, ages were taken as at the commencement of each lactation or season.

Except in the seasons prior to 1930-31 which are mainly concerned with purchased animals and some later seasons which include heifers calving for the first time as three-year-olds, variations in numbers within age groups carried forward in the next season, in general indicate cullings. Excluding the first three seasons when establishment was taking place, the average milking herd has numbered forty cows and heifers.

The Friesian herd, however, as previously mentioned, is but a part of the College dairy herd, the other breeds represented are Jersey and Ayrshire, both pedigree and grade.

TABLE 2.

ANALYSIS OF HERD COMPOSITION ACCORDING TO AGE.

Age of Cows in years	Seasons												
	1927 -28	1928 -29	1929 -30	1930 -31	1931 -32	1932 -33	1933 -34	1934 -35	1935 -36	1936 -37	1937 -38	1938 -39	19 -
2	6	9	4	14	6	3	6	7	6	11	9	9	10
3	2	17	9	4 (1)	14	6	3	5	8	6	11 (2)	7	10
4	1	1	13	9	5	9	6	4	4	8	6	11 (1)	6
5	1	1	1	11 (2)	8	5	6	5	3	3	8	5 (1)	7
6	-	1	-	1	11	5	5	5	3	3	2 (1)	5 (1)	6
7	1	-	1 (1)	-	1	6	5	5	4	2	3	-	4
8	-	1	-	1 (1)	-	1	4	4	1	3 (1)	2	2	-
9	-	-	2	-	1 (1)	-	(1)	4	2	1	2 (1)	2	1
10	-	-	-	2	-	2	-	-	2	2	-	2	1
11	-	-	-	-	1	-	2	-	-	1	-	-	(
12	-	-	-	-	-	1	-	-	-	-	-	-	-
Total Herd Nos.	11	30	30	42	47	38	37	39	33	40	43	43	45

Except that the abortion reactors and non-reactors are kept in two separate herds, and this applies to all breeds, the general conditions of management and feeding are the same for all milking stock. Within this herd, a balance of numbers between breeds is more or less maintained, but with improved conditions of farm practice and increased carrying capacity of the College farm, herd expansion has automatically followed. In Table 3. milking herd figures are given for the three breeds as at December 31st. of each season. Within limitations, therefore, these figures may be said to show the relationship in numbers which exists between the different breeds.

Fluctuations in numbers from season to season vary with breeds, and as with the Friesians may be accounted for by adverse sex-ratios of progeny, disease and disposals. Over the last ten years, total figures have actually increased little, but recent development has been masked by the excessive stocking in 1931. Ayrshires show the greatest relative increase in numbers. Increases in the Friesian and Ayrshire herds in recent years have been accompanied by a decrease in Jerseys, which have been culled more than the other breeds for disease and low production, with the result that the Friesians and Ayrshires have been required to maintain the herd total as well as breed totals. The original grade Jersey stock were purchased and progeny from them have entered the herd from season to season; no grade Aryshires have been purchased, however. At the present time, grade stock, both Jersey and Aryshire are largely the progeny of cross-matings between breeds, and classified according to the breed of their sire. The extent to which the Aryshire sires have been used is reflected in the figures for grade Aryshires.

TABLE 3.

ANALYSIS OF THE COLLEGE MILKING HERD ACCORDING TO BREEDS.

AS AT DECEMBER, 31st. FOR THE SEASON 1927-28 -- 1939-40.

Year	Friesian		Jersey		Ayrshire		Totals	Total Stock (All ages - - all breeds.)
	Pure Bred	Grade	Pure Bred	Grade	Pure Bred	Grade		
1927	10	1	1	11	-	-	23	133
1928	29	2	7	31	2	-	71	146
1929	31	3	5	44	9	-	92	173
1930	40	2	8	40	12	-	102	193
1931	43	3	7	37	10	5	105	205
1932	34	3	13	32	17	5	104	178
1933	34	1	12	29	16	6	98	185
1934	33	-	12	28	16	11	100	203
1935	32	-	16	31	20	11	110	201
1936	39	-	15	21	16	10	101	206
1937	38	-	9	21	22	6	96	206
1938	42	-	14	21	22	11	110	225
1939	41	-	19	35	15	5	115	227

Production Records;

Herd recording, undertaken by officers attached to the College, first commenced in January 1928. Since that date, monthly testing of all animals in the herd has been continued. August 1930 marks the commencement of Group Herd Testing under the control of the Manawatu Herd Testing Association. Though the College records are not considered official as compared with the Association records, the accuracy of recording in both cases is comparable, and for requirements in further discussions, these two sets of records are placed on an equal basis. Complete details are available, therefore, for every animal which has entered the College herd.

In Table 4. is given a summary of all records, normal and abnormal, completed within each season ending the 30th June. Disease, deaths, disposals etc. are the influencing factors accounting for abnormal records. Lactation periods exceeding 365 days have not been considered abnormal, unless one of the above factors directly influenced the production figures. This Table is not intended to represent seasonal total herd productions, on account of the carry-over of certain individuals from season to season, but rather to summarize production by retaining the individuality of each record as far as possible, as a means of showing herd trends in production levels throughout the period under review.

Included in a later section of this paper is a detailed analysis of production records, but it is apparent from Table 4. that an appreciable increase in production both gross herd and individual average output has been effected.

TABLE 4.

PRODUCTION RECORDS FOR EACH YEAR ENDED 30th JUNE.

NORMAL. (Excluding Incomplete).

Season	No. Cows	Milk		Fat		Days		Test
		Total	Average	Total	Average	Total	Average	
1928	-	-	-	-	-	-	-	-
1929	25	235,827	9,433	8,222	329	8,081	323	3.5
1930	26	225,022	8,655	7,687	296	7,750	298	3.4
1931	32	300,240	9,383	9,728	304	9,611	301	3.2
1932	27	245,257	9,084	8,182	303	7,840	290	3.3
1933	35	309,708	8,848	10,891	311	10,390	297	3.5
1934	24	271,943	11,331	9,592	400	6,989	291	3.5
1935	36	362,872	10,080	12,675	352	10,270	285	3.5
1936	19	187,915	9,890	6,741	355	5,982	315	3.6
1937	30	311,310	10,377	11,652	388	9,919	331	3.7
1938	30	297,285	9,910	10,991	366	9,225	307	3.7
1939	31	329,715	10,636	12,498	403	10,981	354	3.8
1940	44	481,260	10,938	17,604	400	13,948	317	3.7

TABLE 4. (Continued)

ABNORMAL.

Season	No. Cows	Milk		Fat		Days		Test
		Total	Average	Total	Average	Total	Average	
1928	-	-	-	-	-	-	-	-
1929	2	6,903	3,452	263	132	233	117	3.8
1930	4	25,400	6,350	890	223	1,176	294	3.5
1931	10	64,394	6,439	2,133	213	3,028	303	3.3
1932	10	43,548	4,355	1,388	139	1,858	186	3.2
1933	10	71,721	7,172	2,495	250	2,709	271	3.5
1934	9	58,318	6,480	2,110	234	2,214	246	3.6
1935	8	62,677	7,835	2,443	305	1,895	236	3.8
1936	6	35,040	5,840	1,215	203	1,371	229	3.5
1937	9	89,085	9,898	3,260	362	3,247	361	3.7
1938	7	46,740	6,677	1,706	244	1,381	197	3.7
1939	5	9,915	1,983	360	72	314	63	3.6
1940	4	18,960	4,740	623	156	614	153	3.3

SECTION IV.

HERD REPLACEMENT STOCK - SOURCE AND SUPPLY.

Total Calvings and Total Births.

A variety of factors influence annual calving figures. Abnormal conditions such as premature births, abortions, and accidents, resulting in a shortening of gestation periods, or reduction in service periods, tend to increase annual calving totals. Other factors such as sterility, accident and the policy of autumn calving operate to delay mating dates, thereby extending the period between calvings. Under the first set of conditions a cow may register two calvings within one season, while under the latter cirsumstances another cow may fail to record any calvings within that normal period. Annual calving figures, therefore, may not be taken to represent annual milking herd numbers precisely. However, over a number of seasons there is a balancing effect between the operation of these two constrasted sets of factors and so average calving figures may be taken as a fair indication of average herd figures.

In Table 5 is presented a summary of total births for the thirteen seasons under review. The slightly higher figures for total births than for total calvings are due to multiple births. For purposes of analysis, these births are subdivided into

(a) Live Births, and

(b) Dead Births, with a secondary classification according to sex.

In a herd such as this where no females are purchased, the annual supply of heifer calves is of the greatest consequence both in respect of herd numbers and standard of production. The main factors determining the supply of heifers in any one season are the ratio of female to male calves, the vitality of the heifer calves at birth and the month of birth. As Table 5

TABLE 5.

Summary of all births in the Friesian Herd, with sex details and condition at calving -- for the period July 1st 1927 to June 30th 1939.

Season	Total Calvings	Total Births	Dead Births			Live Births		Live Female Birth as % of Total Births
			Unidentified	Male	Female	Male	Female	
1927-28	11	11	-	-	-	7	4	36.4
28-29	30	31	-	3	-	11	17	54.8
29-30	34	36	4	3	1	14	14	38.9
30-31	44	47	4	4	2	15	22	46.8
31-32	43	43	2	1	-	18	22	51.2
32-33	35	35	3	-	-	24	8	22.9
33-34	38	41	3	2	1	23	12	29.3
34-35	36	36	1	-	1	13	21	58.3
35-36	35	36	3	4	1	14	14	38.9
36-37	38	39	2	4	2	16	15	38.5
37-38	46	48	4	-	2	26	16	33.3
38-39	38	39	1	1	1	20	16	41.0
39-40	49	51	-	2	3	20	26	51.0
Totals	477	493	27	24	14	221	207	
Annual Averages	36.7	37.9	2.1	1.8	1.1	17.0	15.0	43.4

shows, it is possible for sex ratios to vary markedly from season to season but over the whole period differences are averaged out and the ratio approaches unity. However, in certain years the supply of heifer calves is very restricted and is insufficient for the full application of selective replacement.

The average percentage figure 43.3 per cent, representing the live female births as a percentage of the total births may be expressed as the gross available supply of female replacement stock. Following birth, however, factors such as disease, and accident operate to reduce this figure. Considering seasonal figures, in 1935-36 season, of thirty six total births, fourteen or 38.9 percent were live-born females. Of these, two were slaughtered at birth, one on account of the low production of the dam, the other being a small calf from a two-year-old heifer. Of the remaining twelve calves, two died from disease, another died as the result of an accident, and a fourth was sold fat following injury. Thus, in effect, the above figure of 38.9 per cent was reduced to 27.8 per cent.

Total births, in preference to total calvings were taken as the basis in calculating the percentage figures in the above table, thereby giving a truer picture of the operation and effects of sex ratio and condition-at-calving upon the supply of female progeny, and at the same time excluding the effects of twinning, a phenomenon both irregular and unpredictable amongst dairy stock. These annual percentage figures vary widely from season to season, above and below the average of 43.3 per cent. The maximum figure of 58.3 percent in the 1934-35 season, stands in marked contrast to those of the two previous seasons, 1932-33 and 1933-34. In order to maintain herd numbers in the 1934-35 season, with a herd replacement figure of 20 percent, it would necessitate retaining seven of the eight live female calves born in 1932-33. In 1934-35 season, however,

twenty-one live females, representing 58.3 percent of the total births, were born from approximately the same total number of dams as in 1932-33. Of these twenty-one calves, eight, only, were required to maintain herd numbers for 1937-38, and although twelve finally entered the milking herd, the degree of selection possible was still three times that of the 1932-33 season.

Considering the average annual figures, -- thirty-eight births of which sixteen were live females, if these sixteen represent the progeny of sixteen individual dams (disregarding twinning) then on the average, twenty-two dams have failed to make any contribution towards the supply of replacement stock. In practice, the scope for selection is vastly different from the ideal, with all thirty-eight dams represented. The calves selected for rearing, represent only the best available from sixteen dams or 43.4 per cent of the milking herd, and not necessarily the most desirable blood lines in the herd. It is clearly seen that the operation of selection for production, and the rate of herd improvement, through the dams of a group, by their female offspring, may be very slow.

Sex Ratios.

Stock depreciation and loss operate continuously within a herd, and the maintenance of herd numbers is essential. It is the annual sex ratio and the annual supply of female stock rather than the average figure over a large number of years, which is the essential concern of the breeder. With a limited number of animals as in the College herd, divergence between male and female progeny numbers has not necessarily been very great to give a moderately wide ratio. Nevertheless, this herd has been somewhat at a disadvantage from the point of view of female progeny numbers due to the operation of sex ratios at birth.

From Table 5, a true sex ratio of all calves born is not

possible, owing to a number of unidentified dead births; however an approximation may be made. If of the twenty-seven dead births, the sex ratio was 1 : 1 male to female, then in a total of 493 births, 258.5 were males and 234.5 were females, a ratio of 1.10 males to 1 female. The assumption of a 50/50 sex ratio existing amongst the unidentified births may possibly be very incorrect, owing to a greater mortality being characteristic of one sex, but even if the twenty-seven unidentified births were all females, which is extremely unlikely, the total female births would then only be three in excess of the total male births. It is seen, therefore, that from the total births for the herd over a thirteen-season period, bull calves have been somewhat in excess of heifers. This has been an initial and strictly uncontrollable factor in reducing the supply of heifers available for selection.

Table 6, drawn up on the assumption of a parity amongst the unidentified births, gives some indication of the variation in sex ratios existing from season to season.

By considering total births, the problem of dead births has been more or less discounted, and the operation of one uncontrollable factor, sex of progeny, shown. In eight of the thirteen seasons there has been an excess of male over female births. In three seasons the ratio was greater than 1.5 males to 1 female, while in five seasons, only, were heifer calves in the majority. It may be noted, also that the maximum ratio of 2.68 males to 1 female, for the 1932-33 season is much greater than the lowest figure 0.60 : 1 conversely stated as 1.67 : 1.

Apart from considerations in respect of the herd as a group, the sex ratios existing amongst the progeny of individual dams of specific families are most important. Whether or not a particular blood line persists in the herd may finally be determined by the ability of individuals within that family to produce sufficient female offspring.

TABLE 6.

ANNUAL SEX-RATIOS OF TOTAL PROGENY BORN.

Season	1927 -28	1928 -29	1929 -30	1930 -31	1931 -32	1932 -33	1933 -34	1934 -35	1935 -36	1936 -37	1937 -38	1938 -39	1939 -40
Male Progeny Nos.	7	14	19	21	20	25.5	26.5	13.5	19.5	21	28	21.5	22
Female Progeny Nos.	4	17	17	26	23	9.5	14.5	22.5	16.5	18	20	17.5	29
Ratio: Male : Female	1.75 :1	.82 :1	1.12 :1	.81 :1	.87 :1	2.68 :1	1.83 :1	.60 :1	1.18 :1	1.17 :1	1.40 :1	1.23 :1	.76 :1

Table 7, drawn up in the form of a distribution chart, gives the numbers of dams according to the distribution of male and female offspring (identified births only). Details are given only for those dams which have left the herd.

TABLE 7.

ANALYSIS OF HERD FEMALES ACCORDING TO NUMBERS AND SEX DISTRIBUTION OF PROGENY.*

Male Progeny.

Female Progeny.	0	1	2	3	4	5	6
0		6	7	5			
1	8	5	1	4	5	1	
2	5	3	5	3	2	1	
3	1	6	1	3	3		2
4	2	2		1		1	
5			1	1	1	1	
6	1	2		1			

*Horizontally 0 - 6 indicates the number of male progeny, while the figures in the squares of the chart indicate the numbers of dams with total progeny equal to the sum of the relating male plus female numbers in the particular proportion indicated. Numbers falling on the dotted diagonal line indicate instances of 1 : 1 sex ratios; fourteen of the ninety-one dams detailed fall within this group. Various other totals may be drawn from

this chart.

41 dams have had less female than male calves;

18 dams failed to produce any heifer calves and hence failed to make any contribution towards the maintenance of the milking herd;

24 dams produced only one heifer each and their contribution towards herd maintenance was very small while the possibilities of these dams perpetuating their blood-lines, were not great.

Extreme cases of wide sex-ratios amongst the progeny of the one dam have occurred;

1 dam exhibited the ratio 6 females - 0 males;

2 dams exhibited the ratio 6 females - 1 male;

1 dam exhibited the ratio 6 females - 3 males;

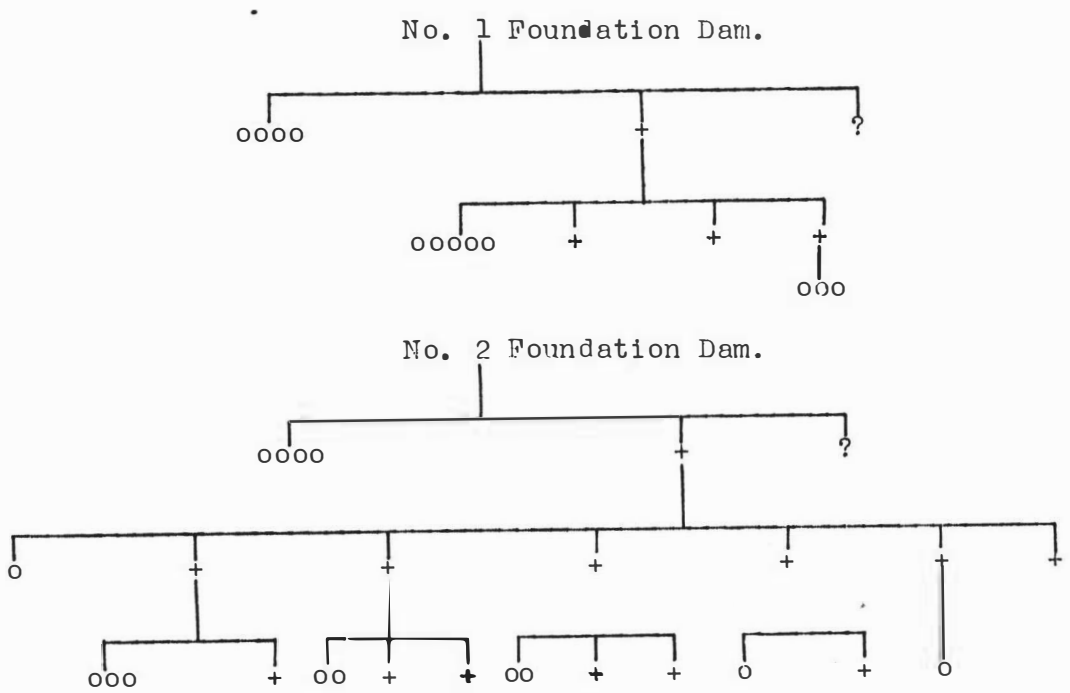
In these instances the possibility of the blood lines surviving under conditions of selection and culling is far greater than in the case of dams with low female progeny numbers. The possible intensity of selection is also increased with the greater numbers of females.

A study of various family breeding records affords further data upon this aspect of sex ratios. Of the forty original foundation animals, purchased during the period of herd establishment, eight failed to give birth to any female progeny prior to disposal. The individual numbers of male progeny for these animals ranged from one to five. Though some of these eight cows were disposed of relatively early in life, there was every possibility that female calves, had they been available, would have been kept during this initial period of herd expansion. However, all chances of the perpetuation of these particular blood lines were last at the outset, as a consequence of adverse sex-ratios. From the breeding records

of other foundation animals two cases have been selected as contrasted examples of sex-ratios in operation, affecting family numbers in the herd. Details of breeding records are given diagrammatically in the form of breeding charts, in which black crosses indicates females -- red crosses indicate females still in the herd, circles indicate males, and ?'s indicate unidentified births.

TABLE 8.

DIAGRAMMATIC ANALYSIS OF BREEDING RECORDS OF TWO FOUNDATION DAMS, ACCORDING TO SEX PROGENY.



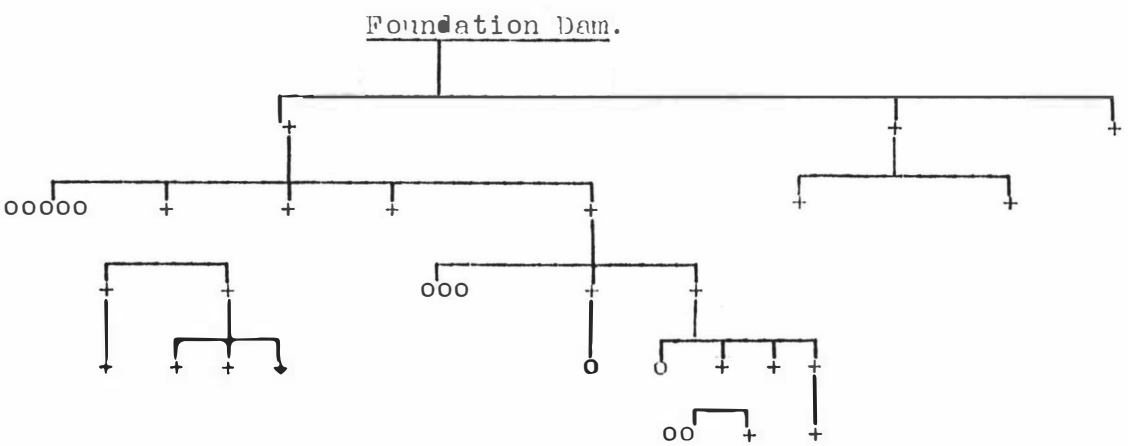
Nine females from the second family are members of the present herd but there is only one of the first family. Though the original dams each had the same breeding result, the subsequent births of the first family have been characterized

by unfavourable sex ratios. On the other hand, the later generations of the second family have been predominantly heifers. Though a secondary factor, disease, has also been in operation, an unfavourable sex ratio has been the dominant factor in determining the present lack of importance of the first family.

In most other instances, the breeding records of families have been so interrupted that clear cut studies of sex ratios within the families are not possible. However, as an example of how a large proportion of female offspring is of distince advantage in perpetuating a blood line, even under harsh conditions of selection, the following family has been selected.

TABLE 9.

DIAGRAMMATIC ANALYSIS OF BREEDING RECORDS OF A FAMILY SHOWING HIGH PERCENTAGE OF FEMALES.



In this family, female offspring have predominated to the extent of 22 females to 12 males, a sex ratio of almost 2 : 1. Culling has been heavy as indicated by the number of individuals which have entered the herd and bred, but, nevertheless, the family ranks amongst the most important in the present herd.

Multiple Births.

From the analysis of total births in Table 10, it will be seen that in 477 calvings, there have been sixteen twin births, representing 3.3 per cent of the total. This is a higher figure than that stated for dairy cattle by Lush (3) of 1.7 -- 2.0 per cent and is possibly a breed characteristic (4). In Table 10, these twin births are summarized for sex and condition at birth.

TABLE 10.

ANALYSIS OF TWIN BIRTHS.

Sex	No.	Dead Births		
		Male	Female	Unidentified
Mixed	7	2	1	-
Female	5	-	2	-
Male	3	4	-	-
Unidentified	1	-	-	2
	16	6	3	2

In general, twinning is not looked upon with favour. The limited number recorded in this herd, moreover, does not allow of any detailed discussion, but they do show a markedly higher mortality - at - birth figure than do single born individuals, namely 34.4 per cent as against 11.7 per cent.

There were seventeen heifers from these twin births three of which were born dead. Of the remaining fourteen, six were twinned to males, and must be discounted as a source of female replacement stock. None of these six heifers were reared, as the possibility of such individuals failing to come into profit is too great to warrant the

expense of rearing for dairying purposes. Lush (5) quotes a figure of about one in twelve of such females being fertile. From the original sixteen dams which gave birth to twins, there remain eight heifer calves available for selection for rearing, a considerably higher proportion than that obtaining with single births, but in respect of individual blood-lines represented, they are the progeny of only five dams. Of these remaining eight heifers, three have been saved for rearing, one of which has already entered the herd.

From the above records the only instances of particular family lines tending to give multiple birth are, where (a) twin sisters (b) dam and daughter (two sets of twins), both from single births, and (c) grand-dam and grand-daughter, both from single births gave birth to twins.

Dead Births.

A common and the most serious type of dead birth, is that popularly termed "slip" of "abortion," and recognized at the time of parturition, chiefly by the premature stage of development of the expelled foetus. A slip birth may often follow some accident or injury incurred by the pregnant dam, or else it may be directly due to the contagious abortion disease (Brucellus abortis). It is possible to distinguish between these two types of slips, by means of a bacteriological examination of the foetus at the time of parturition. Though the bulk of the calves from such slip births are dead at birth, it sometimes happens that the aborted calf though premature, may still be alive, but rarely survives. Two such instances are on record in the College herd, where live calves were born following a gestation period of 245 days and 247 days respectively. Both were killed.

From a total of 493 births in the herd, 65 are registered as dead births, representing a loss at birth of 13.2 per cent

of all individuals born. Eliminating twin births, amongst which the mortality rate was 34.4 per cent, there is a death-at-birth rate from 461 single births of 11.7 per cent. In other words, over a period of 13 years, this herd has experienced one dead birth in every 7.6 individuals born, or one dead birth in every 8.5 of the single births.

If accident and disease may cause the very premature births, it is reasonable to expect that they may also be the influencing factors in some instances where apparently fully developed normal calves are born but a few days before the normal gestation period has elapsed. Therefore in Table 11 (analysis of dead births,) the distinction between "born dead" and "slips" is mainly arbitrary, based upon the judgement of the dairyman. Two apparantly normal live births have been recorded following gestation periods as short as 267 and 268 days respectively. It is necessary therefore to allow for variation in the length of gestation period from the generally recognized period of 282 or 283 days. Those individuals classed as "born dead" show a range of 269 to 281 days gestation period. One case of death shortly after birth followed a gestation period of 287 days. Thus, under the class "bo rn dead" it is assumed that but for some predisposing factor, these individuals, having undergone a sufficiently long period of prenatal development should have been born alive. "Slips" on the other hand, may be termed premature, those calves presented before prenatal development had been completed, and includes those born following gestation periods of 3 months to 265 days. The greatest number of slips have occurred in the 6 to 8 months period.

TABLE 11.

ANALYSIS OF DEAD BIRTHS.

	Twin Births		Single Births	
	Born Dead	Slips	Born Dead	Slips
	6 1ø - -	4 - - -	16 2ø 1! 1e	34 - - -
Totals	7	4	20	34

ø died shortly after birth

! drowned at birth

e retained in utero as "mummy" calf.

Grand Total 65

The possibility that a number of calves have been lost through strangulation or smothering at birth, is worthy of consideration in accounting for the relatively high incidence of calves "born dead," as in practice it has not been possible to give special individual attention to all animals at parturition. Stock recording, however, has not been extended to include such detailed information.

Abortion has been responsible for the greatest proportion of dead births. If one were to assume that half of the aborted unidentified calves were female, though this, strictly speaking, is not a valid assumption since intrauterine mortality is higher for males (6) then the loss of sixty-five calves represents a reduction of heifer calves of approximately twelve per cent.

Female Calves.

A selected number of female calves have been reared annually to replenish herd losses, the remainder being disposed of according to the market offering. Table 12 gives the disposition of all live heifer calves.

The range of variation between the annual figures for calves "kept-for-use" is quite appreciable, but except in the case of the one season 1931-32 these figures represent a very high proportion of the totallive females born. This condition has arisen mainly as a result of the adverse affects of sex ratios upon the total supply of females as shown in Table 5. Since herd policy has never included the rearing of heifers for future sale, these numbers represent an estimated safeguard for herd maintenance and expansion, after allowing for accidents, deaths etc., amongst the young stock.

However, it is not the means of disposal of these calves which is of importance, since, as mentioned previously, that has depended upon the market offering, but rather the reasons for disposal. The chief reasons and the respective progeny disposal numbers may be summarized as follows:-

Out-of-season	21
Females of Mixed Twins	6
Weaklings	2
Cross-breds.	9
Surplus.	23

The class "out-of-season" includes calves born within the period of October to May. Though in many instances calves born within that period have been retained, they have in the main, been progeny of the more outstanding females.

"Weaklings" describes small and weak progeny killed at birth.

"Cross-breds" cover the progeny of Friesian dams mated

TABLE 12.

THE DISPOSITION OF LIVE HEIFER CALVES.

Season	Live Female Births.	Disposals within three weeks.			Kept for own Use	Cross-breds
		Slaughtered	Veal	Dairying		
1927-28	4	-	-	-	4	-
28-29	17	6	-	-	11	-
29-30	14	-	1	-	11	2
30-31	22	-	5	4 ø	13	-
31-32	22	4	2	10	6	-
32-33	8	-	-	1	7	-
33-34	12	-	2	2	8	-
34-35	21	5	-	-	16	-
35-36	14	2	-	-	12	-
36-37	15	-	-	-	14	1
37-38	16	2	-	-	13	1
38-39	16	-	1	1	13	1
39-40	26	-	1	3	18	4
Total	207	19	12	21	146	9
Averages.	15.9	1.5	0.9	1.6	11.2	0.7

ø Heifers sold at birth but later returned. Finally disposed of as young stock for dairying purposes.

to Jersey or Ayrshire bulls. Only four of the eight cross-breds were reared and entered the College dairy herd.

"Surplus" calves include those born within the normal season July to September, but in excess of the numbers required for herd maintenance or expansion. They represent a group disposed of at birth following selection of a more intense nature than that indicated by the generalized classes previously listed. Thus, if the numbers for live heifer births be reduced to net female progeny numbers, to allow for out-of-season calves, females of mixed twins, weaklings and cross-breds, as shown in Table 13, the possible scope for selection for more specific factors such as butterfat backing, family blood lines, type etc., is seen to have been very restricted.

Following herd establishment in 1927, the first three seasons cover the period of herd expansion, and selection of any kind amongst the young female stock was exceedingly limited. In any case it would have been conducted on a basis of limited experience of foundation stock. In 1927-28 all of the four live female progeny were retained. In 1928-29 of a total of seventeen live female progeny, six were disposed of as being out-of-season calves, the remaining eleven being retained. Of the latter, two were definitely born out-of-season, indicating that selection on this point alone, was not complete owing to the necessity of maintaining stock numbers. In 1929-30 of a total of fourteen live heifer calves, eleven purebreds and two cross-breds were retained. The one disposal was a female calf of mixed sex twins.

By this time herd numbers had become more-or-less stabilized, and coincident with the high female birth figures of the next two seasons, there were high surplus numbers. In 1930-31 of twenty-two live female progeny, thirteen were retained. Disposals included one female of mixed twins and eight classified as surplus. The latter were the progeny of

TABLE 13.

ANALYSIS OF "NET FEMALE PROGENY NUMBERS."

Season	1927 -28	1928 -29	1929 -30	1930 -31	1931 -32	1932 -33	1933 -34	1934 -35	1935 -36	1936 -37	1937 -38	1938 -39	1939 -40	Total
Net Female Progeny Nos.	4	11	11	21	14	7	10	17	13	14	13	14	20	169
Kept for Own Use	4	11	11	13	6	7	8	16	12	14	13	13	18	146
Surplus	-	-	-	8	8	-	2	1	1	-	-	1	2	23

of one sire, Hobson Ensign Zozo Acme, whose performance had been disappointing. In 1931-32 only six of the total twenty-two female progeny were retained. Disposals included eight out-of-season and the same number of surplus calves. Of these latter, four were either sired by or closely related to the above bull.

The season 1932-33 was characterized by a very low number of heifer calves. Of a total of eight females, there was only one disposal and the chief reason in this instance was the low production of the dam, though this particular calf was also born out-of-season. Of the seven calves retained, one was a late October born calf. In 1933-34 a similar set of circumstances obtained and eight of the twelve live females born were retained. Of the remaining seasons, 1934-35 and 1939-40 show high female numbers, in both instances over 50 per cent of the total birth figures for the seasons. The supply over the intervening seasons remained relatively constant with 1936-37 the only season since 1927-28 when all the live female progeny born were retained. Since the introduction of abortion testing into the herd in 1936, the replacement of reacting stock and normal losses has entailed the use of nearly all heifer calves born. From a total of sixty-seven (excluding grades) live heifers during the past four seasons, fifty-eight have been kept for rearing. Of the nine disposals, three were mates to mixed twinned males, two were out-of-season and only three were considered surplus. When it is considered that these figures include all calves born of first calving two-year old heifers, any selection has been exceedingly limited.

The proportion of females retained, has been consistently high throughout except for the one season 1931-32 where only six of the twenty-two or 27.3% of the live heifers were retained.

Losses amongst calves kept for own use have not been great; only four deaths prior to weaning have been recorded for the whole period. The next phase in the life of these young animals is that from weaning till entry into the milking herd. The majority of the heifers reared eventually entered the herd, though deaths and disposals have accounted for a small number. Losses during this period are summarized in Table 14.

TABLE 14.

Losses and Disposals of Young Heifers from Weaning till Two Years.

Reasons.		Stock Numbers Yearlings	2 Year Olds.
Surplus Disposals		2	13
Deaths	Disease	1 (Bloat)	--
	Accident	1	2
	Unknown	1	-

From this Table classification of "surplus" may be given for secondary reasons for disposals.

Blood line (Related to one particular Sire)	8
On account of low production of Dam	5
Other secondary reasons	2

The following is an annual average of herd numbers over the period and the relation of births to the rate of replacement:

Milking herd numbers	36.9
Total births	37.9
Live female births	15.9
Females kept for own use	11.2
Females entering herd	9.4

No. of heifers entering herd as per cent of Total Births -- 24.7%

Table 15 presents a complete summary of the above details of female progeny and replacement stock numbers.

TABLE 15.

ANALYSIS OF FEMALE PROGENY NUMBERS.

Seas.	Live Births	Disposals				Cross Breds	Kept for own use.	Losses to 6mths.	Losses 6 mths. -2 yrs.	Females Entering Herd.		
		Out-of-Season.	Mixed Twins	Weak-lings	Surp-lus.					No.	% Live Female	% Females "Kept-for-Own-Use."
27-28	4	-	-	-	-	-	4	-	-	4	100	100
28-29	17	6	-	-	-	-	11	-	-	11	65	100
29-30	14	-	1	-	-	2	11	-	5	6	43	55
30-31	22	-	1	-	8	-	13	-	8	5	23	39
31-32	22	8	-	-	8	-	6	-	1	5	23	83
32-33	8	1	-	-	-	-	7	-	-	7	88	100
33-34	12	1	1	-	2	-	8	-	-	8	75	100
34-35	21	3	-	1	1	-	16	-	3	13	62	81
35-36	14	-	-	1	1	-	12	2	2	8	57	75
36-37	15	-	-	-	-	1	14	1	-	13	87	93
37-38	16	1	1	-	-	1	13	-	-	13	81	100
38-39	16	-	1	-	1	1	13	1	-	(12)	75	92
39-40	26	1	1	-	2	4	18	-	1	(17)	65	94
Total	207	52				9	146	4	20	122		
Aver.	15.9	4				0.7	11.2		1.5	9.4	59%	84%

S E C T I O N V.

LOSSES AND DISPOSALS FROM THE MILKING HERD.

In the computation of annual wastage figures which are given in Table 16, individuals have been classified according to the season of their last complete or part lactation period, in preference to the actual date of their leaving the herd. Frequently, stock culled at the close of one dairying season have been held over till the following season before actual disposal. Especially has this been so with stock sold for dairying purposes, the animals concerned being retained until they were close to profit when their market value is normally at a maximum. In such instances, the actual time of disposal bears no true relationship to the time of culling and culling figures for any one season may be very misleading.

The reasons given for wastage in Table 16 should be applicable to an analysis of similar data from any dairy herd, though the specific definitions of the terms used may vary somewhat according to herd policies. For the particular conditions of this study the following class-headings require definition.

"Surplus"-- stock of fair average quality considered to be in excess of immediate requirements.

"Low Production"-- stock of definitely poor productive capacity as compared with other members of the herd. No definite standard of qualification can be quoted, as such a figure would vary with circumstances. In cases listed, low production was the primary cause of disposal. Where disease (mastitis, abortion) adversely affected production to the extent of final disposal of the individual concerned, disease was considered the primary cause of disposal, and the animals have been classified accordingly.

TABLE 16.

ANALYSIS OF WASTAGE.

Cause.		1927 -28	1928 - 29	1929 - 30	1930 -31	1931 - 32	1932 - 33	1933 - 34	1934 - 35	1935 - 36	1936 - 37	1937 - 38	1938 - 39	1939 - 40.	Totals.	% of Total Wastage.
Surplus.			1		2	7	1	2	4				7	6	30	32.6.
Low Production.			1			4			1			2	1	2	11	12.0)
Age.							1	2	1	1	2				7	7.6) 22.9.)
Accident & Injury.							1	2							3	3.3)
Disease.	Sterility & Abortion.		2		2				3		3	1		2	13	14.1) 67
	Mastitis.					4			3		1	1	3	1	13	14.1) 44.5
	Bloat.		1				2	1	1			1		1	7	7.6)
	Miscellaneous.								1	2		3	2		8	8.7)
Totals.			5		4	15	5	7	14	3	6	8	13	12	92	100.
% Herd Wastage or Herd Maintenance.		-	16.7	-	9.5.	31.9	13.2.	18.9	35.9.	9.1	15.0	18.6	30.2	26.7		

Herd Wastage Average: 21.4%.

"Age" -- Stock which on account of their advanced age, were no longer useful as producers or breeders.

A distinction may be made between herd surplus and true herd wastage though in some cases this distinction may be rather arbitrary. Under the latter category come stock losses and disposals due to low production, age, accident, injury and disease. Total figures under these two headings are :-

Surplus	True Herd Wastage.
30	62

To show the relative importance of the various causes of herd wastage over the thirteen-year period, total numbers for each classes, in Table 16, are related on a percentage basis. Further, total seasonal figures for wastage from all causes, is expressed as a percentage ot the total herd numbers, as given in Table 2. (Herd Composition). Disregarding the figures for the first three seasons, as being abnormal, the percentage average herd wastage or herd maintenance for the ten-year period has been 21.4 per cent. Ward (7) estimates the figure for New Zealand dairy herds as approximately, but not more than 20 per cent. The seasonal variations in herd wastage as seen in Table 16 are marked. Surplus disposals have largely been responsible for such variations, but these in turn have been governed by numbers of replacement stock on hand and uncontrollable losses such as disease and deaths. During the earlier years where replacement-stock numbers were at a comparatively low figure, seasonal herd numbers were very susceptible to variations in the wastage figures. Since 1934-35, the numbers of heifer calves reared each season has been much higher, with the result that not only have herd numbers increased, but the culling rate has also shown a sharp rise. There is a present tendency towards maintaining this higher

culling figure through higher surplus disposals.

Disease.

As indicated in Table 16, disease accounts for 44.5 per cent of the total herd losses and disposals, and is by far the most important single factor operating to cause herd wastage. Of the forty-one cases listed against disease, fourteen have been actual deaths, the specific details being -

Cause of Death.	No. of Animals.	Season of Occurrence.
Bloat	7	(See Table 16)
Actinomycosis	1	1934-35
Tuberculosis (destroyed)	2	1935-36
Malignant oedema	1	1937-38
Pleurisy	1	1937-38
Grass Staggers	2	1937-38: 1938-39

The incidence of fatal diseases has been somewhat greater in more recent years .

Milk Fever.

A notable feature of herd losses, is the absence of deaths from milk fever, due no doubt to the special attention and treatment given all animals during the period shortly prior and subsequent to parturition.

Bloat.

Bloat has been the major factor influencing the number of deaths recorded, accounting for 50 per cent of deaths due to disease, and 35 per cent of the total deaths including animals destroyed. These figures, however, give no real indication of the incidence of this disease. Under conditions of high pasture farming obtaining on the College farm, bloat is extremely prevalent. Though these figures may appear high, they are, under the circumstances, relatively low, attributable to efficiency of herd management. On the heavier land of the

College farm, most fields have been sown down in a dominant ryegrass-white clover pasture, the white clover being of the New Zealand No.1 Certified type, which under conditions of high fertility and mild climate becomes very aggressive. This clover throws a great bulk of very succulent feed in the early spring and autumn months. In the grazing of these pastures, this luscious type of feed is a predisposing factor in the occurrence of bloat, and creates a serious problem in both stock and pasture management during these seasons of the year. In this respect, the practice of reserving late autumn and winter grown, a less luscious and more grassy class of feed, for the early spring grazing, may play an important part in the control of bloat.

Mastitis.

For any one disease, mastitis culling figures are the highest and represent one animal culled for mastitis in every seven animals leaving the herd. Though no definite records are available as to the exact state of infection of the animals concerned, at the time of culling, disposal has in the main, followed advanced chronic mastitis infection. A great deal of investigational work into the problem of mastitis in the dairy herd has been undertaken at the College over the past few years, and the Friesian herd has played an important part in this connection. All infected animals are not culled. In practice, in the presence of the other factors operating to cause herd wastage, the extent of selection and culling against mastitis is very limited. Culling is more or less incident to certain conditions, firstly, where the infected animals become a source of infection dangerous to other members of the herd, and secondly, where the disease is in effect, a primary cause to low production.

The range of production attained by those animals culled for mastitis is as follows :

Highest Level of Production Attained (Approx.)	No. of Cows.
15,000 lbs. milk - 500 lbs. butterfat within 365 days	2
13,000 lbs. milk - 450 lbs. butterfat within 365 days	2
8,000 lbs. milk - 300 lbs. butterfat within 365 days	8
2,700 lbs. milk - 100 lbs. butterfat in 87 days (abnormal 2 yr. old)	1

An excellent example of the manner in which mastitis can be a loss of production and a direct cause of herd loss, even amongst relatively young animals is afforded in the case of the following animal :

Age at Calving.	Milk (lbs)	Fat (lbs).	Days in Milk
First calving 2 yr. 238 days	8,070	320	334
Second " 3 yrs.357 days	4,035	148	214

Sterility and Abortion.

Only one animal included in this class, was culled on account of her failure to come to normal production within a few weeks after an aborted birth, the remainder were sold empty, the immediate cause of culling being sterility. No attempts have been made to determine the specific causes of sterility with the individuals concerned, and the extent to which Brucellus abortis has operated in causing sterility therefore cannot be estimated.

The policy has been to make every effort to get an animal in calf, even to the extent of late matings or the sacrificing of pedigree matings by using bulls of different breeds. Where complete failure to conceive has resulted, disposal for beef purposes has been the final outcome. In most instances, the animals have not been retained for a sufficiently long period to determine whether they be classed as temporarily or permanently sterile. However, in the case of two animals which milked for 653 days and 562 days respectively and failed to conceive even after two normal mating

seasons the evidence is in favour of possible permanent sterility. Neither of these animals had recorded abortion births at any time. Failure on the part of individuals to conceive within the normal mating period has not been uncommon, but with the herd practice of calving a number of cows in the autumn, such animals have either been mated accordingly, or held over for a complete season, in preference to out-of-season mating.

One rather odd case may be mentioned, namely, that of a cow which failed to calve, but retained the calf in utero as a mummy. This animal came into milk following the normal pregnancy period, and remained in the milking herd for 419 days. Under the circumstances the animal exhibited no normal oestrus cycles. Attempts to remove the calf proved unsuccessful.

Facial Eczema.

Mention may be made, when discussing disease, of facial eczema. Though no animals have been listed in the culling records against this disease, some consideration must be given to the possible effects it may have had upon certain individuals. The last and most serious outbreak of facial eczema that has been experienced since the herd was established, occurred in the summer of 1938 when a number of the calves on hand at that time were very seriously affected. Twelve calves were reared through that summer, of which five have been culled following their first lactation, three for low production and two for failure to conceive within the normal mating season. Amongst the remainder, production in the main, were only fair. To what extent the set-back these animals received early in life affected their later development and production, and whether or not facial eczema should be considered the primary cause of this wastage cannot be stated with any precision.

Disease Incidence with Age.

In Table 17, age is denoted by lactation number in preference to years, as ten of the forty-one animals culled for disease did not enter the milking herd until three years (approx.) of age.

Disease is associated with more age groups than any other single culling factor, but unfortunately, numbers are too small to establish any conclusive relation between lactation number and wastage due to specific diseases. However, there is the indication of an increased incidence of mastitis with increase in lactation number. The figures for bloat losses show a reverse tendancy. It may be said they indicate a susceptibility of certain animals to this disease, with a higher number of deaths resulting at an early age. The total figures for each lactation number and the corresponding per centages show that the greater proportion of disease losses occur prior to the sixth lactation; relatively high losses at the first lactation, reaching a peak at the fourth lactation. Ward (7), from an analysis of a large number of New Zealand herds found the highest disease wastage amongst animals from the ages of four to six years. Mastitis was highest at six years and sterility at four years, but the percentage of cullings for age groups increased with age up to twelve years.

Ward quotes the figure for average loss from mastitis over all ages as 4.06 per cent, which is approximately twice that of 2.71 per cent in the College herd. He makes no mention of breed incidence, and though his mastital cullings do not show a definite increase with the higher producing herds, the above comparison is very satisfactory when consideration is given to the high butterfat returns obtained within the herd, from a breed characterized by low tests and

TABLE 17.

AGE INCIDENCE OF DISEASE.

No. of Lactations	Sterility and abortion	Mastitis	Bloat	Miscellaneous	Total	%
1	2	1	3	1	7	17.1
2	2	1	-	1	4	9.8
3	2	-	1	2	5	12.2
4	2	5	1	1	9	21.9
5	1	1	1	2	5	12.2
6	1	2	-	-	3	7.3
7	2	1	-	-	3	7.3
8	1	2	-	1	4	9.8
9	-	-	1	-	1	2.4
10	-	-	-	-	-	-
Total -	13	13	7	8	41	100

very high milk yields.

Low Production.

There were eleven cullings specifically for low production, representing 12 per cent of herd losses and disposals. Though no standard level of production has been adhered to in culling, a mature record of 300 lbs. of butterfat in a normal lactation period, has more or less formed the basis for selection but the standard has necessarily varied according to the supply of replacement stock and the rate of wastage in the Jersey and Ayrshire herds. Every animal has been considered on its own merits. Certain animals have been culled at the close of their first lactation period, while others have completed their fourth or fifth lactation before disposal, as seen from Table 18.

TABLE 18.

Classification for Age of Animals Culled for Low Production.

No. of Lactations in Herd.	1	2	3	4	5
Culling Numbers	3	4	-	3	1

A notable feature of age incidence is that the majority of cullings have been effected at an early age in the life of the animals.

The four animals culled for low production later than the third lactation represent two foundation animals and two of the earlier College bred stock, and kept mainly because of the shortage of young replacement stock during the earlier years following establishment.

Age.

Age has not been a serious cause of herd wastage. The first age disposal occurred in 1932-33 season, six years after herd establishment, and further disposals followed with quite a normal incidence until 1936-37 season. No disposals for age

have been effected during the last three seasons; this may be accounted for by the fact that other figures including surplus have been relatively high. The "aged surplus" disposals for this latter period have accounted for four animals of an average age of eight years. The effect of age varies with individuals, and whereas one animal may have finished its usefulness at a certain age, another may still be a valuable producer. Some animals have been disposed of as surplus, for dairying purposes, even up to ten years of age. The ages of the animals culled for age range between ten and thirteen years, with an average of eleven years. The final disposals of aged animals have been :

For slaughter (beef etc.)	4
Destroyed	3

Their distribution according to production is as follows :

Production Level	No. of Animals.
350-450 lbs. fat	3
451-550 lbs. fat	2
551-650 lbs. fat	2

The breeding contribution made by these animals may be seen from progeny details :-

Heifers entered the Milking Herd		15
Bulls used as herd sires		2
Bull calves sold for dairying purposes		13
Total live births	Male	27
	Female	20

Under herd conditions where a disposal group, "surplus" has played such an important part, animals retained until finally classed as "aged", have only been outstanding individuals.

Accident and Injury.

Numerically these losses are of minor consideration, the details being as follows :

Injury at service	(destroyed)	1
Injury at calving	(")	1
Accident broken leg	(")	1

Surplus.

Surplus numbers are governed by the extent of herd wastage and the supply of young stock on hand. Herd maintenance requirements, due to herd wastage, have first call on the supply of young stock. Surplus numbers, therefore, may be said to indicate the extent of selection exercised for factors other than those classified under true herd wastage. In support of this, it may be added, that without exception, all surplus stock were sold for dairying purposes. Surplus stock as a group represent a very important section of the total stock leaving the herd. They may be described as a buffer group, acting between true herd wastage and the available young replacement stock. In Table 19 is presented a secondary classification of surplus disposals.

TABLE 19.

Analysis of Surplus Disposals.

Reason for Disposal (Secondary)	No. of Stock.
Replaced by Young Stock	9
Low Production	7
Aged	6
Abortion (Positive agglutination test)	5
Late calving	2
Type	1

Certain qualifications are necessary in discussing Table 19, especially in the case of those animals classified for low production since production standards vary from herd

to herd. Whereas certain animals in the College herd may be classed as relatively low producers, their records might quite easily place them amongst the medium to high producers in another herd. In the case of both "low production" and "age" disposals, the animals concerned were still economical producers, unlike the low production and age disposals in the true wastage groups. In Table 20 is presented a classification of surplus animals according to their levels of production.

TABLE 20.

Classification of Surplus Stock According to Production.

Highest Record in lbs. Butterfat	300	300-399	400-499	500
No. of Stock	13	12	3	2

The seven animals listed under low production are all in the class "less than 300 lbs. butterfat", and includes three animals of foundation blood, two of Ensign's and two of Invader's progeny.

A high proportion of the surplus group has been disposed of before reaching maturity, as seen from Table 21.

TABLE 21.

Age Classification of Surplus Stock.

Age in lactations	1	2	3	4	5	6	7
No. of Stock	4	7	8	3	3	3	2

Average age in Lactations -- 3.4

All those surplus animals classified in Table 19 under low production, abortion, late claving and type, fall within

the first three age groups in Table 21, while those under the "aged" class are included in the last three age groups, Those "replaced by young stock" fall within all but the first age group.

Animals sold to make room for fresh calving young stock, represent 30 per cent of all surplus disposals, or 9.8 per cent of the total herd losses and disposals. From production records these animals are satisfactory, all but one having exceeded the 300 lbs. butterfat figure. The ages of this group at disposal vary from four years to nine years and three were seven years or over. Five were sold as autumn calvers, and as the herd requirements for such animals are limited, this may have been an influencing factor in disposal. Undoubtedly a number of minor factors or particular sets of circumstances have determined the selection of this group of animals for sale e.g. hard milkers, temperament, type, etc. The class abortion covers those animals which were positive reactors to the agglutination test for Brucellus abortis infection. The number, though relatively high does not indicate the incidence of reactors in the herd, since some have been culled for such reasons as age and low production, while others still remain on the property, run in a separate herd, under the segregation method of disease control. The testing of all animals has only been in operation since the 1936-37 season, so that abortion surplus disposals are distinguished only for the 1938-39 and 1939-40 seasons. Of total herd losses and disposals over these two seasons, they represent a proportion of 5 in 25 or 20 per cent, a high figure in the initial years of testing, but one which might be expected to fall off rapidly as the period of testing is extended.

The effect of high surplus numbers is reflected in the age

composition of the milking herd, through a higher figure for first calving heifers, and a lower figure for age wastage. Omitting the calving figures for the first three seasons of herd establishment, the average number of first calving heifers entering the milking herd each season has been ten. Replacements following surplus disposals average three per season or 33 per cent of these young stock. The ages of all surplus stock at time of disposal vary between three and ten years, the average being six years.

Age Incidence of Wastage. Details of the age incidence of wastage are given in Table 22. Animals were classified according to their age at commencement of their last season or lactation and these age group wastage figures were related to the numbers for total herd population for the respective age-groups over the thirteen years period under review.

Culling losses exhibit comparative stability at a relatively high figure for the earlier age groups, reaching a peak amongst animals of six years of age, and then falling off markedly in the older groups. The percentage loss in each age group, however, as is to be expected, shows a steady rise with increase in ages.

The Life of the Cow. From the culling and disposal records it is possible to calculate the average life of a cow in this herd. Though ninety-two animals have passed out of the milking herd five of these had had one or more lactations prior to purchase, so that for the purposes of the calculation they have been omitted.

The following averages were determined:-

Age of disposal	5 years 362 days
Age at first calving	2 years 54 days
Period in the Milking herd	3 years 308 days

TABLE 22.

AGE INCIDENCE OF WASTAGE.

Age.	Total Herd Nos.	Wastage		
		Nos.	% for Age Group	% Total Wastage
2 years	102	11	11	12
3 "	106	11	11	12
4 "	86	12	14	13
5 "	69	13	19	14
6 "	51	16	31	18
7 "	31	8	26	9
8 "	21	5	24	5
9 "	18	7	39	8
10 "	11	5	46	5
Over 10 "	6	4	67	4

A figure for average age at first calving of eighty five College bred heifers which have entered the herd to date and have had a normal first calving, is 2 years 9 days.

Wastage in Relation to Foundation Stock Family Lines.

The operation of wastage factors coupled with adverse sex ratios, dead births and cullings at birth, has resulted in the elimination from the herd of twenty one of the original forty foundation-stock family lines. The importance of sex ratios or numbers of female offspring must not be overlooked in the consideration of wastage influences and the loss of blood lines from the herd. Failure on the part of eight dams to produce any female calves, and on the part of another six dams to produce heifer calves suitable for selection for entry into the herd, resulted in the immediate loss of fourteen blood lines. However, of this total of fourteen dams, not one was culled for age.

The following summary indicates the reasons for wastage in the loss of the twenty one families no longer represented in the herd. In each case the reason for disposal of the original dam is given, followed by the reasons of disposal for any successive family members which entered the herd.

No. of Family Lines.	Cause of Wastage.
3	Surplus
4	Sterility
3	Mastitis
2	Bloat
2	Low Production
1	Age (No female progeny. Bull calf served as herd sire).
2	Surplus - Low Production
1	" - Accident
1	Bloat - Low Production
1	" - Sterility
1	Low Production - Sterility.

Notable in this connection is the influence of the herd sire Hobson Ensign Zozo Acme. From five foundation dams, the only female offspring produced, were sired by this bull. Three such heifers though reared, were later disposed of as young stock when the poor quality of the Ensign blood was discovered. Another two family lines, represented in the second generation by Ensign offspring only, were lost when these animals were culled directly for low production.

Though there still remain in the herd, blood descendents from nineteen of the original foundation dams, some of these families are more important than others. No specific selection has operated for particular family lines, except that those blood lines which have tended to breed the better producers with greater consistency, have received greater consideration in the selection of calves at birth. Nevertheless, with the milking herd, cullings have always been based on individual merit alone, no animal being allowed to shelter under the good name of some outstanding close relatives.

In the following summary, wastage details for each of the nineteen families still represented in the herd, are presented. Included also are the figures for present milking and young stock herd members.

In Figures 1 and 2, the disposal details for the first four families as listed in the above summary, are presented diagramatically, in the nature of "family trees." More complete breeding records, however, are shown in these figures. Present members of the herd are indicated by a unidentified progeny by a "?" sign, "+" sign, male progeny by a "o" sign/and past members by their reason for disposal.

Figure 1 is the story of the present leading herd-family. The original foundation dam might be considered the best

Summary of Wastage details for Foundation Stock Families still in the Herd.

Foundation Dams	Reasons for Wastage								Present Herd Members	
		Disease								
	Surplus	Sterility and Abortion	Mastitis	Bloat	Miscellaneous	Low Production	Aged	Accident and Injury	Milking Herd	Young Stock
Dom. Queen Beets	2	-	1	1	-	1	-	1	8	5
" Gertrudes	2	-	1	1	1	-	-	-	4	5
" Woodcrest Domino Colantha)										
" Domino Colantha)	1	1	3	-	-	-	1	-	7	3
" Thelma)										
" Krugersdorp)	3	-	-	1	2	1	2	-	2	1
" de Kol Cornella)										
" Cornella de Kol)	2	-	-	-	-	-	-	-	1	-
" Daisy	2	1	-	-	-	-	-	-	2	3
" Blanche	2	1	1	-	1	-	-	1	3	4
" Margaret	-	2	-	-	-	-	1	-	1	2
" Betty Fayne	-	1	1	-	1	1	1	-	-	1
" Lady Carnation	1	-	2	-	-	-	-	-	1	1
" Colantha Princess	1	-	-	-	1	-	1	-	2	2
" Carnation Fobes Beets	-	-	-	-	1	-	1	-	1	-
" Ormsby Domino	-	-	-	-	1	-	-	-	1	-
Ryvington Carnation Pride	2	-	-	-	-	-	-	-	2	1
Queen Mercena of Otaki	3	1	1	-	-	1	-	-	2	2
Ashlea Abberkerk Colantha	2	-	-	-	-	-	-	-	1	1

producing animal amongst the establishment stock, and perhaps fortunately in the history of this family, several of the earlier matings were made to Totara Netherland Renown, thus bringing together two high producing strains. The particular branch of this family which flourished for a few generations and then disappeared, sprang from a Fendalton Nazli Posch heifer.

A rather contrasted set of conditions operated in the case of the family represented in Figure 2, in which Hobson Ensign Zozo Acme figured prominently as a sire of several of the family members.

FIGURE 1.

DIAGRAMMATIC ANALYSIS OF DISPOSAL DETAILS FOR DOMINION QUEEN BEETS FAMILY.

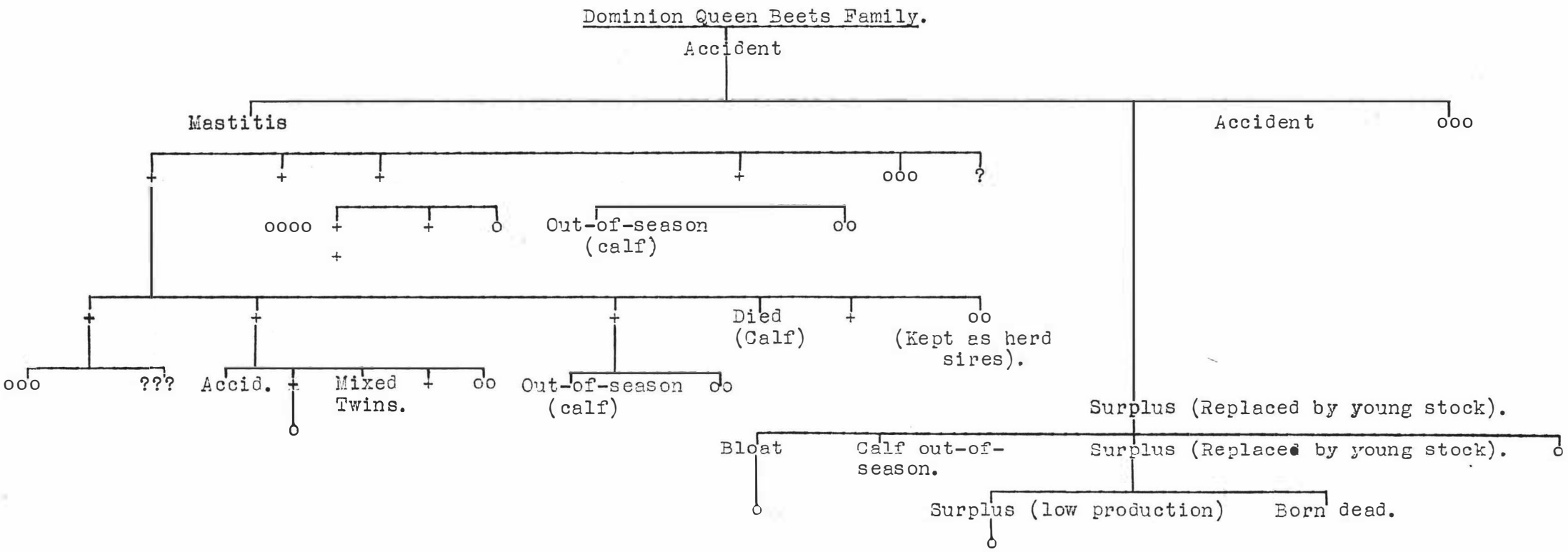
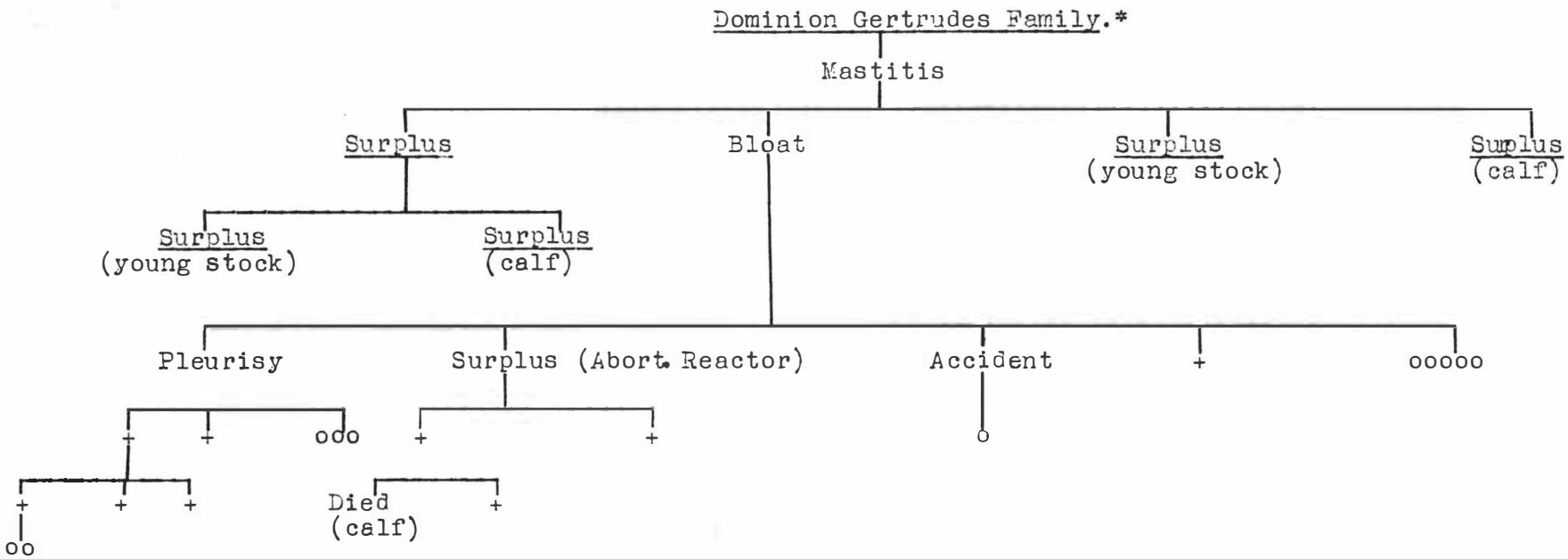


FIGURE 2.

DIAGRAMMATIC ANALYSIS OF DISPOSAL DETAILS FOR DOMINION GERTRUDES FAMILY.



* Those cullings underlined represent Ensign progeny.

S E C T I O N VI.

PRODUCTION RECORDS.

In the analysis of stock production records an attempt was made to reduce all records to a comparable age basis, namely, a mature or maturity equivalent production figure, using the regression formula suggested by Ward and Campbell (8). Their correction factor, however, was not directly applicable for a variety of reasons, nor was it possible to compute a factor based upon their suggested formula. In the first place there was a very limited number of animals with the required succession of lactations free from the effects of disease or some other modifying factor. Secondly, there have been substantial advances in the standard of herd management in the period under review, while climatic affects are so intense that in some seasons two-year-old records bear little relation to subsequent mature productions. Also, there are considerable individual differences in maturity development relative to production as a heifer, which is of considerable importance when dealing with small numbers. Finally, Ward and Campbell's work was based on early maturing Jerseys, whereas this study reveals evidence that some correction must be made, for Friesians, between four-year production and maturity. In consequence, no comparisons between the productions of the original stock and those of the animals constituting the herd during the past season 1939-40, on a corrected basis, were possible. It was necessary, therefore, to arrive at some other means of summarizing production figures in an attempt to trace the trends of production.

All lactation periods in excess of 320 days were reduced to the first 320 days' production (Ward and Campbell). No allowances were made in cases of lactations less than 320 days

the actual record being taken. Annual herd compositions were drawn up to include all animals calving between April 1st. of one year and March 31st. of the following year. These dates are purely arbitrary, but in view of the herd practice of autumn calving a number of animals each year, some adjustment of seasonal dates appeared necessary. It was considered that any animal calving after March 31st. and completing a normal lactation, gave the greater part of her production in the autumn, spring and early summer, following calving and must, therefore, be included along with the spring calvers of the subsequent season. The individuals in the respective herds for the seasons 1927-28 to 1939-40 inclusive, were classified for age, the distinctive age groups being 2 year-olds, 3 year-olds and mature. All abnormal records were eliminated, i.e. those showing the influence of such factors as disease, premature calvings, deaths, disposals or experiment. Finally, production averages were determined for the individual age groups in each season. These production figures are given in Table 23; the butterfat production figures are also shown graphically in Figure 3. Details for the first two seasons 1927-28 and 1928-29, have been omitted, from Figure 3 as not being truly representative of their classes, or comparable with the subsequent seasons, primarily on account of low stock numbers, secondly as herd recording did not start till January 1928, productions previous to this having been computed according to the level of the first testing period, and finally because a large proportion of these foundation stock calved for the first time as three-year-olds, a practice which has not been followed in subsequent years.

On first examination of Figure 3 a general upward trend in all curves is evident. The apparent increase in production in the respective age groups over the ten season period 1929-30 to 1939-40 has been --

TABLE 23.

SEASONAL PRODUCTION AVERAGES ACCORDING TO AGE GROUPS.

TWO-YEAR-OLD PRODUCTIONS.

320 Days or Less.

	Normal				Abnormal			
Season	No.	Milk.	%	Fat	No.	Milk	%	Fat
1927-28	6	9831	3.5	341	-	-	-	-
28-29	9	6820	3.4	235	-	-	-	-
29-30	4	6699	3.3	220	-	-	-	-
30-31	12	6929	3.2	221	2	4384	3.3	146
31-32	5	7665	3.4	259	1	984	3.1	31
32-33	2	7347	4.0	292	1	8555	3.3	287
33-34	5	9228	3.6	335	1	7065	4.0	289
34-35	6	6437	3.6	233	1	2728	3.6	100
35-36	6	7275	3.7	271	-	-	-	-
36-37	11	8251	3.7	304	2	-	-	-
37-38	7	8350	3.7	311	3	2865	3.6	103
38-39	6	8800	3.8	332	3	5415	3.5	192
39-40	5	7170	3.9	281	5	5720	4.3	231

THREE-YEAR-OLD PRODUCTIONS.

320 Days or Less.

	Normal				Abnormal			
Season	No.	Milk	%	Fat	No.	Milk	%	Fat
1927-28	2	11690	4.1	478	-	-	-	-
28-29	13	8603	3.5	298	1	2233	3.7	84
29-30	5	7853	3.4	267	3	6447	3.6	232
30-31	2	8489	3.2	269	1	7454	3.0	224
31-32	10	8074	3.4	275	5	5049	3.3	169
32-33	5	8359	3.4	283	-	-	-	-
33-34	2	10763	4.1	439	-	-	-	-
34-35	4	9050	3.6	325	1	6592	3.5	233
35-36	6	8586	3.7	315	1	6618	3.4	228
36-37	5	9886	3.8	373	1	4775	3.7	179
37-38	9	9572	3.8	361	-	-	-	-
38-39	10	10448	3.7	382	1	8080	3.6	268
39-40	10	10215	3.6	371	-	-	-	-

TABLE 23 (Continued)

FOUR-YEAR-OLD PRODUCTIONS.

320 Days or Less.

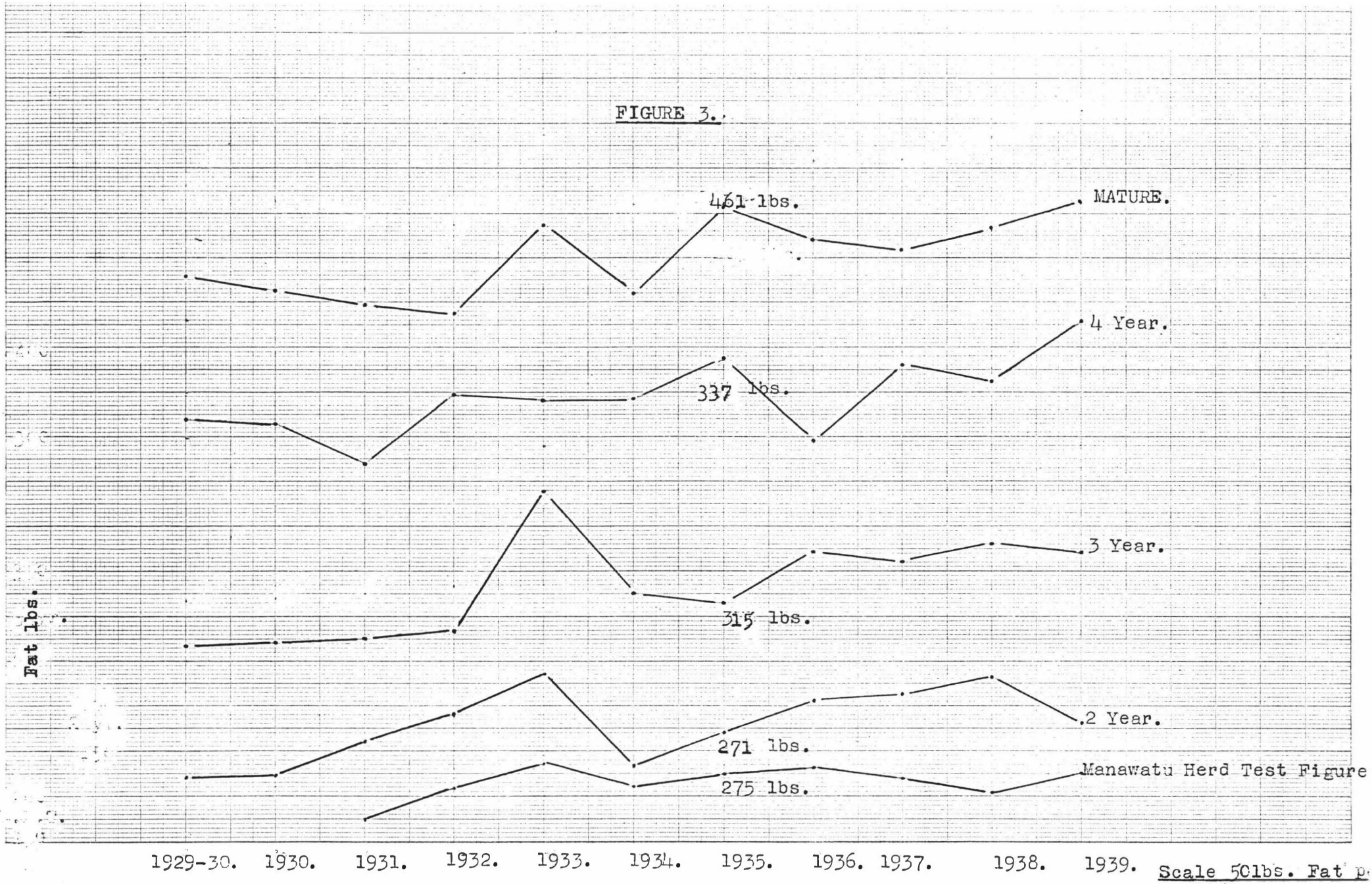
	Normal				Abnormal			
Season	No.	Milk	%	Fat	No.	Milk	%	Fat
1927-28	1	12206	3.5	420	-	-	-	-
28-29	1	10408	3.8	405	1	8837	3.3	295
29-30	13	9439	3.4	319	2	6796	3.3	227
30-31	6	9660	3.3	316	1	4983	3.3	163
31-32	3	7745	3.5	270	-	-	-	-
32-33	8	9951	3.5	347	2	4973	3.2	158
33-34	5	10008	3.4	341	1	6770	3.6	247
34-35	1	8719	3.9	343	1	8193	3.9	326
35-36	2	10510	3.2	337	1	7710	3.2	247
36-37	7	8259	3.6	295	-	-	-	-
37-38	5	10177	3.7	381	-	-	-	-
38-39	8	9745	3.7	362	3	4180	3.8	158
39-40	5	11832	3.6	428	-	-	-	-

MATURE PRODUCTIONS

320 Days or Less

	Normal				Abnormal			
Season	No.	Milk	%	Fat	No.	Milk	%	Fat
1927-28	2	8784	3.5	311	-	-	-	-
28-29	-	-	-	-	1	4760	3.8	180
29-30	3	11880	3.2	383	-	-	-	-
30-31	8	11271	3.2	365	4	5376	4.4	234
31-32	16	10086	3.2	348	7	5408	3.4	184
32-33	13	9500	3.5	337	4	5002	3.3	175
33-34	18	12482	3.5	438	2	5551	3.7	205
34-35	20	10541	3.4	363	4	7576	3.7	282
35-36	10	13086	3.5	461	5	6648	3.9	256
36-37	8	11310	3.7	419	3	7163	3.2	232
37-38	14	11173	3.7	412	3	5678	3.8	218
38-39	10	12207	3.5	433	4	3315	3.9	128
39-40	13	12408	3.7	464	3	4871	3.1	152

FIGURE 3.


461 lbs.
MATURE.
4 Year.
337 lbs.
3 Year.
315 lbs.
2 Year.
271 lbs.
275 lbs.
Manawatu Herd Test Figure
Fat lbs.
1929-30.
1930.
1931.
1932.
1933.
1934.
1935.
1936.
1937.
1938.
1939.
Scale 50lbs. Fat p

2 year-olds 220 lbs to 281 lbs butterfat - an increase of 61 lbs.
3 year-olds 267 lbs to 371 lbs butterfat - an increase of 104 lbs.
4 year-olds 319 lbs to 429 lbs butterfat - an increase of 110 lbs.
Mature 383 lbs to 464 lbs butterfat - an increase of 81 lbs.

Before one is justified in drawing conclusions from these figures alone, consideration must be given to the more important factors influencing production returns, namely environment, management, breeding and selection. Herd management has varied little over the period, apart from the overstocking which occurred in the two seasons 1930-31 and 1931-32. Farm management has, however, played a major part in influencing production figures. Advances in feeding methods and improved conservation of food-stuffs for periods of deficient pasture growth, and improved pastures have without doubt increased production returns. Herd sires have been carefully selected with a view to improving the level of production and likewise within the limits of true herd wastage, selection of females has always been on the basis of an expected improvement in production. Ultimately production returns are the final summary of the combined effects of the above mentioned factors, but the inter-relationship of one with the other renders any assessment of their relative importance in contributing to the apparent increase, almost impossible.

Apart from the main general trend in all curves, there are other seasonal fluctuations which are fairly characteristic of all curves. In no instance does one particular group of animals as represented by their production level in the graph, exhibit a marked superiority over the same age group of the previous season, without a somewhat similar condition existing within one or more of the other age classes. Here again, such influencing factors as those previously mentioned may play a part, but more likely, however, these seasonal variations are

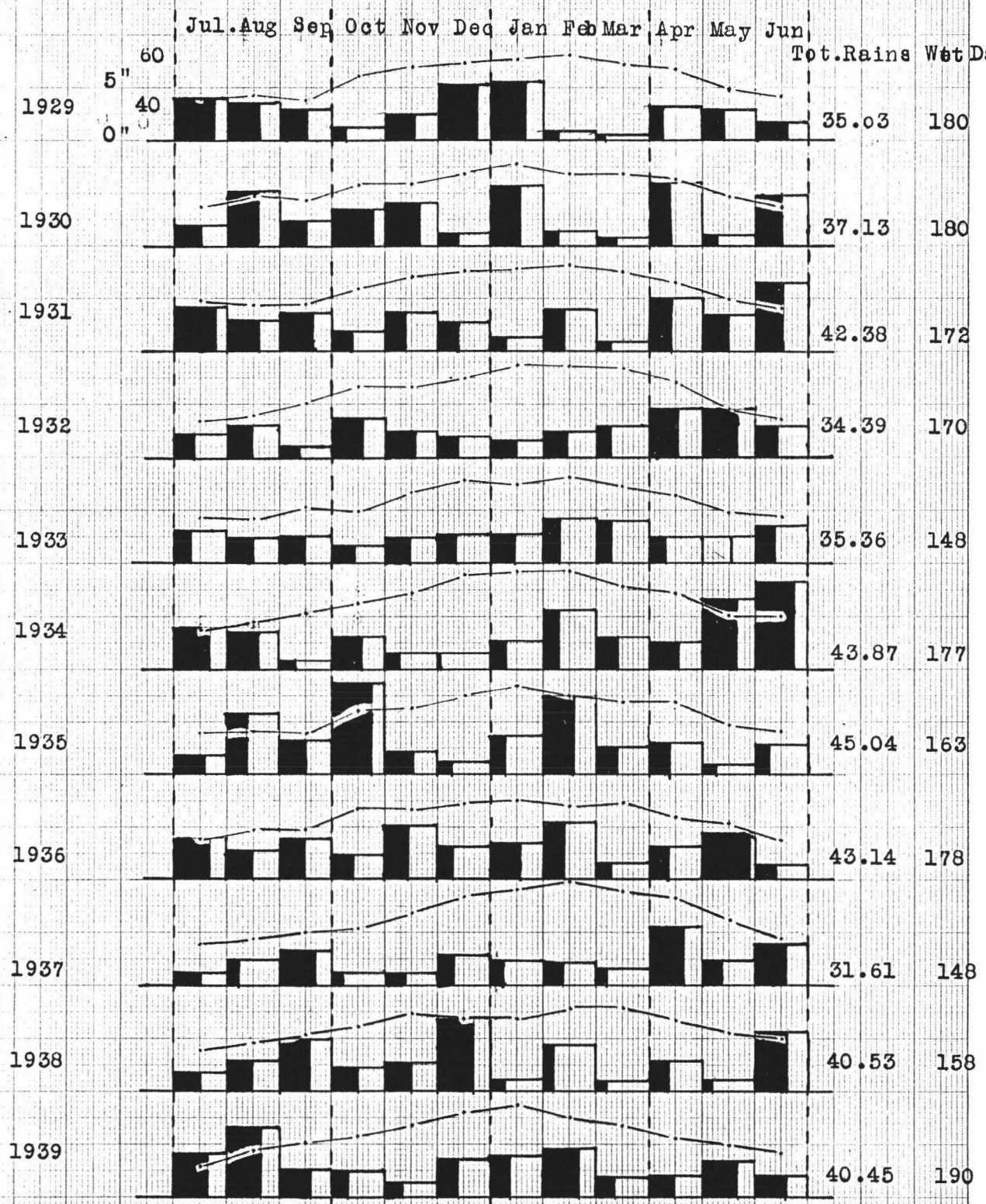
the result of the prevailing climatic conditions. Records from the College's meterological station are opportunely available for a study of the relationship of seasonal production returns to climatic conditions. A graphical account of these meterological observations for the seasons under review, are presented in Figure 4. For convenience of presentation, monthly figures, only, are detailed, and summarized according to seasons. Total rainfall over the month is represented in block-graph form, the number of days in the month on which rain was recorded is represented as a horizontal proportion of the month, and is indicated by the shaded sections of the block-graphs, while mean temperatures, (being ½ daily mean maximum plus ½ daily mean minimum) are represented by means of the superimposed curves. The rainfall distribution within the months, as indicated above, must be considered only supplementary and of limited value in interpreting rainfall figures.

Those seasons characterized by a low total rainfall need not necessarily be the poorest for dairy production, unless this low rainfall has been accompanied by poor distribution, high temperatures and drying winds. The seasons, 1929-30, 1930-31, 1937-38, 1938-39 were all characterized by low summer rainfalls causing drought conditions . In January, February and March 1938, temperatures were very high, coinciding with the period of the last severe facial eczema outbreak. The 1934-35 season was one of high total rainfall, but distribution was very uneven, the spring and summer were very dry with temperatures at a high level, almost peak temperatures being attained as early as December. Dairy production suffered a severe set-back in this very unfavourable season. The 1933-34 season was a very good one for dairying in this district, and other districts also recorded some peak productions

Figure 4.

Meterological Records.

Rainfall(inches) and Mean Temperatures (Degrees Centigrade).



in this year, which affords and excellent example of the importance of distribution of a relatively low rainfall, totalling only 35.36 inches. The remaining seasons, 1932-33, 1935-36, 1936-37, 1939-40, from meterological observations were relatively good seasons, and further, dairy production returns substantiate these conclusions.

In an attempt to relate more closely seasonal climatic conditions with output of dairy produce, figures have been extracted from the Manawatu Herd-Testing Association returns and represent the seasonal returns for all cows tested in the Manawatu District. These returns are shown in Table 24 and include the total number of cows tested, butterfat average yield and days-in-milk average per cow.

TABLE 24.

Herd Testing Association Returns for the Manawatu District.

Season.	No. Cows.	Fat lbs.	Days.
1931-32	12738	226	252
1932-33	13959	258	257
1933-34	16515	282	259
1934-35	18197	258	258
1935-36	17882	275	259
1936-37	16081	282	255
1937-38	14803	270	250
1938-39	15522	253	244
1939-40	16790	277	258

The Manawatu Herd-Testing District extends from Palmerston North, Paraparaumu to Wanganui and climatic conditions prevailing throughout that district are very similar to those at the College farm. Figures for the Palmerston North - Tiakitahuna Herd-testing Group, of which the College herd is a member, were also available, but

total cow numbers were not considered sufficient to overcome the individual herd influences upon the production returns. The College dairy herd, averaging about a hundred cows, actually accounted for from 15-30 per cent, varying with seasons, of the total animals tested in that group. Returns over such a large number of animals as listed in Table are more subject to seasonal variations of climate than any other single factor, though over a number of years it is to be expected that continued testing and resulting selection with improved conditions of management, may have raised the general level of production appreciably. Figures prior to 1931-32 season, on a comparable basis, were not available. The butterfat production averages as shown in Table 24 are also presented in graphical form, included in Figure 3.

Referring to Figure 3, it is apparent that most of the seasonal variations are influenced directly by climatic conditions. The exact degree of influence, however, cannot be measured. The two-year-olds, as a class, are probably influenced by climate more than are any of the other classes, as evidenced by the similarity in the production curve for this class and that of the Manawatu herd-testing averages.

A more detailed study of each age group is necessary in order to distinguish breeding and selection influences. A further difficulty arises, however, in respect to numbers of blood lines represented within the groups. The mature class, throughout the whole period, consists of animals which were the progeny of several bulls, but by 1935-36 the proportion of original foundation animals was very small. In the next two seasons only one of these animals remained. The tendency for the mature group to maintain a higher level of production over the last five seasons does perhaps indicate the superiority of selected College bred mature animals over the original purchased stock. Disposal figures indicate that the extent of

cullings amongst stock, prior to their entering the mature class, has been no greater over this latter period than during the earlier years following establishment and expansion. The age composition of this mature class, with regard to the proportion of five-to seven-year-old animals, to the eight years-and-over group, also remains relatively constant, indicating that age has not been a vital factor in influencing the production average for the class.

Within the other age classes, several pronounced variations due to factors other than climate are evident. In the four-year-curve, the figures for the seasons 1934-35 and 1935-36 cannot be t aken as representative as they involve only one a nd two animals respectively. The apparent large fall in four year old production in the following season, 1936-37, therefore, must be treated with reserve, though, if this particular group of animals is followed through from two-year-olds in 1934-35 and compared with th e 1935-36 group of two-year olds, over the three age groups, they would appear a definitely inferior lot.

In the three-year-old class, the peak point in 1933-34 covers only two animals, one of which was the particularly high producing cow Massey Renown Heterodyne with a production figure of 531 lbs. of butterfat for that season. In the two-year-old class, in most seasons, progeny of two bulls at least, have gone to make up the respective groups, and the effect of individual sires is difficult to determine. In accounting for the marked fall in the production level in 1939-40, for this age group, blood lines would not appear to be the influencing factor, as these animals are by the same sires as the previous season's two-year-olds. This group of heifers, as calves, was seriously affected by facial eczema in the summer of 1938. It would appear, therefore, after taking into consideration the breeding of these heifers and

the suitability of the past season for high production, that the set-back they experienced early in life, was responsible for their apparent lack of ability.

In order to follow the various groups of two-year-old heifers through the milking herd, their successive productions to maturity have been presented in Figure 5. Within certain groups the numbers of individuals were two small to be comparable with the remaining groups, and so have been omitted. In several instances, first-calving three-year-old heifers were omitted in order to keep the particular group composition as uniform as possible. Reduction in numbers within groups has occurred from year to year as the result of normal herd wastage and disposals, but no group at any stage, includes less than five individuals. Blood lines represented within groups have not been considered, as any classification in this respect would reduce numbers in most seasons below a comparable basis. Apart from the still apparent upward trend towards higher production in all groups throughout the whole period, there is a characteristic steep rise between two-year-old and three-year-old productions in particular groups. The culling within groups, of the lower producing two-year-olds, no doubt is responsible for this condition, as subsequent to the two seasons where no culling was effected, namely 1931-32 and 1934-35, this pronounced increase is not evident in spite of the fact that these seasons were climatically unfavourable. The gradients in production between the three-year-old -- four-year-old, and four-year-old -- mature classes respectively within the groups, show greater variations, the influencing factors apparently being climatic conditions, degree of culling effected and the blood lines represented within the groups, from season to season. Restricted numbers of both animals and groups prohibits any closer analysis along these

FIGURE 5.

PRODUCTION RECORDS FOR EACH SEASON'S TWO-YEAR-OLD HEIFERS FOLLOWED TO MATURITY.

lines. The particular sires and their progeny numbers represented, in these groups are summarized as follows, the groups being listed according to the season of their two-year-old productions.

1930-31 - Weraroa sires (7), Fendalton Nazli Posch 2nd (3), Hobson Ensign Zozo Acme (3). All Ensign blood culled prior to the four-year-olds.

1931-32 - Fendalton Nazli Posch 2nd (5).

1934-35 - Fendalton Nazli Posch 2nd (4), M.S.O. Gambler (2).

1935-36 - M.S.O. Gambler (4), Mahoe Donald (2).

1936-37 - Totara Pontiac Invader (10), M.S.O. Gambler (1).

1937-38 - Totara Pontiac Invader (7), M.D. Lionheart (1).

1938-39 - Massey Invader Monarch (3), Tokaora Domino Asjes (2), T.P. Invader (1).

Herd Sires and Production Records of their progeny.

It is not possible to furnish production data for more than a few of the fourteen sires that have been used in the herd. Apart from the bulls at present in use, whose daughters have not yet come into production, very small progeny numbers prevent any critical examination of the performances of several other bulls. The mediocrity of Ensign, one of the original sires, has already been mentioned and no point is gained by a further discussion of his record. Fortunately, his disabilities were early recognized and his blood eliminated from the herd.

. Of the remaining bulls F.N. Posch 2nd., T.N. Renown, M.S.O. Gambler and T.P. Invader have sufficient numbers of mature stock to give some account of their contribution to the herd. M.I. Monarch and T.D. Asjes, used more recently, have no mature daughters and only a preliminary assessment of their ability can be made.

Average production figures, according to the age groups for progeny of a number of the sires are given in Table 25 and Figures 6 and 7. The average records of the foundation cows are also given for purposes of comparison. All records presented are standarized to a maximum of lactation of 320 days.

Fendalton Nazli Posch 2nd.

This bull's record suffers to a considerable extent through his being used in the herd in the early years of farm development when it is probable that the young stock were not grown as well as those in subsequent years. Posch's two-year-old heifers are the lowest producers listed in Table 5 but there is a very satisfactory increase from then until maturity, despite the fact that there was little selection of his progeny. This rather supports the view that his two-year-old heifers were rather better than their records show.

Posch sired a number of first class producers, the most notable being:-

M.P. Gainfull 11,012 gals. milk - 3,511 lbs. fat - life-time production.
M.P. Beets 9,810 gals. milk - 3,421 lbs. fat - life-time production.
M.P. Daisy 7,693 gals. milk - 2,530 lbs. fat - life-time production.

M.P. Beets and M.P. Kiltie are the only Posch cows, in the present herd.

Of the fourteen Posch heifers which entered the herd, twelve reached maturity. This was probably due in a large

TABLE 25.

AVERAGE PRODUCTION RECORDS ACCORDING TO AGE GROUPS FOR PROGENY OF SPECIFIED HERD SIRES.

Age Group.	Foundation Stock.				F.N. Posch Heifers.				T.P. Renown Heifers.			
	No.	Milk lbs.	%.	Fat lbs.	No.	Milk lbs.	%.	Fat lbs.	No.	Milk lbs.	%.	Fat lbs.
2 years.	22.	7,751.	3.4.	263.	11.	7,370.	3.3.	245.	3.	9,933.	3.7.	372.
3 "	12.	8,203.	3.4.	281.	10.	8,685.	3.4.	294.	4.	10,880.	3.9.	422.
4 "	18.	9,376.	3.4.	322.	11.	9,409.	3.4.	320.	1.	(8,719.	3.9.	343)*
Mature.	27.	10,422.	3.5.	363.	10.	11,003.	3.5.	381.	4.	12,173.	4.0.	486.

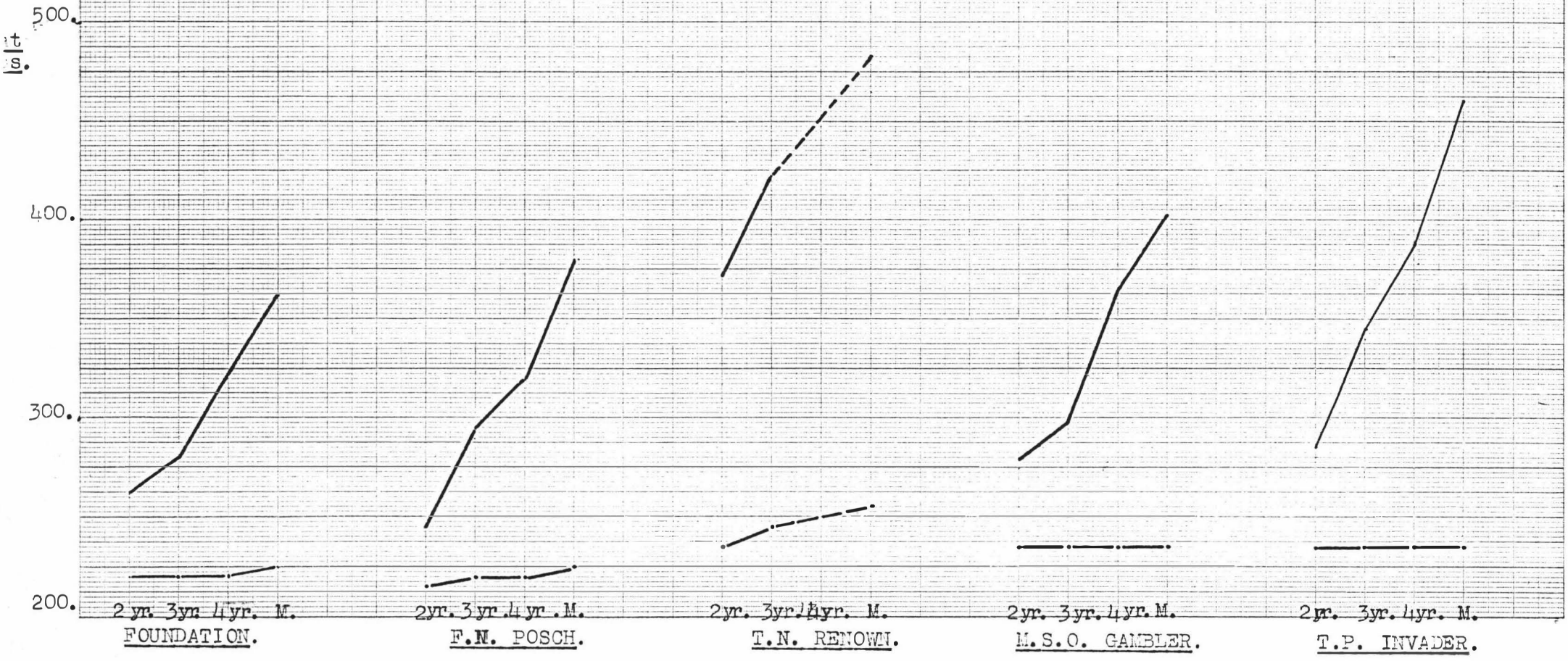
Age Group.	M.S.C. Gambler Heifers.				T.P. Invader Heifers.			
	No.	Milk lbs.	%.	Fat lbs.	No.	Milk lbs.	%.	Fat lbs.
2 years.	10.	7,563.	3.7.	279.	18.	8,287.	3.7.	310.
3 years.	8.	8,050.	3.7.	297.	14.	9,799.	3.7.	369.
4 "	9.	9,726.	3.7.	364.	13.	10,558.	3.7.	387.
Mature.	7.	11,014.	3.7.	402.	5.	(12,322.	3.7.	461.)=

* Production record not included in Figures and

= Eleven progeny in present herd which have not yet attained maturity.

FIGURE 6.

AVERAGE TEST PER CENT. AND BUTTERFAT LBS. PRODUCTION ACCORDING TO AGE GROUPS FOR PROGENY OF HERD SIRES.



measure to the fact that his stock came into production when herd expansion was taking place; also his stock were contemporary with the indifferent Ensign heifers.

On the whole, his progeny were very deep milkers but their tests were low. Posch was bred only to foundation cows and he did no more than maintain their average low test.

Totara Netherland Renown.

Renown's reputation was very largely made by the outstanding M. Renown Heterodyne whose production up till the conclusion of her tenth year totalled 4040 lbs. of butterfat. She is still in the herd and this season is producing as heavily as in any of her best seasons. Five other Renown daughters entered the herd but unfortunately four of them died as comparatively young cows. Perhaps the best of these was M.E. Honeysuckle who, in her best season, produced 617 lbs. of butterfat in 356 days as a five-year-old. Massey Invader Monarch whose record will be given later is a son of Honeysuckle.

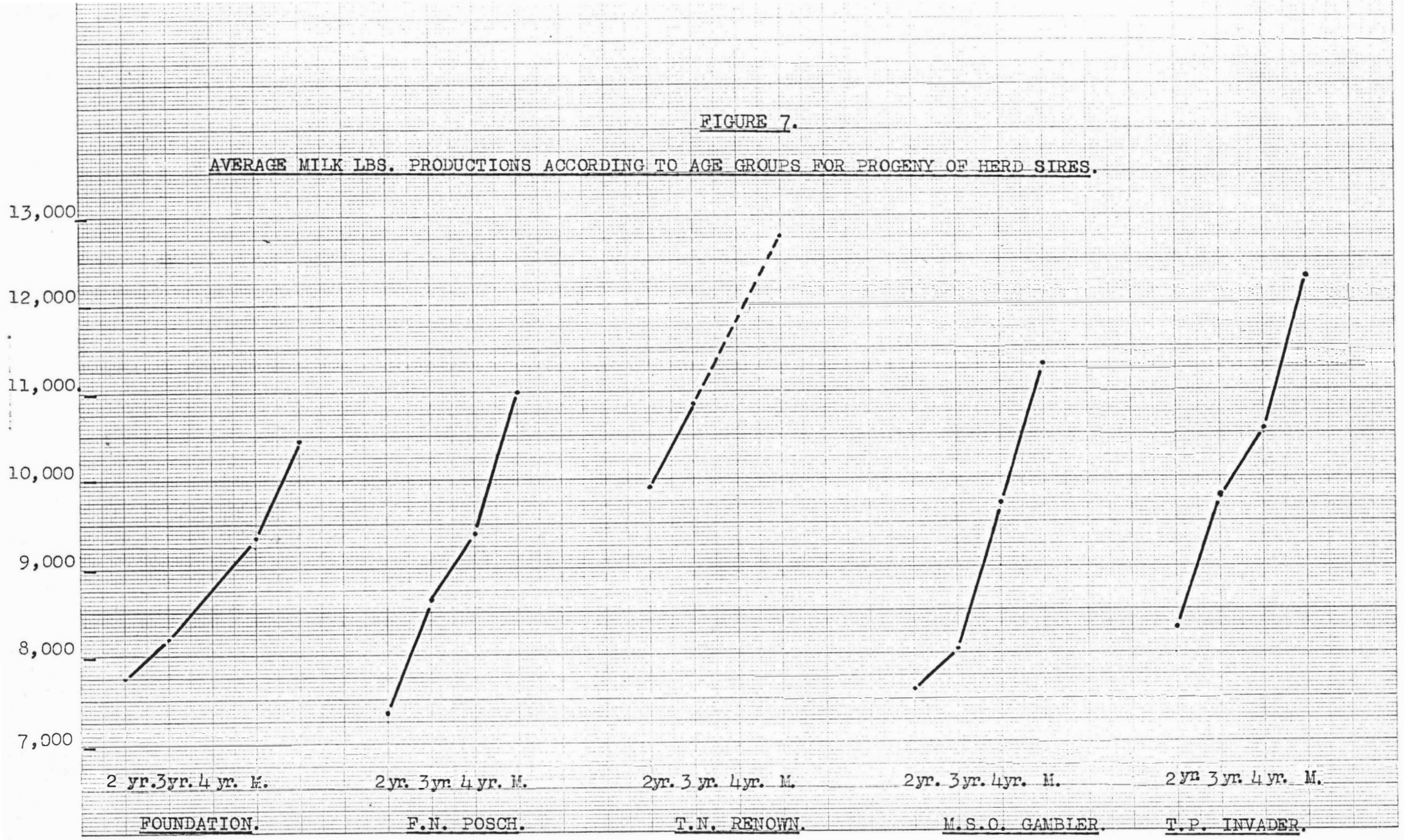
Only one of the six daughters was below the standard of production set for the herd and she averaged 296 lbs. of butterfat in her first four lactations so she could not be described as a bad cow. Renown's daughters were, with one exception, all very high testers, the unweighted average test for all his daughters being 3.9 per cent. of butterfat. Renown was brought back to the College as a thirteen-year-old animal at the beginning of the 1940-41 season but unfortunately he has proved sterile. However, through the maternal grandsons, Monarch, Quality, and Royalty, his blood is still available to the herd.

M.S.O. Gambler.

Gambler was used quite extensively and of his twelve

FIGURE 7.

AVERAGE MILK LBS. PRODUCTIONS ACCORDING TO AGE GROUPS FOR PROGENY OF HERD SIRES.



daughters which entered the milking herd, nine were retained until maturity. Though none of his daughters have completed outstanding life time productions the three remaining members of the present herd are quite reliable producers, their highest records being, M.S.O. Lottie 528 lbs. fat in 357 days at six years. M.S.O. Kilocycle 415 lbs. fat in 266 days at seven years, and M.S.O. Larkspur 469 lbs. fat in 384 days at five years. The first two animals are both out of M.R. Heterodyne, while the latter is from a Posch heifer. Another Gambler daughter, from M.P. Gainfull, and a promising cow, died during her fifth lactation, with a lifetime production of 1,921 lbs. fat. None of his daughters were culled for low production.

In respect to herd progress, he cannot be considered an outstanding sire. His progeny showed higher percentage tests than did their dams, and though he had little or no effect upon milk yields, the net result was a small increase in butterfat production.

T.P. Invader.

This bull was bred very largely to progeny of the three previous sires. His daughters represented in Table 25, include seven out of foundation dams, nine from Posch dams, three from Renown Dams and two from Gambler dams. Fifteen of his twenty eight daughters which have entered the herd remain; twelve were culled prior to their attaining maturity including four culled for low production. It will be remembered that this last season's crop of two-year-old Invader heifers had been seriously affected by the 1938 outbreak of facial eczema; four of the six were culled following their first lactation.

His progeny in the present herd are outstanding; though only three have mature records, seven have already produced over 400 lbs. fat within a normal season. The production records

of some of the more outstanding daughters are as follows:-

Name.	Butterfat (lbs.) Records according to ages.			
	2-year.	3-year.	4-year.	Mature.
M.I. Mistletoe.		428 lbs.	339 lbs.	429 lbs.
" Milly.	416 lbs.		447 lbs.	453 lbs.
" Maud.	309 lbs.	452 lbs.	437 lbs.	452 lbs.
" Nita.	306 lbs.	433 lbs.		
" Mandolin.	356 lbs.	456 lbs.	584 lbs.	
" Nancy.	337 lbs.	451 lbs.	467 lbs.	
" Nikau.	323 lbs.	415 lbs.	409 lbs.	
" Piccolo.	392 lbs.			

Invader has effected an all round improvement in production for both milk and butterfat, and considering total progeny numbers, his performance may be favourably compared with that of Renown. He was more consistent in producing higher butterfat tests than was Gambler. As mentioned previously he had nine daughters from Posch dams; the average percentage test of these dams was 3.3 - 3.5, whilst that of the daughters is 3.7 - 3.8. Three daughters have exceeded 3.9 per cent.

There is little doubt that Invader has featured as the leading sire in the history of the herd. As many of his daughters are still young members of the present herd it mey yet be several seasons before his full contribution can be estimated. Though the wastage amongst his stock is high, indicating perhaps a lack of heifers uniformity in his breeding, some allowance must be made for those affected by eczema. The eight grand-daughters that have entered the herd have proved themselves capable producers and four of these, as two-year-olds, produced 300 lbs. fat in the normal season. Two sons and a grandson of Invader have been used in the herd and have been mated to Invader cows. Of four heifers from such matings

three remain, the two-year-old performances of which have been quite satisfactory. Further records from such matings may furnish some evidence on the breeding variability of Invader, as suggested above.

Massey Invader Monarch.

Very little can be said of the quality of this bull. Of the nine Monarch heifers that entered the herd six now remain, and three of these have completed their first lactation only. From their records, these heifers appear very promising and it does appear as though profitable use could have been made of this sire. From the limited records available, he does not appear to possess the ability of his sires in consistently maintaining a high percentage test. The following butterfat (lbs.) records of his daughters are worthy of mention:-

Name.	Records according to age.		
	2-year.	3-year.	
M. Monarch Pixie.	356 lbs.	433 lbs.	
" " Princess.	321 "	379 "	
" " Polly.		508 "	(incomplete) (320 days.)
" " Patsy.	319 "		

T.D. Asjes.

Only a preliminary survey is possible in this case. The performances of his heifers are very promising as a list of all his daughters which have completed records show:-

Name.	Butterfat (lbs.) Records according to age.	
	2-year.	3-year.
M.A. Pagan.	308 lbs.	315 lbs.
" Pauline.	316 "	323 "
" Quaff.	335 "	
" Pearl.	275 "	381 "
" Quake.	268 "	
" Pansy.	258 "	422 "

The crop of his heifers which have entered the herd in the 1940-41 season are particularly promising. They are characterized by extremely good vessels and are deep bodied with a good bone. In fact, they show those very qualities which were considered when Asjes was selected for purchase. Perhaps there will be some loss in percentage butterfat test as compared with the Invader stock but the loss is not a serious one. The unweighted average test of the daughters listed above is 3.7 per cent. with a range from 3.4 to 4.0 per cent.

Outstanding Families.

In the section dealing with disposals, details are given on page 73 of the family representation within the herd. Where objective selection has been based on production and where natural selection has operated through ability to withstand the strain of continued heavy production, certain families have come to the fore front through their inherent virtues. In the 1939-40 season, eight descendents of Queen Beets averaged 13013 lbs. of milk testing 3.7 per cent., and 482 lbs. of butterfat in 310 days. The individual performances in that season were:

Name.	Age.	Milk lbs.	Test %.	Fat.	Days.
M.M. Pixie.	3 years.	12,150.	3.5.	433.	269.
M.M. Polly.	3 "	13,700.	3.6.	508.	320.
M.I. May.	4 "	8,806.	3.5.	312.	318.
M.I. Nancy.	4 "	13,830.	3.4.	467.	290.
M.S.O. Kilocycle.	Mature.	10,620.	3.9.	415.	266.
M.I. Milly.	Mature.	13,620.	3.3.	453.	312.
M.R. Heterodyne.	Mature.	18,420.	4.0.	740.	348.
M.S.O. Lottie.	Mature.	12,960.	4.0.	528.	357.

The corresponding average figures for the five members of the Domino Colantha family were 10876 lbs. of milk testing 3.8. per cent. and 418 lbs. of butterfat in 297 days. The individual records are as follows:-

Name.	Age.	Milk lbs.	Test %.	Fat.	Days.
M.I. Mandolin.	Mature.	14,330.	3.8.	544.	320.
M.D. Lilac.	Mature.	11,430.	3.8.	438.	295.
M.I. Nita.	4 years.	12,960.	3.8.	494.	293.
M.I. Peggy.	3 "	7,590.	4.0.	306.	287.
M.M. Quaver.	2 "	8,070.	3.7.	296.	290.

The Queen Beets family is noteworthy also, for the relative consistency of its members in breeding high producing progeny.

The above production performances are outstanding and the average figure of 456 lbs. of butterfat for the thirteen individuals is probably well above the average figure for the highest producing thirteen cows, irrespective of family lines, from most commercial herds.

SECTION VII.

DISCUSSION.

Over a period of thirteen years the College Friesian herd has developed to attain in the ultimate year of this study, 1939-40, the remarkably fine average of 10,822 lbs. of milk testing 3.7 per cent. and 402 lbs. of butterfat for the thirty--two cows and heifers which completed normal lactations of not more than 320 days. It is difficult to assess precisely the increase that has occurred in production since the herd was established because of the interaction of a wide number of factors derived from the very largely uncontrollable environment to which the herd has been subject over a number of years. Since 1930-31, which may be taken as the initial year of the herd, after the transitional years of establishment, the butterfat production has risen by at least 30 per cent. per cow. In regard to butterfat test, a feature very much less subject to environmental influences than either milk or butterfat production, as evidenced by the consistent percentage tests of herd members over a long productive life, there has also been a pronounced upward trend. The butterfat test of the foundation females averaged 3.4. per cent. while in the last year of the study the figure had risen to 3.7 per cent.

The Importance of Environment.

If this study had been conducted in one of the older dairying countries it is probable that more conclusive results would have been obtained. The characteristic seasonal variability of New Zealand's grassland dairy husbandry with its absence of housing and rationing of stock, and its dependence on the vagaries of climate, has been accentuated in this study by the fact that the College dairy farm has been in the process of development. Ten years ago the dairy herd was subject to

very different conditions of fodder provision and general management than it is today. In consequence it may not be fair, to attempt a comparison of the daughters of Pendalton Nazli Posch 11 who was used when the herd was first established, with one of the more recent herd sires. The tremendous influence that environment has on a cow's ability to express her inherent productive ability has been established by American workers and it is reasonable to expect that the contributions of environment is even more substantial under New Zealand conditions. The production data that has been examined in this study emphasises the tremendous importance of season on production, even to the extent that in any formula for assessing maturity equivalents under New Zealand conditions, some allowance must be made for a seasonal factor. The relatively low two-year-old records of the early Posch heifers compared with their quite favourable three-year-old records, was possibly due in part to lack of development of the young stock. The obvious lesson from the College herd performances is to feed the young stock well. It may even be interpreted to the point of indicating that selection under conditions similiar to those provided for production, is advantageous, since the entire present herd has been born and reared on the College farm. Other factors of environmental influence may have very drastic effects. As an example of such, the eczema outbreak and its apparent effect upon the later production records of heifers may be quoted. Of the twelve calves reared during the summer of 1938 when a serious outbreak of facial eczema was experienced, five were culled following their first lactation, three for low production and two for failure to conceive within the normal season. The farmer must always be aware of the possible influences of environment upon the apparent quality of his stock before he becomes too critical of their breeding.

Wastage:

The average annual replacement that has taken place in the

College herd is high. The figure of 21.4 per cent. is rather conservative owing to the basis of calculation. Difficulty arises in the estimation of an annual milking herd figure under conditions where autumn calving of a number of cows is practiced and where milk production is maintained throughout the whole year. A more correct conception of replacement data is obtained from the calculated life of an animal in the herd; the average life of the individual in the milking herd was four years, with an average age at disposal of six years. This corresponds to a figure of 25 per cent. replacement, which is somewhat higher than the average annual Dominion figure of 20 percent. as computed by Ward. The seasonal figures have ranged from 9.1 to 35.9 per cent., with a tendency in recent seasons towards a high level. In the handling of herd replacement data, a distinction was made between true wastage and surplus, with low production cullings included under wastage. Surplus cullings therefore represent the extent of true selection operating. Such culling factors as positive reaction to abortion test, hard milking, relatively low production, late calving, or bad type have thus functioned under true selection and have operated to the extent of 32.6 per cent. of the total herd replacements. Wastage, of which disease 44.5 per cent. (Mastitis 14.1 per cent - sterility 14.1 per cent) and low production 12.0 per cent. together make up the bigger proportion, accounted for the remaining 67.4 per cent. of total replacements.

Obviously, any measures which can be taken to diminish losses from the herd are of the utmost importance and the College has undertaken several steps in this direction. The segregation of abortion reactors with the ultimate object of establishing a completely clean herd has now been in operation for three years. Certainly the figures presented for culling on account of abortion are not particularly high, but they do not disclose the less obvious but more important losses the

herd sustains, namely the reduced production of cows in lactations subsequent to abortion, and the reduced numbers of live heifers calves at birth. In the control of mastitis every care is taken in the milking shed, both in the handling of cows and the handling of machines. The low-pipe-line and low vacuum machines are featuring prominently in this respect. Regular brom-thymol-blue testing as an indicator of mastitis infection, though by no means 100 per cent. accurate, is a guide in detecting trouble in its early stages. A simple, though quite sound precautionary measure in the control of the spread of infection by machines, is the systematic order of milking adopted for all cows, the infected animals being milked last. To combat the effects of male sterility, systematic bull testing is now carried out and any danger of mis-matings due to infertility of the herd sires is thus eliminated. Most of these measures are available to the average dairy farmer, and their adoption into routine stock management, would unquestionably be effective in reducing disease wastage.

Though true wastage figures for the College herd have remained relatively constant, the real effect of these measures has been expressed in the reduction of other stock and management problems, thereby contributing, quite appreciably, towards the attainment of the higher production returns. Another aspect worthy of consideration in the possible reduction of disease wastage is brought to light by Ward from records of New Zealand dairy herds, in respect to disease (mastitis) susceptibility or resistance within family lines. The College records do not supply sufficient material for detailed comment in this direction, though the Queen Beets family undoubtedly does exhibit the quality of longevity, despite a very high level of production. Over a period of time, such families must enivitably increase in numerical importance in a herd and the relatively high rate of culling in the College herd may be an attribute of its comparatively recent development.

Replacement Stock:

The supply of replacement stock is an important consideration

affecting true selection in the herd. Both numbers and quality of these young stock have shown marked annual variations, as the result of several influencing factors. In the College herd, where all replacements are by home-bred stock, any factor which seriously influences the supply of these animals may have serious repercussions upon the whole herd. Such factors as unbalanced sex ratios, dead births, and multiple births may seriously reduce the numbers of live heifer calves born. Associated factors such as the vitality of these live calves and their month of birth, also influence their suitability for rearing. Annual sex ratios varied from 0.60 to 2.68 males to one female, the average figure for live births being 1.07 males to one female. The serious effects of adverse sex ratios were very noticeable, when in two consecutive seasons the percentages of live heifers of total births were 22.9 and 29.3 per cent. respectively. Further, though in the previous season 51.2 percent of the total births were live born females, the majority of these were culled at birth on account of the lack of quality of their sire, proven from production performances of his earlier daughters. The net effect of these conditions was not only to reduce selective culling in the milking herd in subsequent seasons, but also indirectly in the presence of wastage toll, to reduce milking herd numbers.

That progress in selection for production through the dam may be very slow where such factors are operating to adversely affect live heifer numbers is also apparent from data available. Also in the persistency of family lines in a herd, sex ratios may be a vital factor. Furthermore, sire survey work by Ward, indicating a general regression or progression of progeny to a lactation average production of about 280 lbs. of butterfat, and in which he emphasises the relative importance of the herd sire, greatly discounts the wisdom of attempting to select extensively on the dam's side. Selection of progeny at birth may be very misleading, as yet we have no definite proof that a high producing dam will consistently give birth to high producing daughter, any more so, than will a good sire, without

an actual production test of these progeny. The apparent lack of homozygosity of our dairy stock as evidenced from their breeding results, is a major difficulty in any early selection of their progeny. This point leads the discussion to family lines and the possible advantages in maintaining and selecting for certain families.

Importance of Family.

The high production and the consistency of members of the Queen Beets family in the College herd is an outstanding example of the part that a good family line can play in herd developments. Four generations have passed into the herd through two lines. That descended from Gabardine has died out but the descendents of Chloe now comprise one-fifth of the total herd, including young stock. As has been stated previously, the eight family members in production during 1939-40 averaged 482 lbs. of fat in an average lactation of 310 days. There was not one low producer in the group though of course the average was to a certain extent affected by the outstanding Renown Heterodyne.

In the parentage of these cows, four different sires are represented and yet the progeny are consistently good. Further, no descendents of Chloe have been culled for low production. Certainly the College has been fortunate in obtaining a strain such as this but this does not lessen the importance of the breeder distinguishing and concentrating on his best family lines, chosen on the bases of high production and longevity. If a herd can be developed to consist of a limited number of blood lines, greater uniformity should be achieved, both in respect of type and production. The value of the productive level would of course be largely governed by the quality of the sires used.

The Importance of the Herd Sire.

Unfortunately, the College herd does not provide a good example of an outstanding sire being proved and then used subsequently to the fullest possible extent. Certainly, Ensign and Posch, the two original bulls, were given equal opportunities. The latter was loaned in the interim of his stock coming to production and the former was sold along with most of his descendents as soon as his lack was ascertained. But Posch could not be described as an outstanding bull, his daughters were too low-testing for this, but they were good milkers. Renown was sold after limited use and in consideration of the paucity of his stock, cannot be said to be really proven so far as the College is concerned. Following these sires there have been a succession of bulls and as many as four have been on the farm at the one time. Invader and Argus were both used for a considerable time and their blood well infused into the herd with excellent results. Invader notably for his high testing daughters and Argus for the improvement that he has made in type and vessell.

Apart from Ensign, the herd, however, has been very fortunate in its sires for though no one sire would provide an outstanding daughter Survey, the final results of their selected progeny speak for themselves. The average merit of these sires may be attributed to the care used in their selection. They have been selected on a pedigree of performance. Invader, for instance, was selected specifically on the high testing characteristics and the longevity of his line. Unfortunately many of Invader's stock have been culled while young animals, but it must be remembered that facial eczema was partly responsible for this. His contribution in the herd is notable in that it shows that it is possible to improve percentage butterfat test without causing a serious decline in milk production.

The policy of the College in utilizing at large number of

sires is in marked contrast to that of the average dairy farmer who with a herd of 40 cows generally relies on one bull for two or three years. It has its drawback in that it adds considerable to breeding costs but it is probable that the advantages out-weigh the disabilities. In the first place there is more security in getting the cows in calf, to calve at the right period. Secondly, a bad bull used over a period of time may seriously affect the quality of replacement stock but if the progeny of three bulls is available, in as many years, the chances are that at least some good stock will be available. Conversely however, if a really good bull is used extensively for a period, then more pronounced successful results are achieved. However the chances of securing a really outstanding bull to lead a high producing herd are not great.

The recent policy of the College has no doubt been influenced by the experience with Renown in that two of the bulls which have left the herd after a limited use have been "tagged" in case they are required again. Monarch was sold with the right of repurchase while Talley has been loaned. This is the policy of Bakewell, the policy of proving sires and then using them to their utmost if their quality should warrant this.

Conclusion.

The College has been remarkably successful in attaining the objective it set itself in 1927, with a foundation of largely unproven stock, namely that of establishing and maintaining a Friesian herd of high productive ability and of good breed type. Its experiences, in the interim, have been those of the average farmer. There have been the losses through disease and accident which have reduced the scope of culling for low production. But in spite of these difficulties, the herd has reached a standard which will not be easy to maintain, except by the proving and using of bulls with a capacity of siring high producing daughters, and by the reduction of the wastage toll. This the College is doing. Management methods have been adopted to minimize the losses due to mastitis, abortion and sterility while blood lines of proven longevity are being concentrated in the herd. Young bulls, after a trying-out period, are being kept available in case their services are further required.

The progress of the herd in regard to type is also good, although with due reason, it lags behind production. Breed type is a refinement, almost a luxury, that may be sought only after essential production is achieved. If the most recent crops of young stock are any criterion, then the objective of type, too, is being achieved.

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