The Expansion and Structure of the New Zealand Pedigree Jersey Breed

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Since pedigree herds provide the majority of sires used in the New Zealand dairy industry the genetic improvement of the Dominion herd is largely dependent upon the quality of registered animals. In view of the lack of information concerning this select group of herds an attempt has been made to describe some features of the New Zealand pedigree industry. This paper deals primarily with the expansion and structure of the pedigree Jersey breed and the size and duration of the herds comprising it.

BREED EXPANSION:

From the introduction of the first Jersey into New Zealand in 1862 the Jersey breed was of minor importance in the Dominion until early in the present century. In 1902, the year in which the New Zealand Jersey Breeders' Association was formed, registered females born numbered only seventy-two. Since then, however, the breed has expanded rapidly during two periods separated by an eight-year interval in which numbers remained fairly constant (see Fig. 1.).

The growth of the breed is of interest because a comparison of the actual and theoretical maximum rates of expansion gives some indication of the selection of female stock which could have been practised in the period under review.

There are no wastage data available for pedigree cattle from which to estimate accurately the maximum rate of expansion. The only available information is that provided by the New Zealand Dairy Board and their figures apply largely to grade animals under commercial conditions during the years 1938-1943. Bearing in mind the limitations of these data, if it is assumed that there has been no culling for low production and that all eligible heifers have been reared and registered, the pedigree Jersey population could be doubled in size every three years.

Table I. shows the number of heifers registered every third year during the period 1904-1949. Counts were taken of registrations born in the early years, and these, with smoothed averages of registrations in subsequent years, were used to calculate the actual percentage increases of registrations during each three-year period.

Between 1901 and 1922 increases approached the theoretical maximum of 100 per cent. during each three-year period. The breed continued to expand until 1931, though at a reduced rate; from 1932-1940 there was little change in registrations, but since 1941 there has been a steady increase.

During the period 1901-1922 relatively few animals were continuously recorded and clearly the period was one of multiplication. This is not unexpected since this same period was one of expansion in cow numbers in the Dominion and, at that time, reliance was placed in breeding circles in the purebred dairy animal per se rather than on selection within the purebreds. This attitude was in a large measure a consequence of American faith in the purebred animal, a philosophy which had infiltrated to the average farmer in this country.

In the last twenty years, however, growing numbers of pedigree cattle have been recorded (Edey 1952) and it is likely that selection on performance has been increasingly practised. The genetic effects of such selection within the bulk of herds are likely to have been small since sire performance has not until recently been accurately assessed and its importance emphasised, and dam selection, even when numbers remain constant and improvement in only one character is sought, effects little improvement in succeeding generations. (New Zealand Dairy Board Annual Report, 1943).

This does not mean, however, that there has been little change in the average genetic make-up of the Jersey breed during the last fifty years. On the contrary, there is good evidence that the heredity of present day Jerseys may differ considerably from that of Jerseys registered fifty years ago. This evidence has been provided from an analysis of registered heifers (Jhala 1952).

Samples of 100 heifers were taken from each of ten herd books at five-year intervals from 1905-1950 and a modification of Wright's short method described by Robertson (1951) was used in the subsequent analysis. Complete pedigrees were constructed to the eight great-grandparents and then one line drawn at random from each great-grandparent until an imported animal appeared. An estimate of the direct relationship of any animal to the breed could then be made since it equalled the proportion of lines tracing through that animal.

By grouping imported animals according to their date of entry into New Zealand, it was possible to measure the contribution of each period to the breed as a whole at subsequent intervals. The proportion of lines tracing back to the different importations and, therefore, the proportion of genes derived from them is shown in Fig. 2. The import-

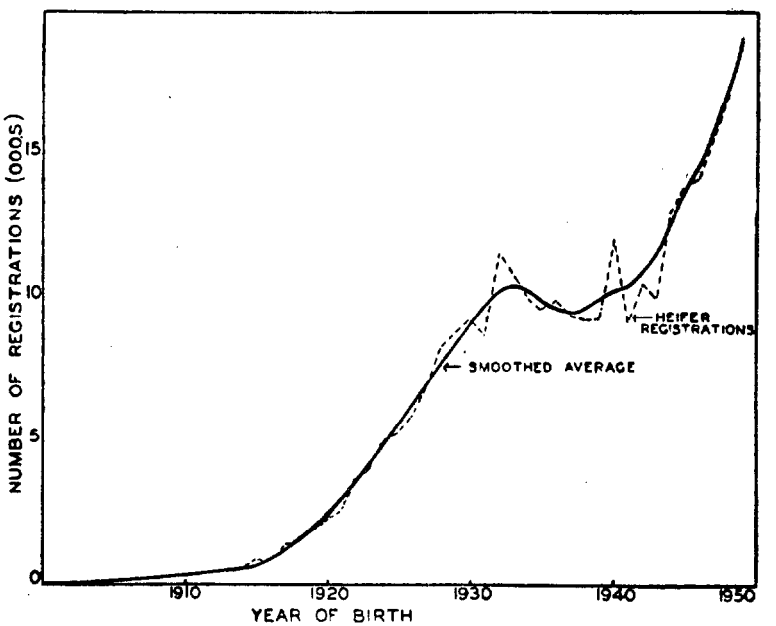

FIG 1. ANNUAL HEIFER REGISTRATIONS AND SMOOTHED AVERAGES TO SHOW THE GROWTH OF THE N.Z. JERSEY BREED 1900-1949.

ance of animals in the country before 1906, called foundation stock for convenience, has been steadily declining, and about one-third of the genes in the breed at present are derived from them. Importations during 1906-15 contributed one-third of the breed's genes by 1920 and have remained relatively important since that year. Of the subsequent important because one sire, K.C.B., imported in 1902, has a direct effect is still increasing.

The contribution made by each period depends largely upon a few individual animals. For example, the foundation stock remain relatively important because of one sire, K.C.B., imported in 1902, has a direct relationship of almost 8% to the breed at present. The 1906-15 importations are important because of four sires, The Owl's Victor (2.75%), Campanile's Sultan (2.0%), Eminent's Fontaine (1.9%), Soumise Majesty (1.9%), and one dam Soumise Lily (2.75%). Only one of the 1916-25 importations is individually important—Violas Golden Laddie (2.9%), while the 1926-35 importations owe their growing importance largely to the popularity of Brampton Dreaming Sam (3%) and Vagaband of Oaklands (2%).

The percentage of genes in the 1950 heifer registrations derived from importations after 1905, 1915, etc., are as follows:—

From importations since			1905	68½%
,,	,,	,,	1915	40 %
,,	,,	,,	1925	25½%
,,	,,	,,	1935	3½%
,,	,,	,,	1945	½%

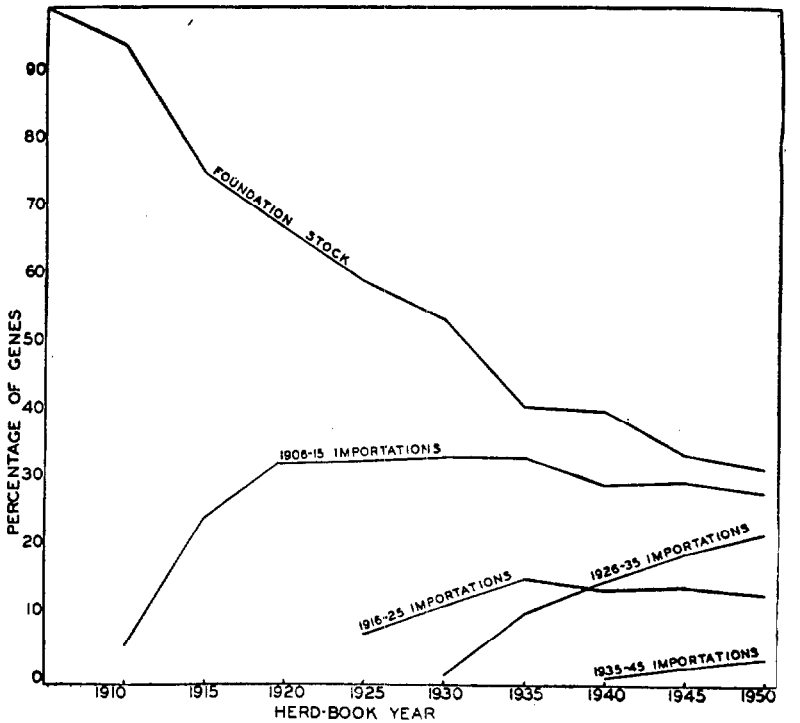

FIG 2. SHOWING THE PERCENTAGE OF GENES IN THE JERSEY BREED DERIVED FROM IMPORTATIONS DURING TEN YEAR PERIODS, 1906-1945.

Clearly the genetic status of the breed at present depends largely upon the quality of importations since 1905 and provided these owed their popularity to outstanding breeding worth, the rapid expansion of the breed already mentioned should not cause concern. It should be remembered, however, that until the 1930s, or even later, showring successes largely determined the popularity of individual animals and herds. In view of this, and the lack of organised effort on the part of the breed society to rid the breed of undesirable genes introduced by by the foundation stock, genetic changes in the breed which may have taken place need not necessarily have resulted in improved productive potential.

The data also illustrate the rapidity with which the influence of popular animals may be spread through a breed. The eighty sires imported between 1926 and 1935, of which only 42 appear in the extended pedigrees, contributed 21% of the genes of heifers registered in the 1950 herd book. Artificial insemination played little or no part in this development, but, should it receive the support of breeders in the future, a small group of sires could be responsible for enormous changes in the average heredity of the breed within ten or twenty years. The way in which the influence of individual animals is spread so rapidly involves a discussion on breed structure.

BREED STRUCTURE:

There is a large traffic in pedigree cattle in New Zealand. Eight thousand registered Jersey bulls are officially transferred each year, as well as many thousands of registered females. As a result, approximately 80% of the sires and 40% of the dams of female registrations are born in different herds from their offspring. The source of these purchased cattle is of obvious importance since herds which supply breeding stock to pedigree herds are likely to have more influence on the future of the breed than those which supply stock to grade herds only.

Pedigree breeders fall into one of three main classes:—

(a) Breeders whose sires are used only in grade herds. There were 1650 such breeders registering in the 1948 herd book, together with an unknown number of breeders who did not register in that herd book (see Fig. 3) (Fahimuddin, 1952).

(b) Breeders whose sires are used only in the pedigree herds in which they were bred and in grade herds. There were 276 such breeders registering in the 1948 herd book.

(c) Breeders whose sires are used in pedigree herds other than those in which they were bred and in grade herds. There were 1,015 such breeders, of whom 679 registered stock in the 1948 herd book, the majority of the remaining 336 having retired from pedigree breeding. Since these 1,015 breeders supply sires purchased by other pedigree breeders they are of greater importance in the breed than the remaining breeders.

If sires used in herds in which they were bred are omitted, it is possible to grade these 1,015 herds according to their status as sources of sires. Of these 1015 breeders there were 289 existing and 205 defunct herds from which the 1,015 breeders did not obtain sires. These form the next stratum. Within the remaining 521 herds, sires were not obtained from 157 existing and 52 defunct herds. This process was repeated until 112 herds remained, from 93 of which registrations were entered in the 1948 herd book. These herds used sires which were homebred, purchased from herds in the same stratum or imported. Twenty of the defunct herds were represented by imported bulls which were used only in the upper strata.

These findings are based on the registrations of a single year, and it is unlikely that the structure of the breed is as rigid as the diagram suggests. The general pattern will, however, resemble that shown in the diagram.

The top stratum consists of a small self-contained group of herds supplying sires to each other and to herds in any stratum below it. The second stratum obtains sires from the top stratum only, but supplies sires to herds in any stratum below it. The third stratum obtains sires from either of the top two strata and supplies to any below it, and so on.

The stratum into which any herd falls is determined by the opinions of breeders themselves. The whole breed is being graded up to the top stratum and differences between herds in the top and lower strata are largely determined by the number of strata through which genes have passed. Many breeders of grade cattle purchase their sires from

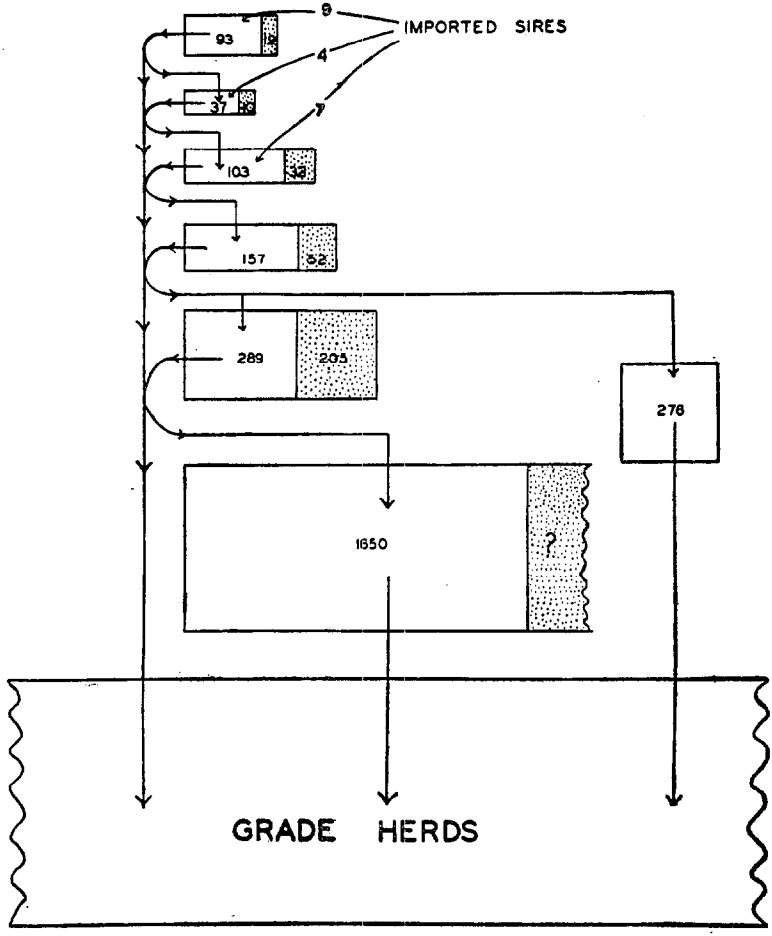

FIG 3 SHOWING THE RELATIVE IMPORTANCE OF HERDS REGISTERING STOCK IN THE 1948 HERD-BOOK (SEE TEXT)

the top group of herds and this short-circuiting may well result in many of the bulls born in high grade herds being genetically superior to many of those born in herds in the lower pedigree strata.

The way in which the effects of certain animals can be rapidly spread through the breed is clear. Each stratum relies on those above it to effect genetic improvement and the sires used in the upper strata eventually determine the quality of the remaining dairy cattle. This continual grading-up process means that unless the top herds are constantly improving, the genetic margins between the different strata will diminish.

In the past, many of these upper strata herds have used imported animals in endeavouring to maintain a genetic margin and, as a result, the genes of these imported animals have been rapidly spread throughout the breed. Bearing in mind the results of sire survey in this country, it is doubtful if imported sires will continue to enjoy a preference over sires bred in New Zealand. It can only be hoped that the selection of alternative breeding stock by breeders in the upper strata will be judicious.

Though the breed as a whole is tied to this upper stratum of breeders there are some opportunities for desirable genes being deliberately assembled in individual herds as the genes pass from stratum to stratum. Accurate selection and wise mating systems may make certain herds outstanding, but they are probably scarce because of the limitations imposed by small herd size, and the short duration of the majority of individual pedigree herds.

HERD SIZE:

Herd size has many practical implications in selective breeding. The smaller the herd the more pronounced the random fluctuations in gene frequencies, the more difficult it becomes to progeny test and to use information obtained to best advantage. A further important disadvantage is the relatively high cost of recording small herds, many of which, for this reason, are not tested.

In view of the rapid expansion of the Jersey breed since 1943 there is good reason to believe that a very large proportion of eligible heifers are registered. Annual registrations should, therefore, provide a fairly accurate measure of herd size. It should be remembered, however, that many farmers keep both grade and pedigree cattle in the same herd and many breeders may not be as handicapped by small herd size as would at first appear from their annual entries in the herd book. But according to the New Zealand Dairy Board, in the 700 herds entered for the Official Pedigree Test in the current season the average herd consisted of 32 pedigree animals and 19 grades. It is likely then that estimates of herd size based on registrations do not greatly underestimate the true position.

The distribution of a sample of Jersey breeders according to the number of heifers entered in the 1949 herd book is shown in Table II. Almost two-thirds of the breeders registered less than six heifers. Even assuming that these breeders owned as many grade animals as pedigrees and allowing for normal wastage, few of these breeders would have sufficient daughters of a sire entering their herd in any one year to permit of one bull being adequately progeny tested. Further, more than 30% of the breeders registering less than six heifers in the 1949 herd book used two or more sires. Clearly the chances of obtaining early progeny test information in the bulk of pedigree herds are remote. Since these small breeders registered 29.1% of the bulls registered by this sample they are of considerable importance to the industry.

Another disconcerting feature of these small herds is the low ratio of heifers to bulls registered. Those breeders registering five or less heifers registered 1.49 heifers for every bull registered, those registering more than five heifers registered in the vicinity of two heifers for every bull registered. This large difference is due partly to the grouping of the data, but the same trend is apparent when the herds in the sample which registered stock in the previous year are studied in their original classes.

There are two possible reasons for these small breeders registering such a high proportion of bulls to heifers. Many small herds belong to "new" breeders who endeavour to recover investments in their foundation pedigree stock as quickly as possible by the sale of pure-bred bulls. Other small herds may belong to breeders of long standing, but they need to sell as many bulls as possible because of the high cost of their herd sires. The small breeder's selection difficulties are thus accentuated by financial considerations.

In the interests of cattle improvement the ambitious man with limited financial resources must not be prevented from entering the ranks of breeders. He should be given every opportunity to make a worthwhile contribution, but this will be possible only if two major obstacles are removed. The first, the financial obstacle, would be appreciably lessened if education were directed to denouncing the value of the registered animal with no production qualifications above the average, attaching more importance to the high grade, narrowing the gap between the prices of grade and average pedigree animals, and encouraging high prices for good bulls to be used at Artificial Insemination centres. The second, selection difficulties, could be met if small breeders co-operated in the use of artificial insemination. This latter suggestion will, however, meet with considerable opposition from many breeders largely because, if adopted, artificial insemination would restrict their choice of mating systems, particularly those based on relationship. This aspect serves to introduce the topic of herd duration.

HERD DURATION:

Many breeders are convinced that nicking is all-important and that line and family-breeding are essential in a breeding programme. To be successful, nicking involves a thorough knowledge of individual animals and lines so that the results of various matings can be anticipated with some certainty. Obtaining this intimate knowledge of families takes time and must be repeated by nearly all breeders since few herds pass from breeder to breeder, as entities. Breeders could hardly become thoroughly acquainted with their cattle, forming distinct lines and testing them, in less than five or six cattle generations. Since each generation is approximately five years (Stewart, 1951), twenty-five to thirty years might well be involved in preliminary investigations. Relatively few New Zealand breeders have registered cattle for this length of time. Table III. shows the distribution of a sample of breeders registering cattle in the 1949 herd book according to the duration of their breeding effort. Over 60 per cent. of the breeders had registered stock for less than six years and less than one per cent. had registered stock for more than thirty years.. 43.5 per cent. of the sires registered were bred in herds which had been in existence less than six years, and in these newly established herds a higher proportion of bulls were registered than in any other class. In view of these findings it is reasonable to conclude that relatively few pedigree animals are bred in herds sufficiently long established to enable mating systems involving line and family-breeding to have had worthwhile effects.

Few breeders in the intermediate strata (see Fig. 3) can hope to build up and maintain genuinely superior herds in the face of the obstacles provided by small numbers and short herd-duration. Clearly

the improvement of the Jersey breed lies at present in the hands of a small group of breeders, each acting independently and following schemes of his own which may or may not be for the common good. It is doubtful whether a breed of steadily increasing merit could be built from such a nucleus by breeding methods at present in vogue. Because local populations and not individual herds or animals are the most important breeding units, the existing machinery is fundamentally inefficient. Methods of overcoming the difficulties which are beyond the resources of the majority of individual breeders must be devised. The next stage in the evolution of breeding methods must be the co-ordination of the numerous individual efforts in which, at present, successes may be largely counter-balanced by failures. The majority of breeders would be extremely reluctant to surrender their present independence unless they were convinced of the need and the practicality of co-ordination.

Realisation of the need for co-ordination could be brought about by education. It should be directed to clearly defining the objectives of cattle breeding and the part individual breeders should play in attaining them, to instructing breeders in the interpretation of performance details, and to emphasising the necessity for pedigree cattle maintaining a genuine genetic margin over grade animals if they are to retain their select status. That breeders are prepared to accept instruction is clearly evidenced from the enthusiasm that has marked the development of official type classification. A technical staff making full use of records of performance and interpretation of such records is an essential part of this programme.

Once the need for co-ordination is generally appreciated, the next step forward in the evolution of our breeding methods will be almost complete. Already, both in New Zealand and overseas, artificial insemination centres have demonstrated that their services can provide the cheapest and quickest means of breeding more productive cattle.

The field is wide open, and, if inspiring leadership is forthcoming, the future of the present pedigree Jersey cattle population is assured.

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TABLE I.—PERCENTAGE INCREASES OF REGISTERED JERSEY HEIFERS AT THREE-YEAR INTERVALS, 1901-49.

Year	Actual Regs.	"Smoothed" Regs.*	Percentage Increase	Females Imported
1901		57		
1904	109	97	70	11
1907	183	193	99	4
1910	655	363	88	21
1913	674	673	85	43
1916	996	1091	62	6
1919	2031	1996	83	4
1922	3672	3553	78	14
1925	5487	5526	66	20
1928	8383	8027	45	23
1931	8749	9745	21	29
1934	10117	10352	6	—
1937	9506	9581	7	—
1940	12052	10361	8	—
1943	11162	11514	11	—
1946	14271	14696	28	—
1949	19101	19101	30	18

*1901-10 Actual count of births.

1913-49 Second repeat of moving average of registration in herd book published in the following year.

TABLE II.—PERCENTAGE DISTRIBUTION OF JERSEY BREEDERS REGISTERING IN 1949 HERD-BOOK ACCORDING TO NUMBER OF HEIFERS ENTERED

Heifer Regs. (No.)	Percentage Breeders	Percentage of Heifers	Percentage of Bulls	Ratio of Heifers/Bulls 1949	Ratio of Heifers/Bulls 1948
-5	65.6	22.5	29.1	1.49	1.53
6-10	17.6	23.2	21.0	2.13	1.94
11-15	8.1	17.3	17.6	1.90	1.98
16-20	3.7	11.5	9.3	2.39	1.76
21-	4.8	25.5	22.9	2.14	1.56
Sample	(454)	(2650)	(1374)	1.93	1.70
1949 H.B.	2691	17223	9047	1.90	

TABLE III.—PERCENTAGE DISTRIBUTION OF JERSEY BREEDERS REGISTERING IN 1949 DISTRIBUTED ACCORDING TO DURATION OF BREEDING EFFORT.

Duration (years)	Percentage of Breeders	Percentage of Heifers	Percentage of Bulls	Ratio of Heifers/Bulls
1-5	62.8	40.3	43.5	1.78
6-10	15.2	16.2	14.6	2.14
11-15	9.9	18.0	17.6	1.97
16-20	4.4	6.8	8.0	1.65
21.25	3.3	4.9	2.9	3.22
26-30	3.5	9.7	9.5	1.98
31 and over	0.9	4.2	3.9	2.04
Sample	(454)	(2650)	(1374)	1.93
1949 H.B.	2691	17223	9047	1.90