BREEDING OF DAIRY CATTLE IN NEW ZEALAND

by

A. STEWART, MASSEY AGRICULTURAL COLLEGE.

There has never been in this country a more widespread interest in cattle breeding than there is today. The Sire Survey work of the New Zealand Dairy Board and the opportunity afforded by artificial insemination to use valuable pedigree bulls has awakened interest among commercial dairy farmers and focussed attention on the improvement of our national herd. The fact that the Dominion's dairy cattle have reached a more or less static position in respect of average productivity (1) together with the uncertain markets ahead which may call for increased efficiency on our part, make a stock-taking at this stage convenient and necessary. No pretence is made of presenting the detailed descriptions and results of methods used in cattle breeding but, in defining some of the problems which confront the breeder, in clarifying and assessing some past attempts at improvement, and in indulging in some speculation as to future developments, it is hoped that the general picture presented will be of interest and some value to those concerned in this work.

HISTORICAL ASPECTS:

The history of New Zealand cattle breeding can be conveniently divided into six periods each characterised by features peculiar to them and of some importance in the present status of the cattle population (2).

The first period, 1814-1840, saw in the absence of native cattle the introduction of Shorthorn cattle from Australia to provide the milk and beef needed by a sparse but increasing population. The dual purpose animal was favoured but in the absence of any incentive it is doubtful if attempts at improvement were made.

The second period, 1840-1885, coincided with the colonisation of the country. The requirements of the early settlers were still for milk and beef qualities in the one animal but stock had an additional function as part of the system of bringing in new land. There was a continual demand for steers which the Shorthorn breeders were able to fulfil. This period also marked the appearance of the various dairy breeds of importance in the Dominion today; the Ayrshires were introduced in 1848, the first Jerseys in 1862, and the earliest Friesians in 1884. The countries from which these foundation animals were imported were, however, only in the process of evolving the breeds as we know them today and we cannot be certain that the earliest representatives in this country were necessarily typical. Despite the presence of these specialised dairy breeds in fairly considerable numbers the Shorthorns flourished due to dairying being regarded mainly as a sideline to other types of farming.

In the third period, 1885-1912, with the advent of refrigeration and the development of overseas markets, there was a marked expansion of cattle numbers. In consequence, there was little selection practised though the need for animals of good milking capacity became apparent. Unfortunately, no reliable measuring rods were available but the value of the specialised dairy breeds came to notice. Superior milking strains were selected from the Shorthorns but frequent crossing with bulls of the same breed of beef tendencies made such selection largely ineffective. The numerous importations of dairy cattle of all breeds and the desire to maintain pure pedigree stocks led to the formation of breed societies and the subsequent publishing of herd books during the early years of the present century.

The period, 1912-1923, marked the first organised endeavour to select on production. Methods enabling individual productivity to be accurately assessed led to a general appreciation

of the merits of the specialised dairy breeds insofar as production of butterfat was concerned. In consequence, sires of the dairy breeds were used on predominately Shorthorn herds in an attempt to improve the milking capacity of the latter. This demand for pure bred sires gave rise to an expansion of the numbers of pure bred cattle of the dairy breeds with a resultant decrease in the severity of the selection practised. In these pedigree stocks, due to the publicity given to the North American emphasis on record breaking, attention was focussed on ascertaining the production of individual cows maintained under optimum conditions.

The fifth period, 1923-1936, was notable for the rapid expansion of the Group Herd Testing Movement and the wide variation in our commercial cattle becoming increasingly apparent. Reliance was still placed upon the registered pure bred bull for improvement of the grade population, while the improvement of registered cattle depended upon the mating of best to best, such animals being most frequently identified by single records and conformation in the case of female stock and dam-production and appearance in the case of the male. The Breed Societies were not oblivious to the fact that registered pedigree bulls were of mixed quality. The Jersey Cattle Breeders' Association and Department of Agriculture, for example, distinguished those bulls which had a certain number of daughters with records of minimum standard, but their methods were selective in the extreme.

From 1936 to the present day, cow numbers have remained fairly constant. With extensive data available from the Group Herd Testing Movement it became apparent that despite the continued use of pure bred sires and the culling of inferior producers, many herd averages were no longer increasing. It was realised that inheritance was a limiting factor particularly in the better than average herds and during this period we have the growth of the Proven Sire Movement.

An essential feature throughout has been the distinction made between registered and non-registered cattle. Thus it is convenient to discuss separately and in some detail the methods practised in attempting genetic improvement of the two classes of stock.

MASS IMPROVEMENT:

In the past 30 years there have been marked increases in the average annual production of all cows in the Dominion (3). Two main factors have been responsible for this, the first and more important, the improvement in the environment on the average commercial farm and the second, the grading up of originally Shorthorn stocks to high grades by the use of pure bred sires, predominantly Jersey. Improvement during the early stages of the grading up process was rapid but as the proportion of pure bred "blood" increased with each succeeding generation the differences in heredity between pedigrees and grades decreased. This, together with the raising of the general standard of management to that hitherto enjoyed mainly by the pedigree cattle, has been responsible for the elimination of the difference in productivity between registered and unregistered stock under group herd test.

But during the last ten years there has been no improvement in the average productivity of our dairy cattle. Attempts to effect progress have involved the elimination of low producing animals and the selecting of replacement stock from dams of a certain level of productivity mated to pedigree bulls. However, these selected animals have, on the average, been unable to demonstrate any marked superiority over those chosen at random, a fact which reduced the effectiveness of culling. The opinion has frequently been expressed that failure on the part of the great majority of commercial men to take advantage of the facilities offered by the Association and Group Herd Testing Movement, has in part been responsible for stationary herd averages. While the attitude of the farmer who refused to test at all may be

difficult to defend, up to 1938 when the Herd Improvement Plan came into operation, the views of farmers who tested every second or third season was not unreasonable. The information contained in herd test returns was of use mainly because it identified the low producers for culling (3). But culling itself is incapable of effecting steady annual improvement unless the replacement stock are better than those displaced from the herd. Such was not always the case and culling was only able to maintain the slight improvement brought about in the initial stages. The Herd Improvement Plan, however, ushered in a new era in cattle breeding in this country having among its expressed objectives sire-survey work based on progeny tests. The need for continuously recording the productivity of all cows then became a real one and attempts to improve our stock through breeding depend largely upon the extent to which herd recording spreads.

Also limiting the improvement in commercial herds has been the extent of wastage in all types of dairy stock(3)(4);this has made it necessary to save a proportion of the replacement stock from dams below the herd average, a shortcoming which has been magnified by the periods of rapid expansion in cow numbers. Equally important has been the attitude of the commercial dairymen in the selection of herd sires. A great number of farmers selected sires from pedigree herds purely on a type basis; a prominent breeder has told the writer that many of the remainder, while professing great concern in the butterfat backing of the animal usually purchase the bull whose appearance appealed to them most. Comparatively few have been sufficiently appreciative of the value of progeny tests to ascertain the manner in which animals in the pedigree of the potential herd sire have bred. Then, having selected the herd sire, the fear of having too many progeny from the one bull in the herd, together with suspicions of the fertility of any sire over the age of five or six, and a reluctance to inbreed, has led to the disposal of many animals before their breeding value has been apparent.

However, the main reason for the static nature of the industry appears to be the quality of the animals used for breeding purposes during this period. A sample of the sires in use in herds under Group Herd Test have been surveyed by the N.Z. Dairy Board and their findings are of particular interest (4).

TABLE 1. RESULTS OF SIRE SURVEYS ISSUED UP TO 30.11.45.:
(Shown at end of this paper)

It is apparent from the table that at the lower levels of production it has been comparatively simple to effect improvement. At the higher levels, however, there have been few sires capable of increasing or even maintaining production. These sires were used in recorded herds which comprise only 15% of the Dominion's cattle. It is probable that the care taken in selecting the bulls to lead such herds was greater than in the untested herds in which case the position in the remainder of the industry would certainly be no better.

RECENT DEVELOPMENTS:

The work started by the N.Z. Dairy Board in 1938 to assist in the identification of superior breeding animals was the first real attempt to bring about mass improvement. The scheme embodies sire surveys based on non-selective progeny tests and their publication along with the names of cows which have reached certain minimum standards of productivity over a number of years. It represents in the light of present knowledge the best attempt to date to measure the genotype of bulls. However, the technique of Sire Survey in this country, though commendable in many respects, is by no means perfect. No allowance has been made for the effects of heterosis, for the effects of varying lengths of lactation whereby the sire of late calving animals is penalised, for the inclusion of the lactations of daughters which consistently dry off soon after calving, or for the influence of season which can have such a pronounced effect upon the accuracy of Preliminary Surveys as estimates of breeding worth. Further, it

is based upon a technique of testing which, though admirable for the purpose for which it was introduced - namely, providing the owner of the cattle with information for his own use - at present lacks the safeguards which appear to be necessary where a falsification of records has considerable financial advantages to the seller of breeding stock. With regard to the female stock, the measurement is purely phenotypic and as such is open to the objections of individual performance as a measure of breeding value. But until a method of estimating genotype requiring less offspring than is needed at present is applicable, we must assume that the animals included in the Register of Merit of the N.Z. Dairy Board are some of the superior breeding stock of the Dominion.

Provision has also been made for the identification of those replacements which by reason of their breeding appear likely to be better than average animals. In this respect the emphasis on selection has swung from the dam to the sire, the offspring of proven "merit" bulls being classified as "merit" calves irrespective of the quality of their dams. The scheme thus allows for one parent being proven and that this parent can have many more offspring in one season than can any one female.

But the N.Z. Sire Survey work still places emphasis on registered sires. In consequence the extent of mass improvements in heredity depends upon the success of the pedigree breeders in providing animals of average quality appreciably higher than that of the commercial animals. While this difference exists the presence of pedigree stock is warranted but as soon as it is apparent that the average quality of the progeny of pure bred sires is no higher than the average of those of grade sires the distinction is not justified. Information relating to this specific point has not been made available but our grade cattle under group herd test have reached an average productivity equal to that of pedigree cows tested under similar conditions (1). Whether the two groups of cattle are of equal average breeding worth is not certain but not unlikely. If such is the case the term "pedigree" in this country ceases to have much significance. An examination of the pedigree system may provide reasons for the apparent failure of the registered cattle to demonstrate their implied superiority over present day grade animals kept under similar conditions.

PEDIGREE IMPROVEMENT:

Breeders have two tools available to bring about improvement in their stock - the selection of animals to be parents and the system of mating to be used - the effectiveness of each varying considerably according to the methods adopted.

Originally, in the absence of accurate measurements of productivity, estimates of worth inevitably became associated with an animal's appearance. It was observed that animals with a certain conformation were on the average more productive than those which lacked it. Though by no means infallible this method did give some indication of worth and much of the early improvement in productivity must be attributed to selection based on type. But the correlation between type and production is only a general one, and there are too many anomalies for reliable identification of superior animals. The gradual spread of recording culminating in the introduction of Semi-Official testing in 1912 considerably increased the accuracy of selection possible. Unfortunately, this measure has not been as widely adopted as was hoped for. A comparatively small number of animals have been selected each year and their yields over one lactation accurately assessed. It has been a popular practice to place the animals under official test as two-year-olds, to provide them with optimum conditions, to delay service and to record production over a 365 day period. The yearly test was introduced because it was believed that the sons of dams which could secrete for twelve months would be capable of increasing the length of the lactations of the grade cattle, an important factor in their relatively poor productivity. The average lactation of grade cows has lengthened during the

present century but improvement in environment has probably been responsible for the major portion of this increase. These 365 day records are usually considerably in excess of average productivity under farm conditions and though an indication are by no means an accurate guide to breeding value. The 305 day was introduced in the 1930-31 season but it was not until it had been in operation ten years that it became at all popular. Though many breeders were prepared to adopt the shorter test previous to this they were reluctant to do so while a few of their competitors used yearly records in stating the merits of their stock. In 1928 as a means of standardising attempts to improve the average conformation of the Jersey breed a classification system was introduced. This permitted young breeding animals to be chosen from dams unknown to the buyer, but of approved type in the opinion of a committee appointed by the Association. A further refinement of the scheme was the publication of lists of male and female animals with certain minimum numbers of classified daughters. The numbers of animals qualifying on the appearance of their progeny has been small and suggests that breeding for type is a more uncertain venture than is generally admitted. Nevertheless, the importance attached to show ring performance and classified status has forced the breeder to pay considerable attention to conformation. This in itself has been all to the good, provided the effectiveness of selection for production has not been reduced. It is possible that productivity was at times lost sight of in the early days so that visible characters not definitely proved to be indicative of real value might be retained. The Breed Societies by issuing standards of excellence and Points scales have done valuable work in reducing the emphasis on unimportant points and promoting uniformity of ideas among their members but at present only selected Jerseys are nominated for classification and those which fail to qualify are not identified. Until all eligible animals are submitted, the scheme loses much of the usefulness it may possess, and so long as selective methods remain the value of the classification system cannot be accurately assessed.

The system of registration in which the only qualification required is that the animal's parents be registered has been and still is a weakness in the pedigree scheme. No attempt has been made to encourage breeders to discard those animals which have not reached certain minimum standards of real value. With a constant and heavy demand for pure bred sires for use in grade herds together with an increase in the number of herds of pedigree cattle the culling of animals eligible for registration has been low. Thus many animals, despite their low productivity and doubtful breeding value have been retained and bred from simply because, when mated to registered animals, their pure bred progeny command high prices due to their registered status which, in the public mind, is identified with superior merit. Though selective registration as practised overseas is open to criticism because of its basis on phenotypic considerations, some comparable scheme would serve a useful purpose in this country. Compulsory recording and classification would lead to refusal of registrations for the inferior stock while the information applying to those qualifying would be of value in selection and mating programmes.

Another feature which has characterised the pedigree industry and which has probably been effective in retarding progress to some extent has been the frequent interchanging of female stock between pedigree herds. The resultant lack of uniformity may be responsible for concealing improvements in heredity which must be recognised early and capitalised on, if progress is to be made. Ideally, herds should consist of animals of similar genotypes which as dams of the succeeding generation make uniform contributions in heredity thus permitting the contributions of sires to be measured with some accuracy.

In spite of these weaknesses all of which are understandable and part of the evolution of the system which has as its

goal breeding the best uniformly and at will, at the present stage of development towards this end it would appear that the most important fault in selection has been the failure to appreciate the basis and value of the progeny-test. Reliance on pedigree with the emphasis on the desirability of the dam and paternal grand-dam has marked the attempts of many breeders to select stock of superior breeding worth. Many have recognised the obvious merits of assessing an animal's breeding value by measuring the qualities of its offspring but few have appreciated the necessity of an unselected sample of the progeny of sufficient size to preclude large chance deviations. It has not been realised that an inferior daughter is as reliable an indication of its parent's genotype as is an outstanding daughter. One owes its excellence to a good sample of genes plus a favourable environment, the other its lack of quality to a poor sample of genes plus an unfavourable environment. Selecting these superior progeny for inclusion in pedigrees presents a picture which can be most misleading. Even when information concerning the progeny of an animal has been available, there has been a tendency to overlook it and give preference to individual performance. Thus, in efforts to breed animals of good conformation, emphasis is frequently placed on a cow very highly commended for type (V.H.C.) appearing in a pedigree rather than on one which has been commended for the type of its progeny (C.P.).

MATING SYSTEMS:

In the past there has been a staunch belief in the effectiveness of line and family breeding and a dislike of in-breeding and out-breeding. No one system has been followed consistently and for a sufficient length of time to suggest that there is a "best" breeding policy for milk and butterfat yields. It is possible that the genes contributing to production are substantially the same in every animal and until it is demonstrated that this is not the case it may be that introducing the added qualifications of relationship into the selection of the parents may be limiting the rate of improvement. Provided the parents possess a sufficient number of these desirable genes it is possible that whether the animals are related or not is of small importance. Should such be the case the fear of outbreeding to superior stock is not justified. At the same time the ability of an inbreeding system to effect homozygosity of a sample of the genes already present cannot be overlooked. When the closeness with which Bakewell and his successors bred their animals is considered, the efforts of most New Zealand breeders at concentration of genes of valued strains appear very mild. There are examples of very closely bred stock but so many attempts to inbreed have ended in disappointments that the uncertain benefits are seldom preferred to the safer results of line breeding.

Though it is impossible to analyse the effectiveness of the various mating systems in vogue in producing the homozygosity for desirable genes for which they are intended, certain features can be discussed. The first is the importance which is attached to the appearance of an outstanding individual many generations back in the pedigree. An animal may have eight great-grand-parents; where each of them is different, any one will on the average contribute approximately one eighth of the heredity of the individual under consideration and this eighth may be a poor sample of the genes carried by the illustrious great-grand-parent. In some cases so-called line breeding to a distant ancestor may in reality be line-breeding to a descendant intermediate between the two generations but even in these instances the same criticisms may apply.

The second weakness is the fairly widespread lack of appreciation of the slowness of family breeding methods in concentrating genes and the sampling nature of Mendelian inheritance. Seldom are animals mated together which have one grandparent in common yet, if such was the relationship, the proportion of genes above the average of the population which are

similar is approximately only 6½% greater than if the two animals to be mated had been selected at random (5). And unless selection has been severe the similarity will apply for both desirable an undesirable genes. Hence the effectiveness of mating animals even less closely related in producing the prepotence desired must, on the average, be small.

In summing up it would appear that the methods of selection and mating as practised by the average pedigree breeder could not have been responsible for appreciable improvement in production in the last twenty years. This contention is supported by the official returns of the Department of Agriculture since 1913 (Table II - see end of this paper). But it would be unfair to condemn the breeders on this account. Proving stock was given little recognition until the 1920's and for some years the emphasis was on technique rather than the paucity of good sires which we recognise today as our major problem. The general lack of interest in cattle improvement among research workers was such that the methods in vogue were not investigated and the weaknesses uncovered. However, there are a number of excellent pedigree herds in the country possibly due in part to the more intimate appreciation of breeding methods of the owners. Few, however, will deny that chance in the form of a fortunate choice of a sire or dam has played a part. With several superior progeny from their own and other herds, these breeders have been able to adopt a policy of mating best to best, preserving in some cases a standard of productivity sufficiently in excess of the average to be noteworthy. Such herds, however, are greatly outnumbered by inferior collections of registered animals which, while providing sires for use in the industry, are contributing little to the improvement of the national herd.

PRESENT TRENDS:

Though Proven Sires have undoubtedly been responsible for progress in some herds, too little time has elapsed for the effects of Sire Survey work to be felt on the general population. The selective powers of both pedigree and grade farmer have been considerably strengthened but there is one weakness, namely the scarcity of "Merit" sires. Any increase in their numbers brought about by an expansion in recording will be counterbalanced by an ever-growing demand for such valuable animals. It appears certain that there will never be a sufficiency of merit sires under our present system. Owing to the time lag involved in proving a bull - he is at least rising five before his first daughters have completed one lactation - a large proportion of herd sires have been slaughtered by the time their breeding worth is first estimated; of those remaining, only a small proportion are of outstanding merit. Then, again, since good sires have been comparatively rare the private breeder who has owned one has usually been loathe to sell. For this reason, the emphasis has been placed on the sons of Proven "Merit" Sires out of dams listed in the Intermediate or Lifetime Merit Register. Selecting such unproven animals may reduce the chances of error but it must be remembered that these young sires are one generation of Mendelian segregation away from their sires and half of their inheritance comes from dams whose breeding value may not be at all certain.

Similarly in pedigree herds the trend is to give recognition to the "Merit" Sires. Further, the need for testing all animals has been realised as witnessed by the enormous increase in the numbers submitted for Government O.H.T. during the last two years and the fact that the recording of all sound animals in herds submitted for official test becomes obligatory next season (1946-47). This should be responsible for the elimination of the major weakness of the pedigree system, namely, the lack of accurate information from which can be assessed the breeding worth of individual animals. Certain Breed Societies, by their refusal to approve transfers for pedigree bulls from dams below certain minimum standards of productivity have indicated that they

realise that more than "blue blood" is necessary in the ancestry of potential herd sires. These are trends which are at least encouraging. However, in the light of the scanty evidence available, an undue emphasis on type still persists. The adoption of classification systems by all the dairy Breed Societies appears imminent and it is hoped that in the near future universal classification for type (as introduced last season by one association) will be adopted whereupon the place of conformation should be seen in its proper perspective.

PROSPECTS OF IMPROVEMENT:

Before laying plans to improve our stock it is necessary to satisfy ourselves that our objectives are sound. The commercial dairymen have as their ideal highly productive dairy cattle which under N.Z. conditions are resistant to disease, of reasonable longevity, are milked cleanly by machines, can be relied upon to reproduce regularly and within 13 months of their previous calving and which will reproduce stock at least equal in quality and preferably better than their predecessors. By highly productive is meant animals which when fed correctly will produce the greatest output of dairy products per acre from farms self supporting in respect of feed supply.

It is necessary that we clarify our ideas on dairy products. For many years by far the greater part of our output must be exported in the form of butter, cheese, dried and condensed milk. Yield of butterfat must be the first consideration but the relation between percentage fat and cheese output must not be overlooked. It is well known that cheese yield per pound of fat declines with increase in the fat content of milk. Recent surveys by Ward (6) also show that an increase in the fat yield of progeny is achieved in some measure by raising the fat content of their milk. Unfortunately, we know nothing of the inheritance of solids-not-fat. This information must be obtained before we can accept without reserve the assumption that increase in fat per acre will lead to a marked increase in cheese per acre. It is conceivable that we may need for our cheese districts cows of the same size as required in our butter areas but with an inherited capacity to increase cheese rather than fat alone. This alternative would, of course, be nullified if the standardisation of milk for cheese were introduced. The issue is an important one at the present stage of stock improvement.

Furthermore, we must never overlook our important though relatively small production of city milk. The production of a large volume of milk per acre of fat content throughout the lactation consistently in excess of the legal minimum must, under existing conditions, be an all-important consideration. This, too, would be effected if standardised milk were acceptable by the public.

Besides a clearer conception of our requirements for particular purposes various other problems must be considered. The first of these is an understanding of the effects of environment upon productivity. In this country herd averages vary widely between farms in any one season and on the same farms in different seasons. To test bulls accurately the variation due to environment must be known if a reliable estimate of the breeding worth is to be made. There must be certain vital features in environment responsible for large effects which are not fully appreciated at present. The consistently poor productions of some herds have not been satisfactorily explained by differences in the management or inheritance of the stock. Further, there has been no real attempt to evolve strains of cattle particularly adapted to New Zealand conditions - active foragers suited to our peculiarities of soil and climate. Perhaps in our adherance to standards of excellence applying overseas we are selecting against a type more suited to the environment of the Dominion.

Incidence of disease is another important aspect of environment. It appears probable that resistance to certain diseases

is influenced by inherited factors. Mastitis is thought to be one such infection (4), and in view of its economic importance and its poor response to treatment, selection for resistance may prove to be the only satisfactory method of effectively reducing its ravages. This draws attention to the need for objective experimentation in this and other spheres of animal research.

The second problem is the means of enabling the percentage of good bulls to be increased. This in turn gives rise to further problems, first, how can all the sires used in the industry be retained until they are proven so that valuable breeding animals can be identified and, secondly, in what manner are the services of these superior animals to be used to best advantage.

On small properties additional male animals considerably reduce gross returns. In addition, progeny tests may involve added expense since the number of daughters required to make a progeny test is frequently in excess of annual herd replacement needs. The alternatives consist of either delaying the progeny test which reduces the value of the information, or increasing the replacement rate, which can involve considerable losses in production due to the high proportion of immature stock in the herd. In large herds the problem is not so acute but it is still a real one; young sires can be used freely for a period and then more or less retired for three years without markedly interfering with farm economy. The ultimate advantages accruing despite the immediate loss of butterfat will need to be most convincingly argued if the retention of sires in the process of being proven and surplus to the farmers' needs is to be ensured. Perhaps the physiologist can assist in this sphere. By blood tests rather than progeny tests, he may be able to indicate at birth those animals most likely to have desirable genotypes, thus reducing the expense, inconvenience and many of the disappointments involved in Proving Sires.

Using the increased number of "Merit" Sires available to best advantage necessarily involves the use of artificial insemination which, though less effective in this country because of our limited breeding season, increases the number of cows which can be successfully served by one sire five or six-fold. But if the average standard of pedigree sires remains in its present position, the number of daughters required each year to enable a sufficient number of untried bulls to be progeny tested so that the needs of A.I. centres for quality sires be fulfilled, would be such that the genetic improvement in the herds covered by A.I., would be largely nullified by the average quality of the daughters of the large number of bulls in the process of being proven.

It is essential, therefore, that the superior sires which appear be used consistently in nucleus herds generation after generation by whatever mating system is shown preferable. There must inevitably follow some concentration of genes though the progress in one generation is uncertain. Ultimately, however, the young unproven sires drawn from these nucleus stocks for use in the commercial herds should be responsible for fewer disappointments than obtain at present. Should such schemes eventuate, the resulting widespread influence of certain outstanding bulls will necessitate test matings to uncover undesirable factors should they exist.

The concept of nucleus herds appears most promising. But its success depends upon the superior bulls proven in the commercial herds being returned to the nucleus stocks so that an unbroken succession of "Merit" sires can be used. Further, the speed at which the concentration of desirable genes in nucleus herds can be effected depends partly upon the rate at which the generations can be turned over. Any acceleration, however, involves a loss of butterfat which may be beyond the means of the private breeder. These considerations call for an organisation which, by controlling the distribution and return of sires by financing the breeders in charge of the nucleus herds during the

early stages and by planning national breeding policies, will bring about an improvement in our dairy cattle which present day methods appear incapable of effecting.

The Breeds Societies have organisations which for their present purposes of stock registration and transfer, operate efficiently. Should these organisations adapt themselves to meet the needs mentioned above? By playing a more constructive part in cattle improvement and thus fulfilling one of the functions for which they were formed, they would at the same time be advancing the interests of all their members.

REFERENCES:

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4. N.Z. Dairy Board — 21st Annual Report
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TABLE RESULTS OF SIRE SURVEYS ISSUED TO 30.11.45

Av. Product. of Mates for each Sire	No. of Surveys	% Bulls Improving	% Bulls Maintaining	% Bulls Lowering
400 and over	185	6	15	79
380 - 399	218	9	28	63
360 - 379	343	16	26	58
340 - 359	452	22	30	48
320 - 339	456	31	35	34
300 - 319	348	42	37	21
Below 300	384	68	22	10
Total	2386	31	29	40

TABLE II

ANNUAL AVERAGE OF FIRST CLASS 365 DAY C.O.R. RECORDS ISSUED TO MATURE JERSEYS, 1926-45

Year	Number	Milk	Test	Fat	Days	
1926	97	9794	5.54	543	350	
1927	78	9670	5.65	546	353	
1928	65	9396	5.57	523	339	
1929	85	9631	5.45	525	340	
1930	127	9690	5.52	535	344	x
1931	135	9915	5.51	547	350	
1932	74	9880	5.63	556	354	
1933	79	10488	5.57	584	358	
1934	115	10240	5.56	569	355	
1935	73	10435	5.52	576	358	
1936	93	10283	5.59	575	354	
1937	97	10363	5.61	581	347	
1938	97	10172	5.63	573	342	
1939	95	9632	5.61	540	351	
1940	107	10550	5.65	596	355	
1941	104	10535	5.58	588	351	
1942	93	10203	5.45	556	353	
1943	76	10091	5.59	564	350	
1944	112	10087	5.52	557	355	
1945	95	10713	5.53	592	354	

x Minimum standards raised 35 lbs. at the beginning of 1931.

N.B. Tables for other age classes and other breeds are omitted but the findings for these are similar to those shown above.

DISCUSSION ON MR. STEWART'S PAPER:

DR. FILMER:
I congratulate Mr. Stewart on an extremely able presentation of his case. It is one of the most balanced accounts of cattle breeding we have had the opportunity of listening to for some time. He has not hesitated to criticise the stud breeders, but I think he has been fair to them in pointing out that it has not always been their fault that they have not done better than they have. Only recently has the idea of progeny testing become at all popular, and it is therefore not very surprising that stud breeders have not taken very much notice of it to date. He has also shown us that the industry must take the lead in this matter, and has indicated that while progeny testing does look - to put it crudely - "the best bet", it is not entirely fool-proof yet, and in some particulars we still have to make the case. Fortunately, we have in this country a dairy organisation which is alive to the need for work, and that work is actively going ahead. Having made the case, it then remains to put it into operation through what Mr. Stewart has called, "the nucleus herd". I think he has probably adopted that term to indicate that it need not be a "stud herd", as we understand the term today. It may, however, be a stud herd, and I believe it will be of advantage to the industry to sell that idea to the stud herds, and for those who take it on, if the idea is right, the benefit from it will be so great that the idea will spread.

MR. MC.LEAN: Mr. Stewart has brought up what is, I think, a rather important point, and that is the possibility of not neglecting the improvement of other constituents of milk than fat. This is a particular problem with which we are faced in the South Island, particularly with regard to the supply of milk to city areas. One knows very well that there are cows of certain breeds which will produce an enormous quantity of fat in a season, but unfortunately they have the capacity for mixing that with a large quantity of water; consequently, the folk who have to drink the milk are rather concerned about it. On one occasion, a suggestion was made that perhaps a change of breed would be one of the ways in which this problem could be overcome. That, however, was not acceptable to the producers of milk in the South Island for city-supply areas. It brings up a further point which is of some importance - should the dairy industry swing towards the production of dried milk? If one envisages a decrease in the demand for butter-fat, then perhaps it would bring forward the necessity of breeding for the non-fatty solids. One cannot help feeling that it is the non-fatty solids which are the important nutritional constituents of milk. They should not, therefore, be neglected in our animal breeding work.