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DAIRY HERD IMPROVEMENT THROUGH BREEDING

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Methods of breeding improved dairy cattle have changed little over the past century. In spite of the publicity given during recent years to research work on breeding, scientists have not yet developed spectacular new breeding methods which have proved vastly superior to the tried methods of the past. The problem of breeding all cattle to a uniform level of merit, equal to the best we have at present, is still unsolved.

The only comparatively new things in breeding are techniques—herd testing, artificial insemination, deep freeze storage of semen, statistical analyses—which may help to extend or refine the application of the old breeding methods. These remain the same—pure breeding with its extreme of inbreeding, and outbreeding with its extreme of crossbreeding. Inbreeding is rightly unpopular; other things being equal, it undoubtedly leads to a decline in milk yield. Planned crossbreeding is unfashionable; certainly its merits for raising cow yields are still under experimental test. There remains selection within a pure breed.

The principles of selection are very simple. If you breed from your best cows and bulls you are more likely to produce high producing offspring than if you breed from your worst. The difficulty arises in deciding which are the best animals—particularly in regard to milk and butterfat yield. To begin with, the dairy bull cannot be accurately selected on his own appearance or performance and it is not always immediately obvious which is the best cow.

The scientist can be of great help in this matter. Partly by theoretical calculations but mainly by careful analysis of existing production records, he can discover what has been or would be the effect of various methods of evaluating cows or selecting bulls. Accordingly he can recommend which methods should give the maximum improvement rate.

Causes of Variation in Production Between Cows Within and Between Herds.

The geneticist (who is interested in the science of inheritance) can help in the problem of obtaining increased economic yields of milk and butterfat, but much of his help is in a negative way. To amend the old saying: "about three-quarters of the pedigree goes in at the mouth". All research points to the same conclusion—that only a small part (about a quarter) of the variation in yield between cows within a herd is due to genetic differences which can be transmitted to the next generation. Even less of the considerable variation which exists between herds is due to "inheritance". It is difficult to define the exact nature of the non-transmissible differences within a herd. They may be the permanent effects of differences in the way cows were reared, or they may be due to chance differences in health or nutrition which are impossible to control, or they may be due to non-transmissible genetic complications. One would expect that improvement in management would iron out the environmental differences between cows within a herd so that only the genetic ones remained. In general this is not so. In high yielding herds the cows are slightly more uniform in yield than in low-yielding herds but the difference is not very striking. We must

accept the limitation that the heritability of both milk yield and butterfat yield is low. Nevertheless, there are sufficient genetic differences between animals within a herd to give a sound basis for selection.

The differences between herds are of a different nature and there are many complicating factors. That they can be of genetic origin to only a very small extent is clear from the structure of breeds. In every dairy breed that has been investigated all bulls descend from a few fashionable bull-breeding herds, or else their sires or grandsires come from these herds. At the same time there is a continuous interchange of cows between herds. This means that the fund of genetic material within a breed must be very similar. The observed differences between herds must therefore be largely due to differences in environment such as climate, soil, topography, feeding, hygiene and, by no means least important, the personal factor.

The overwhelming importance of environment in affecting cow production has been demonstrated experimentally and by commercial herd production figures both in New Zealand and overseas. The yields of individual cows, and even of whole herds, can be increased tremendously by special feeding and individual attention. In one famous Danish experiment, for example, the average yield of six mature cows in an average commercial herd was increased by such special treatment from 1006 gallons of milk at 3.69 per cent. fat in one lactation to 2319 gallons at 3.93 per cent. fat in the next.

That the differences between herds are very largely of environmental rather than genetic origin is expressed facetiously, but none the less truly, by the advice: "if you want to achieve the high yields of an outstanding herd, then buy its stockman and not its bull!" However, it has been shown that some genetic differences between bull-breeding studs do exist but these are much smaller than is generally supposed.

Nevertheless, as a first conclusion, it must be conceded that the average yield of almost any herd can be improved by attention to feeding and management.

Selection of the Most Suitable Breed

From a breeding point of view the first question to ask is whether the breed at present carried is the breed most suitable, genetically, for greatest yields of milk per acre on the one hand, or butterfat per acre on the other. The production of tested pedigree cows on a per cow basis in the 1955/56 season in New Zealand was as follows:—

	No. of Cows	Average Milk (lb.)	Average Butterfat Test (lb.)	Average Butterfat Yield (lb.)	Average Days in Milk
Ayrshire	8,410	6,930	4.09	283	258
Friesians	7,735	9,200	3.65	336	271
Jerseys	49,781	5,930	5.34	316	264
Shorthorns	3,160	6,970	4.01	280	257

However, field surveys by the N.Z. Dairy Board's Herd Recording Department confirm the widely held belief that the comparatively small, high butterfat testing breed, the Jersey, yields more butterfat per acre than do the heavier, lower testing Ayrshires and Friesians; but the Friesian is the most suited to high yields of milk per acre.

The average yield of tested Red Danish cattle is about 8844 lb. milk at 4.14 per cent. butterfat, which gives an average of 366 lb. butterfat per cow. There could be a demand to import some of these cattle to give us still higher yields of milk or butterfat per cow or per acre. But here again the question arises: would it be better to import a Danish farm manager? That would certainly be easier!

Once the best breed for the purpose has been obtained the most difficult task of all has to be faced—how to improve it genetically.

Desirable Qualities in Dairy Stock

Of all the qualities desired in dairy stock—high production, fertility, longevity, ease of milking, resistance to disease and absence of physical defects

—few are strongly influenced by hereditary factors. Regular calving at twelve-monthly intervals is far more likely to be hampered by disease and by poor breeding records than by hereditary factors. Few cows are given the chance to exhibit what ability they might have to live to a great age because of earlier culling for low production and disease. Then in regard to ease of milking and to disease resistance it is true that cows with these characteristics are more likely to leave daughters with these qualities than are cows which do not show the traits. But the odds are not high. On the other hand, physical defects are strongly inherited and hence can be effectively eliminated from a herd very quickly.

In short, by paying attention to good feeding and management of a dairy herd many of the qualities desired in the stock can be achieved.

Nevertheless, by concentrating on production qualities in the selection of breeding stock, genetic improvements in producing ability can be achieved.

Improvement Through Selection of Breeding Dams

In selecting breeding dams it is important to emphasise herd testing records, but these must be approached with caution. Lifetime records of production provide a very much more reliable guide to breeding worth than do first lactation records or highest lactation records at any age. The progeny test is of little practical use in selecting breeding dams because so few cows have sufficient daughters to allow comparisons to be made. However, four records of the dam's own production give information concerning the breeding value equal in value to that obtained by measuring one lactational yield of each of ten daughters. Hence continuous herd testing provides a valuable tool in the selection of breeding dams.

However, unless every effort is made to control herd wastage it will not be possible to save herd replacements from only the highest producing cows in the herd. New Zealand data indicate that three out of four apparently normal heifer calves born must be saved on the average dairy farm if the farmer intends to rely on home-bred replacements to keep herd size constant. In fact, though, herd testing data show that the usual replacement heifer reared in tested herds is from a cow which is 14.6 lb. butterfat better than the cows from which no replacement calves are kept. As the sire contributes half the genetic make-up of the offspring, the heifer replacements can be expected to repeat about twenty per cent. of the superiority of their dams. Hence in tested herds the replacement heifers will show an improvment of 2.9 lb. butterfat per generation. If the generation interval is five years, this represents an improvement in the herd average of 0.58 lb. fat per cow annually.

Improvement Through Selection of Herd Sires

It is well worth while spending some considerable time and effort in selecting the herd sire. Over his lifetime he will probably leave twenty times more daughters than any one cow. Fortunately, there is more scope available in the selection of the sire than in the selection of replacement heifers.

Assessment of the breeding worth of dairy herd sires must depend upon the performance of their female relatives. There are three kinds of female relations of real interest to the farmer who wishes to estimate the breeding worth of his bull—the bull's dam, his half and full sisters and his daughters. A bull is as closely related to his dam as he is to his full sisters and his daughters. Consequently the performances of his dam, or a sister, or a daughter, give equally reliable estimates of the breeding worth of the sire. That is, one lactation of his dam gives as good a picture of the bull as does one lactation of one daughter.

A sire can have only one dam; he seldom has any full sisters, but he may have many daughters. An estimate based on the performance of one female relation is not as reliable as that based on the average of a number of female relatives. It is the fact which makes the progeny so valuable in estimating the breeding worth of sires.

In New Zealand the Herd Recording Department of the N.Z. Dairy Board makes available to testing farmers a method of progeny testing which is as accurate as present-day knowledge can make it. The "sire

survey", as the N.Z. progeny test is called, enables the best breeding strains of dairy cattle and best individual bulls to be identified. The results of these sire surveys are published annually in a register for all interested to peruse. The superior bulls are called "proven merit sires".

In small herds of less than fifty cows it is extremely difficult to adequately progeny test sires. It usually takes six years to prove a bull, by which time in small herds most of the cows in the herd will be by the sire in question. This can be embarrassing if the sire proves inferior, and further, if the bull were to be used further in the herd, inbreeding, which is generally regarded as undesirable, would have to be practised. Then again, accommodating bulls on such small farms over long periods can be costly and difficult. Sire surveying is best left to owners of large herds.

Nevertheless, owners of smaller herds, as well as owners of larger herds, should take advantage of the proven merit sires which are in the industry. But it is not usually possible to purchase a proven merit sire. However, through the artificial breeding service of the N.Z. Dairy Board it is now possible for dairy-farmers in almost every part of New Zealand to obtain semen at reasonable cost from outstanding proven merit sires.

The second choice to a proven merit sire is the son of a proven merit sire out of a cow with not only a high lifetime production but which has also exceeded the average of the other mature cows in the herd by a substantial margin. Such bulls can be bought privately and are also used to a limited extent in artificial breeding. However, it should be appreciated that such bulls are still a gamble and so should be used sparingly until they have been adequately proven. It would be most unwise to allow more than twenty per cent. of the cows in the herd to be sired by any one unproven bull for fear of the chance that he will prove disappointing.

Undoubtedly the soundest plan for herds in which sires are not being surveyed and for which artificial breeding is not desired, or is not available, is to use a series of sons of proven merit sires. Such sons will be better "breeding bets" still if they are out of cows which not only have a series of four or more high production records to their credit but also if these records are consistently higher than those of the other mature cows in the same herd. Of course, if artificial breeding service is available, then use can be made of the "Nominated Service" from selected merit bulls at the A. B. centre to deliberately breed sons of merit sires out of the best cows in any one herd. Provided the latter measure up to the production requirements stated above, and meet requirements in regard to dairy type, then they need not be registered pedigree animals to be dams of potentially good breeding sons. Naturally, these sons of grade cows would not be eligible for registration in any official herd book but this would not be of concern to the dairy-farmer who is not breeding pedigree stock.

There is no doubt whatsoever that by focussing attention on the selection of herd sires and selecting these on the basis of sire survey results, definite and significant progress can be made in improving the producing ability of dairy stock. Moreover, there is evidence that the average production per cow in tested herds in New Zealand has already been increased through the application of sounder methods of selecting breeding stock.

It is true enough that immediate gains in production through breeding better stock may appear insignificant compared with the staggering results that often accrue from improvements in feeding and management. But genetic improvements are transmissible to offspring and hence are permanent. Genetically superior stock produce at higher levels than do poorer stock in any environment. Further, and probably of most economic importance of all, it requires no more physical effort and possibly no higher outlay of cash on the part of a farmer to use a good bull than it does to use a poor one.

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