ANIMAL HUSBANDRY

CATTLE BREEDING AND ITS PROBLEMS*

IT is twenty-six years since, through the discovery of Gregor Mendel's work, the foundations of the science of genetics were laid.

In two respects these years have been very fruitful. The theory of genetics has been quickly built upon the rock of Mendel's discovery, and to-day it is a tolerably complete and, so far as one can tell, a thoroughly sound structure. It is, of course, true that the simple Mendelian hypothesis has had to be amplified and modified, and that the mechanism of heredity has turned out to be a good deal more complicated than was at first foreseen. Nevertheless, genetics is now an exact science, whereas the pre-Mendelian books on breeding contain only a mass of uncoordinated facts and observations. The breeding of plants for economic purposes has also made immense progress. The species which provide the easiest material have been taken in hand with notable and even brilliant results, and the most troublesome are being tackled with new and reasonable hope of success.

In another respect these years have proved comparatively barren. The practical business of stock-breeding stands today very much where it did twenty-six years ago; indeed, it is difficult to maintain that much real progress has been made since Bakewell worked out his system in the latter half of the eighteenth century.

At the moment it is possible to argue for either of two points of view with regard to the future of animal breeding. On the one hand, it can be maintained that the heredity of our farm animals presents so complex a problem, and that the number of individuals that can be handled is so small that Mendelian analysis is quite beyond the bounds of practical possibility. It can be pointed out that Morgan's Fruit-fly (which is presumably a simple organism compared, say, with the dairy cow) possesses at least two hundred pairs of Mendelian factors, and probably a good many more; that it is a species which can be bred literally in millions, and which produces a generation in a few weeks; and yet it has taken a decade and more for a large team of brilliant scientific men to work out a somewhat incomplete picture of its heredity. At the same relative rate of progress, it would require centuries of experimental work on a vast scale to analyse the germ-plasm of a large and slow breeding species like the ox.

There is another side to the argument which I shall try to put before you presently; but in the meantime let us examine our existing methods of breeding and consider wherein and how far they succeed or fail.

There are, of course, certain old established and generally accepted principles that are very good so far as they go. In essence these are reducible to two, which are both as old as Bakewell. Nothing could be better, as a general guide to the first steps of live-stock improvement, than the advice that we should "breed the best to the best." The great early breeders started by selecting the choicest specimens that they could find, or that they could afford to buy, among the general stock of the country, and their subsequent procedure amounted to a severe culling of females and a careful selection of sires. The result was that, for the first few generations, there was marked improvement in the general merit of their herds.

* Reprinted from *The Journal of the University College of Wales*, Vol. XVI.

But with such a method a stage is soon reached when progress slows down and even ceases, and the only further result of our labours is to prevent deterioration. If we start with a herd of cows having an average yield of four-hundred gallons, it is usually an easy business to raise the average, by selection, to six or seven-hundred gallons. But it is very hard, by the same methods, to reach eight or nine-hundred gallons, and even more difficult to maintain such a level from year to year. Again it is comparatively easy (if one has the money) to collect a herd of thousand gallon cows, but it requires rigorous selection to maintain an average of eight or nine-hundred gallons among their progeny. This is what Galton meant by his law of filial regression, this tendency among the progeny of any selected group to regress towards the mean of their race. The explanation, as far as milk production is concerned, is probably that the thousand gallon cow is the result of a happy accident in the way of a combination of Mendelian factors; and partly too that milk production is a fluctuating character, determined by other influences than heredity.

Mass selection then is like swimming against the stream; at first the swimmer makes good progress, but this becomes progressively slower until at last he must exert all his efforts to avoid being swept backwards. It is my belief that, in the more highly improved of our flocks and herds, mass selection is already played out. With the best judgment in the world and with a purse as long as need be, the owner of such a herd who sets out tc buy a young sire is about as likely to do himself harm as good.

The more one sees of the best herds, the more one is driven to the conviction that further progress is only to be made by what the genetics call genotypic selection—the principle of breeding from the proven sire. It is sometimes claimed, and it is possibly true, that there are men who are able, by some kind of instinct, to recognize a great sire before he has been tried; personally I have never met a breeder of wide experience who did not freely admit that he had made big mistakes. It is a commonplace that a really good sire can make, and that a really bad one can ruin a herd, yet, on the whole, surprisingly little trouble is taken to distinguish, by actual trial, the one from the other.

It must, of course, be admitted that genotypic selection presents difficulties. In a dairy herd it involves postponing judgment on a sire until his daughters come into milk, by which time he is probably five years old. But if breeding is to be anything more than a gamble, it is the only system to follow. Bakewell found the practical solution on many of its difficulties when he began his scheme of letting out (instead of selling) his bulls and rams, and thus ensured for himself a wide choice of tested sires.

Even genotypic selection has the drawback that it does not help us to achieve finality. We must keep on testing out sires, one after another indefinitely, always facing the risk that sooner or later we shall not find the animal we require. The lot of the plant breeder, in many cases, is a far happier one. If he produces a Yeomen Wheat or Victory Oat, he has got something tangible and permanent, a landing place where he can escape the current of regression. Is it not possible, by some imitation of his methods, to secure the same advantage?

In plant breeding the principle that has been most fertile of results is that of the pure line; if the animal breeder could, by intensive in breeding, produce completely homozygous strains, he too would secure the advantage of complete fixity of type; it is true that he might inadvertently or unavoidably fix a certain number of undesirable factors, but by crossing one pure-line with another, and by fixing and re-selecting new pure-lines from among the progeny, he might hope ultimately to eliminate these.

But in plant breeding the pure-line system is not universally applicable. Working admirably with species like wheat and peas, which are normally self-pollinated, it breaks down with grasses and clovers, chiefly because of the phenomenon of self-sterility the plant refuses to allow itself to be inbred to the necessary extent.

It is then a question of some importance whether or not pure lines, or strains approaching to the pure-line conditions, are possible in farm live-stock. It is conceivable that the answer may vary from species to species. Pure lines have actually been produced in certain species, *e.g.*, in Drosophila, the Guinea Pig, and the Rat; but there is the possibility that there may exist in other cases a state akin to self-sterility in plants. The answer can only be discovered by trial, and experiments are now being undertaken, for example that with Welsh sheep at Bangor. These experiments will necessarily be tedious and costly, but the point that they are designed tc settle is of fundamental importance for the future of the breeding industry.

If pure-line breeding should be possible, the stock breeder will be in a sense more favourably situated than the plant breeder, because not only will he be able to perpetuate his fixed types, but he will also have the possibility of producing first crosses between these types, and thus securing, for commercial purposes, the added advantage of hybrid vigour.

This, of course, is taking a long view, and in the meantime let us return for a little to the questions of more immediate practical concern.

Practical methods for the further improvement of our cattle must necessarily be confined, for the most part, to measures dealing with bulls. In the main, although there are exceptions, good females are retained for breeding and poor specimens are slaughtered, and on this side little more can be done.

The bull problem has two aspects; the bull breeder should try to produce a good article, an animal that will leave, in an ordinary herd, a lot of uniformly good progeny. On the other hand, the breeder for commercial purposes should be helped in every possible way to secure the use of good sires and should, in my opinion, be prevented from using definitely bad ones.