

SYNERGY

IN DATA RECORDING:

FROM VISUAL TO SELECTION

by Japie van der Westhuizen: SA Stud Book and Animal Improvement Association

PART 1: Lessons from the past



A vogue developed for the 'agricultural conversation piece', where a farmer or landowner chose to be portrayed, not with his wife, children and dogs or horses, but with his livestock and farm employees'. (from: www.jonnyglover.com)

Robert Bakewell (1725 - 1795) (From <http://www.bbc.co.uk/history>)

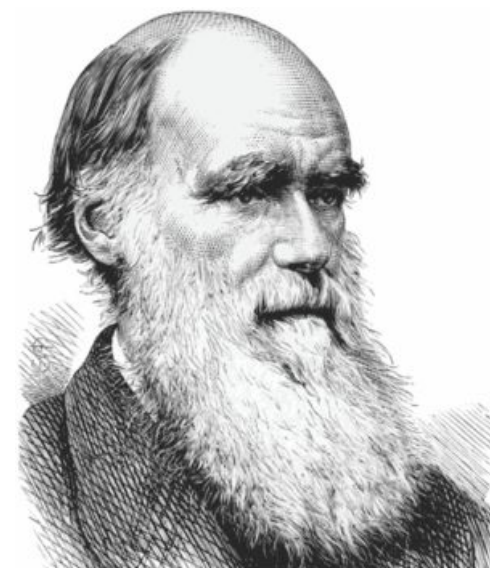
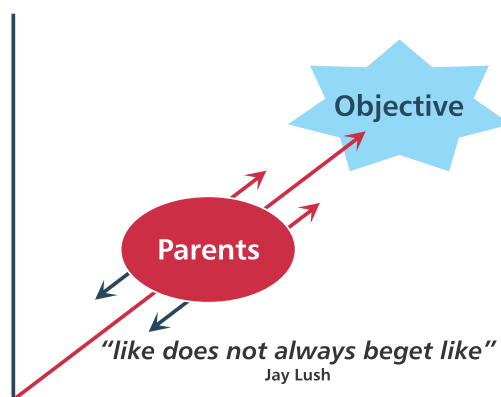
With cattle, Bakewell had noticed that the Longhorn breed appeared to be the most efficient meat producers. They ate less and put on more weight than any other breed. As with the sheep, he began breeding in-and-in to enhance their characteristics and enable him to 'grow' more meat, more efficiently. By the time he had finished, his cattle were fat and meaty but, like the New Leicester sheep, the Longhorns went out of fashion when one of his apprentices, Charles Colling, created the shorthorn breed. While few cattle today are based on Bakewell's breeds, his methods have become accepted practice world-wide.

how his methods lead to marked modification of the form and qualities of his cattle. An interesting observation of Darwin was with regards to the distinct differences between two different strains of Leicester sheep flocks that originated from Bakewell's sheep flock, but were kept apart as they belonged to and were bred by a Mr Buckley and Mr Burgess. This separation happened over a period of fifty years. Darwin remarked that the unanticipated result was that "the difference between the sheep possessed by these two gentlemen is so great that they have the appearance of being quite different varieties".

In the final chapter of one of the most popular handbooks for final year Animal Breeding students, **"Genetics for the Animal Sciences"** (Van Vleck, Pollak & Oltenacu; 1987) the authors list the four key elements needed to genetic improvement in farm animals as:

- Accurate records, not only accurate recording of pedigrees, but likewise collecting records of performance.
- Defining, as accurately as possible, the relative economic values of economic traits as **too much emphasis on selection on unimportant traits will slow down selection progress.**
- Making proper use of proven breeding and selection principles. One could be that **over emphasis on famous but distant relatives will hold back progress.**
- Use Genetic Evaluations. Here they are referring to the **combination of genetic merit prediction for individual traits of economic value weighed by their respective economic weights.**

Although Robert Bakewell, regarded as the "father" of stud breeding, observed that carefully selected animals are more likely to produce progeny outperforming the progeny of mediocre parents (hence the term **"like begets like"**), the father of modern day animal breeding, Professor Jay Lush, coined the phrase: **"like does not always beget like"**.

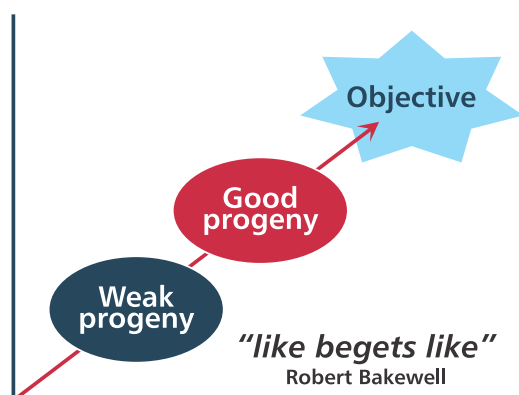


Darwin went to great lengths to describe the effects of artificial selection, referencing numerous examples of what the results of these efforts were. **He even described legislation setting minimum breed standards for horses:**

"In rude and barbarous periods of English history choice animals were often imported, and laws passed to prevent their exportation: the destruction of horses under certain size was ordered, and this may be compared to 'roguing' of plants by nurserymen".

This means that selection for superior animals as parents will most likely produce superior offspring, but not in all cases, as variation in the performance of such progeny is very likely, with some even outperforming the best parent and others performing poorer than the worst parent.

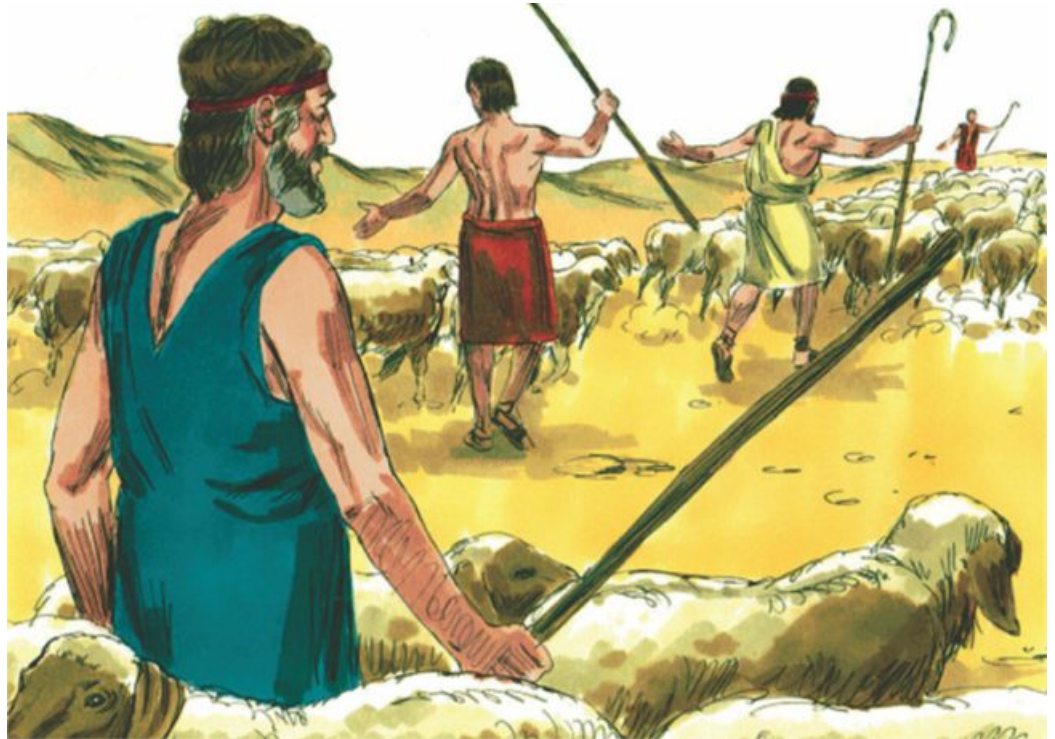
It is fascinating to read about the innovation and ingenuity of Bakewell. Apart from his forward thinking and application of pasture enhancements and irrigation, his experimentation in breeding superior farm animals sets him strides ahead of anyone else of his time. Even Charles Darwin cited his work in "On the Origin of Species" as demonstration of



He made a very interesting reference to South Africa where he referred to the local people “match(ing) their draught cattle by colour”. He also quoted Livingstone in referring to the “Interior” African people cherishing the good qualities of their domestic breeds, people that have “not associated with Europeans”. He believed these keepers of cattle show practices that support the **theories “that the breeding of domestic animals was carefully attended to in ancient times,** It would, indeed, have been a strange fact, had attention not been paid to breeding, for the inheritance of good and bad qualities is so obvious”.

These references, somehow ridicule the belief of some that our present day indigenous (“Sanga”) cattle is merely the result of randomised mating without the interference of man. One could even argue that the African herdsman and owners of cattle laid down their own “breed standards” by favouring some bulls as favourites to sire the next generation's progeny.

Reference to successful selection and preferential mating also goes way back to Biblical times when Jacob not only had to earn his keep, but also had to put his mind to the breeding of specific colours and patterns in small stock to earn a right to marry his cousin (Genesis 30: 31-43). After having to work without remuneration for fourteen years, tending to the flocks of his uncle Laban, but being allowed to marry his cousins, a new deal was struck. It allowed Jacob to keep the lambs and kids that are speckled and spotted from his uncle's flocks, as reward. In a cunning act his uncle had all the sheep and goats with these colour patterns removed (as well as the ones that were likely to breed these patterns, the “streaked” ones) from the flocks under Jacob's management to other flocks under the care of his sons, not allowing access to them by Jacob. This forced Jacob to breed progeny with these characteristics from the ewes and rams with solid skin and hair colours.



Jacob was not only successful in breeding a majority progeny with the desired colour patterns, but also **selected for superiority of performance**, leaving his uncle with the “weak progeny”.

⁴¹ *Whenever the stronger females were in heat, Jacob would place the branches in the troughs in front of the animals so they would mate near the branches,*

⁴² *but if the animals were weak, he would not place them there. So the weak animals went to Laban and the strong ones to Jacob.*

⁴³ *In this way the man grew exceedingly prosperous and came to own large flocks, and female and male servants, and camels and donkeys”.*

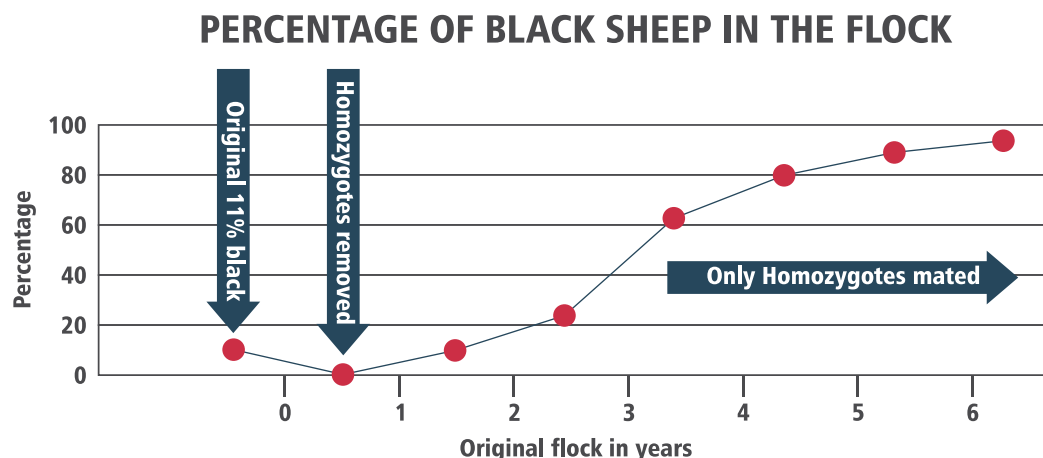
(New International Version (NIV) Holy Bible, New International Version®, NIV® Copyright ©1973, 1978, 1984, 2011 by Biblica, Inc.®)

After 14 years of experience managing the flocks, Jacob became very familiar with the coat colour inheritance in small stock.

He, furthermore, applied selection and mating principles (hand mating) to ensure superior offspring for other desirable traits. His success came within six years of mating.

Using information that colour inheritance in sheep takes place and other very likely assumptions on the frequencies of the forms of the genes influencing coat colour and patterns, stable flock size, the predominant culling of males and the business acceptances of the time (by Jacob's uncle Laban in this case), the most likely scenario would have been that 44.5% of the sheep would only carry the white (two dominant) formats of the genes, 44.5% would carry a white and black format of the colour genes but will appear white (one dominant and one recessive gene) and 11% would have been black (homozygous; two recessive genes). Even after the removal of the black (spotted) sheep, half the flock were still carries of the black (or spotted) gene.

If Jacob carefully selected the right sheep, starting with carries of the sought-after genes, the following graph depicts what would have happened (from Pearson, J.D. Science and Christian belief, Vol 13 No1; 51 – 58) due to applying the right selection plans.



From these few examples, some **lessons** can be learnt for successful breeding:

- All selection is based on the available variation in the population (usually the breed or your herd) you select from.
- The differences in appearance, measurement or observation will not necessarily be transferred to the progeny. The mode of inheritance and the proportion in differences due to the transferable genetic differences should be known.
- Selection without a proper breeding objective and measurable goals will lead to nothing.
- Proper recording is a prerequisite for successful breeding and attaining goals.
- The basic principles of inheritance, breeding and the effect of mating plans have not changed. New research results simply confirm them and allow the implementation of the latest techniques and tools to accelerate genetic progress while limiting any dangers.

Even in ancient times, **Jacob** (possibly with the assistance of Rachel, that once looked after her father's flocks) basically used the same principles to become wealthy from breeding livestock:

- He set **breeding objectives** that included multiple traits or properties (colour patterns as well as fertility, growth and ewes looking after their lambs) with differing modes of inheritance (Mendelian inheritance (non-additive genes) for coat colour and quantitative inheritance (additive genes) for the reproduction and production traits).
- He probably was **unable to keep proper records** of the lineage and pedigrees of the animals considered as selection candidates, but looking after them for such a long period raises the possibility that he was **very familiar with the family structure in the flocks**.
- Performance (and reproduction) as criteria for selection were not the only consideration in his selection program.

He most probably also included functional efficiency and visual appraisal in selecting parents for the next generation, hence the reference to him being able to breed "stronger" lambs for himself.

- **He recognised that setting of breeding objectives, measuring animals against these objectives and selecting on these rankings were important**, but the final step is the careful mating of individuals (possibly using hand matings). It is not known if he inadvertently retained genetic diversity by restricting inbreeding but it seems as if reproduction rate and survival was not at stake. ■

In the follow-up article, these principles and practices for modern day breeders will be discussed.

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