SOME OBSERVATIONS ON
Belted Galloways

Correspondence from William Storrie
Netherwood Farm, Bathgate, West Lothian

Our ongoing correspondence with the late William Storrie during the latter years of his life provided many provocative insights into the belting principles and other attributes of our breed. Mr. Storrie wrote interestingly and informatively from the vantage point of study and observation of the Netherwood herd, closed to outside bloodlines for almost 30 years. Some of his insightful comments have been published in the Belted Galloway Society's Breeders Handbook. Other observations written before and after the International Belted Galloway Teleconference in 1993 are offered below. Photos included are of the Netherwood herd and may be viewed in enlarged form by clicking on the image.

Netherwood, Bathgate,
West. Lothian. EH48. 4LF.

19 September 1993

To: Jane Faul

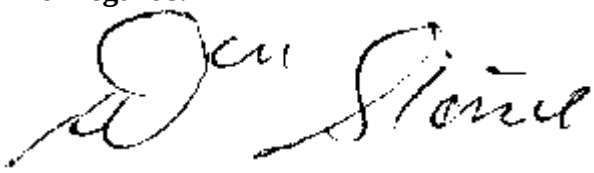
Dear Jane,

I doubt if I am the right person to comment on the perceived wisdom currently being traded on the genetics of Belted markings or mis-markings. I just happen to think that our current beliefs on the inheritance of 'marking' are poorly founded and have been for generations. I can think of no other explanation for the failure of many dedicated and competent breeders to eliminate 'mismarkings' and fix the 'proper markings'.

Most breeders will find it a bizarre hypotheses that Belties are white animals with black markings and that the ability of a developing cell to become pigmented and the subsequent expression of a white middle is dependent on a series of morphogenetic gradients. The idea is a relatively simple one. But the model it builds becomes increasingly complex as development proceeds. For the most part it is of academic interest only: in practical commercial breeding it doesn't really matter whether they are 'black on white' or 'white on black'. But it provides a better basis for understanding why numerous anomalies still occur in the markings.

... I enclose an initial statement sent to the members of the Teleconference held on 8th May together with a suggested draft followup which was sent as a private correspondence for discussion prior to making any definitive statement. It needs considerable cross references and acknowledgements to published research papers to be meaningful.

Kind Regards.



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Netherwood, Bathgate,
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<u>To; All Invited Members of Teleconference 8th. May 1993.</u>

Regrettably, I will be away from home and unable to take part in this conference, which may well be an historic event and a turning point in the fortunes of the Belted Galloway Breed.

Since this will largely be concerned with introductions I hope that the following will serve in my absence.

I am principally concerned with the conservation of the genetic endowment of the 'original' Beltie and operate within a closed nucleus founded on six foundation dams (two lines since discarded) and one bull line. The mature weight of the retained females is above 560Kgs (1230 lbs.). The seventeen and fifteen yr. old, weighed on the 27th. of this month were 510 & 520 at their mid lactation (end of winter weighing). That bull's lowest weighing, when standing at AI was 1020 Kga. Some of the US members have walked the herd

and have handled the present stock bull who is his son. He weighed 940Kgs (2070 lbs) on the 27th (160 Kgs less than his full condition weight). So my idea of 'original' is on the heavy side of average.

Conservation of genetic endowment in a small (40 females/4 lines) nucleus cannot conserve the genetic variation of the breed. It is simply a snapshot at one particular moment of time from one specific viewpoint. It is simply a reference point, not unlike the original Hereford Angus controls used in the Germ Plasm evaluation Program at Clay centre in the US, without the variation inherent in the vastly larger sample numbers. Determining more than one reference point, is crucial. I can only provide one reference point, one specific set of genetic endowment interacting with one particular environment. We could charge into increasing the numbers on the ground and get it disastrously wrong !

Conservation by MOET? In my initial program I collected 70 embryo. 56 are gene banked. All the original dam lines, bred back one generation to Firth King Henry and some semen from his son Burnside David (my original foundation bull).

To round off the 'hands on' experience Dr. Butson agreed to take four embryos into Canada and now has three calves on the ground and one to come. Mr. Chatfield has three and Mr. Randy Hadden in Georgia has two. They all came from a single flush from one donor (Netherwood Nan). Simply in number terms this donor, now six and a half and nursing her fourth natural calf, has already contributed 7 additions to the breed, banked 2, and probably another four in utero. Her fifteen year old dam is currently nursing her thirteenth calf and looks good for a few years yet. But, even if I never flush her again, she has already exceeded her dam's lifetime production.

Conservation by IVM/F (Invitro Maturation & Fertilisation). During the program the team assisting in the work (Edinburgh Genetics, Dr J. Mylne) salvaged ovarian tissue, post mortem, from a seventeen year old, put down because of aged arthritis. From this tissue we recovered 32 oocytes, matured and fertilised 28, all of which graded as embryos but I elected (mistakenly) to limit the storage to 11 of the grade 1. With fourteen natural calves behind her, the extra eleven embryos was a considerable bonus.

Although I did it from a conservation aspect it has enormous potential to increase numbers. Much has still to be learned of breed specific problems, optimal donor and recipient criteria, etc. It still has significant cost penalties when used locally: somewhat less when used as a means of genetic exchange internationally. But improved demand for Belties would shift the balance and improved techniques will also bring costs down eventually. It is worth encouraging.

I consider an Embryo and Semen Register, in some form, essential. I grossly

over-recorded my embryos for my conservation records. ... A much simpler record would be perfectly adequate for all other purposes. Here the IETS might be the best advisors.

Our common ground is to prevent the Belted Galloway from disappearing from the World's cattle population, even though our methods differ considerably. I am totally opposed to the introduction of alien genetics without the filter of a full five generation grading up register. I have the greatest respect for the finely tuned judgement of practical breeders who depend on cattle for their livelihood. The Herefords have hit the right button with their Baldy Beef initiative. We have an equally prepotent marker to stamp on Fl crossbreds and exploit in the same way. And retrieve from that crossbred pool the new damline contributions from a few outstanding females being bred back to a Beltie for another four generations. We shouldn't sacrifice the existing Beltie dams to produce the slaughter generations: we need to hold on to them where they are and breed them pure ! !

I might as well take this opportunity to set my stall out.

I am not persuaded that EPD, BLUP or other methods of objective measurements, on their own and commonly used in breeds with large numbers, is appropriate for Belties at this time. We obviously, and urgently, need some easily measured traits of high heritability and commercial significance. Some "index of merit" of the Beltie's other importance characteristics bolted on to EPD might serve us better initially. Too many variables slows progress considerably. But relying on too few can be a disaster.

Some of the suggested EPDs without their related parameters would be meaningless to me. E.g., Height. Would a two year old bull 52 inches in height who was showing more than 16" of daylight under his ribs meet the criteria of chest depth? Or if he was 36" from shoulder to pins, 12" pins to pelvis and 24" shoulder to poll would these be appropriate length relationships for a Beltie? And weight? 1500 lbs in weight and at least 80" in girth. Knowing his EPD based on height and weight doesn't mean a lot without the others.

Testes mass without knowing the scrotal attachment poses a similar problem. The correlation between mass and fertility is soundly based. But the last thing anyone needs in a stock bull is testicles dangling like balls on a piece of string, knocking against his hocks. They need to be in a thick skinned scrotum with a broad firm attachment.

As far as characteristics are concerned, the following are what I think a typical Beltie should have. Not necessarily what they should be, or what breed standards say.

Polling characteristics? Belties are polled. Full stop.

Belties are Black or Dun if they are homozygous, carrying the Galloway dilution recessive. Anything else is a belted variant of another breed.

A full belt. Nice to see it about 14" wide across the back and not too wide on the underside but not critical. Other mismarks? Personally I wouldn't sacrifice an excellent or above average pureblood female from the breeding pool for a minor mismark. Simply move her out into the third or fourth generation of a grading up register, and use a bull excelling in marking on her. Slightly different with a bull. A slightly mismarked bull with a high 'commercial' EPD isn't going to harm the breed's reputation out working in a commercial beef herd. (That demand should almost be an automatic bonus if we get the pure blood criteria right). What do the Herefords do, nowadays, with a bull slightly mismarked about the head?

The only baircoat a Beltie should have is a survival coat. One that sheds rapidly in the spring upwards and forward from the hindquarters; and takes any buildup of lice nits with it before they hatch. The replacement summer coat should be short, shiny and smooth: it later thickens to form the winter undercoat. The undercoat should start to grease up in the autumn when the guard hairs start to show and lengthen: the function of the guard hairs is simply to gather rain and melting snow and channel it down the body quickly

I haven't seen or heard of any of those mentioned in Belties. I do a lot of sib test mating in my nucleus; son to mother, sire to daughter, full brother sister. So far I haven't turned up any serious deleterious recessives.

I test annually for TB, Brucella, EBL, IBR, Lepto Hardjo, BVD, an IPX for hidden virus and every three years for Johnes. But it has no commercial value whatsoever. Disease priority will vary from country to country and herd to herd. Belties are relatively disease (and parasite) resistant. Disease susceptible animals are probably culled, anyway, for other reasons.

Occasionally I have an animal with sunstroke. Never fatal and usually in a wide belted animal.

I select positively for dam longevity (the associated traits fall into place almost automatically -- feet, thrift, milk, survival coat, head protection, udder attachment, teat placement, mothering ability etc.). I discriminate punitively against poor teat placement or loose udder attachment.

Bulls are selected on the basis of their performance within their yearling peer

group. Any male that isn't steered gets the chance to be a bull. (Usually four or five.) A bull that fights his way to the top of the heap gets the rosette. Invariably that means he's the heaviest, develops the best bone & muscle structure, has the right kind of head and feet and is cocksure and masculine. The top two are mated to four of the worst heifers (two each) and the rest are fattened and killed as young bull beef (21 months and around 560 Kgs).

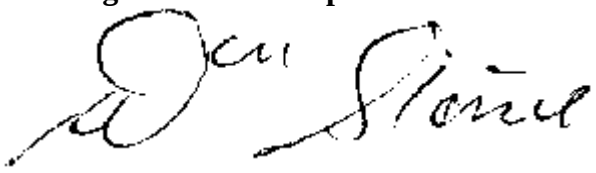
I select very positively for placid temperament in both sexes, simply because fighting with an ill-natured beast is now beyond me.

There is a broad measure of support within the UK for this kind of initiative. Inevitably it must be US led, because of the numbers, and that will mean compromise and give and take from all sides. Smaller societies will want to retain their autonomy within a framework of co-operation rather than compliance.

I hope there is something on the stall that may be of value. This initiative is exciting and has great promise. But it's a big league we're entering. This isn't the ornamental market. Someone has to be the devil's advocate and spell out just exactly what we're up against.

I am online to host computer networks in the US and Europe and can act as an Email postbox in the UK. The conference forums and bulletin boards are not connected with Belties but there is no reason why an attempt couldn't be made to set one up. One significant advantage (in addition to instantaneous transmission of files) is that a log of the proceedings is automatically kept and down loaded at the end of a session. I'm normally on to the US on CompuServe CB simulator (Handle 'Wooden Spoon') for an hour most Sundays from 11 pm GMT. Mostly trivial chat but no reason why it shouldn't be serious. It's relatively inexpensive. ... If any member is online it might be helpful to establish a communication link to start with. The user software is simplicity itself. No special computer knowledge is needed.

Kind Regards to all. I hope we can make it a success.



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Observations on Belted Galloways

by William Storrie (cont'd)

It was a privilege to take part in this first Teleconference and to hear the views of so many prominent breeders of Belties. John Jeffords [teleconference host] has to be congratulated.

I was surprised to find that many commercial breeders continue to agonize over minor mis-markings. Continue to slaughter, on their own admission, some of their good or best performance animals because of a white spot on a foot. Would a Hereford breeder slaughter a high performance rated animal because it didn't have a white switch to its tail? I doubt it: at least, they didn't when I was keeping Herefords.

Beltie breeders have been agonizing over belts and mismarking ever since I started keeping Belties and have probably done so all this century. More often than not the pretty Beltie heifer arrived on the farm as a gift to the new bride as her house cow and survived the harsh reality of survival farming in the early part of the century simply because she was an extremely good house cow. And aptly named 'the romantic breed'.

Today, they are still bought as ornamental gifts to adorn the field near the house and for their docility when handled from calfhood. It is embedded in human nature to want a gift to be seen to be perfect. A Beltie with a white foot might well have been perceived as less than perfect and that idea endures.

Now, some years later, and with a little more understanding of the problem, I have to ask, "Is our perceived knowledge of the mode of inheritance of the markings correct?"

I don't have a white foot problem. But I have two mismarked heifers in the herd at the moment. An almost totally regressed belt and one with a detached black spot, about the size of a saucer. With luck, this will give me an opportunity to find out a little bit more about both of those aberrant markings.

The one with the regressed belt was served a few days ago by her paternal grandsire. Her weight at service was 845 lbs: lifetime daily gain at 24 months 1.15 lbs. That's a poor performance. Yet her dam was never beaten in her class and was a Supreme Champion.

The other with the spot weighed 1378 lbs: lifetime daily gain of 1.74 lbs at 26 months. She is the first ones niece. Her dam, grand dam, two grand aunts, her sire and grandsire have all won supreme championships. By any breed

standard, EPD or otherwise, that's a creditable performance.

I have one other partial control or comparison, left over from the days I kept Herefords. She is a half sister to both. A perfect 7/8th XBeltie bulling heifer who is non registerable, 978 lbs at 21 months; lifetime gain of 1.4 lbs. Her greatgrand dam was the last of my Canadian polled Herefords: her last calf born in 1981 was an XBeltie heifer. She was 21 yrs old and had eighteen calves to her credit.

This descendent heifer is being bred back to her Beltie paternal greatgrand sire. She would stand high in her class at most shows. Some prominent breeders, including some from the US and Canada, were given the chance to pick her out after last year's Highland Show. Not surprisingly they all picked either the regressed belt or the one with the spot.

The mis-marked have full blood pedigrees the length of your arm. At least ten generations. Four of the generations within my closed nucleus.

Let me pose a scenario. The poor performer calves a perfectly marked heifer calf: mediocre or poor in performance but impeccably marked. All I need to camouflage that is a big feed bag. Never mind the quality; feel the width.

The high performer calves a bull calf. A full belt, but a bit narrow across the back, a bit too wide at the bottom, a half moon jink in the middle. And a white spot on his foot; the size of a shilling. And, as is possible, he outperforms his grandsire (2490 lbs); his greatgrandsire (2268 lbs) and his greatgreatgrandsire (2190 lbs). But there is no way into any Register for him or his progeny. His genetic endowment is lost forever.

The XBeltie calves a 15/16th heifer, as perfectly marked as herself; equal in performance or slightly better, l/16th Hereford dam, 15/16th pure blood Beltie sire. Elite performance, perfect markings, indistinguishable in blood type from her pureblood half brothers and sisters. And only distinguished with difficulty by her full DNA fingerprint. Yet once again her endowment is lost.

She'll be carrying an invaluable part of that old Hereford dam from thirty years ago. The mitochondria and cytoplasmic organelles. Virtually immortal, travelling down the generations unchanged and contributed only by the dam.

Sires *can't* pass their mitochondria on to his descendants: it's used up making the sperm tail and that drops off at fertilisation. Numerically, in terms of functional nucleotides in the DNA, 30% comes from the mitochondria and cytoplasmic organelles plus 35% from dam nucleus and the other 35% from

the sire nucleus. We can debate whether the cytoplasmic component has a 40% or 20% or 5% influence on the expression of the genetic endowment. Or even ignore it. But when it's flung away so carelessly, it's lost forever.

Under present rules, probably the best performer and the one most likely to make a valuable commercial contribution to the breed is denied entry to the herdbook by any route. And will be slaughtered.

That scenario has been repeated over and over again this century, Now the breed is on the verge of extinction.

Their blood type, photographic and partial performance records already intrigue me and whets my curiosity. This year I should have a DNA fingerprint for all the Netherwood herd. Who knows what it will indicate in a few more years of continued curiosity. But. unless the mismarked animals can be saved in a commercial grading up register, by then it will be too late.

I shouldn't be arguing this brief, I'm a conservationist, personally concerned with holding on to the limited genetic endowment of the breed I started with and still have at Netherwood. I have 56 embryos safely gene banked and embryo from my Burnside damline still to try and collect.

We can parade them at shows; and show promoters will always want them for the spectacle of some Bellies in the Grand Parade. When I was exhibiting it gave me great personal pleasure exhibiting at shows, and I miss it greatly. On one memorable occasion all the Belties in the Interbreed competition were Netherwood Belties. But Belties don't win Interbreed Championships.

Breeds decline and become extinct for one reason and one reason only. Commercial farmers can't make sufficient profit from the breed and move progressively to other breeds where they can make that profit. And that is the message that we have been getting loud and clear for years.

Perfectly marked belties will continue to turn up among crossbreds as well as pedigree animals. A pedigree the length of your arm won't guarantee a perfect belt. What are the criteria for a perfect belt anyway?

When I started with Belties I was told that the belt was dominant and white feet and mismarks were recessive. The inheritance mode was straightforward Mendelian theory. AA/AA or AA/Aa gave no mismark. Aa/Aa gave some and both parents were carriers; the mismark was 'aa' and would go on producing carriers or mismarks and should be discarded, aa/aa would produce nothing but mismarks. But as a compromise 'aa' females could still be registered, if the mismark wasn't too bad, but male mismarks were barred even if the mismark was tiny. (A=Dominant=belted; a=recessive=nonbelted or mismarked.)

And dun? That was a recessive colour. And the black skin pigment spots in the

belt of a dun heifer I'd bought? Ah, hmmm ah. (B=dominant=black; b=recessive=brown=dun.)

What about scurs? Small ones were acceptable and they were a very rare occurrence anyway.

Mendel might well have had a similar dilemma, but I doubt it. Was this a small wrinkle on a big pea or a big wrinkle on a small one? Was it really yellow? Or were the excessive wrinkles on this pea casting a pale green tone? Well, we'll never know. My guess is that he planted them in a separate plot and examined the progeny.

What I found difficult to accept was that the absence of pigment in the midline was dominant and a similar absence of pigment elsewhere was recessive.

The white feet and other troublesome, recurrent mis-markings were the result of crossbreeding; throwbacks to previous generations and other breeder's errors. Seemed reasonable. At least it was a good fallback position. Females got by a Beltie sire out of a *'Galloway'* cow were Belties and allowed into the herdbook via that year's Appendix register. A loose arrangement at best. But as long as the outcross was to cows believed to be 'Belted Galloway' or 'Galloway' they wouldn't bring in white feet or exacerbate the mismark problem. Genetics, I was assured, was a funny thing.

So I simply did what my grandfather did with his Gold and Silver Laced Wyandottes. I testmated the foundation stock. Sire to daughters; half sibs; full sibs; sons to mothers; as soon as a suitable mating arose.

I was privileged, and greatly indulged, when I was a delegate to the Fourth World Congress on Genetics in Animal breeding in 1990 and was able to parade a team of Belties, including a dun.

Professor Roberts, who had kindly included me as a delegate, introduced me to Dr Alrawi from Baghdad who had made a recent study on colour and performance correlation, and Dr. Lawrie Piper of CSIRO from Australia, whose Ph.D. thesis was on Belted inheritance and seven day weight performance in mice. Thirty years ago as a student at Edinburgh University.

Dr. Alrawi found no correlation. But the bad news was that Dr. Piper, as far as he could recall, had found that as the belt regressed and mismarking increased, performance improved. But commercial breeders of Belted Galloway had already found that out for themselves, long before Lawrie Piper confirmed it with his mice.

After a long and sometimes hilarious debate and cigarette packets turned into Belted mice we decided we just didn't know. The mode of inheritance was much more complex than it appeared to be. Was it partially dominant,

incompletely penetrant recessive, epistatic, hypostatic, many loci and every other option we could think of.

Did the mouse, regressed to white, still have an invisible white belt? Did the mouse regressed to black still have a belt, now masked with a overlay of pigmented hair?

A friend of mine took her White Galloway heifer to be mated to another breeder's White Galloway bull, saw her mated and brought her home. The result? A perfectly marked Belted Galloway. But which one of the parents had the invisible white belt?

The Highlands and Islands Development Council bought a Belted Galloway to serve crofters' cows in the Outer Hebrides. An indignant crofter wanted to know why the Belted Galloway calves had come from crossbred cows and the ones from his 'good Galloway cows' didn't have proper belts and one stirk had a white end on his tail.

Earlier studies into the inheritance of colour coat markings in cattle very rarely went beyond the Fl generations and, as far as I know, no subsequent research has gone beyond the F2. The current studies into the localisation and nomenclature of bovine genes by RFLPs (restriction fragment length polymorphisms) and VNTRs (Variable number Tandem Repeats) doesn't include coat colour or markings. Locus symbols and names follow those for human genes.

Many breeders are unwilling to accept that any differences in the mechanism of inheritance between species is superficial and not fundamental. Personally, I'm quite comfortable in accepting that research in other species is relevant. We don't have much of a choice anyway. There are too few Belties to provide sufficient sample numbers and the cost of mounting a valid research project would run into hundreds of thousands of pounds. All we can do is to provide one of our younger breeders, interested in cattle genetics and belted phenotypes, with as much photographic evidence and observations as possible and tie the findings back to developmental genetics at the cellular level in other species.

DNA fingerprinting in cattle is still experimental but I hope to have full DNA fingerprints for all the Netherwood herd later this year and I may be able to get some valid scientific observations. With this proviso. Observations based on small sample numbers have to be treated with caution until validated by repeats on larger numbers.

I'm on my own in stating my hypothesis that Belties are not genetically black animals with a white belt. They are genetically white animals with a black shirt and trousers that don't quite meet in the middle. Same difference, for most practical purposes.

I've held it for a long time and nothing in my own experience or anecdotal evidence from others has persuaded me otherwise. The two instances of the white heifer and the mongrel cows were just more pieces in the jigsaw. It strengthened my belief that something, some stuff, some kind of signal; whatever it was; was capable of throwing a pigment switch in the cells, very early in development.

Believing that the deposition of pigment is controlled by a morphogenetic gradient emanating from primordial cells at the anterior and posterior poles of the embryo (the front and back end) is one thing; proving it beyond reasonable doubt is an entirely different kettle of fish.

But why don't all the skin cells just fill up with pigment and leave a black animal? The gradient must have a scalar value and at some range of values the pigmenting stops. So the 'stuff' emanating from the polar cells isn't passed from cell to cell at the original strength. It must have a relatively short half life. What about the irregularities on the belt edges and the black skin spots? Damn it! It stutters to a stop. Thank goodness the spots are round and not all mixed up like a tiger's.

Imagine a Beltie skin laid out on the floor and the black marks just a stain spreading from either end. Or try it on damp blotting paper with watercolour and watch how the cells in the paper become pigmented and pass the pigment on to adjacent cells, becoming weaker as it moves away from the pigment source. A primitive illustration of a morphogen, dependent on contact between cells and signal strength to throw the genetic switch in the cell.

It becomes much more complex to imagine the interaction of many gradients in three dimensions. But it offers another possible answer to the inheritance of pigmented skin spots along the backline (the dorsal axis) and the extension of white along the underline (the ventral axis). The partial belt regression phenomenon and the isolated saucer spot where gradients intersect.

A combination of gradient and minor asynchronisation with the developmental clocks (embryonic time) for a very few primordial stem cells could result in the process, fating the cell to produce pigment, being started too late or ending too early. Or, as the cells fated to develop limbs, switch to limb bud cells, they may no longer be responding to the pigment gradient. White foot??

Superimpose a dilution gradient. It again offers a feasible explanation for the black pigmented skin spots on some duns, the variable shades of dun and the occasional dark mark. A distraught new breeder phoned me once; "My Beltie has had a calf, but it's PURPLE. Will it turn black when it grows up?" It didn't grow up black: it was a perfectly marked dun.

Add to that, the probability that it is the dam who determines the axes of the

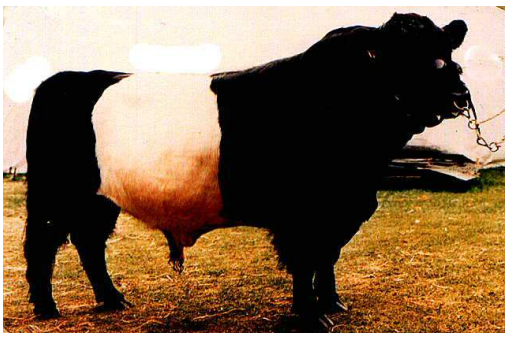
embryo and positions the primordial cells during oogenesis, pre fertilisation, thus laying down the ground plans of the future embryo.

New 'knowledge' comes in with bewildering speed, replacing and refining much of what we think we know with certainty. Only a few years ago, most of us believed that parents dealt out their genes to the next generations with impartiality. Then came the idea of 'genomic imprinting' and 'anticipation.' All the time they've been using a marked deck and it's taken us almost a century to realise that the game was rigged right from the start. "Damn their hides! They cheat!"

We tend to forget that the artificial selection we apply is as much a part of the evolutionary pressure on the species as snow in winter or drought in summer. The fundamental principle in evolution is that it tinkers with what it's got; it makes small changes and lets natural (or artificial) selection test the result. It doesn't advance by great leaps and bounds. That's a fairly sound and well tested model.

And there is no logical process at work determining the interaction of genetic systems or predicting the outcome of genetic change. In Drosophila "nanos," the dwarfing gene, is downstream from a small army of gene. "Hunchback" is present upstream, it's role in that genetic system is simply to clean up the effect of "hunchback" in the posterior segments and allow normal abdominal development to proceed. Otherwise "hunchback" is lethal, "nanos" in other gene cascades produces different effects. When both are absent the embryo and adult is normal. How illogical can you get! Why didn't evolution just eliminate them both? Quite simply it tinkers with what it's got. If the resultant combination works, it keeps it.

<u>I asked at the beginning and I'm still asking; "Is our perceived knowledge of the mode of inheritance of the markings correct?"</u>



The pursuit of knowledge about the inheritance of markings can be a fascinating study for geneticists and molecular biologists. But for all practical commercial purposes it is academic.

I think it would be a great folly to attach overriding importance to perfect markings in the commercial herds. It would be an even greater folly not to have the protection of a five generations genetic filter. It will be twenty years before the first animals start filtering into the fullblood register. Almost certainly, some of the grading up animals will perform well in many different environments and do a great deal to promote the Belties commercial qualities.

And genetics "is not a funny thing," as I was once told. But it needs a lot of time and patience, test mating and reciprocal back crossing to form the most tentative theory.

What we've got is all we've got and all we're going to get to work with. What we know is all we need to know for a start. We can refine it as we go along. It's not a matter of life and death. ("It's much more serious than that." -- what the late Bill Shankley said when his team was losing.)

And what we've got is a beautifully balanced animal, biologically, and genetically. Probably the best example of that essential balance, left among the cattle breeds of the western world. And we have a very prepotent marker in the full belt to stamp on commercial breeding stock. Let's not sacrifice it over trivialities like minor aberrations in the markings.

We need to demonstrate to the commercial farmer that this 'balance' can be put to good effect and leave him a profit. There is ample research evidence that biologically balanced animals will leave as much profit, in the long term, as breeds that have moved from intermediate towards extreme. We should exploit that and not move away from intermediate simply to copy them. And start trying to convince the commercial man that a Beltie with a minor mismark has still got all of a Beltie's essential characteristics. Which it has.

I don't want the breed's epitaph to be.....

> **"For a spot on her belt the dam was lost.**
> **For a spot on his foot the sire was shot.**
> **Hither and thither they continued to dither.**
> **And woke to discover they had lost the lot."**

For goodness sake, let's start looking at some of the more important characteristics of the Belted Galloway.

I have a closed nucleus subjected to intense in-breeding pressure. And I mean intense. The sixty animals in the nucleus are all closely related. One of the best yearling bulls being reared at the moment is from a full brother-to-sister mating. His dam is by his sire bred to his own mother. So far I haven't found any serious aberrant gene combinations, or disease susceptibility. The foundation stock wasn't specially selected.

I may not be able to convince everyone else that the genetic endowment of the old fashioned Beltie is 'clean' and pretty robust, as far as biological fitness is concerned. Inevitably I will have lost some genetic variation and reduced the frequency of others. But I'm well enough convinced in my own mind of the overall merit of the Belties' endowment to let me move on and introduce some lines not represented in the herd at present.

Breeders are very wary of close sib matings. All the evidence is that

inbreeding, sooner or later, will turn up a bad combination of deleterious genes in most stocks. Most deleterious genes involving fitness are recessive, so commercial breeders nearly always opt to mask their effect by outcrossing.

But inbreeding doesn't MAKE bad genes. It is the process that FINDS bad genes that already exist in the genetic endowment (the genome of the breed or species). And allows breeders to eliminate them, or reduce their frequency. If bad genes exist at a high frequency they will be found quickly: at a low frequency only after many attempts to uncover them. If none EXIST none will be FOUND.

There will be very few breeds that have been subjected to such intense pressure. Fewer still that could have resisted it as robustly.

We don't have an accurate census of the breeding animals. Or any estimate of belted animals that might be acceptable to produce some Fl females to start a grading up register. And cattle populations don't grow exponentially from the census numbers, even when it's accurate. It's much more complex than that. Not least among the factors is that, on average, newcomers to a breed only stay with it for four and a half years and register their progeny for less than two years. And most commercial farmers will cut their losses after one disappointing calf crop.

The formulae to determine the minimum effective population size in large animals is relatively complex but it's already been done in other population studies.

There is broad general agreement among conservationists, that the minimum number in a population of large animals is 650 females and 26 males, where the individual natural lifespan is about 12 and the generation interval between four and five years. But to effectively conserve a population at that number requires a sex ratio of I male to every 5 females. And that's hardly a practical proposition. Add to that the need to keep the inbreeding coefficient low in commercial herds and the variations in family group sizes around zero and the need to increase numbers becomes crucial.

If the numbers in individual countries are treated in isolation the future looks bleak indeed. John's initiative and international co-operation, may well be offering the breed it's last chance.

EPDs are not well understood by the average Beltie breeder in the UK who tends to have only a few animals and no association with another breed where EPDs are used.

They need guidance benchmarks derived from the data collected from larger herds. We can't provide that at the moment. But we could provide benchmarks derived from a number of other beef breeds. The following table

is not in any way representative or definitive; merely indicative. A breeder using EPDs could provide better benchmarks as an achievable commercial standard that would be competitive with other comparable breeds.

Final weight	500 Kgs	1121 lbs	Measures	
Dressing out %	62.4%		Hip Ht	55"
Fat thickness	11 mm	5/8th"	Wither	56"
Eye muscle area	74 sq/cm	11.5 sq/ins	Pel/Hum	66"
Retail 8mm trim	217 Kgs	478 lbs	Pel/Scap	58"
Ditto 0mm trim	201 Kgs	443 lbs	B/wt	82 lbs
Top Grade	69%		Wean/wt	450 lb
Age at slaughter	540 days		Dam wt	1160 lb

Breeds and breeders need an index of individual merit. Always difficult to provide in an intermediate breed. Easy for extreme breeds. Volume of milk in three lactations in dairy breeds. Weight of beef in fewest days to slaughter in extreme beef breeds. Traits with negative biological consequences are mostly ignored or overcome by changes in management.

EPDs derived by BLUP methods (Best Linear Unbiased Prediction) which adjust for a great many variables in environment, management, parity of birth and many others have served the major breeds well. Most notably the Angus in the US. To some extent a breeder can select his next bull to modify his own herd to meet his specific requirement. E.g., by selecting a bull with a low EPD for birth weight he could progressively reduce the average birth weight of his calves to what he felt was the optimum value to suit him. And this has great merit in maintaining some essential variation within the breed as individual breeders have different priorities.

But the numbers need to be relatively large and we only have a very limited number of animals from which the data can be gathered.

As I said earlier I need to be advised on EPDs generally. I hope that some other breeders can argue the opposing briefs.

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