

## Some Thoughts on the History of Animal Breeding

H. Wachtel

If in a population there are a lot of deleterious recessive genes, then \*these genes\* in a homozygous state will work havoc.. If the deleterious genes are not present, maybe purged by preceding inbreeding, they will not do any harm. But still there are genes which show a more positive effect in the heterozygous state (either by overdominance of the dominant alleles or by heterozygous superiority of these particular alleles on a gene locus. We need homozygous genes in our breeds (e.g. long hair or many color genes) as specific breed traits. These \*needed\* homozygous genes are not many, perhaps a few dozens. But too many unwanted homozygous genes mostly make those problems keep discussing.

Dogs, as a species, can be regarded as inbred for 10000, perhaps 100000 years (?). A limited number of wolf cubs was tamed by stone age men. A limited population of about less than 300 means inbreeding even without selection or incest mating (inbreeding in the sense of a rising COI -coefficient). Various domestication episodes may have resulted in more and more such populations so dogs (as a species, not as individual populations) became genetically varied, in spite of representing only a fraction of the genetic diversity of the (former) world wolf population. This allowed for occasional deliberate or inadvertent (roaming bitches in season or males) outcrossing. Thus in general, longtime the average COI of the species domestic dog, and probably also of many individual populations remained satisfactory.

But intermittent inbreeding produced a lot of aberrant, mostly recessive traits that sometimes were highly appreciated. New colors, different sizes, shapes, tails, etc. emerged, that have been deliberately fixed by inbreeding and thus breeds were developed. Of course, if a dog emerged that e.g. was an excellent guardian, hunter, tracker etc. it was used extensively for breeding and by inbreeding his qualities were transmitted to a new strain or even breed.

This worked excellently until the dawning of the era of pedigrees. While breeders tried to keep breeds pure even before, there was no strict control to enforce it. Most breeds were used for working, so outcrossing even beyond breed borders happened from time to time, keeping the working qualities high though these breeds were rather heterogeneous (no dog shows and judges officiating at that time).

This was radically changed about 150 years ago. Improvement of dogs was now sought by controlling breed purity by the pedigree system, outcrossing to other breeds was - with exceptions- practically outlawed for established breeds. Such a system tends to build up COIs even without further gene-depleting practices (over-using sires, close inbreeding and line breeding). But these methods also were extensively used, so today we arrive at much too high COIs in many breeds.

This system, modeled after the exclusive pedigree system of the British aristocracy, was developed in Victorian England and conquered the world of farm and pet animal breeding all over the world. The results were spectacular. But today, farm animal breeding shifted to other methods like cross breeding and hybrid production, as rising COIs made it imperative to keep them low and exploit heterosis (hybrid vigor) for best performance. However, pet

animal breeders still kept to the old British method of gene depleting practices. Only today, first feeble reactions emerge in this field too, like this list.

Is it possible to inbreed strongly (continuous sib matings for such a period? In theory, it is. Lab mice have been bred in this way for up to 250 generations, in dog terms, this would be about 600 years! It is, however, very doubtful if mouse biology in this respect can be transferred to dogs.

But still there *are* documented examples of highly inbred breeds that derive from just two or three founders, if not for 150 years, but for about 50: the Krohmfohrlander from Germany and the Czech Terrier. Obviously a lucky incident, finding founder dogs exempt from deleterious alleles. As concerns the Krohmfohrlander, I have been told that crossing with another breed is now discussed, but that is just hearsay.

Sometimes in this list, it is argued in the way selection for performance is all that's needed don't bother about inbreeding. Many practical experiences seem to validate this point. In reality, we have to bother in two ways: select for health *and* select for adequate genetic diversity. In nature, mainly females choose males for "good genes" as well as unrelatedness. Performance (viability selection) selects also for heterozygosity and can thus counteract inbreeding but not for ever.

The reason is that the COI is just a probability, in a progeny there are always individuals with a somewhat higher or lower heterozygosity. Selecting for performance is also selecting the more heterozygous. From the health viewpoint, it would be a good idea to select for some breed-specific performance in every breed, like agility, lure coursing, racing, tracking, or whatever.

In nature, if for some reason finding unrelated mates is not possible, severe natural selection can maintain viability for some time. The breeders 100 years ago could also relative safely use much more close inbreeding, as natural selection was still rigid (no vaccines, less developed vet care, non-sophisticated simple feeding, etc.) and most dogs were working dogs selected for performance, thus vitality. Moreover, breeds were still much more genetically diverse than today.

A significant reduction in natural selection of today's dog breeds in conjunction with continued genetic depletion has brought the domestic dog in a difficult situation. While conservationists and zoo biologists developed sophisticated methods to save as much genes as possible in endangered species, nearly nobody cared to popularize population genetics in dog breeding.

In conclusion, today balancing *both* kinds of selection should be used for best health and viability (of course standard conformity is also necessary, for best health would not help a dog if people think it "ugly").

Dr. Hellmuth Wachtel  
Free collaborator of the Austrian Kennel Club  
Member of the Scientific Council of the Vienna Schoenbrunn Zoo