

## **Evolution, Genetics and Medical Screening**

Subsequent to the Second World War modern agriculture and animal husbandry underwent a revolution driven by twentieth century science and emerging biological technology such as stored semen, radiographic examination, science based breeding selection and the application of evolutionary and genetic principles to create advances such as higher grain yields, more rapidly maturing livestock and increased milk production in dairy herds. On a smaller and somewhat delayed scale these principles and this technology began to be applied to canine breeding, largely in response to genetic defects, particularly dysplastic hips. These emerging defects were to a significant extent the consequence of increasingly close breeding in the process of breed creation and particularly the obsessive pursuit of extremes in type and uniformity.

Modern evolution and genetics is a complex and subtle science, but one increasingly important for breeders in light of emerging biological technology, which is the reason for the brief survey presented here.

### **Genetic Inheritance**

Charles Darwin revolutionized our understanding of life and biology just as surely as Albert Einstein revolutionized modern physics. Both of these great men, through concepts contrary to the reigning conventional wisdom and worldview, brought order out of chaos, opened up entirely new vistas of human knowledge. As always, some men clung to the old ways, but over time experimental results such as the observation that the gravity of the sun does indeed bend the path of passing light and the emergence of the double helix structure of DNA with the work of Crick and Watson as a biological mechanism for the evolutionary process, and thousands of other scientific advances, have verified the validity of these fundamental scientific paradigm shifts.

Those who cling to old beliefs, think the Earth is less than five thousand years old for instance, are just as intellectually crippled as those who believe that the Earth is flat. The Earth is indeed a sphere, curved, just as Einstein showed that space and time are themselves variant, curved. These profound scientific advances have important consequences for the canine world. Men such as Lorenz have shown that behavior propensities are driven by evolutionary processes just as are physical attributes, and understanding these mechanisms is a step toward better breeding selection and training methodology.

Genetic inheritance is the driving force of evolution, the means by which ever more complex and sophisticated creatures have evolved over time. Change at the most basic level comes through random genetic mutations, most of which are by simple probability deleterious and immediately disappear because the individual dies or is incapable of maturing to breeding age and procreating. (Just as a random change to a computer program would most likely be a fatal defect rather than a new and desirable feature.)

Some genetic attributes are incipient defects, present in the genetic code but not exhibited in the phenotype, the outward physical structure, of the individual. They

remain latent in the gene pool until by chance an unfortunate individual inherits the wrong combination of genes and external or phenotypical attributes appear. In the case of poor hip socket formation, for example, these individuals are likely to be less able to hunt and survive and thus procreate, and the incidence of the defect is thus in the wild population, though always present, limited by natural selection, survival of the fittest in its most primitive and effective form.

The original concept of evolution, and one still widely perceived, is that change and speciation was gradual, came about through small, reinforcing genetic change, and essentially uniform over time. But current thinking in evolutionary biology, beginning with the concept of punctuated equilibrium in the 1970s, is that change does not typically come about gradually through small changes in broad populations, but rather much more quickly in small isolated groups. These evolving theories, concepts such as punctuated equilibrium, have important consequences for the understanding of the process of breed creation and preservation.

In simple terms, perhaps overly simple terms, dramatic change requires the isolation of a small breeding population under strong evolutionary pressure. In nature this can be physical or regional separation. Breed creation is a similar process in which isolation is the consequence of the intervention of man through explicit breeding choice, where evolutionary pressure is created by selecting among a small, genetically isolated group according to a preordained set of desired physical and moral criteria.

In nature it is likely that many or most isolated populations under stress fail to adapt, simply vanish, are unable to change quickly enough to experience the necessary genetic changes to survive new circumstances. In breed creation, mankind interferes in the sense of extending the process, of keeping the intermediate stages alive and breeding, which is one of several reasons why breeds can be established relatively quickly, in a few generations.

By definition, the small foundation group for the incipient breed creates something analogous to a line breeding program, and the out cross, by virtue of the isolation, is essentially impossible. In order to succeed, the new breed or species needs to become large enough, rapidly enough to in time create the out cross possibility within the gene pool and thus reestablish sufficient genetic diversity for ongoing breeding while still maintaining new type and character attributes. A vigorous, vital breed is difficult to maintain because it is a delicate balance between tight enough to maintain type and functionality while at the same time providing sufficient genetic diversity for vigor and the containment of inherent genetic defects.

There is a difference between the species and the breed. A species was historically by definition a group of animals which can only successfully breed within the group, that is, produce fertile offspring. Thus once a new species exists it is on its own with no possibility of back crossing for diversity. But a breed is different, for it is an artificial grouping within a species, in our case the canine, and thus has the possibility and sometimes the necessity for the back cross component in the ongoing breeding process.

But in the modern view the concept of the species is more complex and subject to interpretation and academic debate. Some have considered dogs and wolves as a single species because they can interbreed and produce fertile offspring, as can dogs and jackals. Others regard them as separate species because differing geographical range, social patterns and breeding dynamics render cross breedings very unusual and the cross bred population marginal and tending to die out quickly. Current thinking tends to support this latter view. New circumstances, however, can upset this balance. Coyotes and the northern grey wolf were for millions of years separate species, yet because mankind has so disrupted the North American landscape they

now bred together and produce ongoing cross bred populations in south eastern Canada.

Because of these genetic dynamics within a species or breed there will always be latent genetic defects in any population. In the natural order of things those defects which are detrimental to survival are minimized by natural selection; those genetic features which are beneficial in that they lead to increased competitive effectiveness are evolutionary developments. Thus all gene pools have a floating set of genetic defects which from time to time, by pure chance, produce an individual destined to die very young, often as a fetus before pregnancy is even established, or produce individuals which are born but suffer serious defects and thus lead short, unsuccessful lives. Short is the key point here, for it precludes procreation and thus serves to prevent further propagation of the deleterious gene.

There is a down side to man stepping in and breeding dogs in closed genetic pools: artificially interfering with this process so as to allow the dog not viable in nature to survive and be bred short circuits the natural purification mechanism. Breeding dogs where medical intervention has prevented an early death, or where the breeding dogs are so distorted so as not to be viable on their own in nature, allows many serious genetic defects, once under natural selection control and limitation, to expand without effective limit.

Consider hip dysplasia. In the wild canine population and the hundreds of generations as practical working dogs the incidence of phenotypical manifestation, that is, actual, observable physical defect, was effectively controlled by selection of the fit for procreation through breeding. But show dogs that live out lives in kennels after a brief conformation competition career, where they become champions and thus desirable breeding animals, are an example of this. They have become certified as breeding worthy before the effects of the genetically defective hips or other serious defects reveal themselves as observable problems. Animals most likely to have been eliminated by competition in a natural setting become instead primary breeding resources, thus forwarding and concentrating their genetic defects.

Among human beings procreation has been ongoing for millennia under the influence of biological and social drives, needs and customs. Primitive hunter-gatherer bands evolved societal structures where the younger males or females were exchanged among neighboring bands, and incest taboos strongly discouraged breeding among the closely related. This was not unique, for similar social forces encouraged genetic diversity among the wolf packs from which the dog was to emerge and most other wild animal populations.

Where custom or happenstance leads to small, closed human genetic pools, where inbreeding occurs over generations, serious genetic problems do emerge. The royal families of Europe are an example, where the bleeding disease in the Russian aristocracy and the general lack of brightness among English royalty are manifestations of the general tightness. Religious sects with persistent inbreeding and the breaking down of incest taboos in isolated rural populations demonstrate the deleterious consequences of sharply reduced genetic diversity.

In European society it was the princes and princesses, the sons and daughters of the kings and queens, which were most obviously subject to genetic disease. The very narrow gene pool of the aristocracy was and is the causative factor. They had the services of the best medical experts, and it did nothing for them. This population is dying out, or more accurately being dissipated into the general population, which is not a bad thing.

Throughout history man selected for breeding those dogs who served their purpose, which meant relatively mature dogs which had passed the real world test of physical fitness by demonstrating their ability over time in the hunt, in herding

service or in the physical protection of the band, tribe or farming community. Natural diversity and human aided natural selection, a broad pool of genetic resources, maintained physical fitness as well as the necessary moral and working character attributes. Simple, practical choices among mature, proven dogs based on functionality effectively limited genetic defects.

In the years before the turn of the twentieth century, the later 1800s, the concept of the purebred dog with a closed gene pool, the conformation show as the primary breeding selection process and kennel club registration as the primary badge of value and legitimacy, profoundly changed the age old partnership between man and dog.

Instead of large regional breeding pools for local agricultural and hunting needs, with a sporadic injection of lines from remote regions as dogs on occasion were sought out from greater distances, the closed gene pool with constantly narrowing bloodlines emerged as the normal selection process. But this violates all of the principles of nature, replicates on a formal and enforced basis the practices which among human beings and other animals have always, eventually, led to widespread and entrenched genetic degradation.

From the perspective of a century of experience, only the most obtuse could fail to see that the purebred dog concept is based on the hubris of the elite, that ingrained arrogance has created a system preordained to collapse in a genetic sense just as surely as the ongoing incest of the European royal class led to its physical, moral and intellectual decline. The result has been breeding among an ever-narrowing pool of dogs based on fashion and appearance rather than practical working capability, truly functional structure and traditional values.

The consequence of the innate desire of each generation of breeders and judges to stamp a personal mark on a breed as the new desired physique has become more and more bizarre, creating grotesque caricatures of the normal canine. Manifestations of this include the incredibly narrow Collie skull, the extreme angulation of the American German Shepherd show ring and, perhaps the most grotesque of all, the English Bulldog.

These brief paragraphs constitute but an amateur oversimplification of an exceedingly complex subject. The reader is well advised to obtain and seriously study other material, especially the Coppinger book (Coppinger & Coppinger, 2001) and the Bragg article. (Bragg, 1996) Jeffery Bragg has produced perhaps the best overall review of the consequences of medical screening and kennel club registration practices in a number of lengthy articles, which should be required reading for anyone with a serious interest in dog breeding.

## **Medical Screening**

It began with hip dysplasia. In the 1950's and 60's the canine community could no longer ignore the proliferation of crippled young dogs and sought to remedy the problem through use of radiographic hip examinations as a screening mechanism for breeding. The concept was quite simple: since the defective hip socket configuration and the consequent proliferation of crippled dogs was primarily the result of genetic inheritance, the proposed solution was to eliminate from the breeding population dogs exhibiting external symptoms and also those whose hips were deemed faulty through the use of X-ray examination.

This program has had a significant element of success. The certification of breeding stock as free from dysplasia, by agencies such as the Orthopedic Foundation of America (OFA) and various European programs, gradually became the standard of breeder responsibility. This was on the whole a good thing, for there has

been statistical evidence and general observation of a broad improvement in the hip status of many breeds.

As time moved forward and other defects began to emerge the success of hip screening gradually led to a proliferation of further tests breeders were under increasing pressure to embrace. In the Bouvier des Flandres, for instance, numerous problems emerged beyond dysplastic hips. These included heart ailments such as sub aortic stenosis, serious eye problems leading to blindness, thyroid problems and gastric torsion. The Doberman became a walking disaster with wobbler syndrome and von Willebrand's disease leading a pack of horror stories.

But this needs to be kept in perspective. Not all breeds are seriously afflicted and some breeds are problematic primarily in intensively competitive show lines. As a prime example, the Malinois has never been prominent in the show ring, and there are flourishing and significantly independent working Malinois communities in Belgium, the Netherlands and France which provides substantial diversity. This does not imply that there are not dysplastic Malinois and outbreaks of other genetic flaws, for these things always exist, but in such a geographically separated and diverse gene pool long term consequences are minimal. Specific kennels or breeding lines with an emerging problem become less popular as people gravitate to other sources and breeders bring in new dogs or seek outside stud services. Which is, of course, how it is supposed to work.

Working breeders in general are less prone to incessantly breeding multiple bitches to the latest winner because they tend to breed less often and be more selective in choosing a stud dog. Trial wins are a team effort; it is the best dogs and handlers which are in the hunt, so the best dog for breeding is not necessarily the winning dog on the trial field. Dogs which have not had a particularly stellar trial career are often, nevertheless, used fairly widely at stud by those believing that they possess qualities, such as inherent hardness and aggression, that are not necessarily rewarded appropriately in the points. Individual trial wins are subject to happenstance such as drawing a difficult track or a slight miss step by a decoy. In general an older but still actively breeding male with impressive sons and daughters on trial fields is often preferable to the younger dog with wins which might prove to be a flash in the pan.

The working breeder needs to produce dogs which will reliably function at a high level for several years, an entire working career, after maturity, which tends to bring insipient genetic defects into the open. They tend to be more leery of unproven breeding stock because too many years can pass and too much training time can be expended before defects become apparent in the progeny.

The show dog on the other hand can obtain a championship at a relatively young age and with a couple of early major wins go on to an extensive breeding career without ever demonstrating stamina, drive or agility. Such a dog only need work a few minutes, gait a few of times around the ring, and can often be conditioned or drugged for the brief time necessary. With such brief exposure to public scrutiny serious genetic defects are much more easily concealed or ignored. Genetic tests provide some transparency in the case of prominent defects but are less likely to reveal the more unusual problems that extensive work training and trial participation would likely reveal. It is of course possible to substitute a different dog in a medical test, especially if there is not a solid basis for identification such as a microchip, but in the working trial it is generally more difficult to put in a ringer because it is a public event, and serious defects are likely to show up in rigorous exercises such as the scaling wall or long jump.

German Shepherd show lines in Europe are vulnerable in terms of character and structure, and have their share or more of genetic defects. Because of the prestige

and dominance of SV show lines, scrupulously maintained by German judges, other nations do not in general have independent lines which could provide diversity. Working lines are more favorably situated, that is largely independent working communities exist in a number of nations such as the Czech Republic, Belgium and the Netherlands, and much of the old East German blood is being maintained.

The most problematic working breeds are those that are relatively small in numbers and primarily conformation show driven, without in depth working lines, such as the Doberman Pincher and the Bouvier des Flandres. In these popular, intensively inbred breeds and lines medical screening became increasingly fashionable, a way to buy notoriety, importance and the aura of righteousness with relatively little personal effort or risk of dirty hands. One could buy young dogs from among the show winners, or better yet engage a professional handler to buy and show dogs, subject them to testing and establish a breeding program. In the Bouvier world there emerged such extensive screening that it became fashionable to boast of a "five star" dog, one who had passed five leading screening tests. This and an essentially meaningless conformation championship tend to be proffered as hallmarks of quality; never mind that the dog might waddle like a windup toy and would just lapse into dumb passive resistance were anyone foolish enough to try and train him for the work of his breed.

But this is not working well and questions persist after all of these years and all of this testing. Why, after several thousand years of ongoing breeding without medical screening, are we seeing all of these genetic problems and doing all of this testing? Are we really producing better dogs? Or are we in avoidance, putting out brush fires while dissipating the heritage of the founders? Other than providing a revenue stream for the veterinary community and the medical service establishment, what exactly is being accomplished? Perhaps the time has come to step back and make a new evaluation.

There are compelling reasons to believe that the underlying problem is the ever-shrinking gene pool, exacerbated by slavishly breeding tighter and tighter to fashionable dog show winners, leading to breeds sadly deficient in the functional character and robust physique that were their original purpose. The result has been the emergence of a never-ending series of genetic defects and generations of fragile dogs exaggerated in type and lacking in vigor, robust good health and reasonable longevity. The underlying problem is that each new genetic test eliminates dogs from breeding consideration, further contracting the common genetic resources to be available in future generations.

It is true that testing for subclinical genetic defects, those not obvious in the young dog, provides useful information in breeding selection. But in the broader picture, within the context of a closed and contracting gene pool, blindly excluding all dogs testing positive for any of multiple known defects has the potential to so severely contract the gene pool that the breed faces extinction. Combined with incessant breeding to transiently popular show winners, this can eventually push the breed below genetic critical mass.

## **In Denial**

Over several decades significant elements of the canine community has been drawn into increasingly elaborate screening programs primarily because it is the path of least resistance; an easy way out from under proliferating genetic defects much less intellectually challenging than the effort to understand the biological dynamics of breeding and evolution. The conventional wisdom has become that through ever more sophisticated testing, and perhaps ultimately artificial gene manipulation, the need for genetic diversity can be discarded as old fashioned along with the fireplace

for heat and the candle for light. The futility of this can be seen in breeds such as the Doberman Pincher which have been backed into a genetic corner, face practical extinction. It is only a matter of time.

The essence of the problem is that the success of screening in diminishing hip dysplasia set a precedent, and each new screening program further diminishes the gene pool, the aggregate breed genetic resources. In order for this to function in the long term it is would be necessary to replenish this diversity by bringing in outside blood, either from outliers within the breed or from outside. But breeders are loath to do so because winning in the ring comes through breeding ever more tightly to narrowing winning lines, and because the process of bringing in outside resources produces benefits only in the long term while next year's wins are the driving force in breeding, especially for the increasingly predominant short term breeder. The complexities of the registration process and particularly peer social pressure weigh against wider breeding in a world where "purebred" is the foundation mythology. Bringing in outside genetic resources runs counter to the culture, is seen as an admission of guilt, of betraying the heritage.

Thus each newly emerging defect, such as proliferating heart and eye problems, leads to the creation of new screening programs which are promoted as convenient ways of avoiding the consequences of blindly breeding winners to winners. Remember that breeders were dragged kicking and screaming into the age of science when increasing pressure forced routine hip examinations. Once their hand was forced they began to see certified this and certified that as useful promotional mechanisms. Those deficient in understanding of biological principles, ancestral lines and practical breeding selection could simply spend the money for the currently fashionable set of tests to buy credibility, posture as responsible breeders. A great deal of effort and propaganda goes into shaming those who resist useless and meaningless testing and breed in ways established and validated over the centuries, that is relying on diversity and breeding older animals which have been proven in their work. This tends to bring forth latent faults and thus exclude the affected animals, especially the males.

As a point of reference, consider that most human beings have children without passing a five star genetic testing program and the human race does manage to go reproducing itself with minimal incidence of serious genetic defects. Why is this? Do we care more about our dogs than our children? The fact is that over thousands of years we evolved social and cultural mechanisms that encourage sufficient diversity in breeding selection, which effectively minimizes the occurrence of recessive defects. It is true that in unusual circumstances particular ethnic or national groups, because of long-term genetic isolation, develop characteristic, widespread genetic defects. The solution to such problems is generally social, opening up the group to more diverse people to secure more diversity, but sometimes medical screening tests have a role to play.

Over the generations and centuries dogs were bred in very much the same way, with many social and practical mechanisms for genetic diversity. It was the advent of the formal breed and the enormous focus on inbreeding to establish artificial type which is the cause of the serious genetic defects in our purebred dogs today. Rather than more and more elaborate screening to avoid the natural consequences of incest, we need to breed our dogs with similar mechanisms to encourage genetic diversity, broader genetic pools. This is the exact opposite of what we so often do, breed very tightly, especially on a strongly inbred male line.

More diversity requires that in addition to encouraging more open breeding practices and discouraging massive use of momentarily fashionable stud dogs the need for occasional inclusion of dogs outside the studbook needs to be recognized,

encouraged and provided for in the registration process. For this to happen there needs to be an above board mechanism and supportive culture for bringing in outside dogs.

Because of the nature of our free enterprise economic system an inherent aspect of the problem is that genetic testing programs represent income streams and profit to every element of the veterinary care industry, and it is not in their individual, interest to question the ultimate efficacy and collateral damage in terms of the diminishing gene pool. The pharmaceutical houses, laboratories, certification agencies and veterinary clinics all are in business to make a profit, and must be in order to be viable. From a strictly business point of view, a reliable revenue stream can hardly be seen as a bad thing, and inherently fragile and vulnerable populations of dogs produce more revenue than populations of vigorous, resilient, healthy dogs.

This is not some sort of conspiracy theory or meant to cast doubt on the integrity and sincere concern of our veterinary community; these are on the whole honest, hardworking, well-intentioned professionals. But they are and must be business people too, and if there is a demand for a new heart or eye testing and certification procedure they are of necessity going to need to provide the service, regardless of its actual long-term efficacy, least their clientele go elsewhere.

This is not a novel situation, for consider that our pharmaceutical houses routinely spend twice as much money on promoting drugs for problems people are not even aware of as on research and development. Money rather than any abstract desire to improve the human condition always drives the process on the corporate scale. This is the foundation, the essence, of our capitalist system, and if one or a few individuals are too squeamish to squeeze the money out capitalism demands that they be replaced by those willing to serve and prosper.

Each time a new genetic problem emerges the free market responds by developing a screening test, an appropriate foundation with a blue ribbon committee, and the start a whole new revenue stream. The problem is that the purebred system is the ultimate cause of the problem and that more screening programs are only band aids, do not promote or enable real long term solutions, that is, significantly widening breed genetic diversity through the introduction of outside breeding stock. More and more genetic testing is not the answer, and we cannot blame the veterinary establishment, for if breeders did not jump on every passing bandwagon then nobody would be building bandwagons; big business does what makes money, not what is good, desirable or moral from a societal point of view.

In the ideal perhaps the breed clubs and especially the national clubs should provide leadership, but in order to face up to the problem the AKC and the FCI would have to come to terms with the reality that the underlying problem is that their house is built on a false foundation, the closed breeding population, and the inherently flawed nature of the purebred dog paradigm. This is unlikely to happen.

In the Bouvier des Flandres world, as an example, there emerged in the 1990s a plague of the heart defect known as sub aortic stenosis (SAS) and serious eye problems along with the traditional garden-variety problems such as dysplastic hips. The source of this was perfectly obvious to those willing to see; it was driven by the influx and close breeding on the Dutch show line imports in the later 1980s and early 90s and also the closely bred Belgian lines previously popular. Not that these dogs were all bad, but they were already tightly bred and the American breeders, especially in California and the west coast, bred to them blindly and ever more tightly, like another gift of the Euro gods, the keys to the best in show ring.

The reaction to burgeoning blindness and heart failure was yet another round of denial, followed by the usual crusade to make increasingly elaborate and expensive medical screening the mark of the responsible breeder. This was basically an ostrich

head in the sand reaction, because the root cause of the problem was the shrinking gene pool. In essence, a few breeders with large financial, emotional and breeding stock investments in these over bred Dutch show lines were trying to pull everybody else into the mud so they would not feel so lonely and dirty.

Many serious working breeders do little or no testing, confident that a five-year-old dog with a Dutch Police (KNPV) certificate or similar title needs no further proof of vitality and health. While I certainly believe that we should make use of science and medical tests as a rational part of an overall program, that approach has served well for hundreds of years, and we need to realize that more diversity in lines, the open gene pool, meaning mechanisms of legitimately breeding outside lines back into the closed breed studbooks, reliance on working and character tests for fully mature dogs as primary elements of breeding selection and especially breeding the males as more mature dogs at an older age are the keys to ongoing breeding lines with the health and vigor we all seek in our dogs.

The enormous twentieth century scientific advances and the resulting technology, that is, radiographic examination to reveal bone structure, ultrasonic sound to view soft tissue, chemical and biological tests to reveal the presence of disease at early stages, revolutionized human medicine and veterinary practice. These are good things, and failure to use these tools in favor of historical ways of doing things would be irrational; we would still be hunting with chipped stones if this had been the prevailing mindset of mankind.

But technology brings forth problems and dilemmas as well as benefits, and perceived benefits taken to extremes bring forth unexpected consequences and collateral damage. Just as the automobile and the internal combustion engine are producing environmental and economic problems of enormous magnitude that we need to address as a society, medical diagnostic technology can be used in pervasive selection programs which only exacerbate the reduction in the gene pool and at some point introduce more problems than they can resolve. There are all sorts of things floating around in the genetic backgrounds of the various breeds, and if we could test for all of them, which we may in the future be able to do, eliminating every dog with any problem would simply eliminate all dogs and bring the breed to an end.

These scientific and engineering advances are the foundation for medical screening in the breeding of dogs, and most serious breeders will from time to time test for such conditions as thyroid deficiency and in other circumstances where there is evidence or reason for concern. The screening for hip dysplasia has in general led to an overall improvement in many lines and should be ongoing.

But the emergence of the conformation dominated national and international registry bodies based on the breed as a group of progenitors with a closed studbook has resulted in increasingly limited genetic diversity. This has been seriously deleterious to the dogs we live with, as evidenced by the persistent and increasing incidence in many breeds of defects with proven or suspected genetic cause.

The concept of the purebred dog with an entirely closed breeding population, with genetic diversity incessantly lost due to breeding to a few show winning males, selected without regard to working suitability either physically or in terms of character attributes, is failing.

### **Spiral to Oblivion?**

If diminishing genetic diversity, increasing susceptibility to debilitating genetic defects and fragile dogs lacking in vitality and vigor is the problem, what is the solution?

In general a broad based genetic diversity with emphasis on breeding stock demonstrating essential physical and moral attributes is the basis of a viable ongoing program. Physical attributes must mean more than just appearance and structure, must consist of actual demonstrations of power, agility and endurance. Such tests must involve obstacles such as scaling walls, high jumps and pits; running and trotting significant distances and energetically engaging the decoy over a long enough time to reveal inherent structural and metabolic weakness. Character evaluation must be serious training to a significant certification level; a dog which has been prepared for the KNPV or Schutzhund III level, given an honest and rigorous trial, is unlikely to have serious hidden flaws, either in physique or character. Preparation for such examinations generally takes much more than a year, and this long duration, ongoing testing and evaluation is the essence of the process. There simply are no short cuts.

Mankind bred dogs in this way for generations and centuries before diagnostic medical procedures came into existence. Such tests provide useful new tools and capabilities, but cannot replace the time honored process of breeding dogs according to demonstrated working capability. The combination of a conformation appraisal and a set of diagnostic tests to identify worthy breeding candidates, the process in many nations and breeds today, has proven to be inadequate, inevitably leading to degeneration.

Furthermore, it is essential to note and account for variation in circumstance and outlook according to breed. This is especially true among the various national working communities with their more diverse competitive venues and working cultures. Large segments of the working dog population are vigorous and prosperous with substantial diversity both in terms of currently ongoing breeding lines and strong, independent national heritages. Conformation lines tend to be more homogeneous and thus more interrelated and susceptible, as exemplified by the strong SV influence and control over German Shepherd conformation affairs worldwide, with the notable exceptions of the North American AKC and CKC conformation lines, which are a world unto themselves.

The Belgian Malinois is the prime example of a strong ongoing program with vigor and vitality, primarily because over the twentieth century there was relatively little conformation show interference with working culture and lines. While as in any other breed the Malinois is subject to the periodic emergence of genetic defects, there are several distinct national populations with their own culture, breeding stock and sport programs. These independent working communities – that is the Dutch KNPV lines, the Belgian NVBK lines and the French Ring lines – each constitute diverse and robust gene pools and serve as mutual genetic reserves. Other breeders and trainers in these nations, as well as Germany and America, carry on lines of increasingly successful dogs for IPO competition and represent a further diversity and a deeper genetic reserve. Other breeds, specifically the German Shepherd, exist in much larger numbers on the international scale. But a much larger percentage of Malinois are bred for real working character while on the other hand the vast majority of German Shepherds are bred in companion or show lines of no real use as genetic resources.

The show segment of Malinois breeding has never had the popularity, numbers or political influence to exert control over working lines, and this issue was essentially resolved within Belgium through the creation of the NVBK in 1963, taking the essential Belgium Malinois lines out of the hands of the FCI oriented show community. Although there are, and always will be, periodic outbreaks of genetic problems, there is at the moment little apparent potential for a serious genetic diversity crisis in the Malinois.

The German Shepherd working lines, for all of the problems of recent years, are still large in number, historically deep and somewhat diverse. These resources include the Czech lines, the old East German lines, remnant working lines in Germany itself, breeders in Holland and Belgium and other small but persisting pockets of dedicated breeders and trainers with their own faithfully nurtured lines. The German Shepherd working heritage is in serious trouble on several fronts, but for the moment at least, looking at the worldwide situation, genetic diversity is not especially high on the problem list. The essential problem is that the vast majority of German Shepherds worldwide are useless for their work and thus a millstone around the neck rather than a viable genetic reserve.

Even in breeds blessed with substantial diversity genetic screening is perfectly valid, a useful tool in an ongoing breeding program. When defects become evident in specific lines, as they will from time to time, the use of testing to identify and eliminate from breeding those dogs with sub clinical defects, that is, dogs with the potential to pass on the problem but normal in appearance and function, is useful and appropriate, an important means of more quickly and completely weeding out the defective dogs.

While the working shepherd lines, the German and Belgian, are relatively diverse in a genetic sense, the problems come in the show lines, such as those predominant in the SV Sieger show, and the smaller, second tier working breeds, such as the Doberman Pincher and the Bouvier des Flandres.

The Doberman is today a relatively small breed in Germany, with for instance only 612 VDH registrations in 2011, primarily show dogs. Doberman working lines are sparse and the breed as a whole is generally inbred and subject to a long list of genetic problems such as wobbler syndrome, von Willebrand's disease and endemic heart failure. Serious Doberman people understand that a resurrection could not be a recovery, that the resources are not there; a full-scale reconstruction, perhaps bringing in extensive Beauceron or Rottweiler breeding resources, would be essential for meaningful progress. This does not seem likely.

The Bouvier des Flandres is on its last legs as a serious breed. The show lines have endemic inbreeding problems and multiple serious genetic defects. Bouvier working lines – sad for me to say – consist of remnants, are almost certainly beyond recovery. A few of the older, hard-core breeders and trainers persist, taking what comfort they can in going down with their ship.

Seriously troubled lines and breeds, such as the Doberman, have very little likelihood of being revived through testing and selection; when the breeding pool is below critical mass reconstruction from outside sources is the only viable alternative. But in reality this is practically and politically difficult because the people involved cling to their mythology and because kennel club culture and structure create enormous obstructions. Some breeds, such as the English Bull dog, are beyond redemption, need to become extinct.

An illustrative example of the need for a more pragmatic approach to breeding is the Dalmatian. Unfortunately in the 1970s and 80s all purebred Dalmatians had a recessive gene which produced high uric acid levels, which in turn cause an extremely high incidence of debilitating urinary tract blockages. Since the gene was universal selective breeding within the existing base as a solution was not an option.<sup>1</sup> (Nash, 1990)

Yet there is a perfectly viable solution to this problem. In 1973 Dr. Robert Schaible began a "Dalmatian-Pointer Backcross Project," in which a Dalmatian was

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<sup>1</sup> The Dalmatian is also subjected to serious levels of congenital deafness, which can theoretically be remedied by selection within the breed.

bred to a single English Pointer, producing in a few generations dogs which looked like Dalmatians, acted like Dalmatians and for all practical purposes were Dalmatians, yet substantially free of genetic high uric acid levels. But in the eyes of the AKC, British KC and the various breed clubs these dogs are not purebred, are in their eyes low class mongrels to be held in contempt by all respectable people. After forty years of denial the Dalmatian community finally began to relent in the 2011 era, after inflicting pain and suffering on generations of dogs and people in the absurd cause of purity.

This is unconscionable. An ongoing program for breeding a population of dogs for common type, structure, appearance, character and working propensities is a time honored and noble undertaking, a satisfying and useful human achievement. But somehow we deny, at least in our own minds, that these breeds are always created by crossing selected individual dogs, often with substantially different characteristics, to produce the desired result and in time consistently reproduce the desired type. Breeding populations need to be open to occasional, closely controlled and monitored outside matings to introduce diversity, thus maintaining genetic viability and vigor.

Historically the practical means of introducing outside genetic resources has often been the use of a desirable male and then the falsification of the registration, using the name and identity of an existing male within the breed. This is not especially uncommon, and often well known to the insiders. But the introduction of DNA testing is making this difficult or impossible, an instance of the negative consequences of a scientific advance. Rather than using such testing for the benefit of breeding stock, the AKC and other registries will use it to put teeth and consequence into an irrational paradigm.

There have been sporadic attempts to address these issues, but shoveling sand against the tide has proven difficult. In the German Shepherd world, Dr. Helmut Raiser, for a brief period national Breed Warden of the SV, the German national breed club, has taken the stand that lock step selection based on hip X-rays has weakened character in the German Shepherd Dog and proposed that selective introduction of Malinois blood could be part of a better overall approach. It cannot be a surprise to anyone that the German show breeders soon conjured up a way to remove Dr. Raiser from his office and go back to with business as usual. Others from time to time speak out, but the establishment is deeply entrenched and invested in their system.

But there are chinks in the armor, a glimmer of hope in the rapidly declining registrations in both Europe and America. AKC registration totals have fallen by 63 percent over 15 years, and other registries have experienced similar reductions. These dramatic reductions have been especially pronounced in the larger and more aggressive breeds, especially the German Shepherd. As discussed in the next chapter, the ongoing collapse in the AKC and FCI creates vulnerability, but also perhaps the opportunity for better paradigms to emerge.

While line breeding is the foundation of animal husbandry, the process by which breeds are established and maintained, it is generally accepted that the periodic out cross to maintain diversity and vigor is fundamental to the process. The fact that the closed gene pool and the focus on breeding to a very small number of show winning dogs has in many instances made the true out cross impossible, thus preordaining the fragility, lack of vigor and proliferation of genetic faults that we see before us today.

The ideal situation would be a number of concurrently evolving breeding lines, with ongoing interchange among them, to provide the necessary genetic diversity. The Malinois is in many ways a good approximation of this. The problem is that the exhibition breeders, and to a lesser extent the working breeders, tend to go blindly

back to the same winning lines since that is what is seen as the road to recognition, personal status and puppy sales.

Although not widely used today, in Belgium there is an established, formal process to introduce outside lines. One can show his dog to two conformation judges and, upon receipt of good or very good ratings receive provisional papers. (Unfortunately, there is no requirement of a character evaluation.) The offspring of such dogs also receive provisional papers, but in the third generation they convert to full registration. This rational system should be the norm everywhere.

As historical background, this started in pre WWII Belgium where there were multiple registries competing for acceptance. Being reluctant to acknowledge the existence of another registry, this was a face saving way of incorporating existing dogs. In many instances lines developed by working trainers who had ignored registration for economic or social reasons were valuable assets that needed to be included. Also, until relatively recently the French & Belgian registrations were not compatible, that is it could be difficult to import dogs. As an example, in the early 1950's the president of the Belgian Bouvier des Flandres club, Felix Verbanck, was able to acquire a French Bouvier and register it in Belgium, and then forward the dog to the founding American breeder. This was necessary because at that time it was not possible to register directly a French dog in America. In general the Belgian and other European breeders, other than a few people with working lines, are not engaged in this sort of thing, but the tools are there.

The fundamental problem is not the use of medical procedures to determine the latent potential for defects in the progeny, for it would be foolish to ignore this technology, but rather the propensity to use it blindly to eliminate dogs without any thought of the overall consequences. From the beginning the OFA emphasized that breeding decisions should be based on a large picture and broad consideration of consequences, that breeding decisions should be made on the bases of diversity and the gradual reduction of risk rather than blind elimination. The breeding of mildly dysplastic dogs should be viewed as an undesirable but sometimes necessary expedient based on the overall quality of the expected progeny and the aggregate contribution to potential diversity.

Medical screening can only be truly useful and successful as an ancillary practice in an overall breeding program primarily driven by selecting breeding animals from among those who have demonstrated proficiency in the particular purpose of their breed at a relatively mature age. In such a program serious problems such as heart defects, severe dysplasia and juvenile blindness most often become apparent and eliminate the dog from breeding. A four or five year old dog qualifying for a KNPV certificate simply cannot be hiding much, is with high probability a physically good specimen. But when dogs are qualified in the show ring and bred relatively young the breeders can and do conceal physical defects because the dogs never have to publicly scale walls, search in the woods or pull down a man on a bicycle.

Medical screening is truly a double-edged sword. On the one hand it provides a tool to assist in a gradual remediation of widespread genetic problems. But on the other hand it has been used as an excuse for ignoring the real problems before us today, that is, the closed studbooks, the breeding based on conformation rather than function and the shrinking gene pools. But applied blindly, by excluding all dogs testing positive for newly perceived genetic defects in a closed gene pool, medical screening can only further tighten the noose in an ever-tightening spiral to oblivion.

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