

REPORT TO THE BTCA BOARD:

LIVER AND DILUTE COLORS IN BULL TERRIERS INTRODUCTION

At its March 1995 meeting, the Board resolved to create a committee to investigate the implications of the liver color in Bull Terriers. Subsequently it was agreed the committee should look into liver and dilute (blue) colors, both of which are showing up in the breed today.

There are two distinct facets of this investigation; one concerns Phenotype, i.e. the appearance of the dogs, the other Genotype, i.e. their genetic makeup and its ramifications. Both facets are covered in the discussion and findings. The report concludes with recommendations.

II. DISCUSSION

IIa. Phenotype

The Bull Terrier Standard of Perfection calls for:

“The eyes should be ... as dark as possible, with a piecing glint ... Blue eyes are a disqualification. The nose should be black, ... Skin pigmentation is not to be penalized.” For the white variety: “The color is white though markings on the head are permissible.” For the colored variety: “Any color other than white, or any color with white markings. Other things being equal, the preferred color is brindle.”

At no time in the history of the breed have been liver or dilute colors considered normal or acceptable for breeding or showing purposes. They have occurred infrequently and have been shown only rarely with, to date, no champions of record in the U.K. and one – a white male with a liver colored nose – in America.

It is enlightening to review the Standards for the other bull and terrier breeds and those for Bulldogs and Dalmatians, both precursors of the Bull Terrier:

The Standard for American Staffordshires calls for a dark eyes with no pink eyelids and nose definitely black; for coat color, more than 80% white, black and tan and liver not to be encouraged.

Staffordshire Bull Terrier should have a black nose, with pink (Dudley) nose considered to be a serious fault; Eyes are preferably dark, but may bear some relation to coat color; light eyes or pink eye rims are considered a fault, except that where the coat surrounding the eye is white the eye rim may be pink. Black and tan or liver colors are disqualified.

The Boston Terrier Standard calls *for* dark eyes, with blue eyes or any trace of blue a disqualification. The nose must be black with the Dudley nose a disqualification. Colors are brindle, seal or black with white markings, seal being defined as black with a red cast. Gray or liver colors are disqualified.

Bulldogs are required to have very dark eyes and black nose, with brown or liver nose a disqualification; the color of the coat should be uniform, pure of its kind and brilliant. The colors found in the breed, in order of preference, are red brindle, other brindles, solid white, solid red, fawn or fallow, piebald, and inferior qualities of the foregoing.

The Dalmatian standard permits both black and liver (brown) spotting and so the Standard reflects this in the requirements for nose and eye coloration. *Eye* color is brown or blue, or any combination thereof, the darker the better and usually darker in black-spotted dogs. The nose is completely pigmented on the leather, black in black-spotted dogs and brown in liver-spotted dogs; incomplete nose pigmentation is a major fault. Tricolor coats and any colors markings other than black or liver are disqualified.

The four bull and terrier breeds – Bull Terriers, the two Staffordshires and the Boston Terrier – and Bulldogs are all required by their Standards to have dark eyes and black noses. Blue eyes are a disqualification in Bull Terriers and Bostons, the liver nose a disqualification in Bulldogs and the Dudley nose in Staffordshire Bull Terriers and Bostons. Liver coats are disqualified in Staffordshire Bull Terriers and Boston and not to be encouraged in American Staffords. Gray (presumably dilute) coats are disqualified in Bostons. The requirement for brilliant, as opposed to inferior, colors in Bulldogs implies discouragement of liver and dilute coats. Dilute coats do occur in both Staffordshire breeds; blue brindles are not uncommon among American Staffordshires, but are seen only rarely in Staffordshires.

A primary question is whether liver or dilute colored Bull Terriers meet the requirements of the Standard. Specifically, how important is the call *for* a black nose and the eye to be as dark as possible? A liver colored dog has a brown nose and eye, while a dilute, such as a blue brindle, has grey/blue leather and eyes. Are these simply faults – to be judged, like mismarks on white coats, in proportion to degree – or should they be discouraged actively?

The current British Standard is clear on these points, requiring the eyes to be black or as dark brown as possible so as to appear almost black, and with a piercing glint. Blue or partly blue eyes are undesirable. Under color, blue and liver are specifically referenced as being highly undesirable. In Britain very serious faults are not disqualified, rather they are noted as highly undesirable. So for example blue eyes are considered undesirable in Britain, whereas they are a disqualification in America. Thus the addition to the British Standard in 1986 of "Blue and liver highly undesirable." Is equivalent to a disqualification in an American Standard.

Burns and Fraser (Genetics of the Dog, Lippincott, 1966) are clear as succinct with regard to livers: "A dog which has the formula bb (i.e. liver) apparently cannot produce any black pigment anywhere on the body; it is therefore no use breeders demanding a black nose or very dark eyes from such dogs. In fact, for all of the breeds in which liver coat colour is permitted, the Standard of Points permits brown noses and lighter eyes with this coat colour."

Similarly, blue dilution precludes black nose and eye pigmentation, though, as noted by Burns and Fraser, the impact is less severe than in the case of liver:

In a dog that lacks D, i.e. has the genetic formula dd, the pigment granules are clumped into very distinctive agglomerates, larger and much more definite than produced by the gene b. This clumping certainly affects black and chocolate pigment ... The effect on black pigment gives the familiar 'blue' of Greyhounds, Great Danes, Poodles etc."

Such views are echoed by more recent treatises, for example Willis (Genetics of the Dog, Howell, 1989): "The fact that bb animals cannot produce black pigment is important as far as breed standards are concerned because bb dogs will have liver noses rather than black ones. It is thus pointless asking for black noses in liver-coloured dogs. To my knowledge all breeds which permit this coat colour allow brown noses. They usually permit lighter eyes since it is probable that the bb combination affects eye pigment as well as that of the coat."

So clearly the current American Standard for the Bull Terrier, by requiring eyes as dark as possible and a black nose, discourages liver and dilute coats.

Ib. Genotype

Variations in pigmentation and the resultant colors and patterns in the canine coat result from the interaction of at least ten pairs of genes. The genes at location B control the intensity of pigmentation, yielding either black or liver (brown) pigmentation. Those at location D determine whether the coat has full (dense) or dilute pigmentation. Both pairs of genes can cause loss of the normal black pigmentation, but the changes they invoke are different and quite distinct.

Bull Terriers are normally BBDD; BB for black as opposed to brown (bb) pigmentation and DD for full as opposed to dilute (dd) color.

Following are explanations of the changes caused by bb and dd, as presented by Robinson (Genetics for Dog Breeders, Pergamon Press, 1982):

Brown: "The normal pigments found in the coat of the dog are black and yellow. The pigment is present in hairs as exceedingly tiny granules, It is the colour and shape of these that give the hair its colour. In the black areas of the coat, the granules are smaller, oval and intensely brown, while *in* the yellow or reddish areas they are smaller, round and yellow. In liver- or chocolate-coloured individuals ... the granules in the chocolate areas are a lighter brown than those found in black hairs, while the yellow granules are unchanged... evidently the, mutant gene producing chocolate acts only on the black pigment granules, lightening their colour. The effect on the human eye is to change black hairs to chocolate.

"The difference in colour *is* due to two genes, B for black pigment and b for brown pigment. The normal gene *is* B and b *is* a mutant of it. Brown is the designation used by geneticists for this type of mutant, although dog breeders will probably feel they are liver or chocolate, since the colour *is* a rich dark brown. The effect of b *is* to change all of the normally black areas of the animal to chocolate, not only the hairs but also the skin of the lips, mouth and paws. The *iris* of the eye also becomes a lighter colour.

Dilution: "The pigment granules *in* normal hair are disposed regularly as it grows, except at the base, where the disposition tails off and the colour becomes less intense as a consequence. For example, the black hairs are intensely black at the tip, but pale slightly and ultimately become bluish at the roots. The effect *is* due to less granules *in* the hair near the skin. ... The top colour of the coat *is* the intensely coloured tips and *is* the colour normally presented to the eye. The paler region below the tips *is* the undercolour. This *is* not normally visible, but can be exposed in long haired individuals or if the coat *is* partially clipped.

"The 'blueness' of blue coloured varieties *is* also due to 'a lack of pigment granules, but the sparsity *is* caused by a different mechanism. The granules are deposited into the hair in a regular manner but *in* fits and starts. Moreover, the granules may

occur *in* clumps. The outcome *is* that sections of the hair may have more than the normal quota while other sections may have less or none. To the human eye, a genetically black coat composed of such hairs will appear slate blue, and a yellow or red coat a dull cream. ... The difference of pigment granule disposition *is* due to the D genes for normal pigmentation and to *_* for abnormal disposition. The genetic designation of the two are D for dense and d for dilute pigmentation, alluding to the effect presented by the coat to ordinary inspection.”

Robinson goes on explain the fundamental colors *in* mammals – black, blue, chocolate and liver – *in* terms of four genes:

Color:	Genotype:
Black Blue	A_B_DE_ A-B-ddE_
Chocolate	A-bbD E_ A-bbddE_
Lilac	-

Bull Terriers are firmly entrenched in the ‘black’ camp, as are the related breeds, though some American Staffordshires do fall into the ‘blue’ camp.

IIc. Further Discussion

The wisdom behind the breed standards and the implications of these genetic factors raise many questions. Were the permitted colors and pigmentation selected primarily for aesthetic reasons? Would essential type be lost if the requirements for black noses and dark eyes were relaxed? Are the genes for liver and dilution associated. With serious defects or predisposition to health problems? For example, is deafness more prevalent among livers and dilutes? Is there higher incidence of skin problems with these colors?

Willis (Genetics of the Dog, Howell, 1989) provides a well balanced perspective on these issues:

“All pedigree breeds of dogs have certain colours laid down in the breed Standard as being acceptable. In some breeds the range is very wide, in others very limited. In most breeds specific colours are unacceptable or disqualifying. Generally such undesirable colours are selected against because they are aesthetically disliked rather than because they are associated with. Some particular biological defect. One might rightly select against a colour that is associated with blindness or deafness, or even against a colour which is unsuitable for specific kinds of work (for example, white guard dogs) but the wisdom of .d_squalifying a colour for no other reason than it is disliked is open to question. Sometimes the colour under dispute may have been so categorized because it was, in the early days of the breed, associated with ‘blood’ from other breeds. Sometimes it is selected against because of a believed association with physical degeneration (such as white in German Shepherd Dogs). Usually such beliefs are without foundation.”

The Standards for the Bulldog and for all of the bull and terrier breeds demand .black noses and dark eyes. Clearly, the founders of these breeds and their guardians over the years have held firmly to the belief that these particular characteristics are essential to type. Whether the color changes wrought by the genes for liver and dilution are simply disliked, or are associated with problems and defects is not recorded.

Livers are disqualified in Staffordshires and Bostons and discouraged in American Staffordshires and, from the section on color, by implication in Bulldogs. But, why? Because the desired appearance and therefore type would be debased? Early Staffordshire breeders spurned tricolor because they wanted to differentiate their dogs from the working black and tan terriers (today’s Manchesters). However their traditional dislike of livers lacks such a solid explanation. Here are Gordon’s comments (The Staffordshire Bull Terrier, Popular Dogs, 1980):

“Liver coats are usually displeasing because the coat color is often associated with the unwanted Dudley nose and matching eye shades. Stud dogs with li ver coat seem always to produce youngsters that abound in the same colour.”

An analogy can be drawn here with the importance of brindle to breeders of Bull Terriers. There is a considerable body of evidence that the ‘brindle factor’ is key to vigor and soundness in the breed. This evidence, however, is circumstantial rather than scientific in nature. Oppenheimer, a zealous advocate of brindle wrote (After Bar Sinister, Dog World, 1969):

“.. in the last century it was generally agreed among true ‘dog’ man that brindle was an indication of hardiness, and while this savours of an old wives’ tale too many of these have, over the years, been found to be soundly based for one to laugh at them.”

Turning to genetic problems, there is no scientific evidence of a higher. Incidence of deafness among live+s and dilutes. From the wealth of data available on BAER testing of Dalmatians, Dr strain has found no statistical differences between black and liver spotted dogs.

However, there is cause for concern with regard to skin problems. Color Mutant Alopecia *is* a hereditary defect of the outer skin found *in* color mutants of certain breeds. Partial hair loss, dry lusterless hair, scaliness and bumps are typical of the disease. It is most characteristic in Blue Dobermans, but has also been reported in fawn Irish Setters, red and fawn

Dobermans and blue coated dogs *in* a number of other breeds. The disease is incurable, but can be improved with treatment. These colors were termed 'mutant' as abnormal colors for the breeds when they first appeared in-breeding programs. Later, some of these colors were accepted by the breed clubs. Of greatest significance to the current discussion, the disease is associated with both dilute and liver colors. It is unlikely that the first appearance of these mutant colors would have displayed the diseases as this would have discouraged continuing with them. Through careful breeding the occurrence of Color Mutant Alopecia has been reduced. However, the continuing incidence of the disease in the above breeds illustrates the difficulty of eradicating genetically associated disease.

Thus the concern must be with problems that might manifest themselves later, with inbreeding of livers and dilutes, rather than in dogs of these colors in the first few generations. It could be argued that small numbers of livers and dilutes would probably have minimal impact on the breed, but subsequently larger numbers of them might result *in* the introduction of unwanted genetic traits.

The history of the Bull Terrier extends back to the 1860s. During these years mutant colors have no doubt occurred from time to time. However, breeders have continued to focus on the color variations associated with the black genotype and have bred away from the mutant blue, liver and lilac genotypes. Ultimately, the decision whether to open up breeding to these mutant colors rests with the Bull Terrier Club of America and its members as guardians of the breed. In Britain, the national club acted in 1986 to discourage mutant colors by changing the Standard to make liver and blue highly undesirable.

III. SUMMARY OF FINDINGS

* Bull Terriers and related breeds are required to have black noses and dark eyes. They are black in genotype, as opposed to liver, dilute (blue) or lilac.

* Liver and dilute coats and pigmentation result from recessive genes at the Band D locations respectively.

* The genes for liver and, to a lesser extent, dilute color cause a loss of the black pigmentation demanded by the breed Standard.

* The British Standard has been updated to make liver and blue highly undesirable.

* From data on Dalmatians, there is no reason to anticipate a higher incidence of deafness in liver colored dogs. However, data on Dobermans suggests liver and dilute dogs may be susceptible to heritable skin disease.

* The personal likes and dislikes of breeders, rather than scientific reasoning, are responsible for most of the color selections laid down in breed standards.

IV. RECOMMENDATIONS

* The Board should disseminate to the membership information on liver and dilute pigmentation in Bull Terriers, for example by publishing the findings from this report.

* The Board should encourage discussion and further review of the report by the membership, for example by requesting written feedback on this report.

The Board should ensure breeders, exhibitors and judges are fully conversant with the requirements of the breed standard in terms of pigmentation and coat color.

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