The Pigeon Genetics Newsletter, News, Views & Comments.

(Founded by Dr. Willard .F. Hollander)

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Welcome to the NEW YEAR 2020 , and a fresh new look at the world of Pigeon Genetics as it pertains to both the standard and the unusual colour traits found in Pigeon Lofts from around the World.

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There had to be quite a bit of written explanation with this month's topic , so we sincerely hope that you will take the time to read through all of the information as we have explained it. Photos have been added with **thanks to those who provided them**.

January 2020 .

The Single Topic this Month is the " **Colour Locus**" . If you are breeding Pigeons of any type , you are automatically dealing with at least one of the three basic (melanin)colours at a spot where the tyrp1 gene is located on a chromosome . The Wild Type base colour in pigeons is a '**BLACK**" pigment . There have been two colour mutations occur at this tyrp1 locus that are alleles (alternate choices) to Black., they are : **Dominant Red** (mutated only once) and **Chocolate** (mutated at least seven times in the History of Pigeons , but perhaps we are dealing with only one). The Red is dominant over Black ., while the Chocolate is recessive to Black. Black and Chocolate are 'eumelanin' pigment, while Dominant Red is 'phaeomelanin' pigment.

There are a multitude of variations of these three base pigments depending on many other genes that change how we see them. This Issue we take a closer look at all of the information associated with the base pigments and the terms we traditionally use to describe what we are looking at. The term for that which we SEE is '**phenotype**' . The term for the genes which CAUSE that phenotype is '**genotype**'.

Geneticists and other Scientists who have worked with the colour genetics of other animals and indeed birds, have applied some different terms than were applied by early Breeders of Pigeon colours. The reason for that was due to the fact that Pigment in Pigeons looks different to the naked eye in some feathers due to something we have named feather "**PATTERNS**". The Pattern series will be dealt with in Next Month's Issue , but must be mentioned here. Dominant Red pigmented birds in the Pattern series look ASHY gray in colour as opposed to RED. The tail band and flight tips will look like a light tone of the ash, while other Pigment granules known as 'course spread pigment' on the shields will look Red. In the case of the Black pigmented birds , the pattern series birds will look like tones of Gray , which we call "BLUE" with the Smooth and coarse spread pigment granules both appearing black.. Finally in the case of the Chocolate pigmented birds , the Pattern series birds will appear as tones of a greyish brown with the smooth & coarse spread pigment granules chocolate. So in summary we have three 'base' colour pigments : **Dominant Red**, **Black** , and **Chocolate** ., and three 'Pattern' colour series : **Ash**-Red , **Blue** /Black., and **brown** /Chocolate. These latter tone variations of the base pigments are due to the fact that some granules of pigment are somewhat '**clumped**' in their placement in the feather structures. This allows for areas without pigment that are basically colourless, so that we see the combination of clumped pigment and colourless areas as an overall lighter hue of the base pigments.

There is also a mutation at another locus that alters the Intensity of the base pigments so that we may see them in several different and usually just lighter tones that we call 'phases'. The first of these is "**pale factor**" , it lightens Intense colour base pigments by about 1/4 way between Intense phase , and the next phase below it called "**dilution phase**" . Then it is believed that there may be at least one more phase below dilution that has been referred to as "extreme dilution" . This trait is different than the other two mutations in that it is not only lighter in tone , but also expresses phaeomelanin as a cream colour overall and was first named lemon , then **Ecru**. I cannot write about this as a definitive phase at the dilution locus as there are some unknown aspects of this apparent phase mutation yet to be understood, including the phaeomelanin expression .

Symbols have been assigned to the above traits as such: Wild type (+) ., blue (B)., Ash (Ba) ., brown (b)., Pattern (C) , Spread (S), pale (dp)., dilution (d)., and Ecru (dex) .

NOTE: There are **three possible ways** that we will see the Black and Chocolate eumelanin granules in their true colours. (1) when the **Spread factor** gene is present, evenly depositing smooth spread granules over the entire bird. In such cases the colour is '**solid**' (Whole colour but with no Pattern) and referred to as "**epistatic**" meaning that it covers or hides the patterns . (2) when there is visible flight feather and tail Band pattern of **smooth spread** pigment present and (3) when there is **coarse spread** pigment visibly present on the shield area, which automatically expresses along with the smooth spread tail band and flight tips. The Patterned birds are referred to as 'self' (whole colour but with a pattern). Solid coloured and Self coloured birds may also express with areas of pure white feathers caused by a Pied factor (Pi) gene or genes. Three different sets of genes are involved among these three colour expressions, and there is a **linkage** between #(1) spread factor., and #3 Wing Patterns. Linkage means that they occur on the same chromosome and inherit together. More on that later.

Now let's take another look at some photos of the lovely birds demonstrating these traits :

Photo by Crisol Pigeon Dhaka Bangladesh . Solid Black possibly masking self checker pattern.

Photos by Mick Bassett Germany. Spread blue /BLACK solid, and extreme Saturated T-Pattern .

Note pearl eyes on Black birds.

Note false pearl eyes on the Chocolate and Dun birds.

Spread brown, Solid Chocolate masking chk. photo Clint Robertson Canada , and a solid Dun , dilute Black of Stephen Scott's also Canada.

Spread ash - Red presents us with exceptions to the accepted rules we understand when dealing with Black & Chocolate. The main reason for this is that these colour pigment granules of '**phaeomelanin** ' are shaped differently than **eumelanin** , and thus are deposited in the feather structure differently. They reflect light rays differently and thus we see them as ASH instead of RED even when not '**clumped**'. We see the smooth spread areas of the flight ends and the sub-terminal tail band as a very light ash as they are smaller granules , while we see the larger coarse spread as RED. The clumped areas of ash -Red may appear as a slightly darker tone than the actual smooth spread areas but when smooth spread is distributed over the entire bird by spread factor , all of the feathers appear as one solid ashy colour including the ends of the flights and sub-terminal band such that those areas no longer stand out as different. The Coarse spread areas of the wing pattern usually are masked by the smooth spread , but there sometimes may be a slight expression of RED in the pattern areas. I suspect that this is more likely due to the presence of a bronze trait, and possibly another modifier known as Dirty factor.

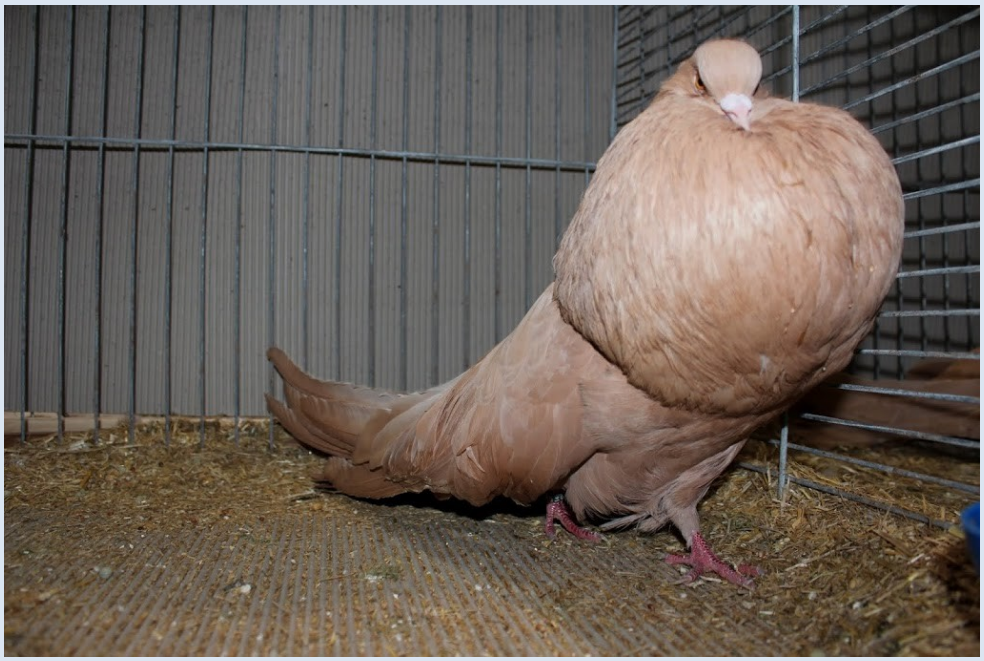
Here are some fine photos to demonstrate the effects of the Ash-Red phaomelanin pigment granules.

Intense spread ash **hetero for blue/Black ,** slightly incomplete **~ Mick Bassett** photo Germany.

Spread pure Ash **~ Robert Corrales** photo U.S.A. Spread ash cream ~ **Stanley Stamer** - U.S.A..

Pale and dilute Spread factor birds may appear almost white.

We have talked about the **EPISTATIC** nature of the spread factor SOLID / whole coloured Bird . The examples were : **Solid Ash**, **Solid Black** , **Solid Chocolate** , but we have another trait we call recessive red (a mutation at the 'Sox10' gene locus) , and its pale and dilute phases Gold and Yellow. This mutation is epistatic to pattern and also to Spread factor . It is important to note that neither spread factor nor recessive red alone are completely epistatic without the help of other gene mutations (modifiers) that enhance their colours. Below are examples of Intense recessive red (e) , Gold and yellow , all of which probably are homozygous for Kite bronze :



Above #1 recessive red Intense phase ., then #2 Gold pale phase , and then #3 Yellow dilute phase . photos taken by **Mick Bassett** Germany.

Some may ask why was white not included. I do not consider "**WHITE**" as an epistatic gene. It does not mask or hide any pattern or colour as it is indeed the absence of pigment granules and thus the absence of pattern. True it prevents us from knowing what colour and pattern the bird is genetically , but there

is nothing expressed in the feathers so nothing is physically masked. White is not solid , nor is it ..self , as it is the lack of pigment. It must be pure for a certain gene that STOPS both colour and pattern expression, so it is '**pure white', you cannot mask or hide that which is not there to begin with.**

We know that we cannot have Base colour without Pattern, we know that we cannot have spread factor without Pattern , and we know that we cannot have recessive red and its phases without pattern. So what exactly is the pattern and why can't we have coloured pigeons without pattern.

The answer takes us back to the word 'epistatic'. All colour expressing pigeons have some sort of total body 'patterning' whereby the feathers express the pigment granules in a wide variety of ways or applications. The wing shields show this patterning more specifically. The few **colour** expressing traits that we talked about on the previous pages tend to 'COVER" up the pattern but **do not replace pattern**. In good light one can still see the pattern underneath the epistasis / covering.

Now let's examine the genetic nature of the traits we have talked about above. We established that the three base pigments are alleles at one locus on a chromosome. **The order of dominance** is : Dominant Red , then Black, then Chocolate. If you place them stacked one above the other that way , Red can carry either black or Chocolate on the matching chromosome. Black is recessive to Red , but can carry Chocolate , and then Chocolate is recessive to both Red and Black, so cannot carry either of the other two. **Note** : this applies to males only as females must be pure (hemizygous) for their base colour.

There are **two types of chromosomes** : Sex-linked , and non- (sexlinked) - autosomal.

The fact that Black and its two mutations Red , and Chocolate are located on the same sex-linked chromosome at the major colour locus means that they are in fact sex-linked. There is an unique reaction of these genes that makes it easy to identify the gender/sex of the babies while still very young just by colour alone. When the colour of a female is dominant over the sex-linked colour of her mate , all of her sons will be her base colour , and all daughters will be the base colour of her mate. The sex-linkage does not work in reverse. It ONLY applies when the hen's base colour is dominant over that of her mate. The first example would be , **a dominant Red hen mated to a black or chocolate male.** All sons would be Red , all daughters would be either Black , or in the second case Chocolate. The same if the cock was Chocolate and the hen Black. All sons would then be Black, and all daughters Chocolate. Below an example:

Hen ash-Red X cock Blue /black (Photos by Gary Keith Canada.)

 X  = **All ash-red sons** and blue/black daughters .

You may ask, Does pattern affect colour inheritance ? No , the same rules apply for base colour no matter what else is going on with any other mutation or combinations of mutations. Base colour inherits the same way , and must be worked out separately from pattern or any other modifier.

(Now, is it possible that there is any other base colour mutation besides the three we have talked about? The answer is indeed yes, that is possible, and we may already have discovered one , but until such time as laboratory DNA testing can be carried out and a subsequent paper published to that effect, we can only speculate.)

Breeders have often asked , what about the so - called "**modifiers**" ? Just like all other traits that we have discussed above , there is a multitude of additional mutations that modify how we see the base colours . The changes are often spectacular , and vary even more when combined in different ways . These modifying mutations can be either Sex-linked genes or autosomal genes. In some cases many genes may be involved to create a specific trait and they are referred to as 'polygenes' . We will be devoting individual issues to many of these modifiers in the coming Months.

What else is there to be known about the 'colour locus' ??

We must talk more about the allele that is **carried** on the matching locus . Females cannot carry another sex-linked allele on the opposite locus as they must be pure for these traits in order to express them. Females do not have a pair of matching chromosomes for sex-linked genes. Males however can carry another allele as they DO indeed have pairs of matching sex chromosomes and because they do there is often a visible effect of that second allele. The most common example is the "MEALY" . This is an ash-Red male that carries either Blue/black ., or brown /Chocolate . In such cases , the birds begin to show flecks of the second allele colour particularly in their flights and tail feathers and often also on their wing shields, when the first adult feathers grow out. Normally all nestlings regardless of colour, have slightly lighter expressions of base pigments , but after the moult we begin to see a deeper more definite expression , not only of the dominant base pigment , but also sometimes of the second base colour present on the matching locus and this flecking may increase with age. The term Mealy means 'grainy' or flecked. Some people think that all ash-Reds should be called Mealies , but that is not correct as it actually only refers to the phenotype of birds as described in this paragraph. The females also sometimes , but very rarely express some variable pigment effects that resemble those of the males heterozygous for either black or chocolate. The reason for this seems to be more likely due to other modifiers that are present in her genome, as she does not carry another sex-linked pigment . Bronze factor mixed with Red , black or chocolate pigment granules certainly would cause some phenotypical changes in how we see that pigment. Not enough knowledgeable research has been done on this subject , which will have to include both DNA testing , and microscopic evaluation of the pigment granules. Many ideas have been tossed around , but nothing concrete has ever been established.

Mealy Cock . photo by : Jochen Klaus , provided by Jith Peter.

Both males and females of certain **autosomal traits** may carry their alleles or other influential autosomal traits.. Some examples of autosomals would be recessive red, milky factor , smoky factor, pencilled, frill stencil, etc. Influence may be seen in some cases such as black hetero for recessive red whereby the neck feathers only may appear bronzed , or the wing shield or flights may express some phaeomelanin.

Heterozygous saturated T-pattern, hetero Kite bronze (split for) recessive red : photo by : **Mixk Bassett**.

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Incomplete Spread factor is when the Spread factor gene does not provide for a complete masking of Pattern in particular. However in some cases a **'spread factor look-alike'** may be produced by the addition of two or more darkening modifiers such as smoky and Dirty as seen below on this lovely American Show Racer by Gary Keith of Canada.. I first showed this bird as spread a number of Issues ago, but believe that it may not be .


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Simetimes for various reasons , the spread factor gene fails to cause the complete masking of pattern and/or other traits such that a similar phenotype is created that is not the typical SOLID colouration.

These birds were bred by the Editor , and they produced as homozygous spread when mated to checker pattern. Paul Gibson was the first to identify this as an apparent gene that usually has only a "Dun Bar " color and pattern phenotype yet produces as pure spread factor when mated to bar or checker pattern.

Here is a dilute version of the black above. They both produced solid blacks when mated to blue checkers . Those blacks bred as homozygous (S).

The black barred specimens were a contradiction to what Paul had noted , in that the birds he had seen and worked with were always "dun-like' in phenotype as if dilutes , but he did not believe that they were, and did not get to do further testing. He never did see an intense phase such as the blacks that I bred. After I presented these birds, Axel Sell of Germany, and Ryan Harvey also of Nova Scotia Canada, presented photos of birds that they had raised that also were black barred intense phase.. dilution had not been introduced.

Another interesting fact was that they all were 'Barred' in pattern. I did not get to continue testing, but no check pattern birds in the dun-like colour were produced .

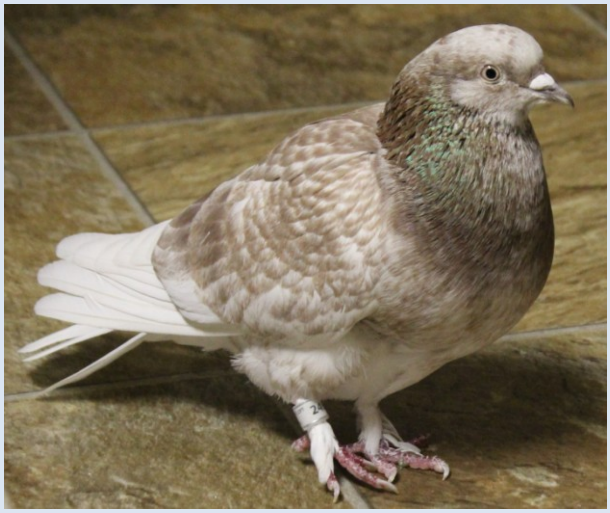
I wish I had been able to continue with this breeding program because these birds were a cross between a Mosaic Black & Dun Lahore cock and a Blue Saxon Monk hen. The white heads bred at first as partial dominants . However there were several other oddities. One was that there was also a Dun barred cock sibling , which should have been impossible if the Monk hen was an intense bird as she appeared to be, or these were not dilute birds.. Lastly, the apparent partial dominant Baldhead design began to pass on as a DOMINANT trait in a cross out to Racing Homers. The birds that Paul , Ryan and Axel bred were non-pieds and as I mentioned above , those of Ryan and Axel were black barred not silver/Dun.

Usually there is a very good explanation why there is any sort of contradiction to the normal expected outcome of any mating , however there is always the possibility that something NEW has taken place !

Even pure spread factor birds may not express a **deep rich black**. Some are dull black with very little sheen on any feathers. The reasons vary greatly. There are many ways to make a Black pigeon , but the quality of the black phenotype is another matter . How do we get and maintain the glossy richness of an intense shiny black? Some quickly say Dirty factor , others will speculate that iridescence is the key and that 'grease quills ' cause this sheen. On the contrary I suspect that grease quills are actually the result of very shiny/oily feathers in areas of the bird where the feather structure is soft , and with the added oily gene cannot unfold and erupt from the quill enclosures properly. These underdeveloped quills have nothing to do with grease production. Some have found that rich shiny Blacks must be hetero recessive red. I bred rich shiny Black Lahores for years and obviously no (e). Selection is key for shiny blacks.

We spoke earlier about the **phaeomelanin** of the ash-red gene and how it expressed differently than either black or Chocolate eumelanin. The spread ash bird may show quite a range of "RED" tones that appear to express on TOP of the smooth spread as opposed to being pattern showing through. Sooty factor causes the red to express in the center most portion of each shield feather and the effect is called 'Dappled' when expressed on Barred pattern birds. Some spread factor ash-Red birds may have a tarnish of red that creates either a lacing of red or near totally Red feathers and this effect is called **Strawberry**. The genetic cause is usually 'Dirty' factor, 'Sooty' and sometimes 'smoky' factor. It may also be caused by residual bronze . We may see the same effects on Black & Chocolate birds when a bronze trait expresses on spread factor. Below are examples of birds mid-way between the two expressions.

#1 unknown/ breeder owner, (lost bird).



#2 Photo Levi Encyclopedia of Pigeon Breeds .

Linkage : This is when two specific genes for different expressions , are located on the same chromosome and are passed on to offspring linked as one package . The most common of these is the linkage between Spread factor and Pattern. Back as recent as Levi's Books , it was still believed that spread factor WAS INDEED a fifth pattern. However it was later learned and noted by Hollander that these genes were linked , and spread factor was therefore not an actual Pattern mutation. You can see why early writings about any traits relating to 'Self' whole colour with Patterns, and 'solid' whole coloured birds with masked patterns, showed their lack of knowledge because the genetic cause of 'Spread Factor' had not been discovered !

I hope that you have enjoyed this new approach and summary of the Base Pigments . Next Issue we will cover everything we now know about the Pattern Series. Please keep in mind that everyone out there would enjoy hearing from YOU, so feel free to send your photos and comments in and we will add them in an appropriate Issue . These issues may exceed the usual 12 pages as some topics are far too complex to be able to make them fit into the 12 page limit.

That is it from the Pigeon Loft for the first Month of 2020 ! Hope you all have a safe and Prosperous new year , and that an exciting new Mutation finds its way into one of your nest bowls !!