October 2018 Newsletter

The Pigeon Genetics Newsletter, News, Views & Comments.

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(Founded by Dr. Willard .F. Hollander)

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"The latest updates from around the World brought to You Monthly"

This Month we have added your comments on various matters that you have offered over the previous weeks , not all views are shared by the Editors . We also do not print references to or recommendations for any individuals or websites of individuals who have been critical of this Newsletter , its content , or of any individuals who do contribute.

Our feature Topic this Month is "Feather Colour". We are all about Colour genetics , but most of us have very limited knowledge of how the colour pigment actually gets deposited (or not) , in the feather structure.

Below are a series of phenotypes by Bob R. that demonstrate various whitening effects caused by a number of different genes. Some block all colour pigment from being expressed while others diminish the expression of pigments to create muted tones of the former expressions. The traits are (1) Baldhead design plus dominant white flights and tail plus Quantitative reduction Checker pattern and Classical Grizzle. (2) The same but with Barred pattern, (3) Again Baldhead , Dominant white flights and hemizygous Stipper gene, (4) Baldhead plus Dominant white flights , plus unknown Pied influences , (5) A recessive white pigeon whereby no visible indicators of other factors are involved , pure white .

We covered the topic of pigment application in an earlier Issue when Jith did an extensive article describing the entire detailed process of pigment formation in the skin and feathers.

There are basically speaking two main types of colour pigment in birds , (1) **Warm colours** , which are Red , Yellow , Orange, green and purple. , and (2) **Cool colours**, which are Black , Chocolate , and Brick Red. The Columba livia Pigeon does not express any "warm" colours. Fruit Pigeon species do have areas of warm colour feathers. It has been hypothesized that "colour" may have come about as a result of evolutionary adaptation to surroundings so that for example ; birds that evolved in the tropics among rich green leaves and brightly coloured flowers and fruit would benefit by having patches of brightly colourd feathers so that they would blend in well with their habitat. Carotinoids in their diet would also have contributed to the genetic mutations . The Columba livia and related species would however require dark colours to blend in well with rock cliffs , and asphalt covered roofs . The colours that allow each to blend in well would allow them to avoid predation either on the nest , or drawing predators away from nests . These same colours may assist them in attracting the attention of a prospective mate. Below the ferals blend in with the shaded roof while a pure white stands out !


We need to get to the molecular root of the entire process if we are to fully understand just what takes place in the skin and feathers that our eyes see as colour or lack of colour. Those interested in that should refer back to Jith's article.

We have a few terms that we use when dealing with this topic in Pigeons , so we will start with those :

FIRST THERE IS THE PIGMENT ITSELF. Pigment in Columba livia comes in two forms (1) **eumelanin**, which is either black or chocolate/brown and (2) **phaeomelanin**, which is red , however not warm red . This red pigment is more of a brick red colour. Then there is the condition of those colour pigments : (**Quantitative reduction,** the amount of pigment deposited), and (**Qualitative reduction** , the quality of the pigment deposited).

Understanding these terms and their origin is something that will probably bring about much discussion in the future.

Below : Photos of an Ash-Red checker and a yellow T-pattern Checker that are affected by both **Quantitative** and **Qualitative reduction** whereby the actual quality of the pigment is diminished so that it appears much lighter than the original Intense and the intermediate Pale phases. We in the pigeon

Fancy refer to this as "dilution". There are at least three distinct "Phases" : Intense , Pale, and dilute . Indications are strong but not confirmed for a possible fourth phase : extreme dilution .

During the early recombination of genetic material from each parent , a host of dominant , partial dominant , and recessive genes are brought together to create the final result that we will see in each new youngster. In some instances , we may see mainly the influence of eumelanin while in other cases the phaeomelanin may prevail giving a creamy tone as opposed to gray. These and other aspects of colour inheritance will be explored more fully in future issues.

Feather colour is determined by two factors : (Source WikiVet & Bird Academy ~ Net.)

(1) Biochromes ~ These pigments may be deposited at the time of feather development and may be Black, brown or gray and they result from "Melanin". These are made up of tiny granules of colour in both the skin and feathers and vary in tones depending on their **concentration** , and **location**. They may appear in a range from the darkest of Black , through reddish browns to a pale yellow. Birds that express warm colours such as bright true red , orange , and yellow are the result of the influence of Caritinoid. Birds that express a true blue feathering in particular are affected by Porphyrins synthesized to produce a form of green, red, and some browns. (tiny pockets in the barbs can scatter incoming light , resulting in a specific non-iridescent colour almost all blue feather .)

(2) Structural properties ~ (light is refracted by a protein in the feathers), here we have a structural change in the feathers OR applications of materials placed on feathers to alter absorption or reflection of light.

Colour mutations are of two basic types :

(1) The genetic **ability** or **inability** to **absorb**, **manufacture** or **deposit** colour pigments , and
(2) An alteration in the feather structure (usually at barbule level) creating a different reflective or absorptive light pattern.

Mutations are often the two types in combination. However, similar colour changes can also be observed due to disease or malnutrition, especially deficiencies of essential amino acids and vitamins.

We see iridescence when the Barbs and Barbules scatter and reflect varying wavelengths of light reflection. Barbs constitute the major surface area of the feather while barbules act as a stabilizing network of hooked rays clamping the vane together in a strong but flexible web.


Iridescent neck feathers of a Feral Pigeon.

When all light is reflected we see the result as a pure white feather. When all of the light is absorbed , the result is a solid black feather. Specific genes control which of these effects will take place.

Pigmented feathers are the strongest and are so designed to resist wear and tear of daily exposure to the elements and activities of the Birds . Smooth spread pigment occurs at the tips of the flights and in the sub-terminal tail band as these are two portions of flight and tail feathers that must endure a great deal of stress. Many modifiers that de-pigment colour over the rest of the bird often fail to do so in these two areas so crucial to the flying ability of birds.

Fret marks are colourless / clear "breaks" (stress lines) that occur in feather development due to malformation of the feather Barbs. This may be as a result of some natural influence , environmental, disease , or actually a stress reaction to drugs. It usually is not genetic and will moult out .

Juvenile Dominant Opal tail which will moult to a normal tail band that is de-pigmented to some extent rather than striations seen here . The white tail feather is a Pied factor.

All photos from Bob R.

The following diagrams may help to visualize how pigments may or may not be deposited in feathers. Various genes may play a role either individually or in combination to give us the visual expressions we see. We have to keep in mind that the pigment cells are minute granules that are even difficult to see under a microscope , so what we see with the naked eye requires rather large amounts of pigment activity.

Photo (1) simply depicts a feather showing the parts and the terms or names given to those parts .

(1)

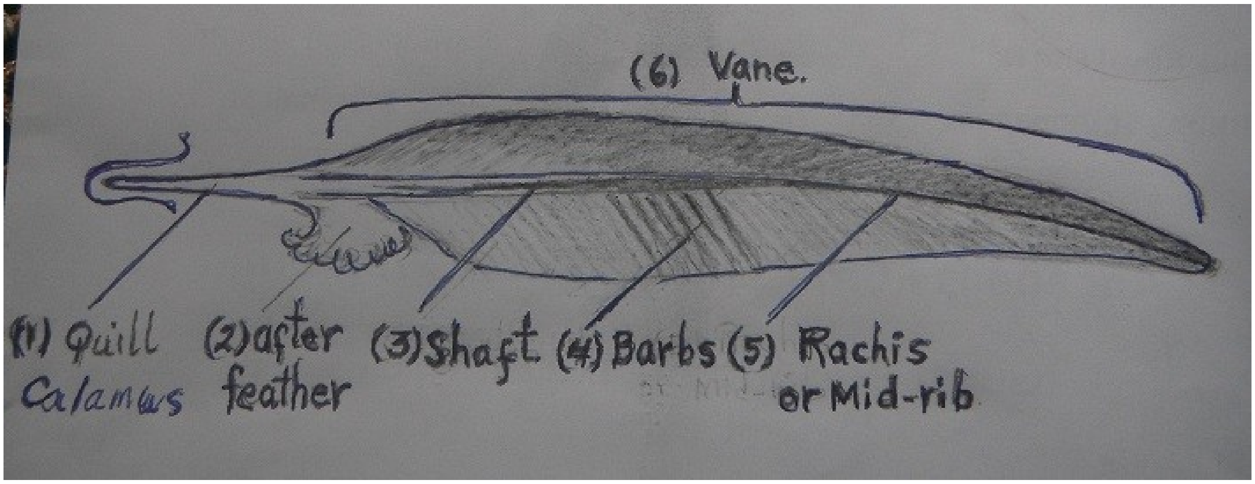
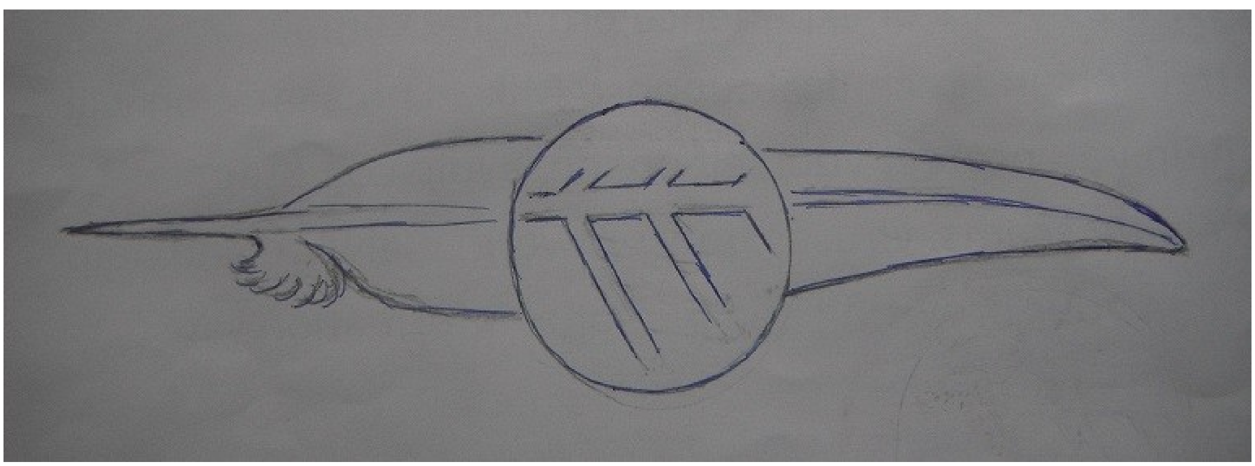


Photo (2) (a) shows an enlargement of the "Barbs" that make up the major portion of the feather vanes.

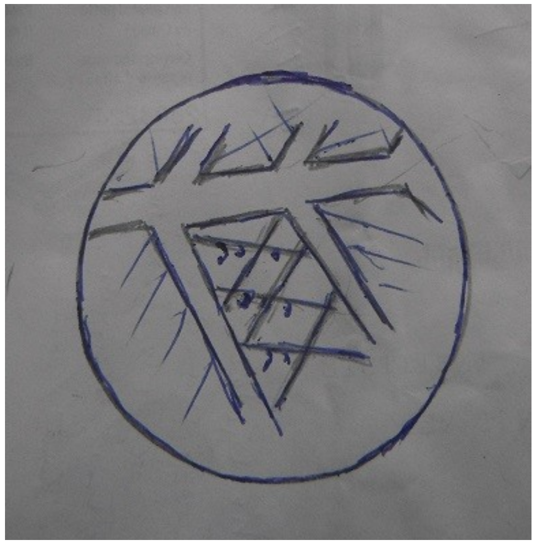
Colour pigment granules may be deposited under the keratin layer in various amounts , in different arrangements or not at all , thus giving the wide array of colour expressions we see with the naked eye, somewhat like we see pink tones of red blood cells under our fingernails , but not the same .

(2a)



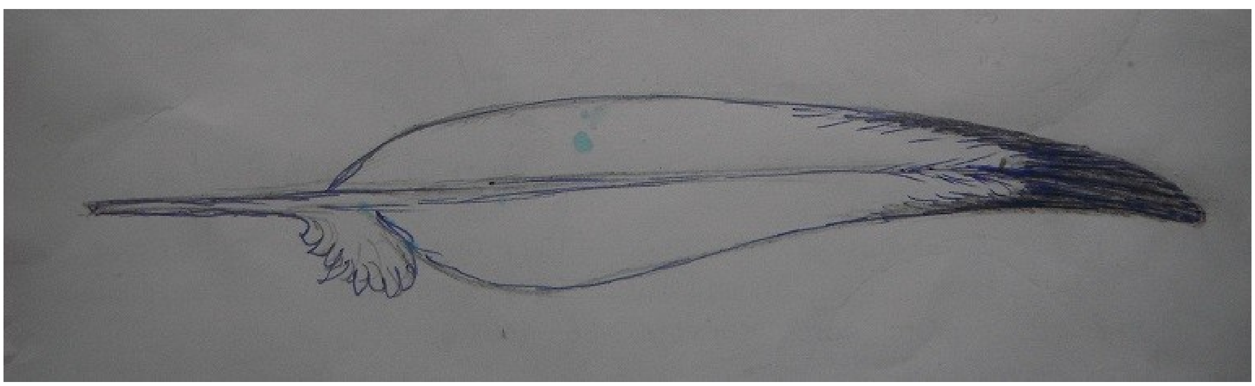
Below : (2 b)

The barbules act as a criss-cross network to "lock" the barbs together .



(2b)

(3) depicts a feather that has only smooth spread pigment granules deposited as usual at the feather tip



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Reactions from YOU the Members to last Month's Issue !

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Joe Powers remarks (Edited), on a post in the last Issue by Octavian Sarafolean and colleagues, etc.

Hi guys
These gray family birds are looking very much like the Tuffy/buff Oriental Rollers going back to Dale Husband.
Subtract Od and Toy Stencil and you get much the same expressions.

Under grizzle may be tied or close to some bronze but that bronze is not Kite bronze which is an almond only expression. I would not say that whole feathered Agate (another almond only expression) is not undergrizzle. I never tested the ones I had. But that expression is very similar to normally seen undergrizzle.

There are many bronzes out there. I'm not sure that the homer wing is even undergrizzle. It does not have near the amount of white usually seen with undergrizzle that I am aware of.

Also not sure undergrizzle is tied to pieds. I had a lot of undergrizzle in some of my Horseman Pouters. Very seldom ever got pouter pied markings out of the selfs even though it took me a long time to (mostly?) eliminate undergrizzle from my family.

The 'sprenkle (?)' (not sprinkle) may just be another black expression missing modifiers that allow the tail bar to express. Hard to say without a better view of the top tail feather or waiting for finished adult molt. Or something else is in the mix (as you suggested) causing this.

We as amateur geneticists need to do more research before coming up with new names. We have to show that what we think is 'new' really is different than proven expressions already known about and not just an added modifier mixed in.

Just got this from Mick (Basset). Interesting that vision happens a bit in patterns that are NOT barless.

I think that this adds to my original email that the test results from the testing report are not accurate since not all barless have this vision issue. AND that some non barless patterns do have it......... The good doctors need to expand their test base to get a broader selection for a more diverse explanation of why vision issues happen.

Hope you are both doing well. Joe Powers . (U.S.A.)
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Hi Bob,
The newsletter has been wonderful. You and Jith are doing a very good job and it is really appreciated here.
I plan to write an article about my observations about the "grizzle" traits soon.
All the best, Paul. (Gibson) (U.S.A.)

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Dear Bob, Read it and as usual INFORMATIVE. Warm regards Ranjith Balram , (India.)

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Response by Hein Van Growu to the report on Pattern from the U of U . sent to us by Gene Hochlan.

Dear Professor Shapiro,
I apologise for sending you this email out of the blue. I read one of your recent publications (Introgression of regulatory alleles and a missense coding mutation drive plumage pattern diversity in the rock pigeon.), which was partly printed in The Pigeon Genetics Newsletter, and that prompted me to write to you. First of all to give an observation, but also to write to you about a matter I was intending to do for a long time.
But first about the recent publication. I have to say that I do not know anything about the 'technical DNA stuff', so I may have understood certain things incorrectly. If so, I do apologise for that.
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In this article it is stated that “Sequence comparisons suggest that derived alleles originated in the speckled pigeon (*Columba guinea*), providing a striking example of introgression”. Does this mean it is suggested that early crosses with Speckled Pigeon are responsible for the checker patterns in Domesticated Pigeons?

I know that in the past, and still, is said that the wing pattern of Speckled pigeon is so similar with that of checkered Domesticated Pigeons, but I really cannot see the similarity. Feathers with a checker pattern are solid grey with a black mark on the outer vane. Both the grey and black are the result of eumelanin, and the eumelanin is present in all of the feather. Whether the black mark is the result of an increase of eumelanin or only a different distribution (clumped versus spread distribution) I do not know. In fact, the black mark on the wing cover feathers of checkered pigeons is very similar to the black mark which forms the bar in bared pigeons. See also attached picture. The feathers 1 (Speckled Pigeon), 2 (Checker), 3 (T-pattern Check.) and 4 (Rock Dove) are all feathers from the second row of secondary coverts. Feather 5 is the first row of secondary coverts (the ones with the bar), and is from a Rock Dove.

The pattern in Speckled Pigeon is due to the (visible)absence of melanin in the feather tip, causing the white triangular spot, whilst the rest of the feather is fully coloured, mostly a mixture of eumelanin and phaeomelanin. So, in my opinion the patterns are rather different; a pigmentless tip (suggesting a natural lack of melanin deposition during early feather development.) on a rather solid coloured feather in the Speckled Pigeon versus a solid grey coloured feather with a black mark in the middle of the outer vane in checkered Domesticated Pigeons.

The Speckled Pigeon wing pattern (white feather tip) is also found in other pigeon species, e.g. Spot-winged Pigeon *Columba maculosa* and the former Spotted Green Pigeon *Caloenas maculata*, although in this latter species the spotting (white feather tips) was not restricted to the wing shields only.

Patterns similar to checker marked feathers (black mark on the outer vane), in my opinion, are found in several *Zenaida* species, with the Galapagos Dove *Zenaida galapagoensis* having an almost ‘perfect’ checker pattern.

It is not too difficult to cross *livia* and *guinea* in captivity, and even in the wild it sporadically happens. The hybrid offspring apparently has low fertility, but so far I’ve never tried these crossings myself. I have, however, seen several hybrid individuals over the years and their phenotype regarding colour and markings depends mainly on the genotype of the *livia* (domesticated pigeon) parent. Also which species was the dame and the sire has effect on the appearance of the offspring. Some of the hybrids I’ve seen clearly had a ‘checker’ pattern (black mark, no white tip) but this can be easily explained if the *livia* parent was a checker. I’ve also seen hybrids which seem to have more like the *guinea* pattern, and also more of an eye ring. From none of these birds I’ve seen in the past I did know the parents (colour and which of the species was the sire). I do not say it is not possible, but so far the suggestion (if I understood correctly) that *guinea* contributed to the genome of Domesticated Pigeon seems not very likely to me. It may be worth crossing a bared *livia* with a *guinea*, in both combinations, to see what the result will be regarding pattern?

I am looking forward to hear your thoughts about this.

And then the other subject I wanted to ask you about for already a long time; this is about ‘Dilution’ in pigeons. One of the subjects I regular publish about identifying and naming colour aberrations found in wild birds. Most bird watchers still call everything Albino, Partial Albino or Leucistic…..

To distinguish the different mutations one can group them together under different ‘umbrellas’. One of these umbrellas is Albinism and some of the mutations which fall into this category are true Albino (Tyr), sex-linked imperfect albinism (which I call Ino = Slc45a2) and Brown (tyrp1). So, in principle mutations under the umbrella Albinism are tyrosinase-related mutations.

Another group (umbrella) is Dilution. What I call Dilution is a group of mutations which causes an abnormal transport of melanosomes from the melanocytes into the feather cells (clumped melanosomes as a result). The result is often blue-greyish where the original colour was black. Genes in birds responsible for Dilution as described above are in my opinion Blue in chickens and also in Domesticated ducks and Muscovy (Barbary) ducks and Milky in the Pigeon. Documented in the mouse, 'dilute genes' are Myo5a, Rab27a and Mlph.

In your research you discovered that the gene Slc45a2 is responsible for a mutation which causes the paler colouration in the pigeon what is known among breeders as 'diluted'. This discovery was very helpful to me as it helped to also understand other mutations better.
The gene Slc45a2 is known for having many different mutations (alleles) in many bird species. As in birds this gene is located on the 'sex chromosome' the allele causing the lightest form is often called sex-linked imperfect albinism (I call this light form Ino). In Budgies and other parrots it is called Lutino, in the Ringneck dove 'White', in the Domesticated pigeon Ecru, Lemon or Extreme Diluted and in many finches Ino, but it is all the same; sex-linked imperfect Albinism, a mutation of the Slc45a2 gene causing reddish eyes and plumage in which there is not much visible melanin left (but there is still some melanin visible). As said, in many species several different alleles of Ino (sex-linked-imperfect albinism) are known, and all these different alleles have different names. In Ringneck Dove the darker form is called Fawn (or Blond), and in the Domesticated Pigeon the two darker forms are Diluted (d) and Pale (d^P). And also apparently in mammals mutations of the Slc45a2 are often called 'Diluted'. And THAT is what troubles me. Obviously, different alleles should have different names to distinguish them. But naming a mutation of the Slc45a2 gene 'Diluted', as many authors/researchers do, while mutations of that gene fall into the group of Albinism does not seem right to me. Dilution in the Pigeon, or Tiger, due to a mutation of the Slc45a2 gene, is a tyrosinase-related mutation and NOT a melanosome-transport related mutation. So, in other words, calling a mutation Diluted or Dilution which is covered under the umbrella Albinism and NOT under the umbrella Dilution does not make sense to me and is confusing. I assume you used the term Dilute for this mutation as it had already that name for 100 years in the pigeon fancy, and perhaps others copied it from you to name mutations of the Slc45a2 gene found in other species, but it is in my opinion confusing and does not make sense in the wider picture of identifying, grouping and naming mutations.
The rather new mutation Ecru (aka Lemon or Extreme Diluted) in the pigeon I, and many with me, consider to be allelic with Diluted and Pale based on breeding results so far. Other still have doubts regarding allelism with d an d^P based on their results. It may be worth testing whether Ecru is indeed a Slc45a2 mutation? Assuming that it is, that would mean that Diluted (d) and Pale (d^P) in the pigeon are in fact darker forms of what I call Ino (sex-linked imperfect albinism). In my opinion in tyrosinase-related mutations, although they are causing a 'weaker' colour, the colour often gets a brownish tone where the original colour was black. In melanosome-transport related mutations the result is often blue-greyish where the original colour was black. The colour of a Brown Spread pigeon (b, S)and a Dilute Black (B^+, d, S = Dun), for example, is almost indistinguishable, whilst Milky in combination with Black (Blue Spread) is silvery-grey (Silver, B^+, S, my).
I would not dare to suggest to the fancy to change the name of the mutation in something else, but do you agree that 'Dilution' is in fact an incorrect name for it?
I hope I made the point I want to bring across clear to you and I like to hear your opinion about my thoughts, please.

With very best wishes.

Hein Van Growu (United Kin

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A progression of the Baldhead gene and related pied traits such as white flights and white tails , if allowed to breed unchecked , or when they are selected for more white expression:

We often are asked for possible breeding formulas that will guarantee a specific result or outcome. While those formulae are available , it is NEVER quite that simple. Keep in mind that no matter how simple OR COMPLEX a genetic combination may be , there is much more involved than just putting one bird with another. Selection of each generation of offspring is very important. You may spend two years breeding before you have the desired first generation offspring that you require in order to proceed with the next step. Most of us get overly anxious and want to use the first two birds that arrive in the f1 generation. They may not be suitable and therefore probably should be culled in one way or another. That may play out many times over. I once read the comments of a fellow who emphasized " SAVE EVERYTHING" ! That can become very expensive , so you have to consider all of this when you decide to take on any new genetic project.

That is it from here for another Month . We hope you are benefitting from our efforts and that you will continue to support the Newsletter with articles , questions and indeed answers.

We leave you with this photo of a wonderful combination of mutations bred by Brad Stuckey ! This German Modena is a Spread blue (Black) Toy Stencil T-Pattern . This combination often produces the White :Finch Marks" at the tips of the flights .
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