

A NOTE ON THE INHERITANCE OF COLOUR  
IN ONE BREED OF PIGEONS—AN ATTEMPT  
TO DEMONSTRATE A MENDELIAN TYPE OF  
TRANSMISSION.

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THE inheritance of feather colour in domestic pigeons having proved so difficult to fit into any scheme, I determined, in 1914, to investigate the matter afresh, confining my energies to one breed and to a small series of colours. I am strongly of opinion that when distinct types or breeds are crossed, the results are complicated by the occurrence of reversion. The matter is obviously complex; a simple beginning was indicated. The work done completes the preliminary stage only; the onset of war, of necessity, seriously interrupted further experiments. The results are given in bare outline, but it was thought advisable to publish some details of what has been done.

The breed of pigeons used is known to fanciers as the "Racing Pigeon," a variety which is being used in the present war in the Overseas Pigeon Service, and is doing useful work. This breed has been firmly established in this country, and more firmly in Belgium, for many years. Various colours are to be found, but the vast majority of the hundreds of thousands bred yearly are of the following colours—blue, blue chequered, red chequered and mealy. A short description of these colours is necessary.

The blue birds are similar in colouring to the *Columba livia*, except that the ground colour is, as a rule, brighter or "cleaner" in appearance, though distinctly slaty-blue. They present, in common with *Columba livia*, the typical wing-bars, the white (albescent) or blue croup and the tail-bar. The ground colour of the primary and secondary wing-quills, and the tail-quills, is dark blue. The blue chequered birds are similar to the blues with the addition of chequering. The wing-bars of the blue are mainly due to spots on the outer sides of the secondary wing feathers; the chequering arises from an extension of these spots to the

smaller wing coverts and other feathers. The wing-bars and the tail-bar are present as in the blue.

The colour of the so-called mealy birds is difficult to describe. The ground colour is somewhat like that of fine oat-meal; the wing-bars are reddish—approaching the colour of damp sand. The mealy birds differ in two salient points from the blues—the wing- and tail-quills are, as a rule, pale in colour, and the tail-bar is absent.

The red chequered birds stand in the same relation to the mealies as the blue chequers do to the blues, i.e., they are mealies with the addition of chequering. The wing-quills and tail-quills are generally pale in colour; there is no tail-bar.

The colour of the birds used being of unknown composition, the results have been based on group, rather than individual, matings. The calculated results have been arrived at by considering all the types of gametic combinations theoretically possible, and by assuming that each pair of birds produces 16 offspring.

The experiments have led to the following conclusions:

1. Red (of red chequer or mealy) is dominant to blue.
2. Presence of chequering is dominant to absence of chequering.
3. Red chequers may be homozygous or heterozygous for colour or chequering.
4. Mealies may be homozygous or heterozygous for colour.
5. Blue chequers may be heterozygous or homozygous for chequering, but are homozygous for colour.
6. Blues are homozygous.

Two pairs of allelomorphic factors may therefore be considered:

$R$  (domt.), presence of red.                       $r$  (rec.) absence of red.  
 $C$  (domt.), presence of chequering.             $c$  (rec.) absence of chequering.

Red chequer may then be represented by  $RC$ , blue chequer by  $rC$ , mealy by  $Rc$ , and blue by  $rc$ .

*Group 1.* Red Chequer  $\times$  Red Chequer.

Composition of parents,  $RCRC$ ,  $RCRc$ ,  $RCrC$ ,  $RCrc$ ,  $RcrC$ .

Types of mating possible, 15.

Number of offspring (16 from each mating), 240.

Calculated appearance:

(240) 196 Red cheq. : 20 Blue cheq. : 20 Mealy : 4 Blue.  
 (70·8)        57·9        :        5·9        :        5·9        :        1·1.

Observed appearance of 71 birds produced in this group :

(71) 50 Red cheq. : 11 Blue cheq. : 8 Mealy : 2 Blue.

*Group 2.* Red Chequer × Blue Chequer.

Composition of parents—five red chequers as in group 1, two blue chequers *rCrC* and *rCrc*

Types of mating possible, 10.

Number of offspring, 160.

Calculated appearance :

(160) 100 Red cheq. : 44 Blue cheq. : 8 Mealy : 8 Blue.  
 (94·8)        59·3        :        26·1        :        4·7        :        4·7.

Observed appearance of 95 birds produced in this group :

(95) 41 Red cheq. : 50 Blue cheq. : 2 Mealy : 2 Blue.

*Group 3.* Red Chequer × Mealy.

Composition of parents, red chequers as in group 1, mealies *RcRc* and *Rcrc*.

Types of mating possible, 10.

Number of offspring, 160.

Calculated appearance :

(160) 104 Red cheq. : 46 Mealy : 8 Blue cheq. : 2 Blue.  
 (44·9)        29·2        :        12·9        :        2·2        :        0·6.

Observed appearance of 45 birds produced in this group :

(45) 28 Red cheq. : 11 Mealy : 4 Blue cheq. : 2 Blue.

*Group 4.* Red Chequer × Blue.

Composition of parents, five types of red chequers as in group 1, a single type of blue, *rcrc*.

Types of mating possible, 5.

Number of offspring, 80.

Calculated appearance :

(80) 40 Red cheq. : 16 Mealy : 16 Blue cheq. : 8 Blue.  
 (40)        20        :        8        :        8        :        4.

Observed appearance of 40 birds produced in this group :

(40) 17 Red cheq. : 7 Mealy : 11 Blue cheq. : 5 Blue.

*Group 5.* Mealy × Mealy.

Composition of parents, *RcRc* and *Rcrc*.

Types of mating possible, 3.

Number of offspring, 48.

Calculated appearance :

(48) 44 Mealy : 4 Blue.

(33) 30.2 : 2.8.

Observed appearance of 33 birds produced in this group :

(33) 28 Mealy : 5 Blue.

*Group 6.* Blue Chequer × Blue Chequer.

Composition of parents,  $rCrC$  and  $rcrC$ .

Types of mating possible, 3.

Number of offspring, 48.

Calculated appearance :

(48) 44 Blue cheq. : 4 Blue.

(72) 66 : 6

Observed appearance of 72 birds produced in this group :

(72) 67 Blue cheq. : 5 Blue.

*Group 7.* Blue Chequer × Blue.

Composition of parents,  $rCrC$ ,  $rcrC$ ,  $rcrc$ .

Types of mating possible, 2.

Number of offspring, 32.

Calculated appearance :

(32) 24 Blue cheq. : 8 Blue.

Observed appearance of 32 birds produced in this group :

(32) 20 Blue cheq. : 10 Blue : 1 Red cheq. : 1 Mealy.

*Group 8.* Blue × Blue.

Composition of parents,  $rcrc$ .

Types of mating possible, 1.

Number of offspring, 16.

Calculated appearance :

(16) 16 Blue.

Observed appearance of 32 birds produced in this group :

(32) 32 Blue.

*Group 1.* In this group the observed red chequer and mealy figures are lower, the blue chequer and blue higher, than the estimated figures. To my mind there is a simple explanation of this. Fanciers generally object to this type of mating, preferring to "mix the colours"; it thus naturally follows that the majority of red chequers are heterozygous for colour, and when mated red to red, they will produce less than the

expected number of red chequers and more than the expected number of blue chequers. The experiments having been for the present almost suspended, the testing of the extracted colours is incomplete. As far as this has been carried out, the anticipated results have been obtained.

The blue chequers have proved to be homozygous for colour, some being heterozygous for chequering; the mealies homozygous for absence of chequering, some giving rise to blues; the blues have proved to be homozygous for colour and absence of chequering. (See comments on group 6 for occurrence of white in these extracted colours.)

*Group 2.* The heterozygous composition of red chequers may be expected to have a greater effect in this type of mating than in group 1 type. The blue chequers being homozygous, and probably the majority of the red chequers heterozygous for colour, it follows that the observed red chequer figure will be low and that for blue chequer high. It is worthy of mention that the colour of red chequers bred from dissimilarly coloured parents (red chequer and blue chequer, or red chequer and blue) is, as a rule, richer than that of birds bred from two reds. This probably accounts for the popular aversion to red chequer and red chequer mating. Red chequer cock birds from red chequer  $\times$  blue chequer almost invariably possess black ticks. I have not found an example of these black ticks in hen birds; brown ticks may however sometimes be met with.

All the red chequered cocks which have come under my notice, having one parent blue or blue chequered, present some degree of ticking. A proportion of those from two red chequers and of those from red chequer  $\times$  mealy, are free from ticks and do not appear to develop any with age. On this may rest the possibility of separating the homozygous and heterozygous red chequers of the male sex.

*Group 3.* As, in this group, red may come from either parent, the effect of the heterozygous composition of red chequer is modified and the observed approaches closely to the estimated result. The extracted blue chequers and blues have so far proved to be pure for colour.

*Group 4.* The results obtained in this group and in group 3, suggest that chequering depends on a single factor, and that it may produce its full effect even when contributed by one parent. The eleven blue chequers in this group were typical of the chequered type.

*Group 5.* A correlation was observed between paleness of plumage (ground colour especially) and light coloured beaks and claws in some of the mealies in this group. Of the blues, however, two in particular were exceptionally sound in colour with dark beaks and claws. Blues

from this group have been tested at greater length than most of the extracted colours and have been found to be pure.

*Group 6.* The results from this group do not support the generally accepted view of fanciers that almost any colour may arise from blue chequer  $\times$  blue chequer. I have examined the results of many breeders, and where cross-mating can be definitely excluded, the results agree with my own. The majority of the birds used in this group had at least one red parent. This fact is strong evidence of their recessive and homozygous nature.

Some blue chequers from two reds have a reddish brown tinge in some of the wing-quills especially. I expected to obtain reds from these, but so far have failed. This type of blue chequer appears to give an increased proportion of reds when mated to reds.

*Pied types.* The behaviour of white is difficult to follow. Two main types are met with, the "gay" pied and the type with a few white feathers. The majority of gay pied birds follow a fairly uniform pattern in the distribution of white. This "pattern" type is probably dominant to self colour. On the other hand the type with a few white feathers is recessive. In testing the extracted colours several examples of this recessive type arose. No pied birds were used in any of the experiments.

*Group 7.* The red chequer and mealy in this group arose from the same pair and in the same nest. Their occurrence is disconcerting as the likelihood of cross-mating was no greater in their particular case than in any other. However, that cross-mating is the explanation, I feel assured of by the subsequent offspring of the parents of these two exceptions. Thus far 14 birds have been produced from this one pair in complete isolation. The seventh pair of young now (Mar. 15th, 1917) three weeks old provides no single atypically coloured specimen.

The appearance of this single family is:

(14) 8 Blue cheq. : 6 Blue.

It may be allowed that the composition of the blue parent is *rerc* and that of the blue chequer *rCrc*.

*Group 8.* In this group one of the birds had two white primary wing-quills. Of the remaining 31 birds, 30 were typical blues, one had grizzle primaries and a general colouring approaching more closely to grizzle than blue. Grizzle being a macroscopic admixture of blue and white, all the birds in this group have been considered to be substantially blue.