Genetics and the Budgerigar

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HISTORY

I believe it would be best to provide a little history about the topic. The study of genetics was systematized by a Moravian Monk named Gregor Johann Mendel (1822-1884) in 1865. His manuscript went undiscovered for the next thirty-four years, or about sixteen years after his death. The dusty old manuscript was reprinted, tested and finally acclaimed by the then "enlightened" scientific community as "one of the greatest advancements in inheritable influence ever discovered." Gregor Mendel did not perform his experiments in a sterile laboratory; but instead worked with garden peas in his simple monaterial garden. He discovered that certain varieties of garden peas, when crossed with other varieties, would "dominate" their appearance; therefore, Mendel called them dominant and the other recessive. The term has not changed in over one hundred years.

Now something about the little fellow that we all cherish. The Budgerigar (Melopsittacus Undulatus) is a native of the Australian Continent. The bird was imported to England by English naturalists, and so begins the story. The budgie, in the wild state, is a small green racy bird found in large flocks migrating at will in search of food, water and suitable habitat, in which to reproduce. To understand the common green budgie, we first have to have a simple understanding of color and how it is produced. In the color spectrum there are three basic colors, i.e. blue, yellow and red! From breeding budgies, we know that we have green and blue, but why don't we have red? The answer is simple, red is a primary color, you can not produce it by mixing other colors, instead you may make other colors by mixing red with them. Why then is the dominant color in budgies green? Why not blue or yellow? Here again the answer is simple. Nature, in her normal ecological balance, allows those that adapt and blend best to exist; and, and those unable perish. You need only to check with Charles Darwin to prove this. Green is a secondary color; however, it is dominant in budgies over all other colors.

The first mutation in the budgie color was the production of the yellow budgie. The reason for this is quite simple! To mix green you take equal parts of blue and yellow; but if the green bird loses its' ability to produce blue the resulting color is yellow. Subsequently, the green bird lost its' ability to produce yellow and the second color mutation occurred — the blue budgie. Thus all budgies came from the green budgie, and that is why this color is dominant to all others. We will see later that green may be modified, but never dominated.

Sky blue normal budgie from the aviaries and show stock of Bill Porter/San Diego.

GLOSSARY OF BASIC GENETIC TERMS

A) Dominant - A character, that even in a minute dose, when present will be visualized.

B) Recessive - A character, which must be present in a 100% dose to be visualized.

C) Homozygous - All components being the same for the given factor.

D) Heterozygous - Both components being opposite for a given factor.

E) Gene - A collection of deoxyribonucleic Acid (DNA) influencing the being of all living things. Always found in pairs on chromosomes in all **normal** living things.

F) Chromosome - A collection of genes falling in linear pattern (in pairs) expressing the total collection of this birds being.

G) *Sex chromosome - That particular pair of chromosomes which determines the sex of the bird. i.e. xx=male♂ xy=female♀
*this sex chromosome configuration only holds true for birds, butterflies and certain species of fish.

H) Genotype - What the true genes of a particular bird are . . . no matter what the bird looks like.

I) Phenotype - What the bird looks like, not necessarily what it really is, i.e. a green bird appears green but it may carry recessive factors or sex linked factors.

J) Allelomorph - A configuration which can replace a gene on a chromosome causing the inherited property to demonstrate itself every other generation.

K) Split - A term used in birds meaning carrying a hidden factor for a recessive color, or in the case of males only a sex linked factor.

L) Mutation - A **spontaneous** change in the number or structure of one or more chromosomes usually resulting in lethal or sterile results.

M) Intensity Modifiers - A term which sounds mysterious but merely means a "Dark Factor". Refer to Dark Factor which is diagrammed later in this text. The intensity modifiers are partially dominant; therefore, they can not be carried in a "split" form. These factors can be inhibited in expression (visualized) by other factors, i.e. "Ino".

N) Intensity Penetrators - This is a term which means an inherited force which alters the basic color, but does not obliterate it, unless the color is recessive to it, i.e. a pure grey bird when crossed to a pure green bird produces all grey/green offspring. It can be seen then that green still remains the dominant color although it has been penetrated. A list of birds carrying these penetration modifiers would include grey, violet, clear flighted pieds and yellow face.

O) Mitosis - A process of a normal cell (not sex cell) dividing itself into two new cells containing everything the same.

P) Meiosis - A process of a sex cell dividing wherein two new cells are produced, but each of the new cells contains one half of the original cell contents.

INHERITANCE

Now that we have covered history and terms, let's progress to the part in which we are all vitally interested. Let's begin with the simple dominant vs recessive inheritance, and build from there:

A) Pure dominant × pure dominant = 100% pure dominant

B) Pure dominant × recessive = 100% dominant/recessive

C) Pure dominant × dominant/recessive = 50% dominant
50% dominant/recessive

D) Dominant/recessive × dominant/recessive = 25% pure dominant
50% dominant/recessive
25% recessive

E) Dominant/recessive × recessive = 50% dominant/recessive
50% recessive

F) Recessive × Recessive = 100% recessive

COLOR INHERITANCE

All color factors are inherited in either a dominant, recessive, modified, penetrated or sex linked manner.

A) Dominant colors
  1) green

B) Dominant Penetrators
  1) gray
  2) violet
  3) Clearflighted Pieds
  4) Yellow face

C) Recessive colors
  1) All colors and patterns not listed above.

DARK FACTOR

We all know that all colors, in their basic status, are graded into three modified planes, i.e. light green, dark green, olive, sky, colbalt and mauve. Knowing that all color is carried on a **pair** of chromosomes, we should learn to write these to indicate whether or not our birds are carrying a dark factor. I would suggest the following formulas to simplify this task:

Light green-gg
Dark Green-Gg
Olive-GG
Sky-bb
Cobalt-Bb
Mauve-BB
Light grey-gy gy
Medium grey-Gy gy
Dark grey-Gy Gy

In other words, the capital letters indicate the amount of the dark factor and the lower case letters indicate the absence of the dark factor. Therefore, it can be seen that the intensity modifier (dark factor) can be carried in a nonexistant state, a single intensity modifier (dark factor) or a double dose intensity modifier (dark factor).

At this point I believe it should be explained that the dark factor does not change the color of the bird (dominant or recessive); however, it may change the influence of the color no matter which parent it came form. Now I'm sure this is totally confusing, but I believe a diagram at this point will clear things up considerably!

Cobalt cock-Bb
Light green hen-gg

		♂ B	b
♀	g	gB	gb
	g	gB	gb

Results = 50% dark green/blue
50% light green/blue

You will notice that the dark green progeny received their dark factor from the blue parent, but none-the-less they are still dark green. Because there exists a special linkage between the recessive blue and the dark factor, there exists two types of dark green/blue birds. One is called a dark green/blue type I meaning it received its dark factor from a dark green parent and when crossed with a sky bird the following will result:

Dark Green/blue type I cock
Sky hen

		♂	
		G	b
♀	b	Gb	bb
	b	Gb	bb
		g	b

Results= 7% light/blue
43% dark green/blue type I
43% sky
7% cobalt

You will notice in the results that the dark factor in the bottom crossed over from the capital G leaving it as a lower case g thus accounting for the 7% light green/blue and because a capital B thus explaining the 7% cobalts.

If however, the dark green bird received its dark factor from the blue parent it is called a dark green/blue type II bird and if crossed with a blue bird the results are as follows:

Dark Green/blue type II cock
Sky hen

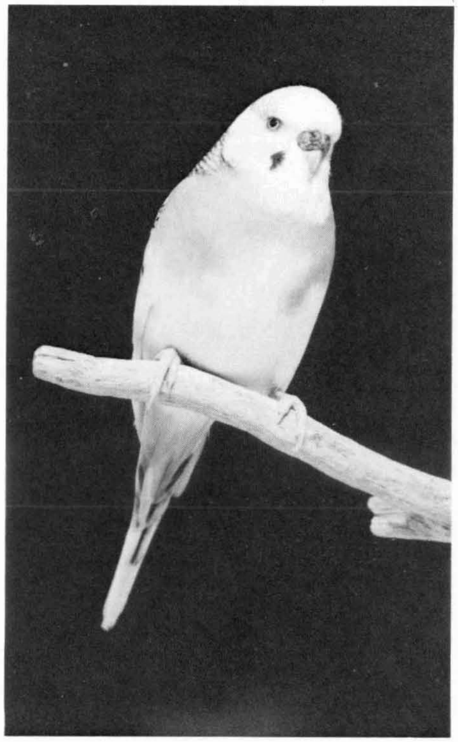
		♂	
		g	B
♀	b	gb	Bb
	b	gb	Bg
		G	b

Results=43% light green/blue
7% dark green/blue
43% cobalt
7% sky

Here again you will notice the shift of the capital B to a lower case b thus explaining the 7% sky progeny, and becoming a capital G explaining the 7% dark green/blue. If Gregor Mendel could only see what we've done with his garden pea experiment, I'm sure he would be amazed and possibly amused! Therefore, the following formulae will further explain:

No dark factor×no dark factor=100% no dark factor
1 dark factor×no dark factor=50% no dark factor, 50% 1 dark factor
1 dark factor×1 dark factor=25% no dark factor, 50% 1 dark factor, 25% 2 dark factors
No dark factor×2 dark factors=100% 1 dark factor
1 dark factor×2 dark factors=50% 1 dark factor, 50% 2 dark factors
2 dark factors×2 dark factors=100% 2 dark factors

photos by Steve Clause



Sky blue Danish pied.

SEX LINKAGES IN INHERITANCE

Those factors influenced by sex linkages are:

A) Ino - lutino (green seires) Albino (blue series)
B) Opalines
C) Cinnamons
D) Slates
E) Red eyed lacewings

Again let's restate that in birds, butterflies and certain species of fish, the male carries two X sex chromosomes writtten XX, and the female carries one X sex chromosome and one Y sex chromosome. THE "Y" SEX CHROMOSOME DOES NOT CARRY ANY OF THE SEX LINKED FACTORS; THEREFORE, THE CARDINAL RULE IN SEX LINKAGE'S IS: THE FACTOR MUST BE PRESENT ON ALL OF THE X's TO BE VISUAL!!!

A) Lutino cock X_LX_L
Dark green hen XY

		♂	
		X_L	X_L
♀	X	XX_L	XX_L
	Y	X_LY	X_LY

Results= 100% split lutino cocks
100% lutino hens
Since the hen only have one X if the factor shows up on that X, then it is visual.

B) Light green normal cock
Light green opaline hen

		♂	
		X	X
♀	X_O	X_OX	X_OX
	Y	XY	XY

Results= 100% split opaline cocks
100% normal hens

C) Light green cock/cinnamon
Light green non cinnamon hen

		♂	
		X_C	X
♀	X	X_CX	XX
	Y	X_CY	XY

Results=25% split cinnamon cocks
25% non cinnamon cocks
25% cinnamon hens
25% non cinnamon hens

note: because the cock is split cinnamon, he appears normal but, carries a "C" factor on one X chromosome.

SOME INTERESTING BREEDING

While the violet, clearwing and greywing hold no special genetic problems, due to their interesting patterns, I thought I would close out this discussion on them. Let us first discuss the violet budgie.

The violet, demonstrates that in fact we are aproaching the RED budgie. It is common knowledge amongst artists, that in order to produce violet you mix varying amounts of blue with RED! It must be remembered, that the violet factor is dominant, the blue budgie is recessive. When you mix the violet factor with the cobalt budgie, either in single or double doses, you create the true visual violet budgie. This, not to say that you can not have a sky violet or even a dark green violet; but, the visual violet, most of us think of when we contemplate the appearance of a violet, is the cobalt violet. It then follows that, to breed numbers of violets we have to breed as if to produce cobalt (with the violet factor) birds. The only two breedings to produce 100% of these would be either a sky violet×mauve, or a mauve violet×sky (refer back to the dark factor). To understand the probability of a double factor violet being available, merely remember the last time you saw a mauve or an olive bird. Sure there are some around, but, it is far easier to breed these than to breed a double factor violet; therefore, all violet birds should be considered single factor birds, until such time as they produce 100% visual violet offspring. How many times have you witnessed someone trying to convince an ABS judge, steward or show chairman that a bird is a violet and not a cobalt. There is one way to help matters along. If in doubt, hold the bird in natural sunlight and you will notice that the true violet bird will demonstrate a light gold edge on the terminal edge of all of its' breast feathers.

Suffice it to say that the best matings for the inexperienced to attempt are: A) visual violet×mauve=25% visual violet, 25% cobalt, 25% mauve violets and 25% mauve, and B) visual violet×sky=25% visual violet, 25% cobalt, 25% sky violet and 25% sky.

CLEARWING AND GREYWING

The clearwing can be bred in both the green and blue series of budgie. It should be considered a recessive trait except when bred with a greywing or yellow or white. It must be remembered that clearwing is recessive to normal. Generally speaking, when a greywing is produced the general body color of the bird is depleted, much like the cinnamon factor; however, in the clearwing, the body color remains rich. Due to the contrast between the clearwing (white or yellow) and the normal body color, the body color looks much more intense. Now when we introduce the allelomorphic property of combining the two birds, i.e. clearwing×greywing we produce a bird called a full bodied color greywing, which has the greywing and the body color of the clearwing. When this greywing is crossed with the clearwing, it is dominant to the clearwing; however, it must be remembered that we now have produced a hybrid color, and not a hybrid bird. Remember a full body color greywing is a culmination of a dominant clearwing and a recessive greywing, and when crossed with a ~~clearwing~~ will result in 50% full body greywings and 50% clearwings.

It is my sincere hope that the foregoing discertation will help more than confuse. I have spent many hours assembling this paper, but I feel I have gained much from its' preparation. I would implore all of you to do the same and share your works with all of us.