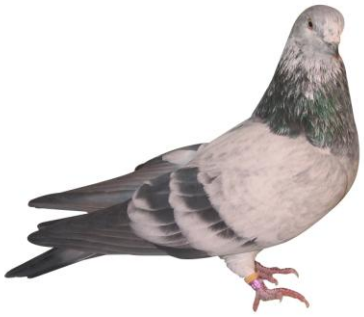
Inbreeding Depression April 2010

"Fact or Fiction"



There has been, and still remains among many animal breeders a fear of "Inbreeding" versus the accepted view of "line breeding" or "Out crossing" as a way to improve their stock. As I have stated many times in the past, the term "Inbreeding", as well as "Line-breeding", are merely a matter of "closeness" in terms of their genetic relationship. For that reason, when I refer to inbreeding in this article, it will represent the progeny of genetically close relatives, regardless of terminology. I am sure we have all heard the horror stories this type of breeding can render like deformities, poor fertility, smaller size, and general lack of vigor, as well as unfit individuals to name just a few. If we put all these in a box, we would have the products of "Inbreeding Depression"...

Let's look at this term "Inbreeding Depression" a little closer. This definition usually is used to describe a "given population" of plants or animals that are so confined in their environment and their given genetic pool, that this inbreeding of relatives results in more "recessive deleterious" traits manifesting themselves . The more closely related the breeding animals are, the more Homozygous Recessiveness the offspring may become, and increasing the risk of unfit individuals. What seems to be misunderstood is the fact that these features can be overcome by the use of "Genetic Purging" or more commonly known as "Culling"?
The other theory is one of over dominance of heterozygous alleles which is a reduction of homozygous genotypes. Remember, we are talking about "Homozygous Recessive" genes taking over the given population and rendering many of them unfit. We also must recognize that this in itself is considered a most severe degree of inbreeding with no intervention from outside forces. The same could be said about "out breeding enhancement", which we will touch on later in the article.

As breeders, we all strive to improve our stock for the betterment of the breed itself, and for personal achievement. We first need to understand what we strive for and how to transform this from theory to a living creature. We do this by having a clear understanding of our ideal specimen in terms of traits and characteristics that would represent the Breed in question. We do this through the close mating of relatives, and this is known in livestock circles as" Inbreeding". Inbreeding itself is not enough to achieve our "ideals". There must be strict selection and culling of all unwanted traits and characteristics to achieve our goals. I practice a lot of close breeding, and for the most part have had very good success with this form of breeding. This year was like many others, and I paired a father/daughter together like I have done many times before without

any unwanted results from the visual perspective. The parents have both been proven in terms of their flying ability and have flown better than 16:30hrs and I was hoping that I could "fix" that trait into their progeny through the forces of inbreeding. Well, as you can see in the picture # 1 below, I was quite unhappy at their visual appearance at a very young age of their development. They were small, their feathering was very inferior at this point and this was in my opinion a direct result of Recessive traits showing themselves, picture # 2, shows a pair of squabs with normal development. Would picture # 1 qualify as a form of Inbreeding Depression?

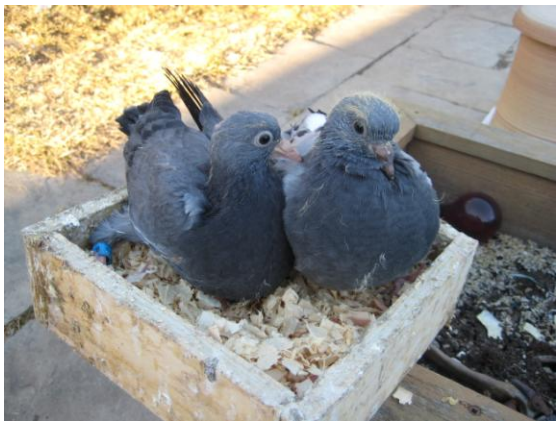
Picture #1

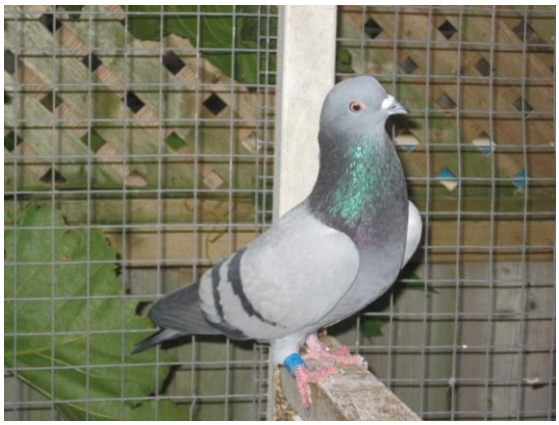
Picture #2

Now if you are of the informed breeders, you will understand that both the hen and the cock contribute 50% of their genetic makeup randomly to their offspring. And for that reason, the genes from each parent that are responsible for their development showed themselves in a recessive state. Remember that when inbreeding, one can get good or bad traits as a result of such mating.

Another fact the needs to be noted is, that if reckless inbreeding is practiced with little regard to what is being produced, and given enough time in terms of generations that it will "Fix" these recessive traits in a Homozygous form and render most, if not all that occupy the loft "unfit" weather it be for show purpose or performance or both! This would result in only one avenue left for the breeder to follow, and that is the culling of all stock and a fresh start. This is why selection for both wanted and unwanted specimens must be followed. This also gives rise to ones "Ideals" as one must know what to select for.

Now after saying all that, here is another father/daughter mating below, slightly older but never the less not showing any signs of development depression. Both are fully clad as they should be and looking great. This particular pair of young birds was doing 10 workouts when the kit flew over and subsequently was stocked.





So, I have only just given a brief outlook on a minor form of "Inbreeding Depression" The question remains Fact or Fiction. Before you answer that, I feel there are other factors that should be revealed, touched on and put in a manner that can be more widely understood.

To further one's understanding, one must have a general understanding of the term "Inheritance" which goes hand and hand to further ones knowledge about "Inbreeding Depression" and terms of breeding that are generally used such as Inbreeding, Line-Breeding, and Out crossing

When Gregory Mendel first discovered the laws of "Inheritance" he really discovered the complex workings of a living animal or plant. He discovered the blueprint of "Inheritance", and how it all came together. Every living thing is made up of thousands of cells called genes, and those genes in turn are arranged in countless pairs on Chromosomes.
Now, we all claim to understand the term "Trait" right, but do we really? What is being represented by the term Trait?
The "Fact" is that every pair of genes, on every chromosome, which varies depending on what "Species" of creature we are referring to are responsible for a given "Trait" or portion of "Trait". It also depends on whether one or both genes are of that pair is dominant or recessive. A dominant gene when paired with its complementary recessive gene will "dominate" the expression of the trait governed by the pair. For our understanding what it is saying is that it will "mask" the expression of the recessive gene.

Mendel explained that "Dominance" had three possible configurations for every pair of genes: they both could be dominate (homozygous dominate), both could be recessive (homozygous recessive) and lastly one could be dominate and one recessive.
Now when breeders talk about "Purity" what they are saying is that a creature is "Pure" for a given Trait, or Homozygous Dominate!! When they state the term "Impure" for a given Trait they are saying it is Heterozygous, and lastly there is Homozygous Recessive,(Pure} These are genetic terms that represent the law of Dominance, with me adding the words Pure and Impure were required to try and make it a more friendly term of understanding.

It is of grave importance that any breeder has at least a good understanding of terminology's and their meanings if they are to be able to go forward with any breeding program with success. When this is grasped, one can see through inbreeding, what we are really doing in fact is purifying the traits we seek, and intensifying the speed of witch this happens by mating our stock

“Closer” than many would consider. A bird or animal can never be to” Pure” for “Traits” we seek, assuming of course we have a clear understanding of what we seek in terms of our “Ideal.”

As I stated earlier, when a given population is deprived of genetic diversity, and are govenered by no outside intervention, inbreeding depression may occur if and when Homozygosity has taken over the population and created largely Homozygous Recessive individuals, it would take countless generations to reach severe degrees of depression, rendering much of the population as unfit individuals.

“Deprived genetic diversity”, or” extreme population bottleneck”, are the basis of how inbreeding depression seems to occur, but there are scenarios that suggest the contrary in certain respects. I ran across an article about a little bird called Black Robin or Chatham Island Robin. This bird was first recorded in 1872 by Walter Buller on Chatham Island off the coast of New Zealand. As the research states, in 1980 only five Black Robins survived on Little Mangere Island, and were saved from extinction by a fellow named Don Merton and his team, and by “Old Blue” the last remaining fertile female. Old Blue was the only fertile female to start with, inbreeding was inevitable, and the fear of inbreeding depression was on the forefront Old Blue and later from her, more fertile females were produced and today there are 250 Robins, a highly inbred species saved from extinction. Now you may be asking what the point of this is, the point is that all the surviving Robins are descendants of Old Blue, and due to that there is very little genetic variation among the population and creating an “extreme population bottleneck” a term we started this with. What’s interesting about this is, that all this lack of genetic diversity among the 250 robins has caused no, that’s right no inbreeding depression! The speculation was that through their evolutionary past, populations were reduced, and along with that so were many carrying deleterious alleles. What must be recognized, from this outcome is that through the powers of “Selection”, whether they are Natural or Artificial, inbreeding depression need not be a factor of In-breeding. Fact or Fiction??

Black Robin (below)

In another case of “extreme bottleneck population” in terms of genetic diversity being so low and the worry of inbreeding depression rising to the surface would be the story of the Mauritius Kestrel. This small bird of prey, weighing a mere 250grams is found only on the island of Mauritius in the Indian Ocean. In pre-colonial time the population was estimated at 175-325

breeding pairs. This small population was thought to exist due to the fact of natural causes like cyclones and deforestation, predators and the worst being the introduction of DDT back in 1950 and 1960s. Now the amazing thing about this story is, that in 1974, the population had been decimated down to only 4 individuals, and was considered at the time, the rarest bird in the world. Initial attempts to raise eggs artificially all were in vain as the eggs were infertile. Not until 1979, was a new attempt made by Gerald Durrell. Carl G Jones established a sanctuary and climbed trees to remove eggs from the nests, and this time they were fertile, and hatched in incubators. By 1984 the estimate was 50 individuals, pretty amassing from only 4 individuals. Natural causes had almost rendered this species extinct if it were not for the intervention of man. Today according to (Bird Life International 2006a, b) there are more than 800 birds and rising. As with the story of the Robin, near panmictic conditions like volcanic activity, habitat loose, availability of food, all played a role down through the ages of generation after generation. Through all these obstacles they managed to sustain, but there numbers suffered keeping their population small. Again, speculation suggests that deleterious alleles that may have caused in-breeding depression were removed through natural selection.
This is another example of the powers of selection, whether it is through Natural Selection, or Artificial Selection. In-breeding depression need not be the outcome when dealing with very small gene pools such as the two examples we just learned about.

Mauritius Kestrel

On the flip side of inbreeding and Inbreeding Depression, there is what is known in genetic terms "Heterosis", a term that represents selective breeding also. This is the opposite of Inbreeding Depression, and is also known as "Hybrid Vigor" or "Out breeding Enhancement". The hypothesis is (over much controversy, same as Inbreeding) is that it will produce superior individuals by this new combination and mixing of the parent's genetic make-up. I think we have all seen the results of this Hypothesis in the dog world; yes there is many a person cross breeding recognized breeds of dog to create the new "Yuppie" or "Designer Dog" commonly called a

Mongrel!! Today's Designer Dog, or shall I say Dog by Design all started in the 20th century for strictly monetary reasons.

The problem with Hybrid Vigor is that for the most part it doesn't work as well as inbreeding with sound selection. When different "Species" are crossed, their new genetic codes are so mixed, and so vast, that when they themselves produce offspring, there is no consistency of animal in terms of size or Type, or what it will look like as some of them take on characteristics of one parent while others take on characteristics of the other parent... Superiority has been proven only in a few instances, such as the Mule, in terms of their work ability's (and they are sterile and unable to perpetuate themselves) a crossing of a horse and a donkey... The above describes the issues when distinct Breeds or Species have been crossed, but there still lies the same problems when two distinct Strains of a given breed are crossed normally called "out crossing". Although there may be the occasional great specimen arise from this type of gene crossing, they are far and few between in terms of superiority and they are short lived. Further more, they may seem similar in appearance and even performance, but they will be largely Heterozygous for gene pairs controlling those features, and their genetic impurity will make them inconsistent breeders. The fancier can not, with any certainty predict the outcome of further generations in terms of prepotency. On the flip side of this scenario any particular pair of genes that are Homozygous, whether they be dominant or ressive, the same process occurs, but with a confident result in terms of predictability. When you're Sire or Dam has a large number of homozygous gene pairs for the ideals you seek, they have become the pre-potent breeders you seek, and are the reason for the high degree of consistency in their progeny. Their genetic purity turns probabilities into predictability's. It all comes down to "Selection" of ones breeding population. Is this Fact or Fiction I ask you?

The "Liger" shown below is the crossing of two "Species" of cat, the result of a mating between a male lion and a female tiger. This is one example of classic "Hybrid Vigor" in the truest sense of the term. As you can see when the genetic codes of a Lion and a Tiger are mixed, the offspring can become distorted in many ways like size or looks. Here, this Hybrid is growing to gigantic proportions, far from its genetic ancestry of either parent. On the flip side of this mating, female offspring are dwarfed in terms of size. As stated earlier, there is no predictability or consistency from such mating. In this case the males are sterile, but the females can be fertile in some instances.

To further discard the notion that inbreeding is the sole cause of unfit individuals, I would like to share with all of you a "Fact", and that is about a woman by the name of Miss King, who has been pairing brother and sister (the closest form of inbreeding) rats together for over 250 generations. She did this using strict selection, and created a family of rats that were not only larger than normal, but are superior in producing greater litter sizes, greater fertility and are indistinguishable from one another, a "True Strain" in my opinion. Some of you may already have heard of this experiment by Miss King, as this article is noted in many books.

What the aspiring breeder must do is understand his "Ideals", and cull all others as their unwanted recessive traits show themselves. As both the "Sire" and the "Dam" equally pass on 50% of their genetic make-up randomly to their offspring as part of the inheritance process, our hope is to intensify their genetic make-up on the "Dominant" side that meets our "Ideal." The more "Dominant Traits" we have that meet out Ideal, the more pure the specimen becomes genetically for those "Ideals" we seek. When one chooses to constantly introduce outside stock of further unknown genetic heritage, it is the opinion of many breeders that support inbreeding that there is no better way to further mask recessive genes, and by doing so make your job of finding and identifying those gene pairs that are Dominate for the traits and characteristics you seek.

Under the law of "Independent Assortment", Mendel stated that all genes and chromosomes are inherited independently of each other. The task of the breeder is to try and sort out all the pieces that comprise his ideal specimen. Knowing also from Mendel's writings about the "Law of Segregation", where he states that all genes, being dominant or recessive maintain their separate identity throughout the reproductive process. If one agrees with Mendel's law of inheritance, we know that all genes are inherited in pairs, one from each parent in a random fashion, and are responsible for one given trait, one can begin to see the task that lie before them in terms of isolating certain genes that form ones ideal. With this in mind, it is soon realized that with every new introduction of genetic material into ones stock only multiplies the task of unmasking all unwanted recessive traits and characteristics. What must be brought to bear in the minds of all fanciers is the fact that they are the builders of their ideal specimen, the genes and chromosomes are their building blocks. The same was said in the movie Jurassic Park, and very true.

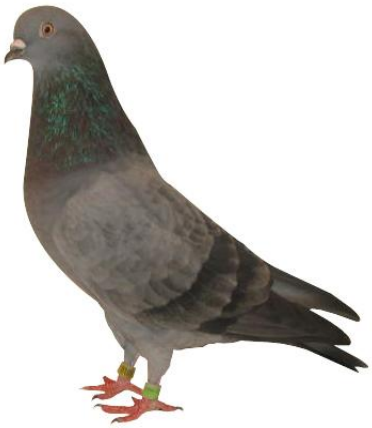
Speaking of being the builders of ones ideals, I think it is worthy to make mention of two genetic terms that are always being thrown around in discussion, but with very little understanding of the terms themselves and how they relate in part to this article.
Each and every creature is actually two, the one you see standing in front of you, and the one you don't see hidden within that same creature. The first is known as "Phenotype" the one you see, and the other is known as "Genotype" the one hidden within.

I could try and give a definition of both, but I think Professor John Blamire sums it up quite grand and is as follows: “Phenotype”. This is the “outward physical manifestation” of the organism. These are the physical parts, the sum of the atoms, molecules, macromolecules, cells, structures, metabolism energy utilization, tissue, organs, reflexes, and behaviors; anything that is part of the observable structure, function or behavior of a living organism”.
The second is “Genotype”, “This is the “internally coded, inheritable information” carried by all living organizisims. This stored information is used as a “blueprint” or set of instuctions for building and maintaining a living creature. These instructions are found within all cells (the “internal” part), they are written in a coded language (the genetic code), they are copied at a time of cell division or reproduction and are passed from one generation to the next (inheritable). These instructions are intimately involved with all aspects of the life of a cell or an organism. They control everything from the formation of protein macromolecules, to the regulation of metabolism and synthesis.”

As I stated earlier, each creature is really two, the one within “genotype” are the codes that are responsible for the “building blocks” of the one we see, “Phenotype”, this is the very important relationship of all living beings, and the facts about inheritance.

I am sure most , if not all of you have heard of the famous Jenson brothers, who over many generations of inbreeding, along with very strict Ideals and culling, created a Strain of racing homers that are renowned the world over. Their racing ability are so renowned that their stock is highly prized in the eyes of others. If one was to check, I am sure that in every homer loft around the world there has been a Jensen bred bird used with the hopes of improving their own stock. Their “Genetic Purity” for certain traits is a product of inbreeding, and in turn sought after.

To further justify, and lay to rest these largely “Fictitious “thoughts about inbreeding, I offer testimonials of other noted breeders of livestock and their practices.



Eugene Davenport:

"No other system of breeding has ever secured the results that Line-Breeding (and Inbreeding) has secured, and if the present state of knowledge is reasonable sound, no other system will ever be so powerful in getting the most possible out of a given breed or Varity, especially of animals, and this with the greatest certainty as we go along. The only requirement is not to abandon individual selection "

Chandler Grover is a breeder of Rollers and states the following:

"I have been breeding one family of my Penson Rollers for about 14 years that have been many generations of brother and sister mating, or always closely related nearly as much. This only works in a family that does not have hidden defects. Mine luckily did not throw misfits and rejects. Last year I tried another pair and raised all bad ones, blind weaklings and such. Only way to find out is to try and I am a fellow that to try and find out for himself "

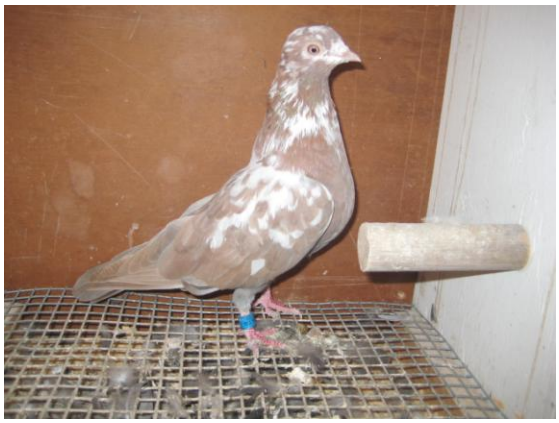
Hey, this is a guy after my own heart LOL!

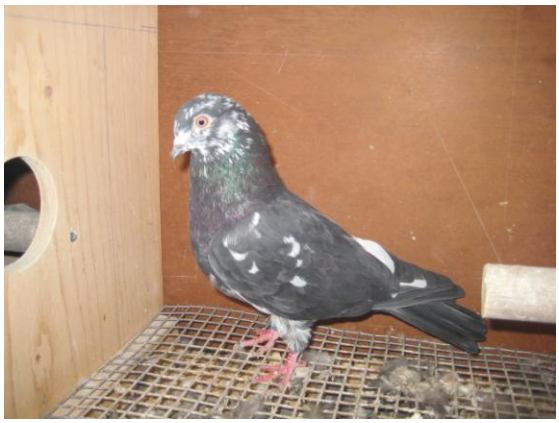
Dr. Carl A. Naether, "Book of the Racing Pigeon" a quote from Violette, a famous Belgian racer the following is stated:

"To breed from a type, but from a type of quality, mated with a near relative, likewise of quality: to maintain the quality, the highest level of quality, at each generation and in all generations; to select stringently according to the principles laid down, such, I think, are the observations which most nearly approach what a pigeon fancier should know and put into practice to obtain tangible results in the breeding of a strain."

You have just heard the testimonials of noted breeders and their beliefs and practices on the theory of inbreeding. They do it with an informed understanding of their "Ideal" specimen, and how to achieve it. They do it without fear, but with confidence and superior results. They speak of recessive traits showing themselves from time to time, but their knowledge, whether it is book learned genetics or practical breeding skills; "their animal sense" keeps them on a path that has proved to be the best way of attaining excellence in their stock, and that is inbreeding. Again, is this "Fact or Fiction"?

If we travel back now to picture number #1, I was going to cull both of these ybs, but there were those that offered up suggestions on what I could do to improve them, or that I was wrong in my thinking. There were even those that asked me why I would cull them, and to give them a chance like my friend Mick Hoskins over in Australia. I told him I had no time to waste on inferior quality pigeons when I had others of much greater quality to deal with. Well for some reason I didn't cull them, (see Mick, my heart is not solid stone LOL!!) and they have almost completely gone through their first molt. I offer them to you now as they are, after months of development. Remember, these are the products of a father/daughter mating of which I have done many times with great success. The family resemblance between these two cocks is so diluted; they share little family resemblance in terms of "Type" a sure sign of genetic impurity. This genetic "Impurity" or recessive traits are being "unmasked" if you will, rather than ones that are genetically pure for those traits. As we see them pictured below, we could be looking at the outcome of recessive deleterious traits or, the early signs of Inbreeding Depression in this first generation between full brothers. Their different phenotypes suggest genetic impurity. The red mottle has received more "Homozygous Pure" traits that express its phenotype than its full brother, the black mottle, in terms of family related resemblance and "Type". He is more "Heterozygous" or "Impure" for those traits and characteristics than his red brother. What must be kept in mind as "fact" is that every individual can only become what they have received through "Inheritance" from both parents when the sperm and the egg unite. In each and every case of a new life beginning, it is only potentially what it is bred to be.
Is this phenomena "Fact or Fiction", in terms of inbreeding, and a direct cause of depression?





Earlier in this article I made note to how and why inbreeding depression would occur. As stated earlier, this would be a result of a population lacking genetic diversity due to certain conditions like a confinement within a given environment. Normally nature's way of dealing with this would be through "Natural Selection", but in scenarios such as I have described, most of the offspring would carry some deleterious traits and therefore, given enough time, the average of unfit individuals would be greater than the average of the population in question. As inbreeding tends to have a "multiplying" effect genetically speaking, the outcome of "fixing traits" whether they be good or bad is realized. One can see how inbreeding depression would occur. "Fact or Fiction"?

To further give rise to Natural Selection, Charles Darwin, "The Origin of Species", the Guru of evolution by many, suggested that natural selection may or may not take place depending on their conditions of which these individuals find themselves. Factors such as habitat, nourishment, perspective mates, as well as disease and predication all perform a role in selection. He also suggests that selection occurs in a given population, when they are diverse in characteristics, and when the traits differ in individuals in terms of how well they equip themselves to survive a particular pressure of their environment (survival of the fittest) takes president.

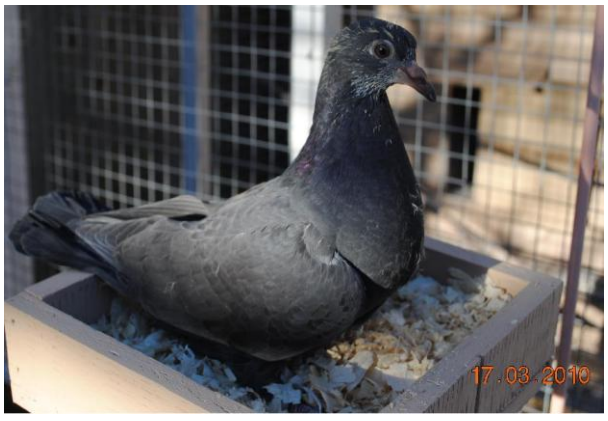
In contrast, artificial selection differs in the sense that long ago, breeders of all types of livestock soon realized they could, through breeding for certain traits capitalize on certain traits, behaviors and characteristics that they seek in a given individual. This exploitation of artificial selection has been in existence since early man and in many cases unintentional as it were. This selection process was deemed by Darwin as a wider process of natural selection, one that had human influences and preferences that in turn give rise to significant effects on domestication. In effect, we could through inbreeding create our own "Ideals" of what domesticated livestock should look and perform like.

For those that still may have some concerns about inbreeding depression, I can offer you this as well. This up-coming season I will be putting the product of a second generation father/daughter breeding back to her sire. This is, as many would state, "close" inbreeding, but in my opinion this is the only way to truly create a strain, as well as change the looks of a given specimen to more closely represent what one is after, in this case her sire. With each passing generation, the

offspring are becoming more “Homozygous” pure for traits and characteristics that we seek, rising in their excellence, and genetic purity.

The original hen I used was loaned to me by my buddy Oskar, and she was of a different “Type” than my stock, a “Type” that differed some from my personal ideals, but to her credit was from Irish stock of a noted breeder and fancier named Manny Fenton. Her excellence was still to be realized in terms of an out-cross as she was never flown or bred. The process of close inbreeding and selection of tested ybs will be done for at least 6 generations, or until I am happy with the results of this breeding program. So far, I have flown the young birds very well in terms of performance, no signs of inbreeding depression and the selection process has started to move closer to the Sires characteristics, or “Type” shall I say. It must also be stated, that when ever intensive inbreeding is practiced, there is bound to be recessives come to the surface, a direct result of the parents genetic make-up, and how pure they are in terms of “Ideals” we seek, whether they are good or bad. If one should find that the bad out weighs the good, the entire program should be scraped, as well as all the progeny, presumably due to unfit individuals.

The ybs pictured below are the product of this season’s daughter/father mating, and the third generation of what many would consider close inbreeding, and a road to devastation. As you can see, at the age of 24 days old, there are no signs of inbreeding depression of any kind. Both have sound development in terms of size, feather quality and development. A direct result of their parent’s genetic make-up. There are those that speak to size becoming an issue when inbreeding is practiced. The use of physical compensation when selecting the two birds that are to be mated should be considered. Remember, if medium is you’re “Ideal” in terms of size, and then there must be at least one of the two to be mated that is medium in size, as you can not get what they do not posses, genetically speaking. In this case ones ideal size. With each passing generation of inbreeding, they will become more Homozygous in their gene makeup for traits and characteristics we seek. If any deleterious alleles in terms of faults should arise, they must be culled.



I wrote this article not only to be informative, but with the hopes of dispelling some fears of inbreeding. It speaks to the lack of “genetic diversity” leading to inbreeding depression. Inbreeding should be viewed as a tool to improve ones stock to a greater level of excellence. As with the scenarios descried above, and our understanding of Artificial Selection, our lofts are in effect a “confinement of environment” in terms of implications of inbreeding that leads to

inbreeding depression. As documented, as well as my own beliefs, inbreeding depression does exist under natural conditions as well as artificial ones. Only under the watchful eye of the informed breeder, along with the use of sound selection, culling of all unwanted recessive traits, (Deleterious Alleles) and testing of progeny, can a positive outcome be realized.

I would like to acknowledge the many people and books already stated in this article that were in part, responsible in its making. Also in acknowledgment are the following:" G. H. T. Stovin, his book "Breeding Better Pigeons", "Genetics Made Simply by Paul P. Cook Jr", Charles Darwin "On Natural Selection", BirdLife International plan 2001-2011 (PDF). And finally my own practical breeding experience of various livestock, and many other informed fanciers.

Nine Bugeja