Mitochondrial DNA and the significance of the maternal line

by Silvio Mattacchione BA MA / Illustrations © Martin Hechanova on 03/06/2010

Mitochondria are found within each of our cells. Their main job is to produce energy so that when we run up a flight of stairs, just enough energy is produced for our cells.

A mightier power and stronger Man from his throne has hurled
For the hand that rocks the cradle Is the hand that rules the world.
[1865 W. R. Wallace in J. K. Hoyt Cyclopedia of Practical Quotations (1896) 402]

You can't prevent it; it's the nature of the sex.
The hand that rocks the cradle rocks the world, in a volcanic sense.
[A 1916 'Saki' Toys of Peace (1919) 158]

As the old adage goes: 'The hand that rocks the cradle rules the world.' Off and on I have given this old adage almost 20 years of thought. I first discussed the importance of this concept and its applicability to our breeding hens with Bob Kinney back in 1992. However as early as 1971 I was fascinated by this quote. I first encountered it in the "Review of Reviews" in reference to the "British Empire" and the role played by women in shaping the minds of their sons. These boys who would grow up to be military men, officers, scientist, innovators, financiers, lawyers and judges and seamen were nurtured by their mothers who in turn passed on to them a world view, a way of looking at and holding their vision of the world. This was not unique to Britain but was in fact common to all mothers in all nations. How men would come to see the world and their role in it was in fact filtered through and passed on to them by the female of the species. This truly fascinated me for contrary to all that "they" , "The press" and "feminists'" would have us unwittingly believe power really was the special prerogative of the allegedly weaker sex. That (1971) was the year that I experienced a paradigm shift in the way I viewed the world and the **"true power"** that females have and can wield. In essence "women" unlike men are "Co-Creative" but our generation has so bamboozled women as to have them willing give up their true power as unique "creative beings" in the name of alleged equality. Without the female of the species all would cease to be! Access to the cradle is true power (and that is why all governments everywhere seek to usurp the role of the female (mother) by enticing all women into the workplace thus allowing their government bureaucrats access to the children) because "the hand that rocks the cradle rules the world."

As breeders of racing pigeons how or why is this even remotely applicable? The vast majority of pigeon fanciers, pigeon breeders worldwide are men. As breeders of livestock, we believe that a Sire in horse breeding or a Bull in the breeding of cattle or a "ram" in the breeding of sheep or a "Cock" in the breeding of pigeons is of intrinsically greater value than the females of that same species. In fact most breeders never really give any real thought or credit to the hens. Our current mindset

clearly rewards the owners of a stock cock from a financial point of view, this is strictly business, but in the sense of one wishing to create a line, or a dynasty, or a strain nothing could be further from the truth. Here is the rationality that is used to confirm the greater importance or value of the Sire. A Stallion, or Bull or Ram or Cock can service many hundreds of mares, or cows, or ewes or hens during their lifetime while the female horse or cow or ewe may only have less than a dozen or so children and the hen pigeon can have many more but nowhere near the numbers of a Cock especially one on the Bull system. On the face of it, it certainly seems to make sense, or does it? Financially it seems to make sense and after all everyone knows that males of any species are stronger, faster, more productive, and more important right?

I will not argue the point. In the current financial and breeding model the male is definitely considered of much greater value from a monetary point of view. The male (of most species) is usually larger, more powerful and in terms of generating offspring definitely more productive but I definitely and adamantly draw the line at the assumption that males are more important. I have come to believe the very opposite that females are more important even the most important element in any breeding operation of any kind. The long-term success of any serious breeding program lies squarely upon the shoulders of the females of the line and not one in ten thousand breeders have yet fully understood this fact.

"Best to Best" formula for lifelong mediocrity

We need to start looking at breeding of racing pigeons or any livestock from a slightly different perspective, from a different point of view. How many times have you heard a racing pigeon fancier or race horse breeder state that the only way to breed is "best to best"? Then go on to state that he himself always breeds "best to best" and would never consider anything else. Oddly enough these fanciers or horsemen never define the term "best to best". Most never will define the term because it is an elastic, catch all type phrase that means everything to everybody and really nothing at all to anyone. Race horse enthusiasts have, almost 300 years of accurate and detailed records (in the form of pedigrees and race results) that they can analyzes and race horse breeders and the race horse industry in general claim that they breed "best to best". So, with 300 years of practice, almost unlimited funding, copious detailed records dedicated to breeding "best to best" just how successful are these allegedly professional breeders at breeding winners? Actually, if you were to check the statistics it seems that, for the most part they are not very good at it at all, actually pathetic. What's that you say?

Here is what Jack Glengarry; pedigree researcher has to say about this very subject:

"The old way of mating selection (breed the best to the best and hope for the best), can work for you, but when just 6% of horses pay their way, you need an edge to get ahead. And as if that 6% isn't low enough, Jack Glengarry, pedigree researcher from

New Zealand, goes on to suggest that only 6% of those that do pay their way, go on to be big winners."

Reference: http://www.tesiopower.com/TesioPowerForBreeders.htm

Now just so that you have an idea of the size and seriousness of the race horse industry worldwide here are some basic facts and figures.

About 37,000 Thoroughbred foals are registered each year in North America, [70] with the largest numbers being registered in the states of Kentucky, Florida and California.[71] [Notes 2] Australia is the second largest producer of Thoroughbreds in the world with close to 30,000 broodmares which produce about 18,250 foals annually.[73] Britain produces about 5,000 foals a year, [74] and worldwide, there are more than 195,000 active broodmares, or females being used for breeding, and 118,000 newly registered foals in 2006 alone.[75] The Thoroughbred industry is a large agribusiness, generating around $34 billion in revenue annually in the United States and providing about 470,000 jobs through a network of farms, training centers and race tracks.[76]

Reference http://en.wikipedia.org/wiki/Thoroughbred

So, 6% of all horses bred (using the "best to best" model) worldwide **hopefully** break even and of that 6% only 6% ever turn into winners of any note. So less that 1% of all the race horses bred in the world each year will ever make money to some degree or other! So, what is wrong with this picture and what does it say about the concept of allegedly breeding "best to best"? If what I have outlined above is in fact the case in the horse racing industry then how much more dismal are the real results likely to be in the racing pigeon breeding industry worldwide? I would venture to state that they are a great deal more dismal! No exponentially more dismal.

Professor Anker in his book confirms all that I have stated above and provides a real-world example as well. Here is what he has to say on breeding "Best to Best" which he refers to as "Good with Good"

The expression "good with good" is well known among pigeon fanciers in connection with mating. This expression is only valid in case of additive properties. You often miss the target with the non-additive properties. When we study the previous text, we´ll quickly find the solution. Janos Horvath, an fancier in the thirties and forties, possessed a super flyer at the time. It was a Hopfner crossed with an American pigeon. He had a lot of vitality, was always in form, flew many first prizes and usually finished with the first five up to a distance of 960 km. His power was not in the additive properties, but in his excellent organism, vitality, form properties etc. During 15 years, Horvath mated him with ever better partners, but the offspring was far below expectations.

In connection with this subject, I remember that there lived a horse phenomenon named Gladiator in the sixties of the last century. He won the English Derby in addition to the French Grand Prix, a fete accomplished by only 4 horses in 100 years.

One of them was the Hungarian stallion Kisber. Why was it that he had so much class? Well, by luck his organism became a super organism. Such a super organism is being established by numerous factors which cannot be determined in advance. Just as unexpected as a card player receiving only trump cards. So, pure chance. But, this by chance-created organism, developed from tens of thousands of threads, cannot pass on his qualities to his offspring at such level. That´s why such individuals, despite their performance, do not succeed in the breeding stable. They cannot reproduce themselves. They are excellent in the non-additive properties, but unfortunately, they cannot pass them on, or only every now and then. In this case "good x good" is of no help.

There has got to be a better way

Horseracing is a serious agribusiness and if the very best that these professional breeders can muster using the "best to best" model is less than 1% stakes winners then the breeding paradigm requires a major rethink. With these types of depressing results new breeding models should always be seriously investigated. There is a great deal of pseudo-knowledge out there and "breed best to best" is just one example.

Reliable information, we need, to help us from our breeding choices is often elusive. There is a lot of pseudo-knowledge out there, such as the correct sounding "breed the best to the best", a practice that doesn't even return 50% on its promise. We are doing what we can to improve our stocks' productivity with better nutrition, worming… etc. Now we need to learn what breeding choices do in fact work, and stop wasting time and money on those that don't.

Reference http://www.sport-horse-breeder.com/successful-breeder.html

Research is the Key

So if "best to best" is not the optimal breeding model then how does a breeder of any stock, but in our case, "racing pigeons" go about manipulating the odds in his favor?

Well research is the key and a number of successful stockmen in our racing pigeon sport have understood that they must constantly be on the lookout for exceptional foundation pairs whose success is proven to have been inter-generationally transmitted. Freddy Vandenheede, in personal correspondence with me, put it very succinctly when he said:

"Good pigeons make master breeders."

Another exceptional breeder of high-quality racing pigeons and partner in PIPA and the "Pipa Elite Center" also makes this same point in a slightly different way and helps

us further focus on the key element in breeding champion racers and breeders. Dr. Carlo Gyselbrecht puts it like this:

"*… It is in their 'genes', it is in the family!*"

Piet de Weerd said:

"*only a few families rule the nationals and these are the very best!*"

Our job as breeders of thoroughbred racing pigeons is to locate those exceptional pigeons that consistently produce winners inter generationally that derive from a family or line. In the past some breeders have been fortunate enough to stumble on to one of these "jewels of the sky" and have quickly built a reputation for themselves and unfortunately just as quickly lost that reputation when the original golden pair was no longer producing because they failed to maintain, through a proper breeding program, the quality genetic package that they stumbled on to.

Step One and Step Two

So, step one is to locate these exceptional specimens and then even more important step two is to figure out how you can maintain or perpetuate this exceptional genetic material for as long as possible. Most breeders of racing pigeons fail miserably on both of these counts.

In 1992 one of my authors and friend Bob Kinney explained this two-step process in very easy to understand terms. Here is how he put it so that it was very easy to visualize:

"….To put my thoughts on breeding into the very simplest of examples. Consider the following. Image a jar in front of you with gold dollar coins in it. Imagine that each gold dollar coin represents a winner gene and you want to reach into that jar and pull out another winner. There are say 20 gold dollar coins in that jar. So long as there are only gold coins in that jar, every time you reach into it you will pull out a winner. So, let's imagine that you now decide to bring in a cross, unproven, an unknown quantity, that you now mix into your loft (or jar).So now your jar is full of the 20 gold coins to which you have just added 20 copper pennies. So, it is easy to understand that your odds of pulling a winner out of your jar have just been reduced by 50%. Now do that for another generation because the bird that you imported or bought cost so much and is claimed to be so good and you now have say, 60 copper pennies and the same 20 gold coins. If you multiply the number with even more unknown gene packages the likelihood of ever finding one of those gold coins is even further reduced. The above is a formula for lifelong mediocrity.
When I found that super pair, I literally culled everything and worked with that pair and their children. Some were proven as youngsters others were bred for stock. I proceeded to mate them together because I had no choice. With a total of seven

pair, I started over. I was LUCKY enough to find the "gold mine" my jar was full of gold coins… Over the years I have twice cut back to seven pair only. Each time resulted in a leap forward in performance…"

Reference: Bob Kinney from personal correspondence.

Clearly the tools that Bob Kinney employed in the perpetuation of the superior attributes of this exceptional Foundation pair **"Silverado Stier X Blue Pride"** were those of **inbreeding and line breeding**. First locate an exceptionally prepotent pair, then build a family or line around this pair and finally preserve this family once its superior attributes have been fixed. Bob certainly did this but he was also in constant pursuit of exceptional individuals whose origin was also from proven pairs that could be used to even further elevate his own base family of pigeons.

Breeding remains as much (possibly more) an art than it is a science. The breeding of racing pigeons is very complex because many traits are involved rather than a single trait. So each of these traits is further influenced by environmental as well as genetic factors. In short, breeding exceptional racing pigeons is not as easy as one might hope. After all if it was, Champions and Champion families would be a "dime a dozen" rather than the rare "jewels of the sky" that they really are.

What Bob Kinney did for his **"Silverado Janssen"** family was to try and bring desirable genes (traits) to a homozygous state. In his particular case he was fortunate enough to choose correctly in his original stock, and so he was successful, but if he had chosen his original breeding stock incorrectly then the task of breeding out the undesirable characteristics would have proven totally impossible. In most cases this is exactly what happens, that is, the undesirable characteristics only compound through intensive inbreeding and line breeding and quality that never existed to begin with only further degenerates.

In the hands of a visionary, it is possible to conclude that an inbred family can be purified, in which case the offspring would be almost identical in appearance, equally good racers, potential winners on race day, and ultimately, very valuable stock birds. I can in recent times think of the family that was created by Frans Sablon and Etienne De Rauw now often referred to as the "De Rauw Sablons". These two men spent 30 years cooperating closely and the synergy that was created by their mutual cooperation was much greater than their own individual talents. Winners coming from a winning family, prepotent, generation after generation. Such a family is highly desirable for out crossing because of their homozygosis. This is in fact is the theory and rarely is it ever achieved without great struggle and perseverance and even then, it is not achieved by many.

Generally speaking, certainly in 99% of all cases, there is no advantage to be had by inbreeding because the quality of most pigeons is only mediocre at best and as we know inbreeding is a special purpose tool that is used to fix characteristics (both good or bad unfortunately) and in the case of mediocrity there is very little that one can do other than to distance yourself from such substandard pigeons and keep looking for something really special.

Good pigeons make master breeders!

Most fanciers who know me know that I inbreed and line breed to a very great degree. I have done so for over 20 years but please allow me to be very, very clear on this point. Most breeders should never consider inbreeding their stock because it will serve absolutely no useful purpose in doing so. Inbreeding is not some magic method that is employed to somehow magically inject into a line what was never there to begin with. Inbreeding in fact is the ultimate test of quality and if you are wrong the results will be disastrous. I chose to inbreed my foundation pair in the hope of discovering just how good they really were knowing full well that the probabilities were stacked against my foundation pair of "St. Thomas X Deanna". However, I knew that only by inbreeding would I truly discover if there was something of true value in this pair. I took the risk based upon all that I knew of the "Kanon Line" and the risk was worth it. Was I brilliant? No, I was lucky! Let's remember what Freddy Vandenheede stated clearly:

"Good pigeons make master breeders."

It is not nor has ever been the other way around "Master Breeders" do not create good pigeons! Master stockmen have the uncanny ability to somehow recognize quality, quality that already exists, Master Breeders cannot start with substandard livestock and somehow miraculously produce in the horse racing world "Northern Dancer" or in pigeon racing world an "Albert" (De Rauw Sablon) or "Johnny Boy" (Geert Munnik) or "Den Dromer" (Koopman) or "Freddy" (Vandenheede) or "Chipo" (Steveninck) or "Lucky 848" (Limbourg).These referenced Champions are rare, they are the "rarest of the rare" and that is why they have value!

Figure 1 Winners are two pence a dozen; it's the birds that produce them that are so hard to get in the first place. Recently (May 2010) a daughter of "Lucky 848" sold at public auction, on PIPA, for 17.400 EURO to- 3-D Lofts & Khanlofts.com – USA.

Truly pre-potent sires or dams are the rarest of the rare!

They are to be cherished, and unlike diamonds, they will not last forever. Use them wisely! To find one is truly like panning for gold. You go through tons and tons of rock and dirt to find only a grain-a nugget-of real gold. That is why it has value, because it is rare! Yet once found they are rarely ever appreciated nor in most cases properly used. This is because people ignorantly believe, "Oh, well, I'll find or breed another." Well, good luck because the reality is you rarely will.

So, Silvio, why do you say this? Well, here is why. Let us say, for arguments sake, that a pigeon only had 25 pairs of genes. If this was the case, then each pair of pigeons would produce approximately 33,500,000 different genotypes. You must admit that

this is an incredible number. But how many genes does a pigeon really have? Well, he/she has 6,000 pairs, which really means that if each pair was heterozygous, they would in fact produce 3 to the 3,000th power different genotypes. Do you understand just how big this number is?

So, what becomes only too clear is not that variations occur-because this is the norm-but rather that offspring of a pre-potent sire or dam can be so consistent in producing exceptional quality! This is why pre-potent pigeons are so rare and valuable.

Only through a well-defined, well-thought-out and executed plan can you seek to thwart Nature's law. Most pigeon breeders lose. Once the sire or dam is gone, so is their human owner's supposed, ability as a great breeder? You see, it had nothing to do with the alleged ability of the alleged Master Breeder; it had to do with chance and blind luck. So it is with so many self-proclaimed master breeders with many, many all-American and European alleged Master Breeders. Were they really master breeders or just extremely fortunate to have a long-lived pre-potent sire and dam?

Well, I have attempted in the preceding pages to make a number of important points. Some readers will understand most will not and that quite frankly is okay.

The bottom line that what all of the worlds Champions have discovered is this **"great pigeons make champion pigeon fanciers"** not the other way around. So, our job is to diligently research and locate these exceptional pigeons before other fanciers realize that they are truly special.

So, let us assume that you have found something special, now what? Well, if you are correct you need to begin a breeding program that seeks to ensure a constant supply of this special genetic package for generations to come. Quite frankly this is where the "rubber hits the roads"! This is what makes or breaks us all and guess what It really has very little to do with how much money you have or do not have. In fact, it has everything to do with your intuitive livestock resources rather than your monetary assets. But I have already stated that true "stock sense" is in limited supply and that not one in ten thousand has it, so does that mean we are doomed to failure? Well, no not really you may not have stock sense but so long as you have good common sense, great research skills, a lot of determination and you undergo a slight "paradigm shift" you might just be on your way to greater than average success.

The champion producer has no price!

A number of years ago a friend of mine Colin Chapel of Australia wrote a marvelous article entitled "Second Helpings" we have since communicated many times because of this article but towards the end of his article (that is quoted verbatim herein) he deals with the issue of appropriate price for a Champion producer and his

answer while disconcerting to many readers is exactly what I myself believe. Here is what Colin has to say:

And that's the appropriate price for a champion producer, be it a horse or a pigeon: rare, often unexpected, but irreplaceable. VIN Blanden was for many years a major and influential member within the SAHPA. He knew all the great fanciers in his part of the world, and was extremely knowledgeable about the various families and lines of birds within South Australia. He owned the famous stock-hen widely known as 'Henrietta', bred from brother and sister. Blanden wrote a column on pigeon racing which appeared in a South Australian newspaper each week, and one of them written somewhere around 1958 was headed "Mate Brother to Sister". It could have been the story of his famous hen, but it reads as follows:

If a valuable family is to be retained, the best way to gain the end is to mate brother to sister. Winners are two pence a dozen, it's the birds that produce them that are so hard to get in the first place. The valuable pair are the two birds which produce a number of offspring which in turn keep breeding winners season after season. The best son of the pair should be mated to the best daughter before it is too late.
Many good prize winners this year, including several of the twelve Association winners are descendants of three birds bred from brother and sister. Quite a number of these are inbred back again to such extent that they are descended from all three birds.
The proof of the pudding is in its eating, and the ultimate result proves the point."

Reference: from "Second Helpings by Colin Chapel

The ultimate advantage?

Most fanciers are bored with genetics, most do not understand it and do not want to take the time to try and understand it because it is different, confusing and requires a great deal of thought and effort. Everyone is after the quick fix. How many times have you heard someone say that "I do not need to know how to build a car to drive a car" then they say "just show me where to insert the key and I will be on my way". Well, it would certainly be better if the person understood the basics of the car, but most people, including most pigeon fanciers are not really prepared for what should really be done, if they can get by with a short cut. With this in mind I am going to provide you with a **"possible"** shortcut that may just give you an insight and an advantage over other fanciers who are not aware of this information. The hen is the key to your entire breeding operation. The hens are the keys to your success. The hens are the keys to your longevity as a successful breeder of racing pigeons. Without great hens, without exceptional hens, without a family of exceptional hens you will achieve nothing of lasting value!

Energy is the essential key to success

Without energy everything comes to a standstill. All we have heard of since the 1970's relates to a nonexistent energy crisis. Well, let me state that our racing pigeons are intricate biochemical species (as all forms of life including man are). Every single organ in their bodies would find it impossible to function if they could not depend on a constant supply of energy. These organs include the heart, the liver, the kidneys, the brain and all of the muscles. The energy is produced by the body, in the form of a chemical, is called ATP (adenosine triphosphate) which is then used by the body for essential body functions.

Reference http://www.hitechbloodstock.com/

The open secret!

In one quick sentence, the open secret is that ***only females can pass mtDNA onto their offspring and that the Mitochondria are the energy powerhouses of each and every cell in the bodies of every living thing on earth.***

What is Mitochondrial DNA?

Rather than me reinventing the wheel I am going to quote from http://www.dnaheritage.com/mtdna.asp as they have defined Mitochondrial DNA As:

- ***Mitochondrial DNA (mtDNA) is contained in the mitochondria of the cell. The mitochondria are organelles located outside the nucleus in the cytoplasm of the cell. These organelles are responsible for energy transfer and are basically the "powerhouses" of the cells… This form of DNA is in short strands and therefore does not mutate or change form very quickly - it is relatively stable and can be compared across several generations. Mitochondrial DNA is only passed along the maternal line - so if we want to compare a sample … we have to obtain a blood sample from the mother or any of the siblings (who would share the same sequence of mtDNA as the mother), but in terms of nieces or nephews, we could only obtain it from a sister's children (a brother's child would obtain his or her mtDNA from the mother who would not be related).***

  Your maternal ancestry can be followed back using a special type of DNA called mitochondrial DNA. We call it mtDNA for short.

  Mitochondria are found within each of our cells. Their main job is to produce energy so that when we run up a flight of stairs, just enough energy is produced for our cells.

However, it's the way that the mitochondria and, more importantly, the mtDNA inside is passed on to the next generation that is of most interest to genealogists and people looking into their past.

In one quick sentence, females pass mtDNA onto their offspring.

Therefore, everyone will have received mtDNA from their mother and in turn, those mothers received their mtDNA copies from their mothers too. In this way, the path of the mtDNA has travelled down the generations through the direct maternal line.

Reference: http://www.dnaheritage.com/mtdna.asp

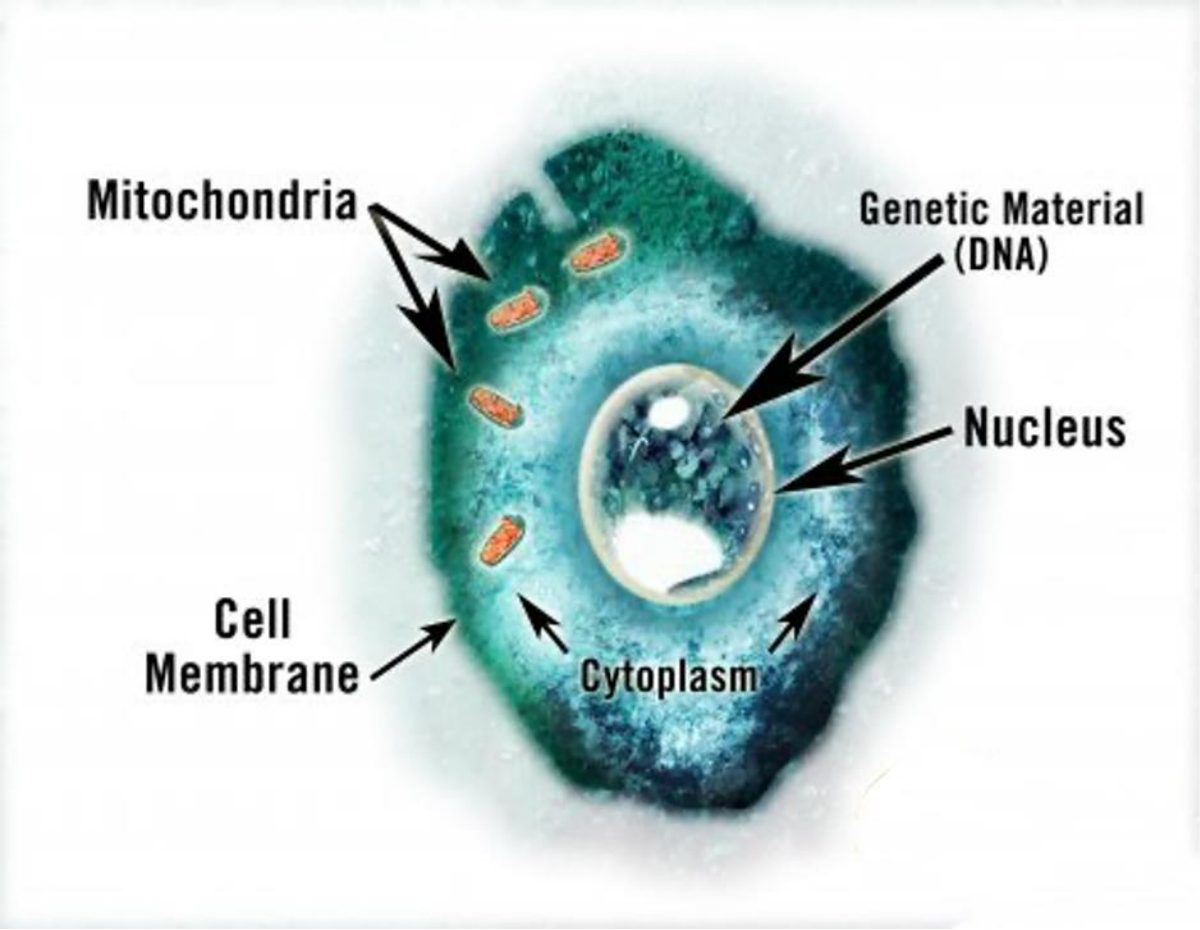

Figure 2 Mitochondria are found in the tens of thousands in the cytoplasm of each and every one of our cells. As you can see the Mitochondrial DNA is separate and distinct from the nuclear DNA contained in the nucleus of each cell. Illustration © Martin Hechanova

What are Mitochondria?

Mitochondria are the little factories in each of the cells of the body that are responsible for making most of the body's source of energy. Every cell contains literally tens of thousands of these Mitochondria. Body organs (especially the brain, heart, muscle, kidneys and liver) cannot function normally unless they are receiving a constant supply of energy. The energy is produced in the form of a chemical called ATP (adenosine triphosphate) which is used by the body to drive the various reactions essential for body functioning, growth and development.

A number of biochemical reactions which occur in an ordered sequence within the mitochondria are responsible for this process of ATP production. These reactions are under the control of special proteins called enzymes. The genes found within the mitochondria contain the information which codes for the production of some of these important enzymes.

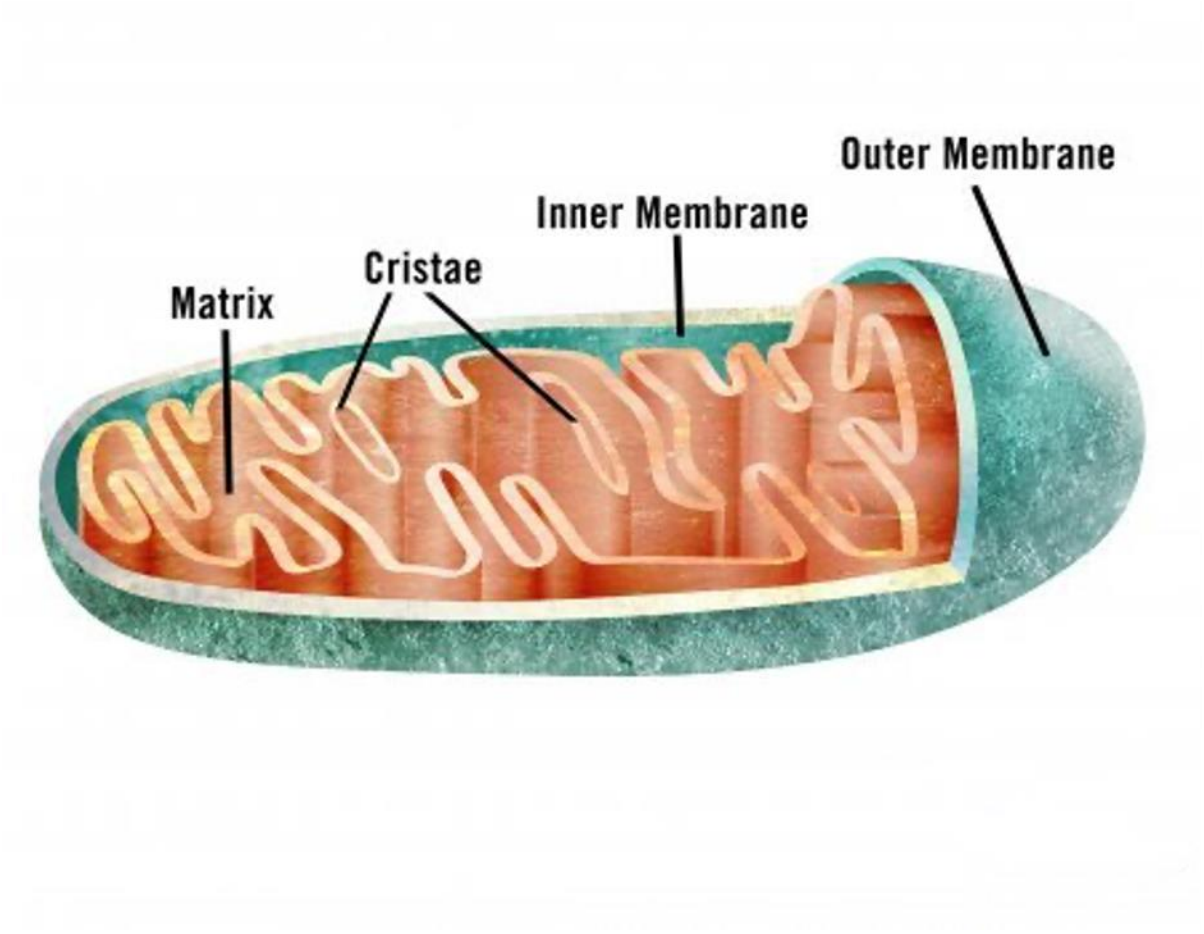

Figure 3 Mitochondria are the little factories in each of the cells of the body that are responsible for making most of the body's source of energy. Illustration © Martin Hechanova

If you were to visit http://www.hitechbloodstock.com/ you would find the following passage defining Mitochondria as the "energy factories" of every cell and that these energy factories make up most of the bodies energy source. We pigeon fanciers spend a lot of time on concocting feed supplementation in order to give our birds whatever little advantage is possible because the difference between Champion

pigeons and the rest is an incremental advantage. That is why we "carbo-load" before races using either small seeds or oils etc. However rarely does anyone give thought to these "energy factories" that give certain champion pigeons an advantage from birth. Please note that these energy factories have nothing to do with the male of a species and everything to do with the female of the species. So it's time to "rethink" the role of the Hens in your loft because they truly do dictate your success or lack of same. The hen literally provides the "power source" inside each cell in our pigeon's bodies. Now take a moment to really think about that for it is a revelation. Additionally, not just any hen will do you need to do your research and remember the words of Dr. Carlo "… It is in their 'genes', it is in the family!" or those of Freddy Vandenheede who you will remember stated:

"Good pigeons make master breeders."

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What are the biochemical reactions that occur in the mitochondria?

The biochemical processes which occur in the mitochondria and produce energy are known as the "mitochondrial respiratory chain". This "chain" is made up of five components called Complex I, II, III, IV and V. Each of these complexes are made up of a number of proteins. The message for the body to produce these proteins is contained in separate genes.

There are over 80 different genes needed to produce the components of the mitochondrial respiratory chain. Some of these genes are found in mitochondria rather than in the nucleus.

Mutations in any of these mitochondrial genes can result in biochemical problems due to absence or malfunctioning of the enzymes involved in the respiratory chain complexes. This leads to a reduction in the supply of A TP. This can have severe consequences, resulting in interference of body functions including any of the following, either in isolation or in various combination.

Examples of the impact of faulty (mutated) mitochondrial genes

- **General**: small stature and poor appetite
- **Central nervous system**: developmental delay/intellectual disability, progressive neurological deterioration, seizures, stroke-like episodes (often reversible), difficulty swallowing, visual difficulties and deafness
- **Skeletal and muscle**: floppiness, weakness and exercise intolerance
- **Heart**: heart failure (cardiomyopathy) and cardiac rhythm disorders
- **Kidney**: abnormalities in kidney function

Can mutations in the mitochondrial genes be inherited?

The number of mitochondria in every cell of a horse's body varies from a few to hundreds. All of these mitochondria, and therefore the DNA within the mitochondria, descend from the small number of mitochondria present in the original egg cell at the time of that horse's conception. The sperm does not contribute any mitochondria to the baby.

Thus, an individual's mitochondria are only inherited from his or her mother. An abnormality in one of the mitochondrial genes can therefore be passed by the mother in her egg cells. As most of the mother's egg cells carry the same mitochondrial mutation, the risk of this mother having another affected offspring with the mitochondrial disorder is high. This pattern of inheritance is therefore referred to as maternal inheritance.

Super mt-DNA

Certain individuals in the Horse Breeding Industry believe that great stakes producing mares have some mutated special mt-DNA when coupled with large heart sized

genes produce stakes class performance. (Historical mares in this class quoted in this category are Selene, Plucky Leige, Nogara and more recently Mrs. Moss and Height of Fashion)"

Reference: http://www.hitechbloodstock.com/

Professor Anker on Vitality

A high vitality makes it possible for a pigeon to have greater energy reserves during races than his competitors in general. The in-flight energy losses fatigues the constitution of such pigeons less. They need to mobilize less power to get home on the same races or, when everything is needed, to fly the soul out of their body.
In that case, the average pigeon is already far behind. Pigeons with excellent vitality recuperate faster, they are quicker able to form new reserve in kidneys and liver, and as a result of this, also get faster back in shape. I don´t think that I need to say more to my sport friends who raced good how much this means in practice. More classification results, more prizes. It is therefore wise to keep only those pigeons in the racing loft who possess an excellent vitality… A pigeon with a great vitality doesn´t lose his shine during mating, breeding and the upbringing of the youngsters. One doesn´t notice change. Their nose tips are white as snow, their muscles don´t lose body, elasticity and shine of wings remain unchanged. Such pigeons possess an above average vitality. Such a constitution can also cope with a lot in the basket while other pigeons only show something on those competition races which are lighter and demand less power.

We all speak of vitality yet never have we come to understand the role of the Mitochondria in the very existence of this vitality. Mitochondria dictates vitality because it dictates the availability of energy and the more important realization that only the female of the species can pass on the Mitochondria to her children. Let us for a moment think about the comments made by Dr. Mark Hyman M.D. on http://www.ultrawellness.com/blog/ultrawellness-key-6.

Why are these little energy factories so important to your health?

The answer is simple: Mitochondria are the place where metabolism happens.
When your mitochondria aren't working properly, your metabolism runs less efficiently or can practically shut down.
Problems occur because these powerful energy producers are VERY sensitive to damage.
And when they are damaged, you suffer all the symptoms of low energy—fatigue, memory loss, pain, rapid aging, and more.
Fatigue is the most common symptom of poorly functioning mitochondria, and it is

the reason we tend to poop out as we age. We add constant insult and injury to our mitochondria, and this causes them to break down and stop producing energy. The main way your mitochondria are damaged is by uncontrolled oxidative stress. That may sound complicated, but in reality, we are all familiar with "oxidative stress" even if some of us don't know what the term means.

Mark Hyman, M.D.
Reference: http://www.ultrawellness.com/blog/ultrawellness-key-6

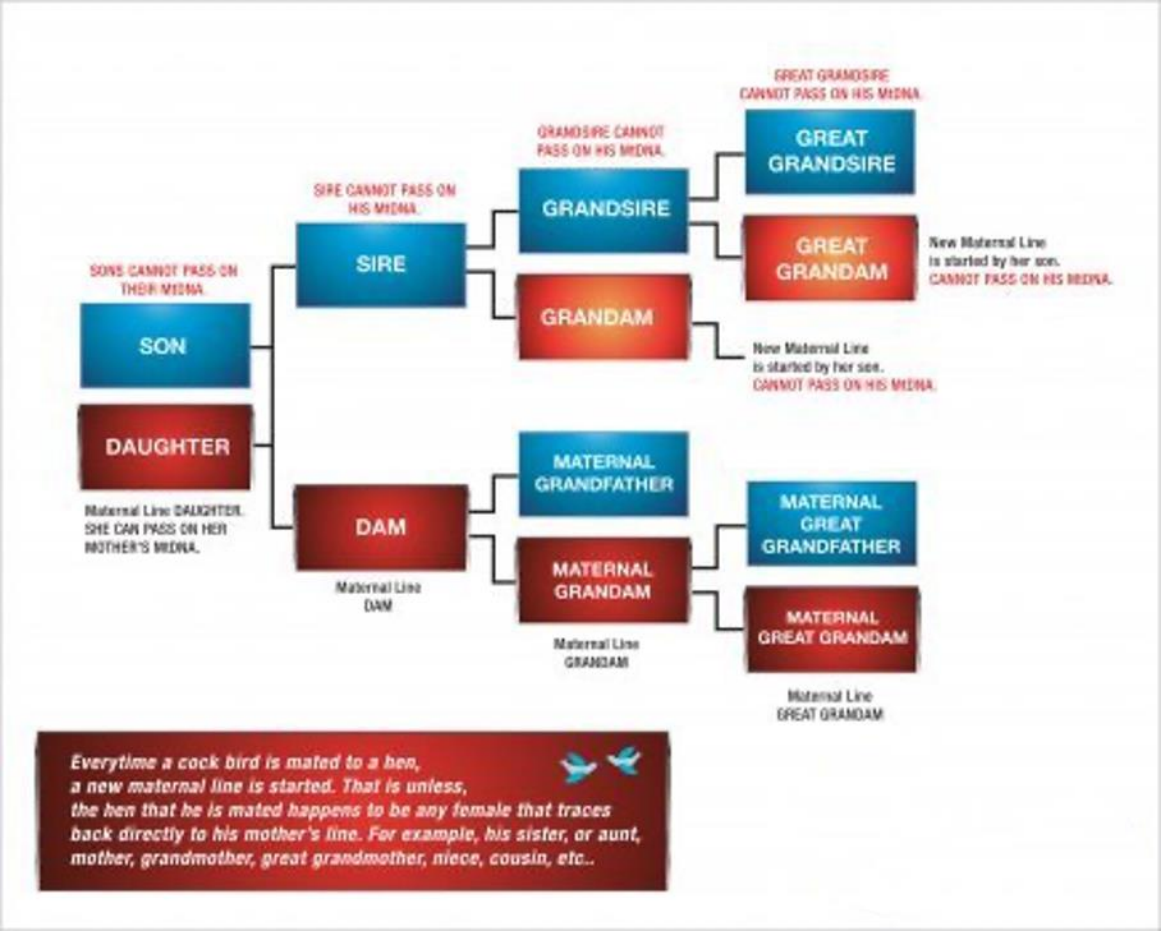
Figure 4 The Mitochondrial DNA of the cock is contained within the tail of the sperm. Illustration © Martin Hechanova

It will come as a surprise too many to understand why only mothers pass Mitochondrial DNA on to their children. All of your Mitochondrial DNA is identical to that of your brothers and sisters, your mother, her sisters, their mother, their grandmothers and so forth. Your whole maternal lineage can literally be traced back to the beginning in this fashion. When a cock mates to a hen the cock supplies the sperm and the hen the egg however since the Mitochondrial DNA of the cock is contained within the tail of the sperm and since the tail falls off as the sperm enters the egg it is impossible for the resulting offspring to carry anything but the Mitochondrial DNA of the hen or the mother. Now think of this when you are planning your mating every time a cock mates to a hen other than his sister or mother or other

female member of his mother's maternal line he is in fact creating a NEW hen line each and every time.

"Around the globe you will see the most successful farm operators active at acquiring quality mares and fillies;
they know maternal strength is the pathway to success."(McLean)
(Reference http://www.sport-horse-breeder.com/the-Mare.html)

Figure 5 Illustration of the passage of the Mitochondrial DNA along the maternal line only. Illustration © Martin Hechanova



Recently I was reading the contents of the Sport Horse Breeder website and found references to the advances made long ago especially by the giant of the horse breeding world Frederico Tessio regarding "nervous energy". This was long before science had knowledge of the existence of Mitochondrial DNA. The Italian Frederico Tessio remains to this day the giant of the race horse breeding world. He was an intuitive genius!

Knowledge in any field comes from the hard work of many people. The advances in equine genetics and breeding are no different. Following are just a few of the "giant's shoulders" we are standing on today.

Frederico Tesio, the father of balanced line breeding, was an intuitive genius, instinctively he chose broodmares with reserves of nervous energy- this was long before Mitochondrial DNA was ever imagined.

Ken McLean in his "Genetic Heritage" announced the importance of the dam's x chromosome and he anticipated the future findings in Mitochondrial DNA.
Bruce Lowe attempted to trace and classify those female families that were potent for racing excellence in a number system that is still in use today.
Clive Harper gave us the statistics that have clearly shown that sex balancing pays in his "Thoroughbred Breeders' Handbook" and then explored the power of the mare in depth in his "The Thoroughbred Broodmare Book".

Marianna Haun thrilled us with her "The X Factor" which traced the large heart gene coming down the x chromosome.
The above is a partial list, but enough for you to see that all of these ground breakers were ON TO SOMETHING.

(reference http://www.sport-horse-breeder.com/the-Mare.html)

Blue Hens

Thoroughbred breeders have classified especially potent mares as "blue hens" and Ellen Parker has developed a "reins de course" list and made an in-depth study of the female families.
(reference http://www.sport-horse-breeder.com/the-Mare.html)

A proper understanding of the function of the Mitochondrial DNA as the "power house" of each cell the engine that actually produces the energy for all organic life forms on this planet and the further understanding that these powerhouses can only be passed on by the females of any given species should assist us all in viewing any pedigree in a very different fashion from here on. The female plays a markedly more profound role in producing individual Champions and perpetuating a winning family for generations than has hitherto been realized.

It's time we stop looking at our hens as "incubators" and start understanding that they are truly the genetic powerhouses that can make or break our efforts to breed exceptional racing pigeons. It has taken a great deal of time and study but I have come to understand that long term success depends much more upon your hens than it does upon your cocks and with this knowledge in mind you might want to study your pedigrees in light of this newfound understanding.

Practical Application of These Concepts

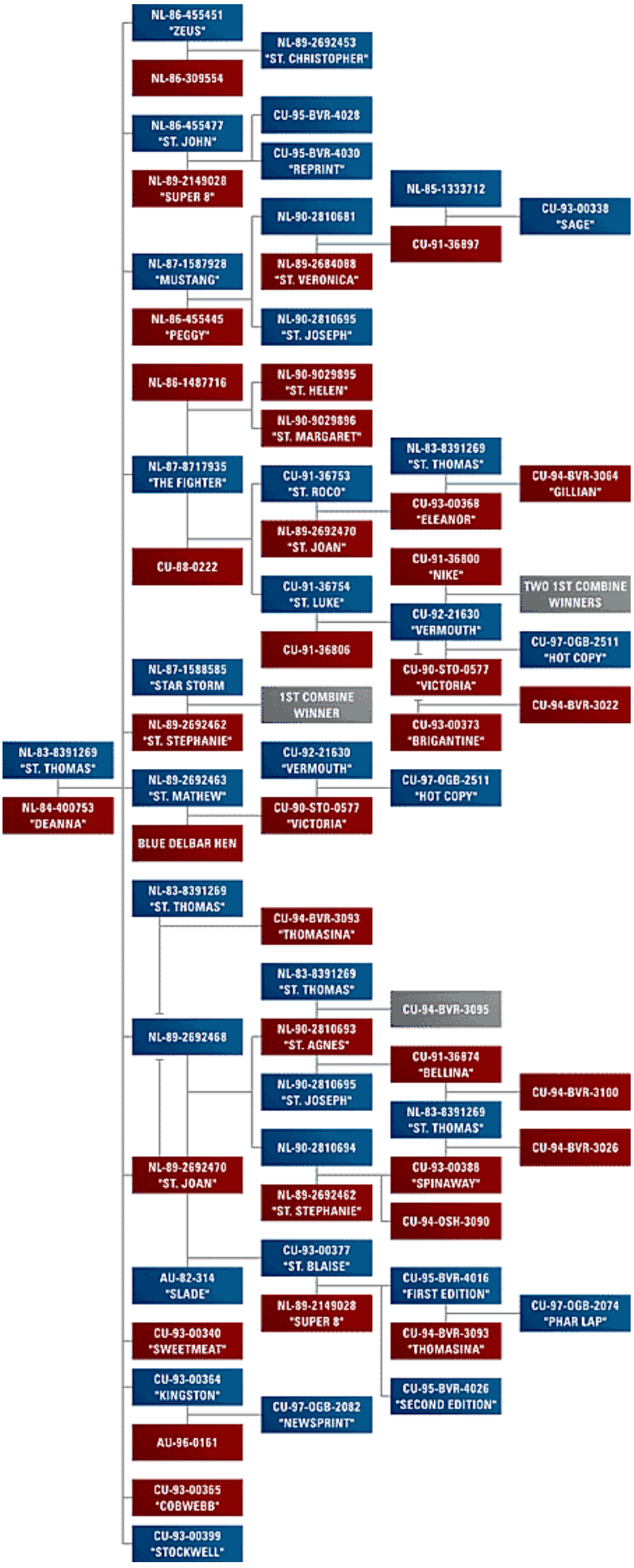
I can hear it now OK so just how do I use this information in the real world? How can it help me? Well I can give you a very practical example of how I used this info to develop an entire line of pigeons based upon only two Janssen pigeons. My entire colony after twenty years of selective inbreeding of my foundation pair of "St Thomas " X "Deanna". I came very early to appreciate the value of the "maternal" line and I believed that the longevity and strength of any colony had less to do with the cocks and much more to do with the hens. Since this pair of "St. Thomas" X "Deanna" had produced many successful sons and daughters that had won many races in Holland, the USA, Canada, Taiwan. Mexico etc I decided to find out just how good they really were and so I decided to embark upon an intensive inbreeding program by mating "St. Thomas" to his daughters, and then "St. Thomas to his granddaughters (who were also his direct daughters) and then to his great granddaughters (who again were also his direct daughters).At the same time I was mating his sons to their sisters, uncles

to nieces etc and then these hens back to "St. Thomas". To my surprise the line did not deteriorate but only became more dominant.

In essence I intentionally created a line that was based upon the Mitochondrial DNA of my foundation hen "Deanna". The children of St. Thomas became more and more consistent with every generation; the hens throughout the loft were like peas in a pod. They looked the same, they handled the same, they had wonderful vitality and fecundity, they were intelligent, soft of feather, moist flesh, buoyant they could easily be tamed and to top it all off they were very, very pretty to look at.

I made it a point of trying never to bring new blood into my line and if I did I brought in only a well-researched and selected cock as in the case of "Slade" (who I purchased at public auction in 1992) who was a very successful foundation cock of the American "Bob Kinney" from his foundation Janssen pair of "Silverado Stier" X "Blue Pride" (Bob Kinney bred the mother and father of the 1998 Sun City Million Dollar Race for Bob Qualls as well as the 5th place winner in 2003).Since cocks cannot pass on their Mitochondrial DNA there was no danger of me effecting or changing the maternal line that I had established in my breeding program. Please review my chart entitled "St. Joan" to see how I used the Kinney cock "Slade".

During the development of my maternal line, I did make use of two outside hens but again I ensured that they would not change my maternal line. How did I do this? I did this by ensuring that I bred only from their sons. You can see an example of how I did this in my chart showing how I used a hen called "Super 8'.
The chart that follows outlines the creation of my inbred line originating from "St. Thomas X "Deanna"

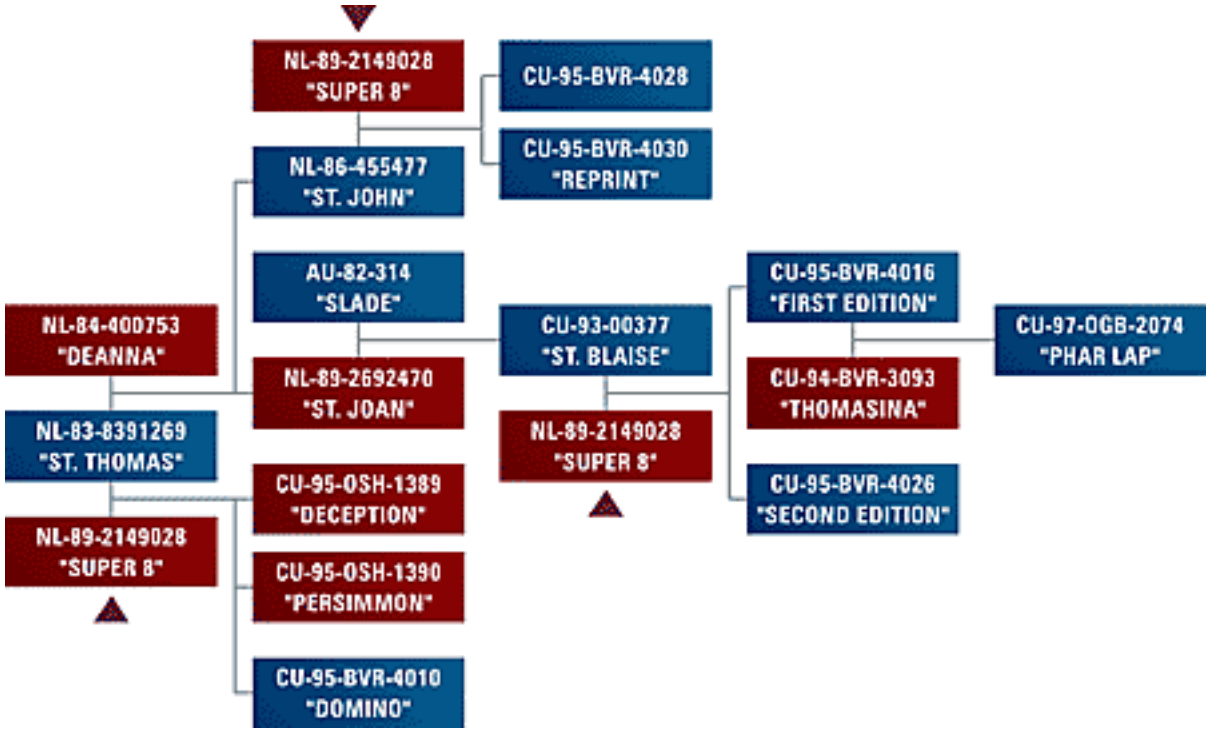


"St. Joan" (NL-89-2692470)

This chart shows how "St. Joan" (NL-89-2692470), the daughter of "St. Thomas" (NL-83-8391269) and "Deanna" (NL-84-400753), has been interwoven into the "St. Thomas" (NL-83-8391269) x "Deanna" (NL-84-400753) line through selective inbreeding. Note the arrows indicating "St. Joan" (NL-89-2692470 and "St. Thomas" (NL-83-8391269).

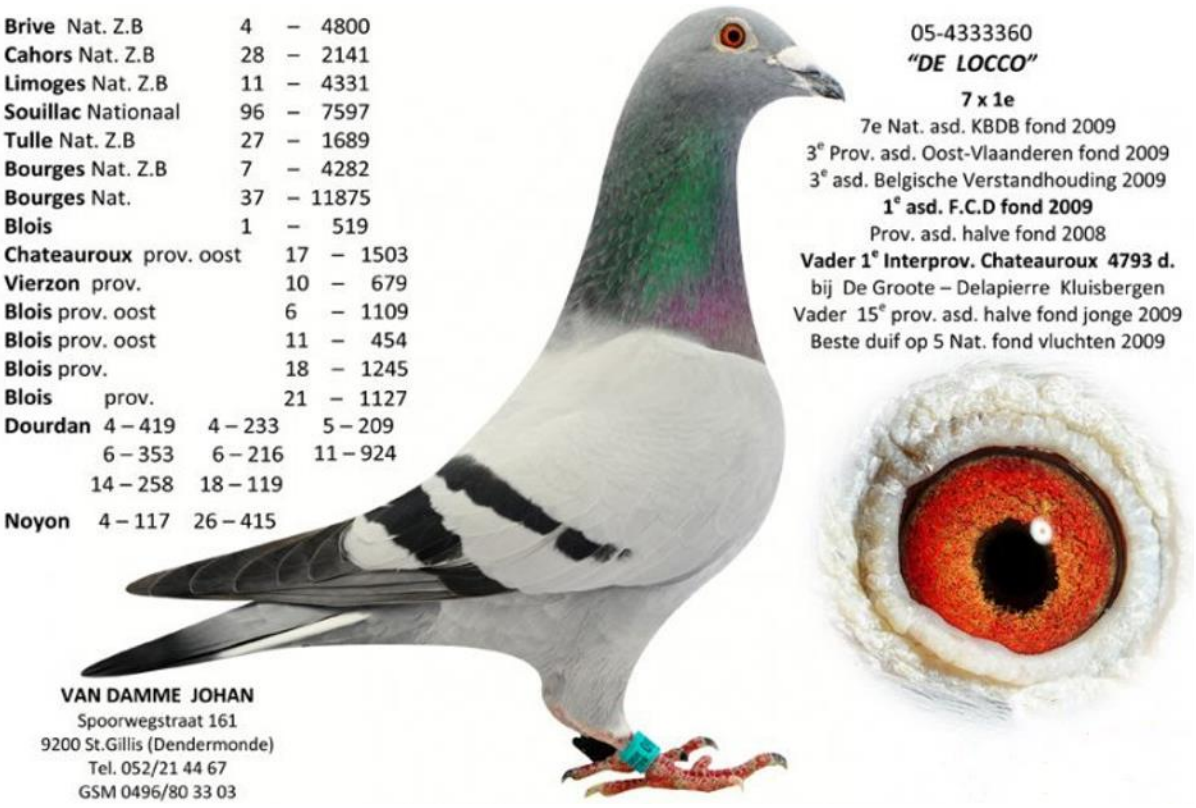
"Super 8" (NL-89-2149028)

This chart shows how "Super 8" (NL-89-2149028) has been interwoven with the "St. Thomas" (NL-83-8391269) x "Deanna" (NL-84-400753) line using both unrelated crosses and inbreeding.



Blue checker hen. Descendent of a line of the greatest of the Janssen pigeons, the "Olieman", "019", "16" (owned by De Prut), plus the 1985 First Ace Cock of Holland, Super 8 (NL-89-2149028) was bred by Gijs Peters from the line of the world famous "Super 73" and the "Van Herpen Hen". She is the daughter of NL-87-1068291 (bred by Gijs Peters) and NL-85-1689445 (bred by Van Herpen). As a racer, Super 8 won a 1st from 370 km against over 17,000 birds. She has also proven to be a dominant breeder. She is the dam and grand dam of over 100 winners to date, in 4 different countries. Children of this incredible hen are proving themselves around the world as top flight breeders. It would be impossible to determine how many top breeders this hen has produced, but it is significant. For example, she is dam by three different cocks to 8 x 1st winners and 178 prize winners by 1995.

Johan van Damme wins 1st National Brive with super bird Locco!



As I was completing this article the exciting news came through of the monumental victory of "Locco" of Johan van Damme by an astounding 10 minutes ahead of the 2nd place pigeon at National Brive against 16,813. Interestingly enough as if to prove my point we see that both of "Locco" grandmothers are descendants of the fabulous "De Rauw Sablon" foundation pair "Albert X Paola". Therefore, the Mitochondrial DNA (which you will remember are the energy engines of all of the cells of the entire body of "De Locco") of "De Locco" is that of his maternal grandmother who traces back to the original "De Rauw Sablon" foundation pair or to be more specific from a Mitochondrial point of view back to "Paola".

I did some investigating as to the whereabouts of these two grandmothers of "De Locco" and interestingly enough they were purchased not long ago by Marc De Cock. Smart move Mark, a very smart move!

It was alleged to me on Sunday May 30 2010 that an offer of 125.000.00 Euros made by Eric Limbourg for "De Locco" was refused outright.

16813 PIGEONS-DUIVEN

VIEUX-OUDE BRIVE NATION 29-05-10 LACHER : 8.10

NO	NOM	LOCALITE	DISTANC	JR	CONSTAT	VITESS
1	VANDAMME JOHAN	ST-GILLIS	682633	1	15.0200	1656.88
2	DEVOS ETIENNE	DEERLYK	648454	1	14.5100	1617.09
3	VANDENBERGH LEON	LONDERZEEL	687153	1	15.1600	1613.04
4	DEBAENE HUBERT	BEERNEM	679359	1	15.1300	1606.05
5	DANHIEZ EDDY	HARMIGNIES	615048	1	14.3300	1605.87
6	HOUFFLYN PATR+DIMITRI	WORTEGEM-PE	653309	1	14.5700	1605.18
7	HENDRICKX ALF+ZN	BERLAAR	701128	1	15.2700	1604.41
8	HENDRICKX ALF+ZN	BERLAAR	2	1	15.2710	1603.80
9	VANOVERBEKE-CLAUS.	ESEN	662294	1	15.0300	1603.62
10	TRUYTS CONSTANT	DEURNE	708129	1	15.3200	1602.10
11	SANFRINNON ERWIN	APPELTERRE	658427	1	15.0100	1602.01
12	GYSELBRECHT-MADEIRA	RUISELEDE	670649	1	15.0900	1600.59
13	DENYS MICHEL	HANDZAME	665246	1	15.0600	1599.15
14	CELIS ARMAND	VORSELAAR	716099	1	15.3800	1598.44
15	HOUFFLYN PATR+DIMITRI	WORTEGEM-PE	2	1	14.5900	1597.33
16	VDHEEDE FREDDY+JACQUE	ZINGEM	660599	1	15.0400	1595.65
17	VANMALDEREN STAF	MECHELEN	694038	1	15.2500	1595.49
18	ANTHEUNIS-VANGOETHEM	DE KLINGE	706572	1	15.3300	1594.97
19	VANDENBRANDT LEON+C	ZANDHOVEN	714381	1	15.3800	1594.60
20	DECOMBELE ANDRE+RIK	TORHOUT	668635	1	15.1000	1591.99

The National victory this weekend is a fantastic ending to the racing career of wonder bird Locco. This victory is again a great succes for the De Rauw Sablon birds because both grandmothers of Locco are original De Rauw Sablon!

The Mitochondrial DNA of "De Loco" is that of his mother who is a "De Rauw Sablon" through her maternal line.It would be interesting to futher investigate the relationship if any of the two maternal lines represented in the pedigree of "De Locco".Though the Sire of "De Locco" also originates from the "De Rauw Sablon" hens I am unsure as to whether both of these Maternal hen lines are in fact related.

Figure 6 Since preparing this chart it now seems that both of the referenced grandmothers of De Locco trace back to the famous De Rauw Sablon pair.

Figure 7 Young Johan van Damme is indeed fortunate to have as his mentor Frans Sablon.

For those Interested please see the detailed pedigree below to view the role played by the De Rauw Sablon hens in the success of "De Locco".

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Duiver
Locco