Geneticist's Pedigrees

Interview with Melissa Cox, PhD -- October 22, 2005

By Judy Huston

The Geneticist's Pedigree is the foundation of Dr. George Padgett's work. Detailed information can be found in his book, *Control of Canine Genetic Diseases*. Using a geneticist's pedigree is a very important step *after* the establishment of an Open Registry. The White Shepherd Genetics Project has the Open Registry, which includes reports of diseases and symptoms submitted by breeders and White Shepherd owners. Now, we need geneticist's pedigrees to help us use this registry in the best possible way.

Following is my interview with our White Shepherd Genetics Consultant, Dr. Melissa Cox:

Judy: Melissa, I want to do an article for our newsletters to introduce this concept and begin to clarify its use.

Melissa: Sure.

Judy: hen were you first introduced to the concept of the Geneticists Pedigrees?

Melissa: I knew of them since basically high school when we started studying genetics in biology. That's where, when you first look at genetics and recessive, dominant, etc., you are always looking at a family so you are looking at mother, father, all the offspring, their offspring because you want to see which of the offspring carry a certain trait.

This is the way all geneticists track information whether you are looking at peas, people, horses, or dogs. She said we (White Shepherd breeders) are always thinking about the one offspring, the one animal we are going to breed and looking back at all of the generations leading to that one animal. But, a geneticist always thinks "offspring." A geneticist is always thinking, what came before and is looking at *all* of the relationships.

A geneticist has to look at statistics, at probabilities. They look at how things come down through generations. If you only know one individual from this generation, that is not going to help you much. You need to know the traits of this individual in this litter, but you also need to know the traits of the brothers and sisters and then you have to see what their offspring have so that you can track. You ask the questions. Is this an isolated occurrence? Could this be genetic? If you have one single occurrence, it is really hard to predict what is going to be happening because you don't have enough data. You have to have data on all the offspring, the cousins and their offspring, etc. Just following one dog back tells you nothing. You need to know about the aunts, uncles, great aunts, great uncles, in other words as much information as you can get on all generations.

Judy: It appears to me that very few breeders do this whether our breed or any other breed.

Melissa: They usually don't know any genetics. They know about coat color. This is what is astonishing to canine geneticists. Breeders are scientists, they are experimenting. Every breeding is an experiment. And yet, they don't know what they are experimenting with and this is what is astonishing to geneticists. Because everyone is breeding by how the dog looks and by their temperament, but they don't have the other important knowledge. It is so much more complicated than what you see on the surface. Most geneticists are not into coat color. Breeders are concerned about complex diseases like Hip Dysplasia and Elbow Dysplasia, but they never look at the animal's entire package, the genes that make up the entire animal. Geneticists have a saying, "Genetics is life – everything else is just the details." You go back to it and everything starts with genes and chromosomes.

Judy: Please give me an example of how you guys utilize the pedigrees and how you use Progeny. Progeny is a software program created for human pedigrees. It is the tool that will allow me to draw the pedigrees.

Melissa: Progeny is difficult to work with (it is not designed for use with animals). Even those of us who are used to trying to assemble a geneticist's pedigree find it difficult so that's just to let you know that this kind of work is not intuitive and it does take a bit of effort. We used it in my graduate lab when I was doing my PhD to assemble all of our pedigrees. So, when you are looking at hundreds and hundreds of dogs and multiple traits, you need to have some way to track it systematically. So, we would have an entire pedigree put together. The problem we did have is that there are so many numerous inbreedings and line breedings that you don't have in a human pedigree. In a human pedigree you would have usually one individual with offspring with one or two mates, but you usually won't have mating cousins and complex relationships. With Progeny and using animals, you will find that you have so many different ones crossing lines to show matings that it gets somewhat complicated and there may be a point where you cannot put any more data on there and you have to set up separate file for another part of the family and put them together after the fact.

We would track things as simple as an X-linked disease which is what I studied, a hereditary kidney disease, and we could see by putting it in and looking at the parents and all the offspring, that this disease was tracked through male affected and female carriers. You have to have that information on the parents and multiple offspring. You have to have this to see that it goes through every genera-

tion and that it always affects the male. And, if you have one female, and if you don't look at her brothers, you are not necessarily going to know she is a carrier (well she has a 50% chance of being a carrier) but you are not going to know that unless you knew that one of her brothers was affected. Her mother would not have shown the trait if she was a carrier. If you never knew she had an affected brother, you are going to be very surprised when she in turn may have affected sons so you need to be able to track all of those offspring.

We use these pedigrees when we are trying to track different traits and trying to see if they are linked – too see what is in common. One example is deafness in double merle shelties and collies. What they have found in most double-merle shelties and collies is hearing and vision problems. And, if you were coming across the very first of these animals, you wouldn't necessarily know that they were linked to color unless you tracked them in Progeny where you can actually show two different things at the same time. You can show they were affected with something and then you can also show other traits, which might be their eye color, coat color, etc. A particular symbol you selected could mean eye color, another symbol means something else but you are showing them all on the same pedigree. You can show them in color to indicate black eyes, or brown eyes, white coat, or black coat, etc. You can do this to show a dog's deafness, ear problems, etc. You can show whether the parents are a blue-factored sable and you would be looking at all of these traits at one time on one pedigree without having to go back and write it in afterwards or use PowerPoint or other program and try to assemble it. You would have it in one place.

Judy: How are the reasons you are gathering the information different than the breeder's reasons?

Melissa: We are looking at the obvious things from the beginning, the color of the eyes, coat color, etc. Say we have a beautiful tri-color sheltie and then we look at Progeny data and we would be able to see this sheltie had an aunt that was a double-merle with hearing problems. You would then know from looking at the data that the tri-color has a chance of inheriting some of those genes. Then you would look at the tri-colors siblings and half-siblings from different litters and then you could see that we are seeing that there are some blue merles and there are some shelties with problems and you would know that some tri shelties could have problems and be carrying the gene for hearing problems. If you didn't have this data, you couldn't know it. I'm using coat color only because that is what most breeders are familiar with. The same thing would be if you were tracking Dalmatians with blue eyes and you would realize they are more likely to have deafness so you would do the same thing, you would track traits for linking, etc. But, you wouldn't know how it works if you didn't track everything. So if we're trying to figure out with the White Shepherd whether IVDD and IBD are related or if they are the same thing and one is secondary to the other, unless you track that and really look, you won't know. You have it in your database and that is good, but you can't remember it all. We need to see pictures and that is why if you can get all that data together in "picture form" (Progeny) then I can see it all together and I can begin to see patterns. If you track things like this, you can actually see that this dog had IVDD and no other problems, but this other dog had IVDD and these other traits as well then which of these things go together. You start looking at what are the linking traits.

Judy: It will be helpful to be able to track this.

Melissa: You will be able to see that you have a bunch of dogs with bowel problems but if only Ky (my girl) had the spinal problem then you might come to the conclusion that the IBD and the spinal problem is unrelated, but on the other hand, if you see more dogs diagnosed with IBD and also spine problems then you begin to see the possibility of linking traits. You ask the questions whether, for example, Kyra's bowel problem was exacerbated by the spinal problem. So if you were able to look at all of her relatives it would give you the insight to see that there were two problems (or more) going on here and not just one. But, you wouldn't know that if you just looked at her. When you just look at one individual dog and at their parents and assume the parents are normal and you see one offspring with a lot of problems you can't know if they are all related or if they are separate entities. You can't see it without looking at all the offspring so breeders must keep track of all the offspring. They need to keep in touch with the owners and make at least one call per year and ask the right questions.

Judy: Yes, I remember George saying that if each breeder just made one call each year to each of their puppy buyers, they would have the data they needed. (Melissa also pointed out here that it wasn't even all about what you could get from the puppy buyer but about how you could help and support them if they were having problems or symptoms with their dogs.)

Melissa: If you track things you have an idea of what is going on; if you don't, you don't have a chance of knowing.

Judy: Clearly, we have to continue to track everything and we have to track things we think are genetic and things we *think* we know are not genetic. When we begin to introduce this concept of the geneticists pedigree to the individual breeders, it seems as if either we have to agree breed wise on what we are going to focus on, or each kennel is advised to look at and see the problems in their lines and track those. What is your suggestion?

Melissa: The only way it can work is that you have to be pragmatic. You have to do something that will work for you (the individual breeder). If you take on the whole world or try to take on all diseases and track every single

thing, you will get so overwhelmed and won't want to do anything. Of course, keep doing this tracking of everything for the Open Registry, but for the Progeny work on the geneticists pedigree for the individual breeder, you track the severe stuff and/or whatever it is that interests you. With Progeny you don't have to share it and show it around if you don't want to, you can use it for your own breeding decisions. What I really want to get across to breeders is like it or not that every breeder is a scientist and every breeding is an experiment. If they can look at what they are doing a little more objectively and say, hey, I wonder what is going to happen with this litter. I don't necessarily know probabilities and statistics, but I have a pretty good idea by looking at the pedigrees and looking at Progeny and I can say that these offspring have these traits so what is likely to happen. So, you are sitting there planning your next breeding. You are sitting there and you study your bitch and say, "Here are her traits." Then, you are considering three males. Well, that one has a nice head, this one has better ears, the other one has a better topline. You are just looking at the phenotype of the dog – you are looking at what you can see. Obviously, you need to do this, but just as important, you need to be looking at what you can't see when you look at the dogs – the traits that you tracked on Progeny and that were entered in the Open Registry. You could forgive heavy ears if that animal has other good traits. Maybe Dog A looks better but the littermates have produced problems like IBD and a couple of bad hips, etc., and Dog B has heavy ears, but the offspring of siblings are great. So maybe you want to take a chance on heavier ears and healthier dogs. You need some more give and take that way with less emphasis on how the dog looks. I'm not saying that is not important. I want a Lab that looks like a Lab.

Judy: I've always said I want both. I don't want a White Shepherd that can do everything but is not a good-looking dog. I want both, just like I had with Kyra, but now the information is available so I can focus on traits the sire and dam carry so I can avoid some of the complex problems she manifested. My new bottom line is the best-looking, best-working, *and* healthiest pup I can find. When I got Kyra 10 years ago, the bottom line was whether the parents were healthy and whether they had passed their OFA – and they were healthy, and they did pass OFA.

Melissa: I'm looking for the total package. It is a lot of guesswork when you are looking at complex diseases.

Judy: Autosomal recessives should be fairly easy to reduce in our breeds, should they not? I'm thinking that these easier ones are the ones to focus on

Melissa: You will still be producing some as you work them out of the breed, but not as many. Actually when you are looking at a geneticist's pedigree, you can track the actual percentage by following it down to where you are in the pedigree so you can see what chances the offspring have of being affected with a disease. The value is knowing what the other relatives are carrying because if granddad was affected, and you don't know if the father of your animal was a carrier or not, you won't know until you see an affected dog. You can know one and not know the others but if you found one that was affected, then you would know which ones were carriers and could make some predictions.

Judy: We can make these predictions by becoming more familiar with all the tables in Padgett's book.

Melissa: Yes, it is scary and it is mostly fractions. There are pedigree programs that you can put the info in and get the predictions. I don't know which program will give you the info. It is complex. The concepts are fairly difficult. It is easy to get turned around. I know there are computer programs that you can put in grandfather affected and get a prediction for the offspring. There have to be such software programs available. (Another thing to research.)

Judy: Basically what you are saying is that it is not enough to have the Open Registry. We have to do something with the data.

Melissa: You have to do something with it. If you just have the Open Registry, that's very pretty, but you have to use it. Remember how much it costs to refund for a puppy, to put championships on a dog, to campaign them, etc., just use some money to prevent disease.

Judy: I went to Leader Dog for the Blind and spent a couple of hours with Judy Campbell. It was very interesting. Even though I went for the same kind of information we have been talking about here, I wasn't able to get it, but I did get information about her experience breeding the GSD, etc. Do you agree with Judy Campbell that all the money and research is going into diagnosing diseases, treating symptoms, but not preventing disease?

Melissa: Absolutely I agree.

Judy: It seems to me that people need to be supported in their breeding decisions even when there are differences of opinion -- because as you said it is science and experiments and this is how we learn. But, the bottom line needs to be to share the information and learn from it so that we all do better breeding.

Melissa: If you have a dog you know has produced disease (or is affected with a questionable trait but you otherwise think the dog would produce what you desire), the smart thing if you want the line to continue is to use a daughter, then use the daughter of that bitch. Eventually, we'll have tests we can use.

What about when there is a 100% chance the dog will be a carrier. Carry on your line by using the data from the Open Registry, and these new geneticist's pedigrees -- don't just breed "in the dark."

Breeders can be so frustrated because so many are doing the best they can. They know of a problem so they don't use the line and they find another dog to use and

they either still get the disease or get something else.

Write things down. Make some assumptions based on the data. Ask yourself what your concerns are. Write down the information that you have and figure out the dogs you know are carriers and the chances for the offspring. When you write things down, it becomes easier to make the decisions.

Judy: Do you see any value in using temperament, herding, etc., to simply illustrate the value of the geneticists' pedigrees and get people accustomed to looking at them. I think maybe temperament testing and herding instinct?

Melissa: I'd go with herding instinct to use as an example. I like using coat color, but in whites…. I would put in simple diseases, either autosomal recessive or x-linked as illustrations. You could also make up data just to use as examples.

Judy: As I'm learning to use Progeny, I'm using data submitted for me to use from Susan Ewart's, Braehead's White Shepherds. This will be the first complete geneticist's pedigree and it becomes very complicated. Just when I have a clear grouping of dogs, I discover that dog I'm entering to the pedigree was also bred to another dog that shows up on the other side of the pedigree and then I have lines crossing lines and it gets very sticky. I know this will get easier.

Melissa: You have to eventually print it off. It is all visual. Eventually you will have a few hundred dogs, but only a few will be bred. Welcome to genetics. You take all the info, put it all on the pedigrees, run it off, stick it up and put it together that way while you are working on it.

What you do is ignore the dogs that don't have the disease. If you have a dog that whelped eight puppies, seven survived, all were clean, then that is enough information, you don't have to show all the squares and circles. (Square represents males, circle represents females.)

Judy: Do you have any other ideas about how to introduce this concept to breeders?

Melissa: No, I don't, but you have to make it as user friendly as possible. It has to be accessible.

Judy: I think it is going to be difficult enough for most people to just get me the information that I need in a consistent and usable format to then apply in Progeny.

Melissa: You need something to spearhead this. Think of Progeny as visual tracking.

You have a master copy and run copies to work with. On one you are tracking eyes, hearts, hernias. On another, you would track IVDD, LS, DM, IBD – because this is the way we can see if they are associated. So you would track those together and you could see that this usually goes with that. That's the type of helpful linking information you can get.

Judy: Melissa, thank you for taking the time to answer these questions and to get me started using Progeny. The White Shepherd world is indebted to you.

Note: I used the herding instinct trait as a way to demonstrate the visual value of geneticist's pedigrees. Since herding was Kyra's great love, I simply started with her and filled in her closest relatives to show the relationships. The circle represents females, the square represents males. If there were triangles, it would mean sex unknown. When the symbol is completely filled in, it means the dog expressed the trait we are talking about or is "affected" in this case with the desirable herding instinct. If it is half-filled in, it means the parents were, at least, carriers of the trait. If the circle or square is blank, it means the dog was never tested. Ideally, there would be another color symbol to indicate a dog was tested and failed, but right now, we don't have records of dogs that failed.

I did not even attempt to show all the littermates, or other breedings from a dog that produced puppies that passed since this is not intended to be anything but an "example of a geneticist's pedigree.". Using Luger (same dam as Kyra, earlier litter) as an example, he passed herding instinct and of his one litter, three puppies were tested and passed the first leg of the Herding Capability Test or earned their first title. One of these puppies, Luna (with Polo), produced two litters and three puppies were tested and passed herding instinct. Polo was never tested, but he is an Angus' offspring (Angus demonstrated instinct) so he is at least passing along the instinct and may have it.

Once a pedigree is completed, you save it as a "master copy" and only add new breedings to it. You make copies from the master and use your copy to track whatever traits you are interested in whether they stand alone or whether you are looking to see if they link to some other trait.

It was through the use of a geneticist's pedigree that I drew by hand that Dr. Padgett determined that based on the visual evidence, we do not have Degenerative Myelopathy in the White Shepherd. The pedigree contained a few hundred animals and Dr. Padgett had the visual picture (like the attached herding instinct example) to see where Lumbosacral Stenosis occurred on the pedigree and where dogs diagnosed with DM showed up on the pedigree. He came to the conclusion that the spinal condition we need to track is Lumbosacral Stenosis since all of the dogs with a diagnosis of DM were littermates or aunts/uncles/nieces/nephews/grandparents, etc. of dogs diagnosed with LS. However, we can only be 100% sure if we continue to track all dogs with symptoms and then do necropsies. Without this type of pedigree, we would still be guessing.

Once the pedigree is finished for Braehead Kennels and I have an opportunity to show Susan how to use it, I'll be ready to start the next Progeny pedigree for another kennel.

EXPLAINING THE HERDING INSTINCT EXAMPLE OF A GENETICIST'S PEDIGREE

What exactly are you seeing on this pedigree? You see a family of dogs that either have the herding instinct themselves and/or that have produced it. The filled in circle or square means the dog, at the very least, passed herding instinct and has an HIC certificate. Some may have first legs toward a title or titles as in the case of Kyra, Luna, Lazer, Kimber, Haley, Isaac, Dylan, Pebbles, and Kyla. The half-filled symbol indicates the dog is a carrier for that trait, at the very least. The dogs farther back in the pedigree with nothing filled in were never tested. Considering all the dogs that have passed, it is highly likely that most of the dogs would have passed, if tested. This is great news for our breed.

What is missing from this pedigree? In a complete geneticist's pedigree, you would see under Angus and Ashlee not only the four girls that passed herding instinct, but you would see one female that didn't pass and one female and three males that were never tested. I showed exactly the way all offspring would be listed with the Hugo/Haley example and the nine puppies they recently produced. I believe that Mona plans to have this entire litter tested, so an update on this pedigree would show how many puppies passed and how many failed. Obviously, any pups that fail would be retested more than one time since the instinct to herd doesn't always kick in the first time out, especially with pups so young.

What is the diagonal line through the symbol? This symbol indicates the dog is deceased. **What is the hook through some of the lines?** This indicates that the two lines of dogs intersecting are independent of each other. **What about the dogs with a long box above their name?** This is called the "shadow" feature and means this dog appears one or more times and that there was no way without totally rearranging everything or totally complicating with a lot of "hook" lines to keep the matings together. In this pedigree, you will see L. Angus and Sabre twice and Lancelot twice and Q three times, while Angus appears twice.

What would show up on this pedigree if we were looking at something as simple as black spots on the tongue? Kyra and her daddy Angus would have their symbol filled in as would littermate Jaz. Ashlee would have her symbol half filled in. Any other dog listed on the charts with the spots that appeared on this pedigree would also be filled in. You would see at a glance that producing black spots on the tongues of our dogs is not something that happens very often, while producing herding instinct seems to be prevalent.

So what is the benefit of seeing these pedigrees? Back to herding instinct again. If every breeder had geneticist's pedigrees done and all HIC dogs were entered into them, one could see at a glance in which lines the herding instinct is prevalent (hopefully everywhere) and where dogs are not passing – or haven't been tested. For someone like me who has a top priority of herding instinct, it would point me in the right direction.

What else do these pedigrees show us? As Melissa pointed out earlier, let's say we were tracking Lumbosacral Stenosis and we wanted to see if there were any linking traits or connecting diseases, then, Kyra, for example, would have a quarter of her circle symbol filled in for LS, she would have a quarter filled in for IVDD, another quarter for IBD and then, we would track these same traits throughout the pedigree to see how many other dogs had these diseases in common. Each disease would be represented by a different color.

There are numerous ways to use these pedigrees and I think it would be valuable for White Shepherd breeders to research their potential and consider having one made up for their kennel.

Anyone with any questions on these pedigree or on how to have a pedigree created for their kennel, please contact me at hustonjudy@gmail.com or 517 546-3046. ■

(Please see the next page to view the sample pedigree.)

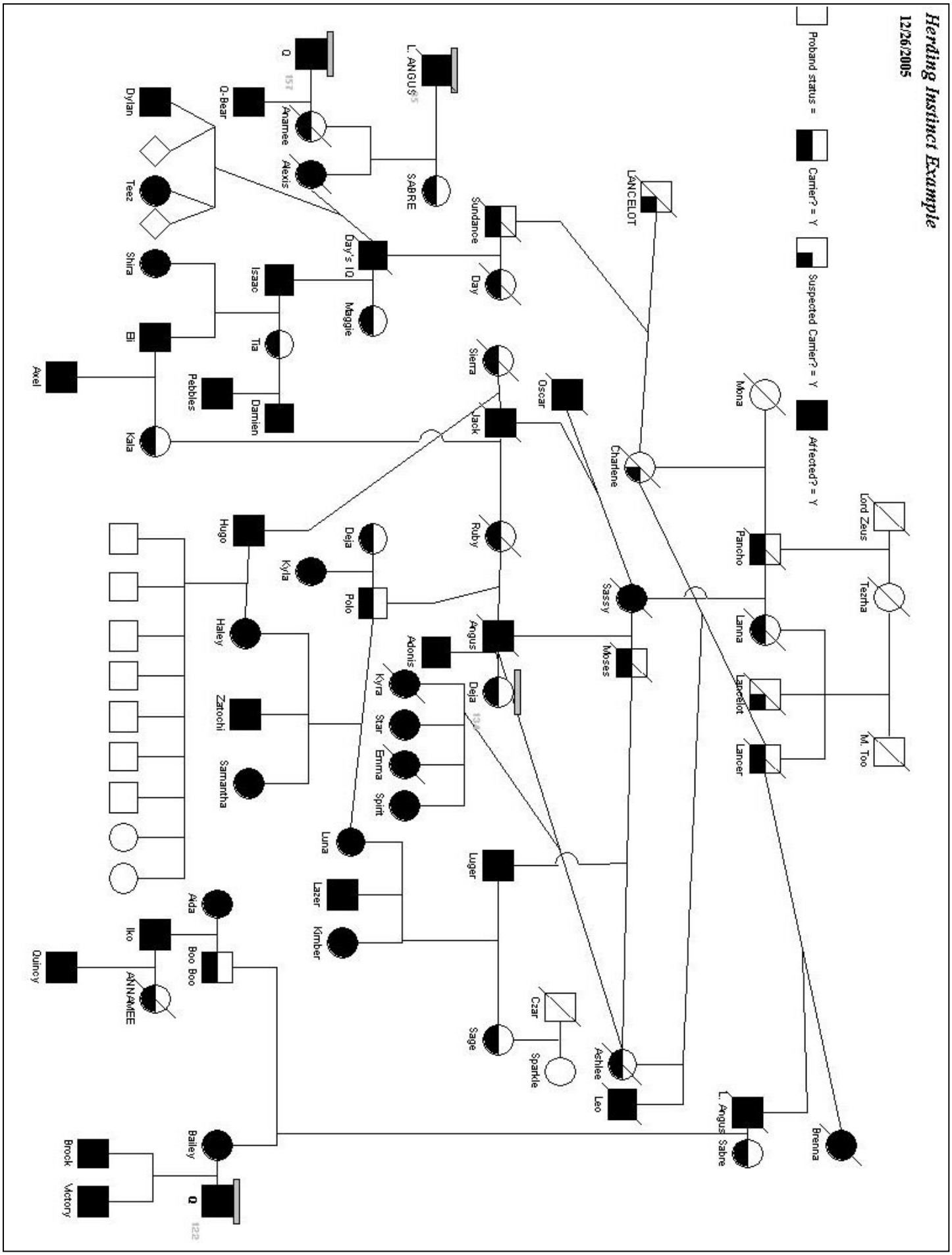
AWSA Classified Ads HELP WANTED!

GRAPHICS/PUBLISHING:
AWSA's Café Press moderator needs someone with computer graphic experience. Contact Susan Morabit by email at slmrn98@bellsouth.net. AWSA receives a portion of all sales at www.cafepress.com/awsa.

Public Education Coordinator would like help preparing a few standard advertisements that can be used in various printed media. Any help would be appreciated and individuals can determine their own level of involvement. We have a lot of material already available to us, it just needs to be properly presented and formatted.
Please contact Melanie Fuellgraf at
valleydogs2000@yahoo.com or (724) 712-7627.

The *AWSA Times* and the AWSA Website need volunteers to do research, write articles, and generally assist in the continuous effort to communicate with our members and the public. Contact any board member to volunteer.

RESEARCH:
Health and Genetics Chair needs help validating OFA scores that are sent in without paperwork. This simply requires the ability to go to the OFA website list and look up names, then send copies to Jacki Wheeler at jackiwheeler@comcast.net. This might involve a couple hours a month.


Herding Instinct Example
12/26/2005
Proband status =
Carrier? = Y
Suspected Carrier? = Y
Affected? = Y
Q
157
Dylan
Q-Bear
Anamee
Alexis
L. ANGUS
SABRE
Teez
Shira
Day's IQ
Maggie
Isaac
Tia
Eli
Axel
Pebbles
Damien
Kala
Sundance
Day
LANCELOT
Sierra
Jack
Oscar
Charlene
Mona
Lord Zeus
Tezha
Pancho
Lanna
Lancelot
Lancer
M. Too
Sassy
Moses
Hugo
Kyla
Deja
Polo
Ruby
Angus
Adonis
Kyra
Star
Emma
Spirit
Deja
Haley
Zatochi
Samantha
Luna
Lazer
Kimber
Luger
Sage
Czar
Sparkle
Achlee
Leo
L. Angus
Sabre
Brenna
Ada
Iko
Boo Boo
ANNAMEE
Quincy
Bailey
Q
122
Brock
Victory