



The COAT COLOUR Connection

By Roberta Pattison

Findings from a new, WCVM-based study confirm that coat colour is linked to the ocular anomalies that affect one of out every two Rocky and Kentucky Mountain Horses in Canada and the United States. The College's researchers also question two long-standing conclusions about the mode of inheritance and the precise nature of the eye abnormalities found in these two breeds.

Horses come in a fantastic array of colours from black to white, from bays to greys, and with or without varying amounts of white. The glorious, spotted coats of Appaloosas are a common sight for western Canadians and so are golden palominos — thanks to Roy Rogers and Trigger.

On the other hand, silver dapple is a colour that's still on the unusual side. The colour occurs in several breeds — including the gaited Rocky Mountain Horse — in which the typical, smoky chocolate coat with flaxen mane and tail is often seen and highly admired.

Veterinarians aren't usually concerned with the coat colour of their equine patients, but when a particular colour or pattern is associated with disease conditions or abnormalities that can affect horse health, it becomes an issue.

Such is the case with *congenital stationary night blindness* (CSNB) in Appaloosas. A few years ago, a research team led by veterinary ophthalmologists at the Western College of Veterinary Medicine (WCVM) confirmed that CSNB is linked with horses that are homozygous for the leopard spotting gene (see the Summer 2008 issue of *Horse Health Lines* for the latest update, www.ebrf.usask.ca).

Members of that same team, headed by veterinary ophthalmologist Dr. Bruce Grahn, have also been investigating eye anomalies in purebred and crossbred Rocky Mountain and Kentucky Mountain Horses.

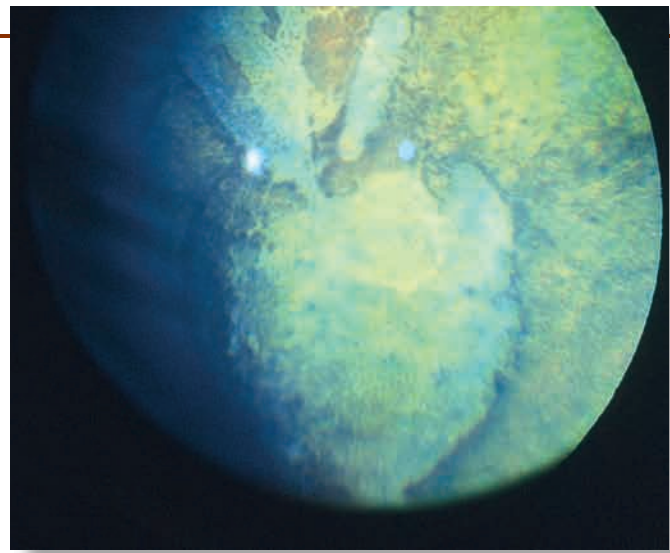
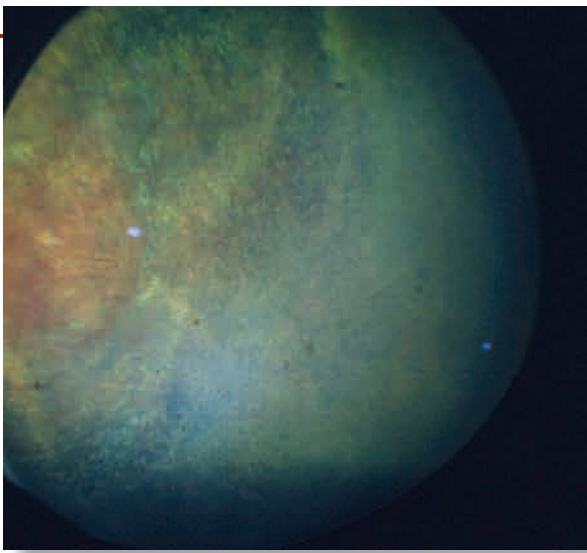
The study's findings, which were published in the July 2008 issue of the *Canadian Veterinary Journal*, support the long-standing theory that these anomalies appear to be associated with colour — specifically, silver dapple. However, the WCVM study's results also question two previous conclusions about the mode of inheritance and the precise nature of these anomalies.

Besides Grahn, the research team included Dr. Chantale Pinard of the Faculté de médecine vétérinaire at the Université de Montréal and WCVM veterinary ophthalmologist Dr. Lynne Sandmeyer. The genetic aspects of the study were conducted by Dr. George Forsyth of WCVM's Department of Veterinary Biomedical Sciences, Dr. Rebecca Bellone of the University of Tampa, and Sheila Archer, a Saskatchewan-based phenotype researcher.

The Heather Ryan and L. David Dubé Veterinary Health Research Fund, which was created in 2006 to support multi-year equine health research projects at the WCVM, provided funding for the two-year research study.

Does Colour Indicate a Problem?

Unlike the eyes of Appaloosas suffering from CSNB, which appear completely normal on ophthalmic examination, the eyes of Rocky Mountain Horses show a variety of obvious lesions. While veterinary ophthalmologists have identified defects of the iris, cornea, retina and eyelids, fluid-filled



cysts of the *ciliary body* (a muscular ring located in the front part of the eye) is the most common condition.

In most cases, affected horses don't suffer from significant visual impairment but rupture of these cysts occasionally leads to retinal detachment and affected vision. While this condition is *congenital* (present at birth) and inherited, it isn't progressive.

The association between the eye anomalies in Rocky Mountain Horses and the silver dapple colour is undeniable. But the exact nature of the association — whether or not the same gene is responsible for both the eye abnormalities and the horse breed's colour — has yet to be determined.

Tracking the expression of the dilution gene that produces silver dapple is somewhat difficult since the gene only affects *eumelanin* (black pigment) and not *pheomelanin* (red pigment). In other words, chestnut horses (whose coats contain no black pigment) may carry the silver dapple mutation, yet they will look no different from chestnut horses that *do not* carry the gene. Meanwhile, a silver bay whose black points have been diluted but has a red body coat may look very much like a flaxen-maned chestnut horse at first glance.

These kinds of situations require close study and analysis, points out Grahn. "We have two coat colour experts on the team, but coat colour genetics is still an imprecise science."

Question of Inheritance

The WCVM-based research study includes horses that come from two herds — living on opposite sides of Canada — that are linebred within their own ranks but unrelated to each other. One herd includes 97 purebred and crossbred Rocky Mountain Horses, while the second herd consists of 37 Kentucky Mountain Horses. The incidence of ocular anomalies within this population of horses is close to 50 per cent, consistent with the findings of earlier research done elsewhere involving these two breeds.

During the project, veterinary ophthalmologists examined the eyes of purebred or crossbred Rocky and Kentucky Mountain Horses as well as the eyes of horses that were unrelated in breeding. The specialists used a transilluminator, a biomicroscope and an indirect ophthalmoscope to examine the horses' eyes after their pupils were dilated.

Next, the team constructed a pedigree with related horses to investigate the mode of inheritance of the multiple eye anomalies and their relationship to coat colour. Coat colour experts assessed all of the horses, and photographs of all animals involved in the study were archived.

After a detailed pedigree analysis, the research team was able to confirm that the mode of inheritance of the ocular anomalies in Rocky Mountain and Kentucky Mountain Horses is an incomplete penetrance of a dominant inherited trait.

"Our conclusion is based on the fact that when mares with no relation to Rocky or Kentucky Mountain Horses were bred to affected Rocky Mountain stallions, there was a range of outcomes. Some offspring had complete, multiple ocular anomalies, some had temporal ciliary cysts, while other foals were completely normal," explains Grahn. "These findings are inconsistent with the codominant mode of inheritance."

For many years, veterinarians and horse owners have described the collection of eye anomalies associated with silver dapple colour as *anterior segment dysgenesis* (ASD), because of the apparent similarities to anterior segment lesions that are well-documented in other species — including humans. Grahn says it's certainly possible that Rocky Mountain horse eye anomalies develop partially as ASD. However, after close examination of the affected horses involved in this study, he and his colleagues found none of the lens-related diseases or abnormalities that are usually associated with ASD.

The WCVM research team also observed that the corneas in affected horses weren't significantly different in shape from the corneas in non-affected horses. This observation concurs with what other researchers have previously found in earlier studies.

Work still needs to be done to determine whether the gene controlling silver dapple colour, which has now been identified, is also responsible for the ocular anomalies. While many researchers believe this will turn out to be the case, Grahn is skeptical.

"We don't think it's the same gene, but another gene close by on the same chromosome. We have a black horse with the condition that isn't considered silver dapple, although some people think this classification must be a mistake. I don't agree. We also have a silver dapple horse that's clear [of ocular abnormalities] and there may be others. We need to extend the pedigree."

With most of the ophthalmic research completed, Grahn says the investigation of ocular anomalies in Rocky and Kentucky Mountain Horses is now in the hands of the geneticists on the research team: "The area where the gene resides is known, and we're getting close." **H**

Roberta Pattison is a freelance writer who is a regular contributor to the national publication, Dogs in Canada. Recently retired from grain farming, she still lives on her farm near Delisle, Saskatchewan.

Previous page: Large temporal ciliary cysts — fluid-filled cysts of the ciliary body — are the most common lesions in Rocky and Kentucky Mountain horses. **Above (left):** This image of a Rocky Mountain Horse's eye shows retinal degeneration secondary to previous cysts. **Above (right):** This third image shows focal areas of retinal degeneration related to previous cysts. *Photos: Dr. Bruce Grahn, WCVM.*