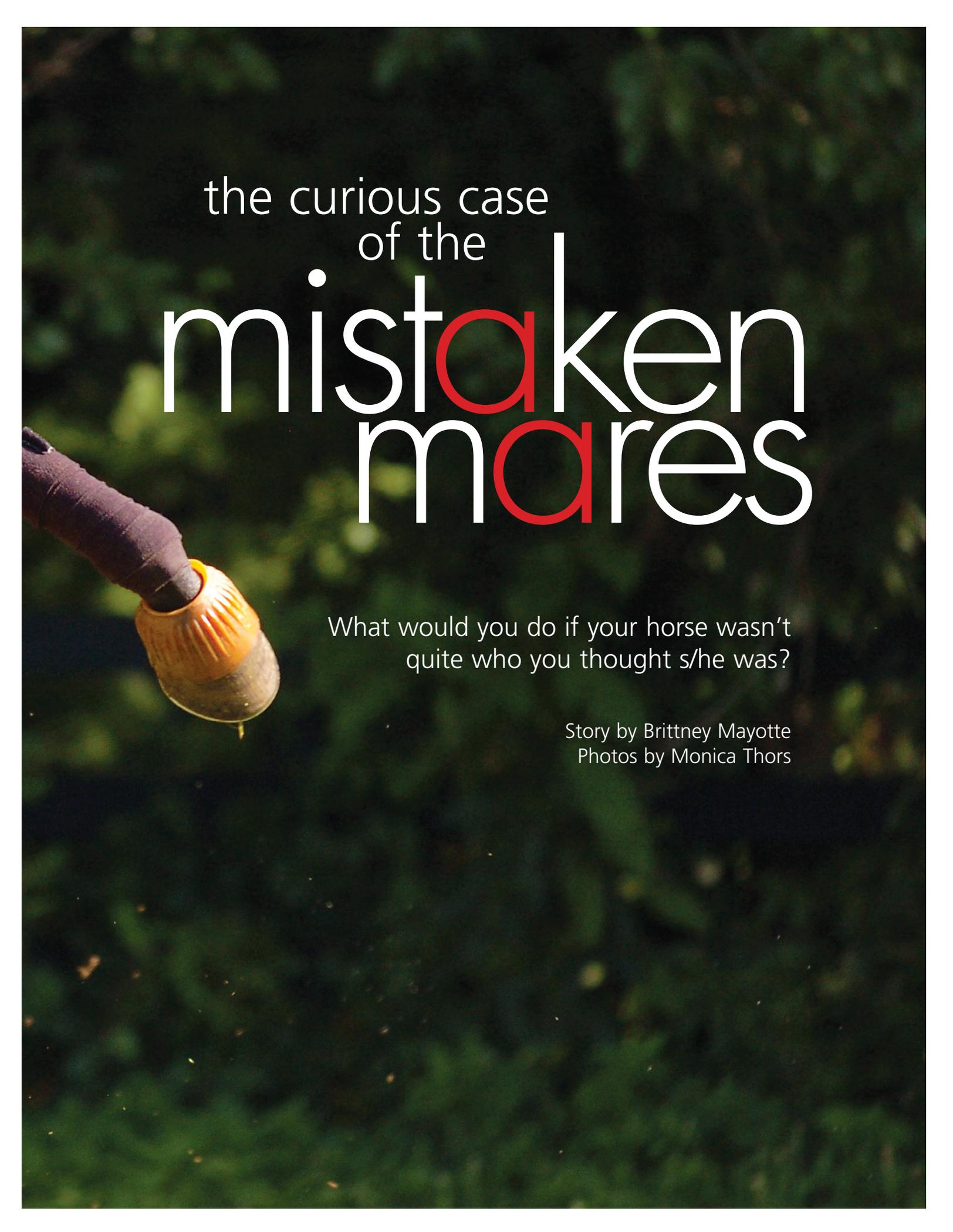




(MARTHA MÁXINE AT GAITWAY FARM, MANALAPAN, NJ)



the curious case  
of the  
mistaken  
mares

What would you do if your horse wasn't  
quite who you thought s/he was?

Story by Brittney Mayotte  
Photos by Monica Thors

## mistaken mares

Arizona Helen and Martha Maxine are proof that the old saying rings true: in horse racing, anything can happen. Favourites can break stride, underdogs can step up to the plate and apparently, mares can be males.

At the beginning of the year, a unique genetic condition surfaced on the harness racing scene in the six-year-old pacer Arizona Helen, who was, for her whole life, thought to be a mare. The winner of 19 races in 109 starts with \$178,399 earned and a mark of 1:52.2 had been racing under the care of trainer Rich Bilach for owner Niele Jiwan of Burnaby, British Columbia, when she was discovered to be... well... a he.

More recently, it became obvious that the five-year-old multiple stakes winning pacer, Martha Maxine (who is trained and co-owned by Erv Miller along with Tony Alagna of Sorrento, Florida and Brittany Farms of Versailles, Kentucky) shares the same condition. Martha Maxine, a winner of 20 races in 41 starts with \$451,815 banked and a mark of

1:50, was set to sweep the third and final leg of the Classic Distaff in early June before her sex came into question.

Both pacers were originally thought to be mares and as a result were racing in the appropriate classes throughout their careers. But last year, Pennsylvania initiated standard testing for anabolic steroids and in December 2008, Arizona Helen's test results came back positive for high levels of testosterone after winning a pair of conditioners at Harrah's Chester. Martha Maxine tested positive for high levels of testosterone following her two starts in the Betsy Ross at Chester in April 2009. Both horses, who had not received steroids, were re-tested. After similar results were presented, further examinations were conducted in both cases, which ultimately revealed that both Arizona Helen and Martha Maxine have an intersex condition called *pseudohermaphroditism*. They are actually classified as males and deemed unsuitable for breeding purposes.

### How is this possible?

While Dr. Tracey Chenier, Assistant Professor of Theriogenology, Dept. of Population Medicine and Dr. Daniel Villagomez, Associate Researcher, Dept. of Biomedical Sciences at the Ontario Veterinary College, University of Guelph have not clinically examined Arizona Helen or Martha Maxine themselves, they are in the midst of studying a family of pseudohermaphrodite quarter horses – so the pair can offer some insight on a condition few professionals have run into before.

In basic terms, they explain, there are three levels of sex differentiation: 1) chromosomal or genetic sex (XX for females, XY for males), 2) gonadal sex (ovaries, testis), and 3) phenotypic or external sex (clitoris, penis). Pseudohermaphrodites have a discrepancy at one or more of these levels, and this condition is probably better described as a disorder of sex development.

Traditional classification of pseudohermaphrodites is based on the gonadal tissue, which may not necessarily match the genetic or phenotypic sex of the horse. Female pseudohermaphrodites have ovarian tissue and male pseudohermaphrodites have testicular tissue, while true hermaphrodites have both ovarian

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and testicular tissue (ovo-testis). Additionally, the development of the phenotype may be classified as complete, mild or partial.

External and internal physical examinations, endocrine tests and chromosome analysis performed by the New Bolton Center School of Veterinary Medicine at the University of Pennsylvania revealed that Arizona Helen and Martha Maxine are both male pseudohermaphrodites. They are genetically male (XY) with internal testes, but have partial feminization of the external genitalia, which is why they were mistakenly raced as mares. Since both horses have male gonads, their levels of testosterone were elevated in comparison to

Martha Maxine; Arizona Helen's dam is Brets Excellence while Martha Maxine's dam is Another Agenda, who is out of Brets Excellence. "The fact that both affected standardbreds share a close female ancestor suggests that an X-linked condition may also be present in these cases," says Dr. Chenier.

In AIS, the testes produce the usual *androgens* effective in male development, but the body lacks a key androgen receptor, resulting in the development of a female phenotype (instead of male) to varying degrees. But Dr. Chenier says that the horse's brain still responds to the androgens, which explains any stud-like temperament in these horses that appear to be female.

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the normal level for females when tested for steroids. (Dr. Chenier notes that normal testosterone levels for females and males vary from lab to lab and depending on the time of year, being higher within the natural breeding season. Comparisons are made between the sample taken and those from known stallions, geldings and mares to determine low or elevated levels.)

### Why does it occur?

While there are different causes of intersex conditions, Dr. Chenier and Dr. Villagomez suggest that a condition known as *Androgen Insensitivity Syndrome (AIS)* may be occurring. "This is linked to the X chromosome in people and the pattern of inheritance that we're seeing in our family of quarter horses suggests that it's the same in horses."

And there's a connection between the two standardbreds that speaks strongly to this hypothesis: Arizona Helen is a half-brother to the dam of

"In the case of our quarter horse family, phenotypically they all look completely like normal females," explains Dr. Chenier. "One, when it was presented to us, was actually nine years old and had always been pastured with geldings and was never a problem. Then she moved to a different farm and was put out with other mares and instantly she showed stallion-like behaviour. That's why she was presented to us."

"There are other things that can cause stallion-like behaviour in real mares, like ovarian tumours, so that was our first thought. But it turned out that the horse was an intersex and that's how we started following the family. There are three of them affected and they trace back to a common granddam – which really supports the idea that this is X-linked through the female line."

"We don't have enough information on the standardbreds to know for sure, but the fact that they also shared an ancestor on the dam side really suggests

that it's a mutation on the X chromosome," says Dr. Chenier.

Dr. Villagomez says that without testing these horses it's difficult to pinpoint exactly where in the maternal line the condition originated as a spontaneous mutation, but it does appear, at the very least, that Brets Excellence and Another Agenda are carriers; they may have other offspring who are intersexes or are carrying the trait according to basic inheritance patterns.

### Genetics 101 - What is an X-linked trait and how is it passed on?

In a typical breeding, one sex *chromosome* is randomly contributed by each parent – the female (XX) can offer only X chromosomes, while the male (XY) can offer either X or Y, depending on the luck of the draw. It's always that random contribution of the male that determines the sex of the foal – male or female. Two options.

If one of those female X chromosomes, however, is carrying a recessive trait, you have four genetic options instead of two – so there is a one in four chance that she will pass that trait on to her offspring.

Let's assume that the red X is the chromosome linked to the recessive trait, while the black X is not. So mom (XX) meets dad (XY) and you could end up with:

- 1) A normal XY male,
- 2) An XY male with the trait,
- 3) A normal XX female, or
- 4) An XX female carrier (since the trait is recessive, it will be carried, but not phenotypically evident, in a genetically true female).

### How common is this?

"Of all the intersex conditions combined I see up to half a dozen a year here from all over," says Dr. Chenier. "Some years I might see one or two, but I've had years where I've seen six or seven. It's rare and sporadic."

"Mutations occur spontaneously at various degrees," adds Dr. Villagomez. "On a regular basis we believe that any gene has its own rate of mutation."



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Because of the overall rarity of intersex conditions, Dr. Chenier suggests that steroid hormone testing is the best screening test (the fastest and cheapest) for suspicious cases.

Aron Weir, Senior Genetic Analyst at Maxxam Analytics, says AMEL is a genetic test done at their lab, which is able to precisely determine the gender for animals involving normal genetic sex. When the genetic sex determined by an AMEL test contradicts the outward appearance of the animal (the *phenotype*), a detailed cytogenetic study of the chromosomes (a *karyotype*) may be required for definitive gender assignment and diagnosis of genetic complications.

Karyotyping, says Dr. Chenier, is able to identify which sex chromosomes are present and test for the male sex-determining SRY gene. This test, which is more expensive, time consuming and requires specialized lab facilities, may not, however, catch other forms of intersex conditions.

### Up for debate

The new classification of Arizona Helen and Martha Maxine's sex presents a variety of issues – ownership of purse money they won while competing in distaff races, for example, and payments their connections made into upcoming stakes that they are no longer eligible for.

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At the end of June, the Pennsylvania Horse Racing Commission stated that no one had appealed the purse monies won by Arizona Helen or Martha Maxine and the commission is allowing the purse money won in previous races to stand.

In regards to the payments made by Martha Maxine's owners to added money events like The Roses Are Red and Milton Stakes, Jamie Martin, Woodbine Entertainment Group's senior vice president of racing, suggests the Ontario Racing Commission (ORC) would be responsible for any refunds.

“WEG cannot refund payments made to stakes as those payments form part of the purse. The connections could go to the regulator – the ORC – who could decide to order the purse adjusted and the payments refunded. To date (June 23), I'm not aware of the connections of Martha Maxine making such a request.

“This is a very unusual circumstance of which I can't recall anything similar in the past,” he adds. “For our added money events with conditions such as money won lifetime and such, we do get horses nominated in error because they

don't fit, but that is caught when nominated and the payments are returned. Generally, our stakes are for a certain age and sex – it's easy to get that right all of the time.

“There have been many instances when horses become ineligible for a stakes race due to suspension of the horse, owner or trainer. Again, any relief the owners seek on payments needs to go to the regulator.”

Payments made to the Breeders Crown mare pace for Martha Maxine could potentially be transferred to the open division.

“Our normal procedure about payments for horses that are found ineligible to a stake is that where many of our races have a companion race, they can transfer into the companion race,” explains Callie Davies-Gooch, Stakes Manager of The Hambletonian Society. “If not, they would forfeit, because once you've made a payment under USTA rules, a nominator is required to guarantee the identity and eligibility of the horse.

“The Society, however, has not made a decision on Martha at this time,” she adds.

Whether Martha Maxine will be an open level stakes competitor has yet to be determined.

“We'll just have to see as he goes forward,” says trainer and co-owner Miller. “I don't know if he'll go with the best colts or not, but he is a very high speed horse.”

### Glossary:

**Androgen** – Any steroid hormone, such as testosterone, that stimulates the development and maintenance of the male reproductive system and secondary sex characteristics.

**Chromosome** – A threadlike structure located in the nucleus of the each cell which carries genetic information.

**Phenotype** – The physical and physiological makeup of an organism, which is determined by its genetic makeup.

**Karotype** – A display of the chromosome pairs of a cell arranged by size and shape. **T**