A Charles R. Knight rendering of forest horses from the Miocene period. Photo courtesy Dept. of Library Services, American Museum of Natural History, Neg. #35818, Photo: A.E. Anderson

Stanley: equine calamity

A tale of horses, grass, and climate change

Millions of years ago, many unusual beasts roamed through North America. There were giant ground sloths, enormous lions, oversized beavers, and three-toed horses, says Hopkins paleobiologist Steven Stanley .

Over time, species evolved or perished, for reasons that scientists can sometimes only surmise. One evolutionary conundrum has long puzzled scientists: Why did the number of horse species dwindle drastically six million years ago, from about 11 to only about four species. Whatever calamitous event caused the extinctions, it spared only the horse species with the very longest **teeth**.

Stanley believes he knows what happened. He has developed a reputation for thought experiments that unite seemingly unrelated phenomena. For example, in previous research, he connected the Ice Age and a reduction of trees to an increase in human brain size. His current theory, which he described in October at the annual meeting of the Geological Society of America, once again links seemingly unrelated phenomena.

Stanley began to ponder The Mystery of the Long-Toothed Horses about a year ago. He started with the following facts. About six million years ago:

- The Earth's climate became cooler and drier.
- Grasslands expanded and forests declined.
- The grass profile changed. Grass species known as **C4** grasses began to replace **C3** grasses, and to become the predominant type of grass in many parts of North America. **C3** and **C4** plants use different types of photosynthesis. **C3** plants include many of today's lawn grasses such as Kentucky blue grass, as well as wheat and rye. **C4** plants include Bermuda grass and corn.

- Long-toothed horses expired. Very long-toothed horses survived.

Can you connect the dots?

Until recently, scientists believed that the shift from forests to grasslands somehow led to the extinction of the horses with shorter **teeth**. Scientists hypothesized that a reduction in carbon dioxide favored **C4** grasses.

But that did not completely answer the question of *what* caused the animals' extinction, says Stanley.

To Stanley, the data suggested that a change in the horses' diet was causing their **teeth** to wear down faster. Whatever the change was, it apparently did not harm the horses with very long **teeth**, who had enamel to spare, but it wore down the **teeth** of the horses with only long **teeth**. These horses apparently did not get the nutrition they needed, says Stanley. Perhaps they became malnourished and weakened, more prone to predators or disease.

So Stanley asked himself, "What is it about grasses that grinds down **teeth**?" He found the answer: silicates--the gritty compounds that are also found in sand and used to make glass. Plants use silica compounds as protection against predators. Perhaps, Stanley hypothesized, **C4** plants have more silicates than **C3** plants. "I thought it was a long shot," says Stanley.

But he turned out to be right. On average, **C4** plants have about three times as much silica as **C3** plants. And **C4** grasses prefer drier conditions. So from extra silica to horse extinction, there is the connection, says Stanley.

"People think a lightbulb just goes off, but it's always logic," he says, in explaining how he does his science. "It was a hypothesis. I tested it just by looking at the literature. It's almost a deterministic thing."

Horses are not the only mammals who may have been affected by this transition, says Stanley. Other grazing mammals including rhinoceri and camels also became extinct around the same time, perhaps for the same reason.

By approximately 11,000 years ago, all horses in North America had died or been killed by human hunters, notes Stanley, but not before several horse species had spread to Europe by crossing the Bering land bridge that once connected Alaska and Siberia. Spanish conquistadors then reintroduced horses into the New World. --*MH*

Here's the beef