EQUUS RISING

HOW THE HORSE SHAPED U.S. HISTORY

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EVOLUTION OF THE HORSE

Most kids would probably beg their parents to bring it home as a pet: a small mammal about as tall as a medium-sized dog that bounds on deer-like legs. Its back is hunched like a rabbit's and its feet are padded like a dog's, with three toes on its hind feet and four toes on its front feet. Its small eyes sit close together about halfway down its snout; its mouth is full of basic molars for nibbling; and it has a small, simple brain.

But there would be a major obstacle to the pet adoption process: this animal, the first horse, is long gone. Known as the dawn horse, with a hotly debated scientific name of either *Hyracotherium* or *Eohippus*, depending which scientist you ask, it emerged fifty-five million years ago—that's eleven million years after the extinction of the dinosaurs—and marks our story's beginning of how the horse shaped U.S. history. The incredible evolution of this rodent-like creature into the powerful modern horse sets the scene for

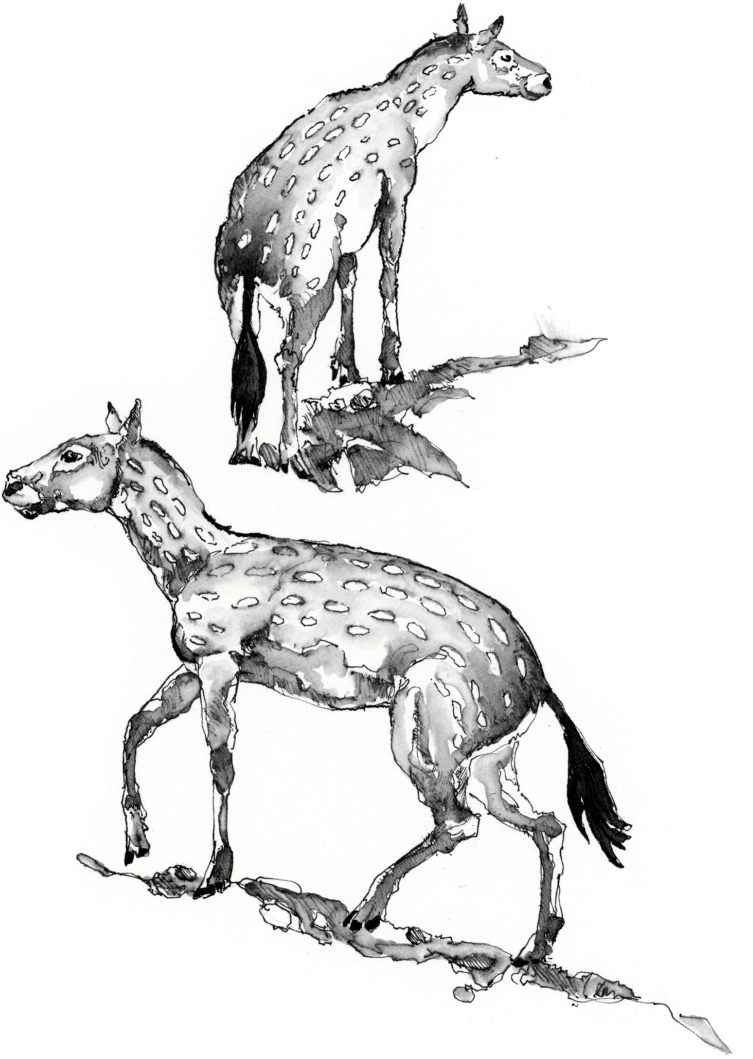
this story in two important ways.

First, the horse's evolution itself is part of U.S. history in that it occurred primarily across the North American Great Plains.

Second, since the ancient horse evolved to live on the plains, it should be no surprise that the modern horse thrived upon reintroduction to the American West by Spanish *conquistadores*, both as a powerful tool humans used for exploration and conquest and, eventually, as a wild animal. There the modern horse found a similar environment, though a bit warmer and wetter, to the one that existed at the time its ancestors last set foot on the continent thousands of years earlier.[7] Understanding the horse's adaptations to this environment helps us to make sense of how the animal could have had such a tremendous influence on the establishment and growth of the U.S., as well as on American culture.

When the dawn horse emerged, the climate of what is now the western U.S. was drastically different from the dry, open landscape we know today. Think tropics. It was hot, humid, wet, muddy, and covered in jungle-like trees and plants, resembling the jungles of today's South America more than today's Wyoming.[8]

The dawn horse was a browser, meaning it used its simple, short teeth to crush and chew succulent leaves and soft berries. Its widespread, padded feet kept it from sinking in the muddy swamps and getting stuck, just as snowshoes prevent a person from sinking into snow. It did



not need to run long distances or have excellent vision to escape predators, because it could just bound under the thick foliage to hide if danger arose. We know this animal was well suited to its environment, because fossil records show it reproduced and spread all over the place.

But eventually the global climate began to change. Over the course of millions of years, Earth grew cooler and drier. These changes affected the horse in numerous ways. Luckily, it had an incredible ability to adapt to new circumstances.

The horse's extensive genetic variation resulted in a huge range of physical traits. At one point in time, at least twenty horse species existed in North America alone, many of which differed considerably from one another and occupied different ecological niches. Even within a species, horses could vary quite a bit. One fossil bed in Nebraska revealed two horses of the same species with a striking difference—one had one toe on each foot, while the other had three toes on each foot.[9]

The wide range of physical characteristics found among horses meant that whenever the environment changed, at least some variations of the horse continued to tolerate and thrive under the new conditions. The horses with traits that allowed them to survive in new environments left behind offspring with those traits. The animals with traits that were not helpful for survival in new environments died before producing many offspring, and eventually those traits disappeared from the gene pool. This process is called

evolution by natural selection.

As the climate continued to change, becoming cooler and drier, grass eventually overtook the leaves-and-fruit-filled woodlands; horses began to lose their food sources. Some horses died out. But others adapted to eating grass, thanks to two interesting characteristics that emerged in their skeletal and digestive systems.

Grass presents a significant problem.[10] Like most plants and animals, it has a built-in defense mechanism to try to keep from getting eaten. It extracts silica (sand) from the soil to make itself abrasive, like sandpaper. It acts like sandpaper, too, eventually wearing teeth down to nothing. When animals' teeth wear down, they lose the ability to eat. They die.

Many animals that depended on the woods for food were not able to adapt to eating grass, including some types of horses. They died out. But the horses that did adapt to become grass eaters, called grazers, had larger, more complex teeth with ridges and grooves that allowed them to grind their food, like modern horses. These teeth took a long time to wear down, too, even against their new sandpaper-like food source.

Over time, horses' teeth evolved to be even longer. They also began to function in a specialized way: as grass wore the teeth down, they would continue to push up through the gums to maintain a grinding surface for eating. It would take decades for grass to wear away these large, intricate teeth to uselessness. Longer teeth meant a longer potential

lifespan.

But it takes more than good teeth to live off grass. Around the same time the teeth adaptations developed, the cecum, or hindgut, also emerged as part of the digestive system. A large cecum allows horses to absorb more nutrients from nutrient-poor foods than other grazers, meaning they can live on foods that are not nutrient-rich enough for other animals, such as modern cows, to subsist on.[11] This characteristic allows horses to live in harsh, desolate areas where other animals may not survive, but they must eat constantly to take in enough nutrients.

Horses born with this combination of teeth and digestive system changes had an advantage over other horses, because they could eat the foods available to them in their new, grass-filled environment.

Escaping predators is as essential to survival as eating. The shifting climate changed both the horse's predators and its ability to evade them. Saber-toothed cats and dire wolves were large and fast, and horses could no longer bound under thick foliage to hide.[12] Much of the foliage was gone, replaced by grass. Over time, the horses that survived these new threats emerged with numerous additional adaptations that helped them escape the jaws of predators.

The eyes moved up and outward in the skull, allowing the horse to watch for predators while its head was down to graze or drink.[13] The eyes also increased in size and complexity. The horse became sensitive to quick movements and developed a wide range of vision.

The little dawn horse of fifty-five million years ago had padded feet with numerous toes on each one, which helped it to stay aloft and succeed in a muddy environment. But as Earth cooled and became more arid, the landscape slowly transformed from mud to the dry, hard ground of today's plains. Over time, the horse adapted by reducing its toes down to one, meaning horses whose genes had mutated to produce one toe instead of three were better suited to survive the new environment than their multi-toed counterparts, which eventually died out. This toe—a hoof—was specialized for speed on the hard ground, helping the horse to escape new predators. (Having one toe classifies the horse as an odd-toed ungulate, an unusual distinction it shares with the modern rhinoceros and tapir.)

Other speed innovations included a straighter back and longer legs. Several leg bones also fused together, so the legs could not rotate as easily as a human's but became extremely efficient for running.[14]

The horse's body size also increased over time. Larger horses were better able to defend themselves against increasingly larger predators and, according to Bergmann's Rule, may have been able to better maintain their body heat in a colder climate. Although some small horses existed alongside larger ones for quite a while, only larger horses ultimately survived these new environmental and ecological challenges.

Eventually the horse developed a much bigger, more complex brain in comparison to the dawn horse's. These

adaptations may have been important for making rapid decisions in response to danger in the exposed grasslands and for the elaborate social relationships horses have in their bands, the groups of family and allies they live with.[15] Fortuitously, the horse's brain adaptations that allowed it to navigate social relationships within its own species would contribute to its ability to form relationships with humans later.

By the time *Equus*, the genus in which our modern horse belongs, emerged three to five million years ago, and *Equus caballus*, the modern horse species that includes both domestic and wild horses, emerged approximately 1.7 million years ago,[16] it was packed with all of these evolutionary adaptions for success in its drier, cooler climate, and eventually our modern world.

Some species of *Equus* wandered back and forth across the Bering Land Bridge into Asia, Europe, and Africa starting about two million years ago and began to differentiate, eventually resulting in our modern zebras, wild asses, the onager, and Przewalski's horse.[17]

Equus survived in North America until around the end of the Ice Age. But, mysteriously, it disappeared from the continent between eleven thousand and eight thousand years ago.[18] This disappearance occurred alongside the extinction of nearly one-fourth of large-bodied mammals in North America, an event known as the Quaternary Extinction.[19] A great controversy surrounds the reason for the horse's disappearance from the continent, but many

scientists agree that a combination of abrupt climate changes at the end of the Ice Age and hunting by the humans, who arrived at least fifteen thousand years ago and possibly as early as forty thousand years ago,[20] did them in.

Despite the fact that early peoples in North America lived in small, scattered groups, evidence shows they developed and spread an effective type of stone weaponry

SIGNIFICANT ADAPTATIONS OF EQUUS		
	Dawn Horse	Equus
Teeth	Basic molars for nibbling berries	Large, complex teeth to grind grass
Digestive system	No cecum	Large cecum to digest nutrient-poor foods
Eyes	Small eyes; halfway down snout	Big, well-positioned eyes to spot danger
Toes	Three toes on hind feet and four toes on front to stay aloft in mud	One toe (hoof) to run on hard ground
Legs	Small, deer-like	Long for running
Body size	Similar to a medium-sized dog	Large for safety and to maintain body heat
Back	Rounded to bound like rabbit	Straight for running
Brain	Small and simple	Large and complex to navigate threats and social relationships

used to hunt megafauna, known as Clovis points, across the entire continent in a span of just two hundred years.[21] One author posited that even without the dramatic climate shifts that occurred, Clovis hunters alone could have brought the megafauna to extinction within a few centuries.[22] Thankfully, before going extinct in North America, ancestors of the modern horse walked across the Bering Land Bridge and spread through Asia and Europe.

The last known species of ancient *Equus* to go extinct in North America was *E. lambei*, known as the Yukon horse for the location it was found, about eight thousand years ago.[23] Scientists first classified *E. lambei* as a unique species based on the visible physical characteristics of its fossils. More recently, however, molecular biologists have found, using mitochondrial DNA, that *E. lambei* is genetically equivalent to *E. caballus*, the modern horse.[24] Although *E. lambei* looked more like Przewalski's horse of Mongolia than a modern Quarter Horse, their genes indicate *E. lambei* and *E. caballus* are one in the same.

So the last horse species to live in North America, which humans were likely in part responsible for finishing off, could be considered the same species the Spanish later reintroduced to the continent. Whether our modern wild horse should be considered a native, wild species—one that evolved in the U.S.—or a nonnative, feral species—an escaped domestic animal exotic to the U.S.—is controversial to this day and has implications for wild horse management policies, as we'll discuss later.

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