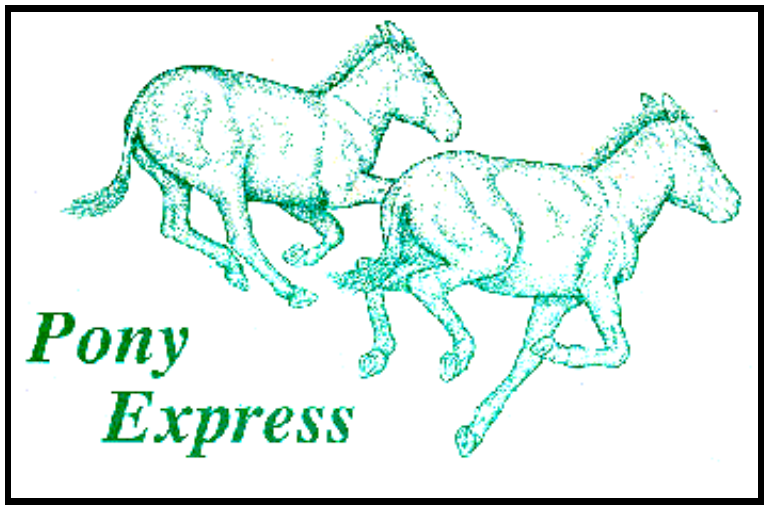


Florida Fossil Horse Newsletter

Volume 2 Number 3 3rd Quarter--September 1993

What's Inside?

Fossil Skeletons and Mother Lodes

For those who have collected old bones and teeth from Florida, you can attest to the fact that although fossil mammals are indeed plentiful, they are usually found disarticulated; the skeletons are almost never found in tact. Localities throughout the world that do preserve complete skeletons are indeed rare and these have been called **Lagerstätten**, a German term roughly meaning "mother lode." Steve Gould once noted that ".Lagerstätten are rare, but their contributions to our knowledge of life's history is disproportionate to their frequency." Why is this so? For invertebrates, soft-bodied organisms may be preserved thus giving insight into various fossil groups not normally fossilized (see Book Review below). For vertebrates the same can be true. At the fabulous Eocene Messel in Germany, carbonized impressions of stomach contents of palaeotheres (close relatives of horses, see chart on page 6) indicate that they were eating grapes, and that bats were eating butterflies. For other Lagerstätten containing vertebrates, the Scientific value is in the completeness of the skeleton. These entire specimens allow paleontologists to decipher the anatomy and biology of these extinct organisms.

The western U. S. has several examples of extraordinary localities with complete fossil

skeletons that can be considered Lagerstätten. During our trip out west on our way to Salt Lake City, we had the opportunity to visit some of these truly extraordinary fossil sites. One of them, Hagerman National Monument in Idaho (see *Pony Express*, Vol. 1, No. 3 and back of this issue preserves Complete skeletons of a 3.5 myrrh old (Pliocene) species of zebra of the genus *Equus*. Ashfall Fossil Beds State Park is another example of Lagerstätten. Ashfall is located in the beautiful rolling hills of northeastern Nebraska. This locality, now preserved as a state historical park, has been worked for many years by Mike Voorhies and assistants from the University of Nebraska. Ashfall is Miocene in age, about 10 million years old. The local mammals that lived during that time were engulfed in a volcanic ash that ultimately led, over a period of days to months, to their deaths. As such, exquisite preservation is the norm at this locality. There are literally hundreds of complete skeletons of fossil mammals, many of which are rhinoceroses (some with the bones of developing embryos inside the mothers), and some of which are horses. Several kinds of horses found at Ashfall also were characteristic of the Miocene, elsewhere in North America. These include *Pseudhipparion, Cormohipparion, Pliohippus, Astrohippus*, and probably species belonging to *Neohipparion* and *Dinohippus*. The species of *Pliohippus* from Ashfall is considered by Voorhies to be "the transition horse" because in the single population preserved there, are some individuals that are three-toed, and yet others are, one-toed (the latter similar to *Equus*). The exhibits at Ashfall are attractively displayed and clearly explained. In addition to the visitors' center (where the shop, interpretative displays, and preparator's lab are located), another structure houses the "rhino barn," where visitors can view the excavations in progress. The recently established Ashfall state park is a must see for fossil enthusiasts traveling out west.

Artist Marc Marcuson's reconstruction of Pliohippus *the "transitional horse" found at Ashfall Fossil Beds in northeastern Nebraska*

Ashfall Fossil Beds State Historical Park, Nebraska Fossilized complete skeletons of the rhino Teleoceras. *More than a hundred such skeletons in similar state of preservation have been excavated from this fantastic site.*

For further information contact Ashfall Fossil Beds State Historical Park, P.O. Box 66, Royal, NE 68773, Phone: (402) 893-2000.

After leaving Ashfall we drove west across Route 20 in northern Nebraska past some other famous fossil horse localities (e.g., the Burge quarry). At Chadron we headed northwest to the Black Hills in western South Dakota. In Hot Springs we visited the Mammoth site where, like Ashfall, complete fossil skeletons are preserved and you can go inside the visitors' center and see the excavations in progress. Considerably younger than Ashfall, Hot Springs is about 25,000 years old. It preserves a time during the latest Ice Age (Pleistocene) just before the extinction wave that decimated many largerbodied mammals in North America, including mammoths, mastodons, sloths, saber-toothed cats, and indigenous horses. All three sites mentioned here, Hagerman, Ashfall, and Hot Springs, are extraordinary localities worthy of being called Lagerstätten. These sites are definitely worth becoming destination points for fossil enthusiasts on a western trip of the United States.

Famous Horseologists--George Gaylord Simpson (1902-1984)

George Gaylord Simpson was one of the great paleontologists of this- century. He was a prolific writer of books and scientific articles and had a major impact on paleontology, evolution, and related disciplines. By the end of his career he had written some 800 articles and 20 books, the latter of which were translated into numerous languages. The range of his writings was indeed impressive, from introductory biology textbooks, to specialized books on taxonomy, statistics, and evolution. His scientific articles focused on fossil mammals, mostly from the Americas. In addition to his scholarly writings, he was an avid field paleontologist and during his career he amassed important collections, particularly from Colorado, New Mexico, and Argentina.

Simpson took his training first at the University of Colorado and then Yale University, where he received his Ph.D. in the 1920s. For his dissertation he described the tiny Jurassic mammals from the Age of Dinosaurs (Mesozoic) that had been collected during the late 19th century from the western U. S. by 0. C. Marsh and others. After a postdoctoral fellowship in London, he returned to

a position as a paleontologist at the American Museum of Natural History where he spent the majority of his professional career. He later held posts at Harvard and the University of Arizona. His articles are far too numerous and span such a breadth of knowledge that it is impossible to review each facet here, but suffice it to say that every paleontologist studying fossil mammals during the 20th century has been impacted by his many books, Tempo and Mode of Evolution (1944), Major Features of Evolution (1953), and Principles of Animal Taxonomy (1961) were very influential contributions.

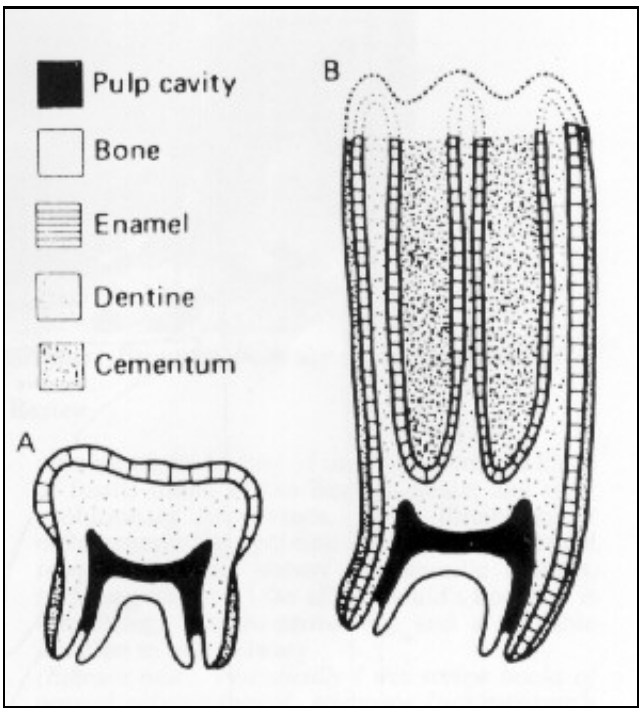
Two other contributions of Simpson deserve mention here. First, one of his first assignments in the late 1920s and early 1930s was to describe Miocene mammals that had been sent to the American Museum from Florida. Prior to the 1920s little was known of pre-Pleistocene mammals from the southeastern U. S. Simpson wrote two classic articles (1930, 1932) in which he described fossils from around the Tallahassee area, north central Florida, and the Bone Valley region. Even to this day, paleontologists describing the taxonomy of Florida fossil mammals make frequent reference to Simpson's contributions. Secondly, Simpson also made a significant impact on our knowledge of fossil horses (e.g., *Hyracotherium*, or *Eohippus)*. Although he wrote some primary research articles on fossil horses, his major contributions to knowledge in this field were as a synthesizer and promoter of the importance of horses to an understanding of evolution. In the books mentioned above, he uses horses extensively as examples of numerous evolutionary phenomena. By far his most visible work in this field was his 1951 book Horses.

What kind of person was Simpson? When I first saw him at a meeting in Dallas in 1973 he was besieged by students and colleagues and it was impossible to get an audience with him (actually his wife, Dr. Ann Roe, was running interference for George and fending off the throngs of well-wishers). Some ten years later Simpson came to the University of Florida to present a lecture and I had the responsibility (actually, I viewed it as an opportunity) to be his chauffeur. In the few days that I got to know him, he was quiet, shy, and proper. To him, one of the highlights of the Florida trip was when we visited Thomas Farm. It was a typical Florida September day (very hot and humid) and Simpson climbed over a fence and through weeds while wearing a suit in order to see the site. While in Tallahassee a half-century earlier he had seen some of the earliest fossils found at that site, but he had not visited it until our trip with him.

In the mid-1980s the Florida Museum of Natural History was fortunate to receive Simpson's professional library containing about 30,600 article separates ("reprints"), 2,000 books, and runs of about 25 scientific journals. The George Gaylord Simpson Paleontological Library has been a major addition to our research program and we will be forever grateful to him for his generous gift. For further reading see: Simpson, G. G. 195 1. Horses. Oxford University Press. 1978. Concession to the Improbable: An Unconventional Autobiography. Yale University Press.

Mammal Tooth Structure

Most mammals have a similar group of tissues making up their teeth. Internally, just next to the jaw bone, is the pulp, which is the "living tissue" that carries the blood and nerves to the tooth. Next to the pulp is the dentine, which consists of about 85% of the mineral called apatite (or, more properly, hydroxyapatite) and 15% organic tissues, mostly Collagen, which also is a common tissue in skeletal bone. The dense, hard external covering of mammal teeth is enamel, which consists of more than 95% of the mineral hydroxyapatite. In primitive mammals the enamel forms the principal chewing surface until old age, when in some mammals it is breached and the underlying dentine is exposed. A hallmark of mammals is that the enamel characteristically, consists of a complex of bumps (cusps) and ridges, which together increase the surface area of the tooth.



Side (sagittal) sections of molars showing primitive condition (human, left) *and advanced condition (horse, right) in mammals.*

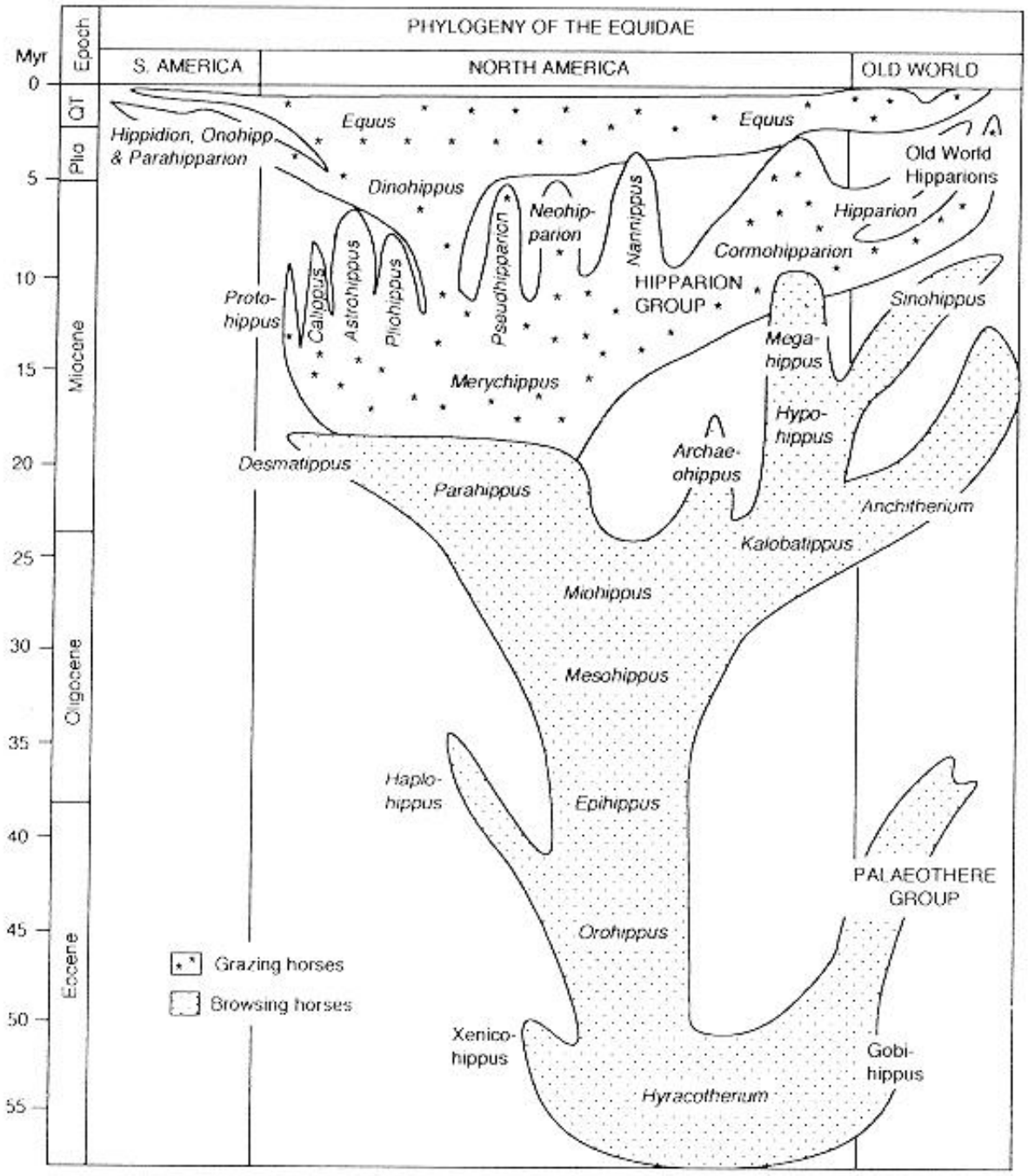
There are many variations upon the basic theme seen in primitive mammal teeth. The number of teeth (44, see *Pony Express,* Vol. 1, No. 1, page 5) and the tooth "families" (incisors, canines, premolars, and molars) are found consistently in primitive mammals, but in some groups like horses, they are reduced to 40 or less. The structure of the dental tissues is extremely conservative; almost all mammal teeth have the pulp, dentine, and enamel which varies very little in composition. A notable exception to the conservative nature of teeth is the addition of another tissue, cementum (or cement), which forms an outer coating to the tooth and provides additional chewing surface.

The structure of the chewing teeth (premolars and molars) in advanced horses is greatly modified from the basic theme, although they retain the same dental tissues. One of the most striking features of advanced horse teeth is that the crowns are elongated relative to primitive mammals (see illustration), so that they become high-crowned (hypsodont). Highcrowned horse teeth have several layers of folded enamel, forming "lakes" or fossettes on the chewing surface (also see *Pony Express*, Vol. 1., No. 3, page 6). These lakes can vary from simple in forms like *Pseudhipparion* to very complex in modern *Equus* and some fossil forms like *Cormohipparion*. The reason why advanced horses evolve complex teeth is a classic story in paleontology that we will also elaborate upon in later issues of *Pony Express*. For now, the simple explanation that the high-crowned teeth, with complex enamel surfaces exposed throughout the life of an individual, are advantageous when feeding on abrasive foodstuffs like grasses.

Horse Phylogeny

A phylogeny is a genealogy, or family tree, of ancestors and descendants through time, but instead of humans, it can be the pedigree of any group being studied. Phylogenies can depict whatever level in the Linnean hierarchy see *Pony Express*, Vol. 1, No. 1, page 6) the investigator would like to present, but usually are of ancestral-descendant species, or genera, or families. For horses, the most common phylogeny depicted is of genera, as in the illustration below. The reason for this is simple: there are about 35 known genera of fossil horses depicted here. If all the extinct and living species (of which there currently are about 200 known) were included, this chart would get far too complex and confusing to readily grasp. Thus phylogenies, or phylogenetic trees, are almost always simplified representations of the actual ancestor-descendant relationships. Simpson (1953, page 261) aptly noted that the phylogeny of fossil horses is a "greatly simplified representation of the

phylogeny of the Equidae. Only generic branches are indicated, and even at this level many students would recognize more branches. Each generic area should be thought of as made up from several thousands of different strands, the real lineages."



Interrelationships of the currently recognized genera of horses.

The phylogeny and phylogenetic tree of a group of organisms, particularly if it is well known and contains many taxa (kinds), usually is the result of many scientists' research. The horse family tree has its roots in the simple diagrams of 19th century paleontologists like Marsh, but has been added to, and refined, hundreds of time since then as a result of original research contributions by workers such as Matthew, Skinner, and Simpson. A phylogeny should never be fixed in stone--as new scientific discoveries occur in the future, modifications will be made to reflect the current state of

scientific knowledge.

Member Profile--Steve Hutchens

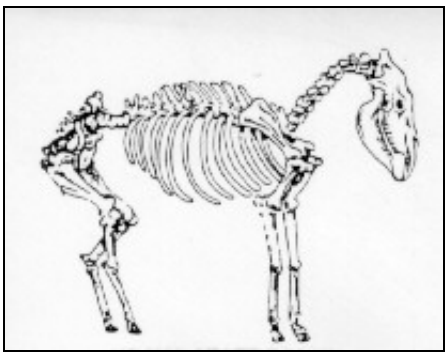
Steve Hutchens collecting the lower jaws of the titanothere Brontops f*rom the Oligocene badlands of Nebraska.*

A native Floridian, and recently moved from the Tampa Bay area to Oldtown, Steve is an avid fossil collector with an interest in horses and other mammals. He combines his love of collecting fossils in the field with his profession as a sculptor. His sculpting has given him the background and wherewithal to put fossils back together once collected and he really enjoys the process. Steve has collected fossil mammals from numerous localities in Florida and during several trips to the Badlands out west. For example, in 1991 he collected a complete lower jaw and neck vertebrae of the Oligocene titanothere Brontops from western Nebraska (see photo) and during the following year he returned to the same site and discovered the skull of the same individual! He since has spent much time preparing the skull and jaws and mounting them on iron work and a wooden base, all constructed by Steve. During the Spring of 1993, Steve began to do volunteer work in the Preparation Laboratory at the Florida Museum of Natural History working with Senior Preparator Russ McCarty. Steve says that he likes to volunteer in the prep lab so that he can learn new techniques as well as interact with the folks in the VP laboratory. He is a great addition to our group at the museum and we hope that he will continue to volunteer with us in the future.

Book Review

Wonderful Life: The Burgess Shale and the Nature of History, 1989, by Stephen Jay Gould. New York: Norton Press, 347 pages, retail $19.95, but see below. T'he Cambrian aged (ca. 500 million years old) Burgess Shale from British Columbia is one of the best known fossil localities in the world. It is perhaps most notable because of its spectacular preservation, oftentimes including impressions of soft-bodied organisms otherwise not known in the fossil record. As such, The Burgess Shale truly is a Lagerstätten (see article above on Ashfall). The Cambrian was an important time in the history of life because it marks the beginnings of many of the major phyla that we know of today; it also includes some enigmatic organisms that defy being placed in our modern schemes of classification. Gould presents a lively account of the history of investigations, the kinds of fossils found in the Burgess Shale, and their evolutionary importance. His discussion of orthogenesis (straight-line evolution) has broad relevance to the history of scientific thought, including horses. Like all of Gould's books, it is interesting, thought-provoking, and a valuable addition to one's library.

(Editor's note: Periodically I will review books of general paleontological relevance [not necessarily dealing with horses] because readers might find them to be interesting and/or I have located the book at a greatly discounted price. Both apply here. Wonderful Life *was advertised for $4.95 (+ $3.00 postage and handling) in the July 16th catalog offered by Edward R. Hamilton, Bookseller, Falls Village CT 06031--5000.)*



Courtesy of Greg McDonald, Paleontologist, Hagerman National Monument.

IDAHO STATE FOSSIL

March 16, 1988

Idaho designated Equus simplicidens as Idaho's Official State Fossil

(Sponsored by Hagerman Valley Historical Society)

Pony Express

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Editorial Staff:

Direct all Correspondence to:

Pony Express Department of Natural Sciences
Florida Museum of Natural History
P.O. Box 117800
Gainesville, FL 32611-7800
Phone: 352-392-1721

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Pony Express--Statement of Purpose:

The purpose of this newsletter is to communicate news and information about fossil horses, particularly in Florida, and to develop a state-wide constituency that will support and enhance the research, exhibition, and educational programs offered at the FlaMNH that pertain to fossil horses. Contributions to the Fossil Horse Fund will be deposited into an account at the University of Florida Foundation, Inc., a tax-exempt entity, and will be used for the purposes stated here.

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