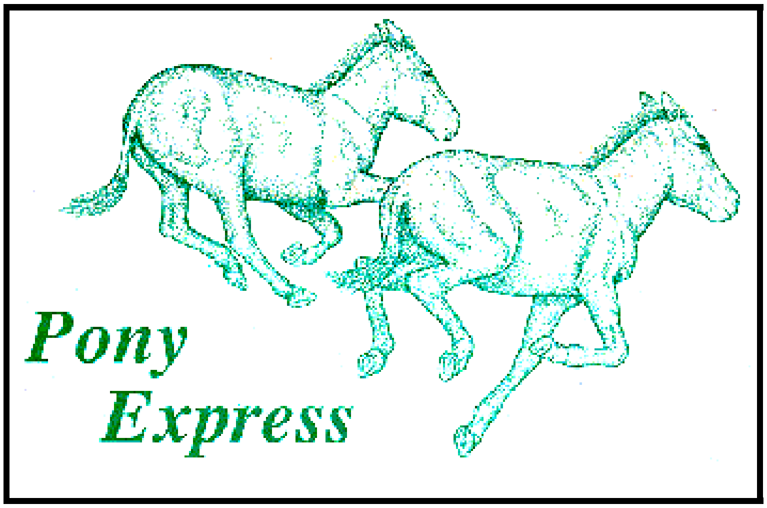


Florida Fossil Horse Newsletter

Volume 3, Number 2 2nd Quarter--June 1994

What's Inside?

Fossil Horses and the Great American Interchange

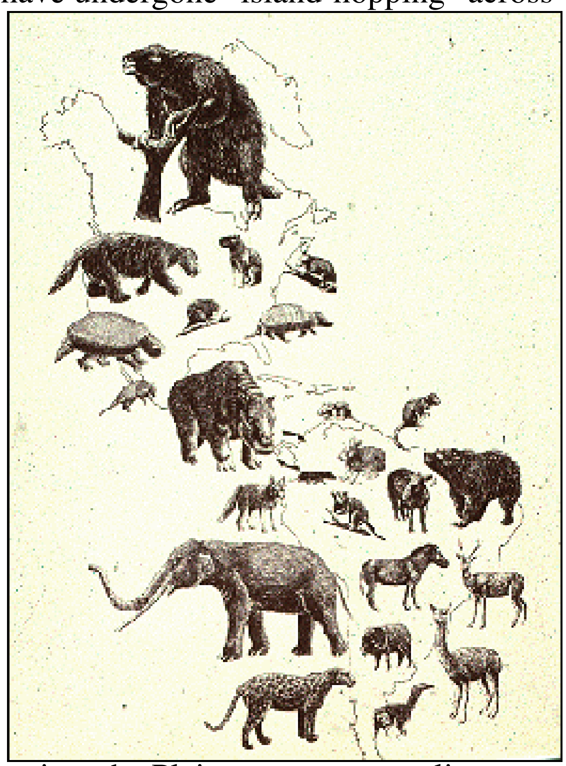
It is a fact of nature that isolation of organisms results in unique and interesting evolutionary histories. For example, the mammals currently living on the island continent of Australia combine a unique ancestry of monotremes and marsupials that have evolved into ecological niches similar to placentals in the northern hemisphere. Yet, even though they have exploited the range of herbivorous and carnivorous habits of their northern counterparts, they nevertheless have many unique characteristics, for example, their mode of reproduction.

Although North, Central, and South America are today connected by dry land, during most of the Cenozoic Era from about 60 to 3 million years ago, the Isthmus of Panama did not exist and South America drifted as an island continent, much like Australia is doing today. Consequently, South America evolved an isolated biota, including indigenous mammals unlike those found elsewhere at the same period of time. South American pouched marsupials occupied the carnivorous niches of their northern hemisphere placental counterparts, the former perhaps most strikingly exemplified by the Miocene saber-toothed possum *Thalacosmilus*, which was only a very distant mammalian relative of the familiar Pleistocene saber-toothed cat Smilodon from North America. In addition to mammalian carnivores, other groups, such as large flightless birds and land-adapted crocodilians, also were the top carnivores in terrestrial ecosystems during much of the Cenozoic. Several stocks of South American mammals, including the litopterns and notoungulates, independently evolved herbivorous habits. During the Miocene many groups of South American notoungulates evolved very high-crowned teeth, presumably for feeding on abrasive plant foods like grasses, independent of horses in North America during the Miocene. Some of the litopterns evolved a simplified limb with only a single functional digit (see ***Pony***

Express, Vol. 1, No. 4, pg. 6), much like North American *Equus*. The widespread and diverse indigenous edentates, including sloths, glyptodonts, and armadillos, also evolved during the isolation of South America.

During the late Oligocene some 30 million years ago, this isolation of South American mammals was disrupted by the immigration of two major groups of mammals, the monkeys and rodents. Although the exact origins of the South American representatives of these groups has been enigmatic, recent evidence indicates that they probably originated from Africa and dispersed by a combination of island-hopping and rafting across the South Atlantic Ocean. Early South American monkeys are relatively poorly known and highly specialized ecologically. In contrast, the rodents underwent an explosive adaptive radiation after they arrived in South America and exploited many kinds of ecological niches. They also have been thought to have caused the extinction of some of the indigenous small mammals, such as the rodent-like marsupials, that flourished prior to the influx of rodents. Many of the modern-day South American rodents, like guinea pigs, chinchillas, and capybaras, to name a few, have evolutionary origins that can be traced back into rodent families that originated during the Oligocene immigration from Africa.

The next major evolutionary event in South American mammalian history occurred about 7 million years ago. At this time, raccoons and their relatives (procyonids) somehow migrated into South American and underwent an extensive adaptive radiation. Similarly, in North America we have the first occurrence of South American immigrants (primitive sloths) in several localities in Florida and elsewhere. The exact means of dispersal north and south is enigmatic, but it must have involved some overwater swimming or rafting because we know from geological evidence that the Isthmus of Panama had not yet been totally formed; there is some fossil evidence to suggest that sloths may have undergone "island-hopping" across the Antilles archipelago in the Caribbean during the Miocene.



Map of the Americas showing Pleistocene mammals involved in the Great American Interchange. the mammals shown in North America, including the gigantic ground sloths, armadillos, and glyptodonts were immigrants from the south, whereas the mammals shown in South America, including mastodons, tapirs, llamas, and horses were immigrants from the north.

During the Pliocene, starting at 3 million years ago and continuing into the Pleistocene, mammalian faunal assemblages in South America undergo a dramatic change. In addition to the then indigenous notoungulates, litopterns, rodents, primates, and edentates, localities from this age also include North American immigrant mammals including llamas, mastodons, tapirs, bears, saber-toothed placentals (*Smilodon*), and several different kinds of horses. It is clear from this dramatic change in mammalian composition in South America (and North America, too) as well as geological evidence from Central America, that the Isthmus of Panama had closed by 3 million years ago allowing a dry land bridge for mammals to disperse across. Paleontologists have termed this extraordinary mixing of indigenous and immigrant mammals the " Great American Biotic Interchange."

Not all of the mammals arrived in South America the same instant (i. e., 3 million years ago). For example, three distinct genera of horses are known to have been involved in the Great American

Interchange. Two of these, *Onohippidium* and *Hippidion*, apparently arrived in South America along with the first wave of immigrants across the Panamanian connection during the Pliocene. In contrast, *Equus*, although very widespread in Pleistocene deposits in South America, apparently did not arrive there until about 1.5 million years ago. For the past 1.5 million years these three different kinds of horses coexisted and seem to have adapted to different ecological niches. The earlier immigrants, *Hippidion* and *Onohippidium*, apparently fed on a mixture of browse (leaves from trees and bushes), other soft vegetation, and abrasive grasses, whereas *Equus* seems to have been more of a specialized grazer feeding predominantly on grasses. Based on their widespread abundance in interchange fossil mammal faunas, horses were very successful in South America until about 10,000 years ago. At that time horses rapidly became extinct over a period of only several thousand years as did many other large indigenous and immigrant mammals in South America; this also occurred to both indigenous and immigrant groups elsewhere in many parts of the world. The reason for this rapid extinction of mammals has been hotly debated in the literature, but recent evidence suggests that this almost certainly resulted from a combination of dramatic climatic fluctuations during the later glacial ages as well as the advent of humans that rapidly populated South America and the rest of the New World at that time. Like North America, the presence of horses in South America today is the result of a secondary reintroduction during the time of the Spanish conquistadors.

For further reading on South American mammals and paleontology, consult the following:

Simpson, G. G. 1978. ***Concession to the Improbable***: An Unconventional Auto-biography.
(A wonderfully readable autobiography of one of the great paleontologists of this century and pioneers
in the study of South American fossil mammals. Contains numerous passages about Simpson's experiences in South America.)

Simpson, G. G. 1980. ***Splendid Isolation***: The Curious History of South American Mammals. New Haven: Yale University Press.
(An account of the evolution of South American mammals written for the lay-person.)

Stehli, F. G. and S. D. Webb. 1985. ***The Great American Biotic Interchange***. New York: Plenum Press.
(A series of authoritative technical articles.)

Webb, S. D. 1994. "Successful in spite of themselves and the Great American Interchange."
Natural History, vol. 103, no. 4, April issue, pages 50-53.

News from La Paz, Bolivia

Since early March, I have been in Bolivia on a Fulbright Senior Research Fellowship. My principal research affiliation has been in the Department of Paleontology at the National Museum of Natural History in La Paz where I have been working with my friend and colleague Federico Anaya. We are working together on several projects related to fossil mammals from Bolivia and I am also studying the fossil horses *Onohippidium*, *Hippidion*, and *Equus* from the classic Pleistocene locality of Tarija in southern Bolivia (see article above). In June I start teaching an 8-week course on fossil mammals of the altiplano at the Universidad Mayor de San Andres in the Faculty of Geology.

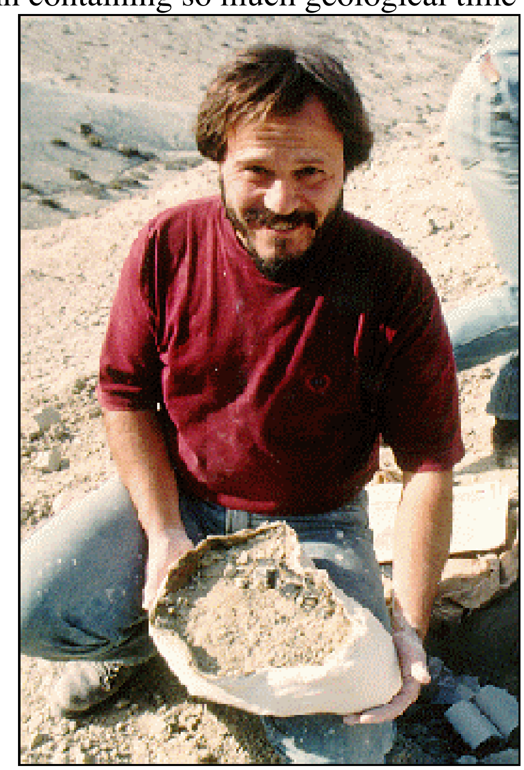
In April I traveled to Patagonia in central Argentina where I attended a conference on South American paleontology. There were several days of talks presented on various aspects of mammals and other fossils. It was a wonderful chance to see and hear what kinds of

Magellenic penguin colony visited during our field trip to Punta Tombo, Patagonia, Argentina.

interesting research our colleagues are doing in South America. I also participated in two field trips. The first one included a day-long trip to some fossil mammal localities around Trelew, the city that hosted the meeting. That trip also included a trip to Punta Tombo to see the penguin colony on the shores of the Atlantic Ocean where over one million individuals roost. (see photo)

After the conference I had the wonderful opportunity to participate in a 4-day long field excursion to some of the classic fossil localities in Southern Patagonia. Ever since the turn of the century, fabulous fossil mammals have been collected from this region and they form the basis for our understanding of the extinct mammals that evolved in isolation on what was then a floating, isolated, island continent. To further add to the excitement of this trip, this field excursion was led by Rosendo Pascual, one of, if not THE, leading authorities on South American mammals and a professor emeritus at the University of La Plata, Argentina.

During the first two days of the field excursion we visited some early Paleocene (55-60 million years old) and late Oligocene (25 million years old, at Cabeza Blanca) localities, the former of which has recently yielded specimens of monotremes (related to the duck-billed platypus and previously only known from Australia) and the latter a classic assemblage of Deseadan-aged fossil mammals like those I am currently studying in Bolivia. Thereafter, we visited some fossil wood localities and the classic "Grand Barranca" (=great cliffs), a series of extensive exposures that span some 40 million years; this is one of the classic localities for fossil mammals in the entire world. Hunting for extinct fossil mammals in the Grand Barranca was a special treat as was the knowledge that in this one small place you could walk up to a rock column containing so much geological time and mammal evolution.



Atfredo Carlini, Associate Professor of Paleontology and Anatomy, University of La Plata shown here collecting a plaster jacket of a skull of a notoungulate (see dark teeth in top corner of jacket). This specimen was collected from a classic fossil mammal locality, Cabeza Blanca, during our field excursion to Patagonia

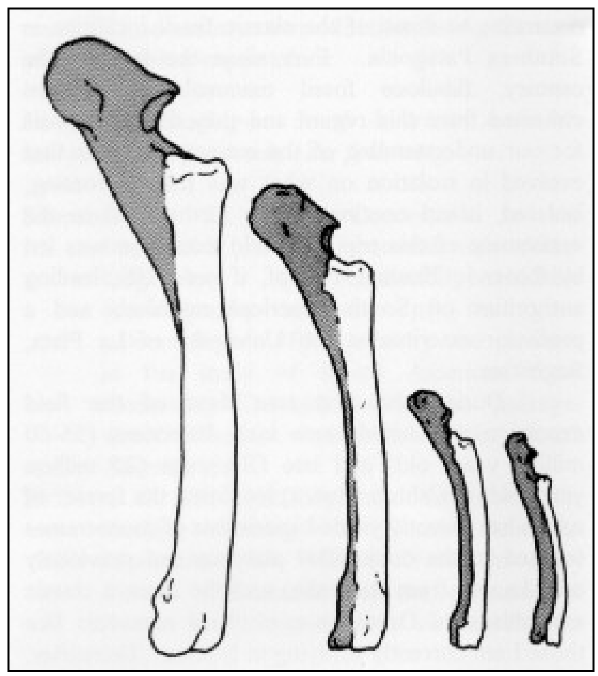
During May and early June I have been involved in working at Salla, an important late Oligocene

25 million-year-old site in northern Bolivia about a three-hour drive south of La Paz. Field crews from UF have worked at Salla almost every year since 1981 and we have learned much about the fossil mammals that lived in what is now the Bolivian Andes during the Miocene. This includes many different types of extinct South American hoofed herbivores, or ungulates (including the notoungulates and litopterns), very primitive armadillos and glyptodonts, a variety of rodents, and the oldest South American monkeys. In addition to paleontologists from the museum in La Paz, my graduate student Bruce Shockey from UF, and Ralph Hitz, a University of California Ph.D. student, this year we are joined by faculty and students from the Department of Biological Anthropology and Anatomy from Duke University. This begins a five year project funded by the US National Science Foundation for obtaining a better understanding of the Miocene faunas from Bolivia and Argentina and to recover additional fossil monkeys. In mid August I leave Bolivia and travel to Argentina where I will be a visiting professor in the Department of Geology at the University of Buenos Aires. When not teaching, I will travel to nearby La Plata where I will study famous fossil collections of Pleistocene horses.

Horse Bones- the ulna and radius

While it is obvious to us that wild horses are fast animals, we can deduce from fossils that *Hyracotherium* was also quick. However, the leg construction of these and other horse genera differ greatly. One of the differences among these horses involves the ulna and radius.

Hyracotherium had body proportions and running mechanisms similar to small dogs. The ulna and radius were separate bones, which allowed some rotation of the forearm while running. While these characteristics were apparently effective for a small animal like *Hyracotherium*, they would not be mechanically sound when scaled up to a larger horse like *Equus*. The limbs of larger horses are restricted to one plane of motion and the amount of fusion between the ulna and radius is increased. This reduction of mobility in the limb decreases the chance of leg dislocations while running.



The ulnae (shaded) and radii of (left to right):
Equus, Merychippus, Mesohippus, Hyracotherium.
Modified from Simpson, 1951.

The change in horse legs over time is not a straight-line evolution from the small Hyracotherium to the large *Equus*; these are generalizations that just touch upon the complex evolution of the horse. (Linda Chandler)

Thomas Farm--1994

This year's Thomas Farm dig (Spring Collection Adventure '94) was held on the weekend of April 22-24. We had eight participants this year with four of them being repeat diggers. The staff this year included Dan Cordier, Art Poyer, David Whiddon, and Theresa Gibbons. Dr. Bob Chandler entertained us Saturday evening with a talk on his research involving extinct "big birds." The weather was perfect for digging with it being cloudy but not raining, and the site was in prime shape for the hunt for Archaeohippus. Unlike previous digs, we did not have the problem of fire ants eating their way into the tents or a leaky shower flooding the kitchen area. Along with 26 plaster jackets, many fossils were bagged for processing at the museum. A partial list of what was found includes:

Person Name	**Sci Name**	**Material**
STEFI ADLER	*Archaeohippus blackbergi*	vertebrae, astragalus, proximal femur, cheek teeth
	Parahippus leonensis	incisors, canines, upper cheek teeth, lateral metapodials, third proximal and medial and phalanges, proximal tibia, vertebrae, distal humerus, pelvis fragments, proximal femur
	Chelonia	shell fragments
	Alligator olseni	osteoderms, teeth, phalanx
	Moschidae	small deer calcaneum
THERESA GIBBONS	*Archaeohippus blackbergi*	calcaneum, proximal fibula
	Parahippus leonensis	proximal femur, proximal lateral metapodial, lateral hoof, distal tibia, calcaneum, vertebrae, upper cheek teeth, metacarpal, distal femur, third proximal phalanges
	Chelonia	shell fragments
	Alligator olseni	osteoderms, vertebrae
	Anura	frog limb bone
	Camelidae	ectocuneiform and calcaneum
	Moschidae	small deer astragalus
	Carnivora	small canid distal humerus and phalanx
TOM HARRIGAN	*Archaeohippus blackbergi*	dentary fragment with molar, calcaneum, vertebra
	Parahippus leonensis	astragalus, third proximal, medial, and distal phalanges, lateral metapodial, proximal scapula distal tibia, partial pelvis, vertebrae, upper and lower molars
	Chelonia	shell fragments
	Alligator olseni	osteoderms, vertebra
	Moschidae	small deer calcaneum
	Carnivora	arge canid claw
MITCHELL HOPE	*Archaeohippus blackbergi*	proximal metacarpal, lower cheek tooth, third proximal phalanx
	Parahippus leonensis	lower jaw symphysis, distal tibia, patella, third proximal phalanx
	Chelonia	shell fragments

	Alligator olseni	osteoderms, teeth, phalanx
	Moschidae	small deer calcaneum
*DERK KUYPER	*Archaeohippus blackbergi*	calcaneum, phalanges, upper cheek teeth
	Parahippus leonensis	third proximal, medial, and distal phalanges, astragalus, incisors, partial pelvis, lateral hoof, vertebrae, lower cheek tooth, proximal femur
	Chelonia	shell fragments
	Alligator olseni	osteroderms
	Moschidae	small deer astragalus
	Carnivora	small canid phalanx and distal humerus
*BILL LEE	*Archaeohippus blackbergi*	lateral metapodial, calcaneum, upper cheek tooth
	Parahippus leonensis	upper and lower cheek teeth, proximal tibia, lateral metapodial, vertebrae, incisors, third proximal and medial phalanges, distal humerus, partial pelvis, proximal scapula;
	Chelonia	shell fragments
	Alligator olseni	osteoderms, teeth, vertebra
	Moschidae	small deer astragalus
	Carnivora	small canid phalanx
SARAH LONGINO	*Archaeohippus blackbergi*	lower cheek tooth, proximal femur, astragalus
	Parahippus leonensis	distal metapodial, vertebrae, proximal, medial, and distal phalanges, lateral metapodial, partial pelvis, patella
	Chelonia	shell fragments
	Alligator olseni	osteoderms, teeth
	Artiodactyla	distal femur
	Carnivora	small canid toe
*SHIRLEY WOODRUFF	*Archaeohippus blackbergi*	distal metapodial, third proximal phalanx, astragalus, pelvis
	Parahippus leonensis	upper and lower cheek teeth, incisors, third proximal and medial phalanges, astragalus, calcaneum, distal metapodial, patella, lateral metapodial, vertebrae, jaw fragment with molar;
	Alligator olseni	osteoderms, teeth
	Anchitherium clarencei	calcaneum
	Moschidae	small deer phalanx
	Carnivora	small canid astragalus
* JEFF YAUN	*Archaeohippus blackbergi*	lateral metapodial, cheek teeth, calcaneum
	Parahippus	upper and lower cheek teeth, partial pelvis, distal tibia, third

	leonensis	proximal, medial, and distal (hoof) phalanges, incisors, proximal femur, proximal rib, lateral metapodials
	Chelonia	shell fragments
	Moschidae	small deer astragalus, phalanges
	Artiodactyla	phalanges, teeth
	Alligator olseni	osteoderms, teeth
	Carnivora	small canid phalanges, calcaneum
	Cynodesmus iamonensis	complete upper dentition

One very special find was made this year by a newcomer, Stefi Adler. Stefi found a complete skull of Alligator olseni, the only one in the museum collection. The other known skull, which is the type specimen, is part of the Thomas Farm collection at Harvard. Even though it's not a horse, much less the right horse, I think we will keep it.

Stefi Adler and preparator David Bunger with the complete skull of Alligator olseni.

The FlMNH staff would like to thank this year's participants for their help in collecting more skeletal material of Archaeohippus. Each field trip brings us closer to our goal of a mounted skeleton of the small three-toed horse. We are planning more field trips for the future. Please feel free to write us if you have any suggestions regarding these digs! (Art Poyer)

*** Participated in previous digs.**

Pony Express

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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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