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Zion National Park Paleontological Survey

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The spectacular rocks exposed in Zion National Park, Utah, include many fossiliferous units ranging in age from Permian through Holocene. In cooperation with the Utah Geological Survey (UGS), National Park Service (NPS) interns have been inventorying paleontological resources within the park. The goal of this work is to identify new fossil localities and to assess the distribution of fossils within formations to establish baseline paleontological resource data to support the management and protection of non-renewable fossils.

This project was initiated in the summer of 1999 when NPS intern Joshua A. Smith (now a graduate student at the University of Utah) began an inventory of paleontological resources within the park under the direction of NPS paleontologist Vince Santucci. Because most of this work was done during the hot summer months, the work was concentrated in the cooler confines of Zion Canyon. In the summer of 2002, Don DeBlieux of the UGS joined Josh for several weeks to continue work in Zion Canyon. In the spring of 2003, recent Duke University graduate Jennifer McGuire began a three-month internship to continue the inventory work. Don DeBlieux and Jim Kirkland (UGS) assisted her for several weeks along with volunteers from the Utah Friends of Paleontology (UFOP).
Our work in 2003 took advantage of the cooler spring temperatures to concentrate on some of the stratigraphically lower formations, found at lower elevations within the park. Fossil-bearing formations within Zion National Park include the Permian-age Toroweap Formation and Kaibab Limestone, the Triassic Moenkopi and Chinle Formations, the Jurassic Moenave, Kayenta, Navajo, and Carmel Formations, the Cretaceous Cedar Mountain and Dakota Formations, and Quaternary lake deposits. While the eye of the visitor to Zion National Park is drawn to the spectacular cliffs of Navajo Sandstone, the eye of the paleontologist is drawn to the strata exposed as slopes and ledges below the cliffs - those of the Kayenta, Moenave, and Chinle Formations that are known to contain significant vertebrate fossils.

The most common vertebrate fossils found in Zion National Park are dinosaur tracks that are concentrated primarily in the Whitmore Point Member of the Moenave Formation, at the top of the Springdale Sandstone Member of the Moenave Formation, and in the Kayenta Formation, all of Early Jurassic age. Prior to Josh's arrival in Zion, only four track localities had been documented within the park; his work led to the discovery of dozens of new track localities and allowed us to predict areas having high potential for track discoveries (Smith and Santucci, 1999). The most common tracks found in these formations are those of large and small three-toed bipedal dinosaurs. The large tracks are placed in the ichnogenus (track-genus) *Eubrontes* while the smaller tracks are assigned to *Grallator*. One site preserves several *Eubrontes* trackways with track spacing and directions suggestive of possible gregarious behavior (Smith et al., 2002). In addition to *Eubrontes* and *Grallator* tracks and trackways, we found other types of tracks including four-toed, crocodile-like tracks, bird-like tracks, and swim tracks. In the summer of 2002, we located the second known tracksite in the Navajo Sandstone at Zion.

The tracks preserved in Zion are important not only from a scientific standpoint but also provide avenues for interpretation to educate the many visitors to Zion National Park. Different modes of track preservation, combined with erosion, have produced many tracks that are aesthetically quite appealing and will be of interest to park visitors. The track record of Zion National Park is also pertinent to the investigations underway at the recently discovered Johnson Farm tracksite in nearby St. George, Utah. The Johnson Farm site preserves numerous trackways on many horizons within the Whitmore Point Member of the Moenave Formation and is one of the most significant tracksites ever discovered in the western United States. Jenny McGuire, and St. George paleontologist Andrew Milner, discovered a significant tracksite in the Early Triassic Moenkopi Formation. This site is located stratigraphically low in the section, below the Virgin Limestone Member, and preserves several types of tracks including those of therapsids (mammal-like reptiles). In fact, this may be the earliest known Mesozoic tracksite in North America. Further research is already underway to more fully document this site.
The Late Triassic Chinle Formation in Zion National Park is composed of two units; the resistant cap-forming Shinarump Conglomerate, and the overlying multicolored mudstones and sandstones of the Petrified Forest Member. The Shinarump Conglomerate was deposited in braided-stream channels and is best known for preserving abundant fossil wood and plant material. Bone is sometimes found preserved in the Shinarump and a well-preserved reptile

continued on page 7

Table of Contents

The Centennial Site, ~~a~~ Significant Discovery in Wind Cave National Park

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After a fruitless search in near 100-degree heat on July 23, we had split up to cover more ground on the way back to the truck, when Dr. Greg McDonald found some large fossil teeth weathering out of a steep hillside. The previous day, Greg, the National Paleontological Coordinator from the Geologic Resource Division (GRD), helped Wind Cave National Park inventory the seven localities of the Klukas Site, an Oligocene-aged deposit that is part of the White River Group. During the inventory process we discovered three new localities (see "Resurvey of the White River Group Sites in Wind Cave National Park" Park Paleontology, Vo. 7, no. 2, Fall 2003). With an extra day before Greg headed back to Denver, we decided to survey some additional White River exposures in the park.

Dr. James Martin, from South Dakota School of Mines and Technology (SDSMT) had determined through surveys conducted in 1986 that these soft claystones and siltstones exposed as scattered windows in the prairie of the park represent the Scenic Member of the Brule Formation. This is the same part of the White River Group that is extensively exposed at a much lower elevation to the east of Wind Cave at Badlands National Park However, Dr. Martin had never searched this particular part of the park. Our initial thoughts were that we had found a brontothere skull. This would have meant that the deposits were older than the Brule. The fact that no brontothere skull had ever been found in the Black Hills added further significance to the find. Looking around, we also found fragments of tortoisee shell, vertebrae, and the proximal end of a humerus, possibly from an oreodont. Although we found bone fragments scattered 20 feet downhill from the discovery, the bone seemed to be originating from a very small source area. After some quick pictures of the specimen (Fig. 1), we immediately headed into the park headquarters to talk with the Superintendent, Linda L. Stoll about this significant discovery.

Figure 1: The *Subhyracodon* upper palette, the photo on the left was taken the day it was discovered and the other one month later, show the weathering that occurred during that short time period. Photos by Greg McDonald and Rod Horrocks.

Sitting in her office, we analyzed the discovery according to the guidelines found in NPS 77, in the "Paleontological Collect/Leave Simplified Flowchart". The Superintendent readily supported an emergency excavation to recover the threatened fossils. Not only were we worried about fossil poaching or rapid weathering of the soft sediment, but we were also concerned about the proximity of the fossils to an often-used bison wallow. In order to protect the site in the interim, everybody at the meeting agreed to keep the discovery secret.

After Greg headed back to Denver, it became obvious that no one had any budget for this emergency excavation, so we had to find a way to do some paleontology on a shoestring. After completing the environmental screening form (ESF), we borrowed the necessary excavation equipment from Badlands National Park and the Mammoth Site, and then we secured the return of Dr. McDonald. We also solicited the help of Dr. Rachel Benton of Badlands National Park and Megan Cherry, and Gavin McCullough, students at the South Dakota School of Mines, who were working as seasonal employees at Badlands National Park and Dr. Larry Agenbroad and Kris Thompson from the Mammoth Site. The crew was completed with the park's cave management staff, Rod Horrocks and Marc Ohms and their summer intern, Kali Pace. As part of our new joint working relationship with the nearby Mammoth Site, we just happened at the time to be sponsoring an international volunteer from Cambridge University in Great Britain, Catherine Burgess. Part of the agreement was that Catherine would spend a portion of her time as an intern preparing Wind Cave specimens. With the discovery of these fossils, we had the perfect project for her to work on. The final detail involved the arrangement for the park's law enforcement staff to keep the site secure once work began on the recovery operation.

When we returned to the site after one month, we were surprised at the amount of weathering that had happened since our initial discovery (Fig. 1). With a very competent crew on hand, everybody started on their pre-assigned duties. Dr. Benton was able to revise our preliminary identification of the skull, assigning it to *Subhyracodon* (probably *occidentalis*), a five-foot high, hornless rhino that lived approximately 32 million years ago, and not brontothere (much to Dr. Martin's relief). After Megan and Gavin set up a zero datum and a working point on a true north/south line, we installed a metric grid over the site. We then used a total station GPS to map the location of the exposed bones and locate the zero datum.

When Greg started blocking around the skull, he discovered disarticulated bones from the rest of the skeleton of the rhino. As the blocking process progressed, we also started finding the disarticulated remains of *Mesohippus*, a small horse and *Leptomeryx*, a deer-like mammal. The tortoise turned out to be nearly complete, but badly disarticulated due to weathering (Fig. 2). The rhino remains seemed to be concentrated in the southwest half of the deposit and

continued on page 3

Figure 2: Dr. Greg McDonald (on left)works on blocking the tortoise while Rod Horrocks works on exposing rhino elements along the edge of the bone bed. Photo by Marc Ohms.

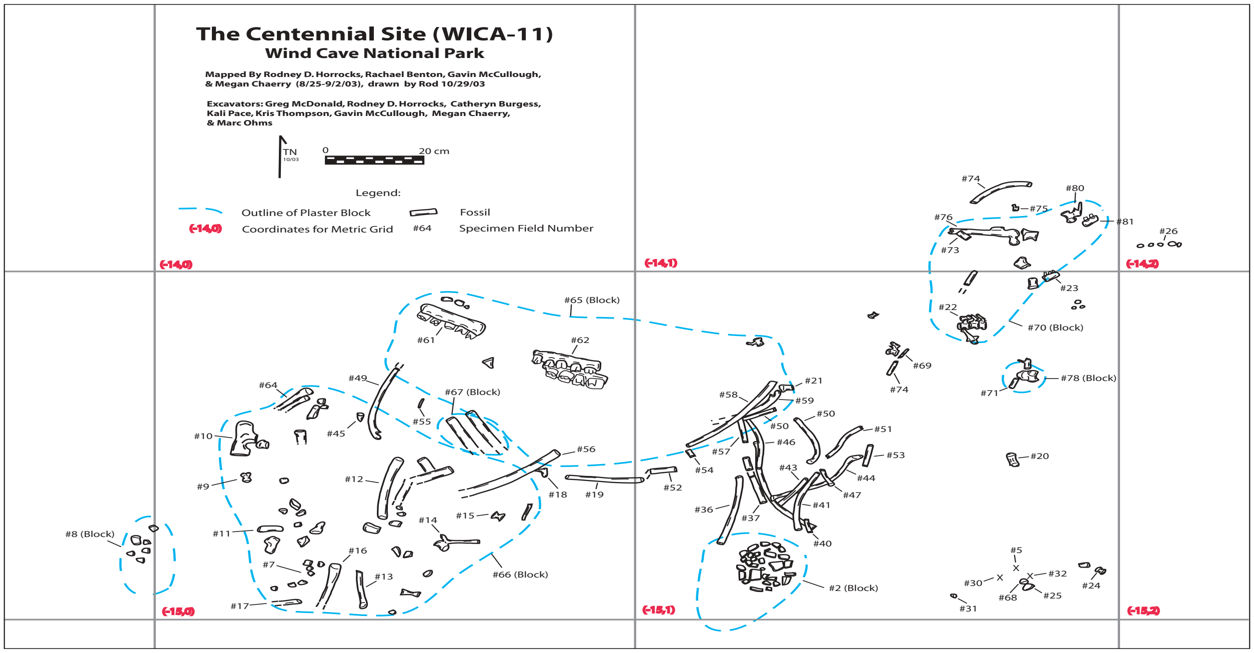

Figure 3: Preliminary map of the Centennial Site drawn by Rod Horrocks.

the horse in the northeast-half. We also found an isolated carnivore-tooth next to the femur of the horse. We noticed that some of the bones had been broken prior to fossilization and some were turned up vertically in the deposit. By the time we had much of the deposit exposed, we realized that we were dealing with a very small bone bed (about 25 cm thick, by 0.7m wide, and approximately 2m long) that apparently followed a paleo surface that had a 25 degree slope. The taphonomy of the site will certainly prove to be interesting (Fig. 3).

We took a week to stabilize the fossils and remove two large blocks and five small ones, before backfilling the excavation. The blocks are currently being stored at the nearby Mammoth Site in Hot Springs, where limited preparation is being conducted. To date, we have partially reconstructed the right jaw from the rhino that had weathered down the hillside and some of the small elements that were bagged during the excavation.

The Interpretation Division suggested naming it the "Centennial Site" since 2003 is the 100th anniversary of the creation of the park. This discovery is significant because it is the first occurrence of a bone bed of this age with skeletons and associated skulls that has been found in the Black Hills. Dr. Agenbroad, the Principal Investigator at the Mammoth Site, said, "This is an exciting discovery which provides for cooperative ventures in the prehistory of the southern Black Hills. Within an approximate 20-mile transect, we have at least five localities providing paleontological "windows" to view the animals that lived in this region around 32 million years ago; 263,000 years ago; 26,000 years ago; and 10,000 years

Additional Reading

To learn more about the Centennial Site visit the park's web page at http://www.nps.gov/wica/Rhino/Paleo_Site-01.htm

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Fossil Rhinos in Parks

When people think of rhinos they usually think of Africa or perhaps India or Southeast Asia. Today there are only five living species of rhino but they were more diverse in the past and have a very rich fossil history. Fossil rhinos first appear in North America in the Eocene and were very successful until their extinction here in the late Miocene. Fossil rhinos are known from many national parks. One early rhino called *Teletaceras* is found in Death Valley. The rhino, *Subhyracodon,* recently found at Wind Cave National Park is also known from Badlands National Park and John Day Fossil Beds. The *Subhyracodon* from Badlands is one of the animals found preserved in an ancient waterhole whose carcasses were scavenged by the entelodont, *Archaeotherium*. Another famous site rich in rhinos is Agate Fossil Beds where literally thousands of bones of the rhino *Menoceros* have been found. *Subhyracodon* like many early rhinos lacked horns. One of the earliest horned forms was *Menoceros* which had a pair of horns on the tip of the nose.

Paleontology Internship Report – Wind Cave National Park and Mammoth Site of Hot Springs

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I left high school in 1999 with every intention of becoming a physicist and started my degree in Natural Sciences at the University of Cambridge, planning to major in physics. Fortunately in my first year I also studied chemistry, math and geology and by the end of the year I had already realized that geology was the subject that fascinated me, this was further confirmed by a few weeks hiking in the beautiful geology of the Swiss Alps. So, I returned to Cambridge for three more years study, specializing in earth sciences in general and paleontology in particular. I received my Masters of Science at the end of June 2003, with my master's project written on an early ornithischian dinosaur.

I had wanted to spend the summer working in vertebrate paleontology before trying to find funding for graduate studies and since opportunities in Britain are limited I applied for the internship program at the Mammoth Site in Hot Springs – taking a big leap forward in time from the dinosaurs! When we realized that getting a visa for me to train in the US would be a problem, the idea of a collaboration with nearby Wind Cave National Park was suggested and an agreement was reached, the Park Service provided my visa and the Mammoth Site provided funding and facilities. As a result I have spent my time working on two different vertebrate paleontology projects from two completely different geological periods.

Wind Cave National Park Project

When I agreed to carry out voluntary work for Wind Cave we were planning on retrieving some previously discovered fossils from storage so that I could prepare them. However, I arrived at just the right moment to take part in Wind Cave's most exciting paleontological discovery to date, the excavation of an Oligocene (31 million year old) rhinoceros called a *Subhyracodon* and a primitive horse (*Mesohippus*) and deer (*Leptomeryx*). I spent two days in the field helping Greg McDonald and Rod Horrocks of the NPS in their excavation of the fossils and since then I have been able to prepare some of the material in the laboratory at the Mammoth Site.

Between the initial discovery of the fossils and their later excavation and collection, one side of the jaw of the *Subhyracodon* had been eroded, so all the sediment from around and below the fossils was screened (passed through a mesh with a <1cm diameter) to collect the fragments of the jaw. My job so far has been to take these fragments and attempt to reconstruct the jaw. My first task was to clean up the fragments until they were recognizable, this was done largely using water and a toothbrush but in a few cases a weak solution of hydrogen peroxide or mechanical preparation using an air scribe were required. I then tried to identify the bone fragments as far as possible, they belonged to both the *Mesohippus* and the *Leptomeryx* as well as the *Subhyracodon* and included ribs, vertebrate and parts of limbs besides the jaw. As I pieced together the fragments of the *Subhyracodon* teeth I was able to eventually build up the tooth row and the bone in which they were embedded, discovering in the process that there was still an unerupted tooth inside the jaw – so our animal is still not fully mature (probably around 5 years old). I am now working on the back part of the jaw and realizing that while this may be a subadult it is still a pretty large animal! This work will be continued by Rod Horrocks on a volunteer basis once I return to England and hopefully when we have fitted together all the fragments that we can, the large plaster jacketed bocks containing more of the skeletons will be opened up for preparation too.

Catherine Burgess piecing together pieces of the rhino jaw that had eroded out of the sediments.

Inset - the partially reassembled rhino jaw.

Mammoth Site

The Mammoth Site is much younger that the fossils from Wind Cave, around 26 thousand years old and I have a variety of work here. I earn my keep by giving guided tour around the site and answering questions from visitors but I also work in the bonebed and in the lab. Most of the fossils at the mammoth site have been left in situ in the bonebed and a building has been built around this site – the remains of an ancient sinkhole. This means preparation work is carried out in the bonebed as well as the lab. In the bonebed I have been primarily working on cleaning the fossils, removing a thick layer of preservative applied to the bones around 20 years ago that is now turning brown with age and replacing it with a thinner clear layer to restore the bones to closer to their natural state. Down in the laboratory I have been trained to prepare the fossils from the site using hand preparation tools such as dental picks and paintbrushes and mechanical tools powered by compressed air to remove sediment from around the bones. I have also been trained in the use of a variety of consolidents and glues to help protect the fossils and prevent them cracking and flaking apart. I have worked on cleaning and consolidating two mammoth caudal vertebrae and a broken mammoth bone that remains unidentified.

The work I have carried out on both these projects has been excellent training and experience for me and I hope it has also proved useful to both the National Park Service and the Mammoth Site.

Partially reconstructed rhino jaw and skull of *Subhyracodon*.

Dinosaur Depot Prepares Dinosaur Bones from Curecanti National Recreation Area

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On February 2nd, 2002, personnel from the Curecanti National Recreation Area at Blue Mesa Reservoir, delivered a field jacket to us for preparation. The jacket is part of a specimen excavated in 1995 and 1996 through a partnership between the Park Service, Dallas Museum of Natural History, the Forest Service and the Academy of Natural Sciences in Philadelphia. Part of the specimen was prepared at the Academy to confirm its identification. Those parts and the rest of the specimen were returned to Colorado to the Museum of Western Colorado, the nearest preparation center to Curecanti. The number of jackets is more than that museum can handle alone, so we at the Dinosaur Depot Museum in Cañon City, volunteered our lab to help.

The six by four by 3 foot high jacket contains a few vertebrae from a large *Apatosaurus* and looks very impressive in the lab window. One of our volunteers working on the bones in the jacket is Dennis Dilley of Cañon City, pictured working on the centrum of one of the vertebra. He has been a volunteer for a number of years and this is the third

Delivery Day at the Dinosaur Depot. A forklift was needed to move the field jacket containing the dinosaur bones into the preparation lab at the Dinosaur Depot in Cañon City.

Dennis Dilley preparing a vertebrae of *Apatosaurus* from Curecanti.

major specimen he has worked on. Another newer volunteer, Bruce Wheeler of Pueblo is working on his first project and enjoying the work more than he dreamed. He has been joined recently by his son Mathew and together they are learning how to work on a large specimen; especially how to keep all of the pieces straight. It is fun for these volunteers to help visitors visualize the size of the animal that had these huge vertebrae. They also enjoy talking with more interested visitors about the process this specimen has gone, is going, and will go through as it is readied for its' ultimate destination as an exhibit at the visitor center at the Recreation Area.

We at Dinosaur Depot Museum are delighted to be a part of this project. The excavation and preparation of the specimen are just the first stages of a project of this size. The specimen will still go through a research stage before its final destination is reached. The information it can add to our knowledge of *Apatosaurus* dinosaurs is its most important value. The next most important value is being shared with the visitors of three museums as it is worked on, and ultimately the visitors of the Recreation Area where it was found. A bonus value is that folks from other walks of life, like Dennis, Bruce and Mathew, get to do some of the technical work on the specimen. We will enjoy staying in touch with it on all the stages it will go through and look forward to seeing it on exhibit in its final home.

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Closeup of one of the prepared *Apatosaurus* vertebrae showing the pneumatic sinuses characteristic of the group.

What is an Apatosaurus?

When you mention dinosaurs most people immediately have a mental image of a huge animal with a long neck and tail. This group of dinosaurs is known as the sauropods. Sauropods lived during the Jurassic and Cretaceous and are known from every continent except Antarctica. In North America our best records of this group come from the Jurassic Morrison Formation which is exposed in many of our western parks such as Dinosaur, Arches, Colorado, Glen Canyon, Hovenweep, and Curecanti to name a few. Many different types of sauropods have been found in the Morrison Formation but perhaps the best known is *Brontosaurus*, the thunder lizard. While sauropod bones are common, complete skeletons are rare since often dinosaur carcass were scavenged and the bones scattered before they were buried. Many of the dinosaurs found in the 1800's were based on single bones or rarely a partial skeleton, so the first paleontologists to study these animals often gave different names to the same animal based on different parts of the skeleton. Later, as more complete skeletons were found, it was often discovered that these different parts were from the same animal, in which case the earliest name given had priority and was the appropriate name to call the animal. This is what happened to *Brontosaurus*. While the name became very popular with the general public, continued research showed that the animal called *Brontosaurus* was the same as an animal that was described earlier as *Apatosaurus* or beautiful lizard. Since *Apatosaurus* has priority it is the appropriate name to use for the best known of the Jurassic sauropod dinosaurs.

Modern Forests of Mexico: An Analog to the Ancient Forest at Florissant?

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New research sponsored by Florissant Fossil Beds National Monument is examining the modern vegetation and flora from El Cielo Biosphere Reserve in the Sierra Madre Orientale, Tamaulipas, Mexico. These forests have been cited in previous literature as being one of the modern analogs to the fossil forest at Florissant. The project's objective is to compare the modern vegetation of this region with the fossil plants known from Florissant in order to gain a better understanding of the paleoenvironment at Florissant during the late Eocene, as well as the paleobiogeography of New World temperate and tropical forests.

The research plan was initiated by Florissant Fossil Beds National Monument, and the field work is being done under permits from the Mexican agencies Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT) and Secretaría de Relaciones Exteriores (SRE), and the Tamaulipas Comisión Estatal de Vida Silvestre. The project leader is the Monument's paleontologist Herb Meyer, and other participants include paleobotanist Steve Manchester from the University of Florida, palynologist Estella Leopold from the University of Washington, and a group of five plant ecologists from the University of Arizona who were funded by the Monument under a CESU agreement. Project funding is being supported as an 80% Fee Demonstration Project.

In this transect through the cloud forest, researchers from the University of Arizona are making a census of all plants within one meter of a randomly placed line.

Palynologist Estella Leopold collects an epiphyte in which the local pollen rain has become trapped, providing information to show how the pollen rain reflects the actual abundance of plants in the forest. Dr. Leopold is the daughter of renowned conservationist Aldo Leopold, and was one of the most influential advocates for the establishment of Florissant Fossil Beds National Monument. She has long thought that the flora of the Sierra Madre Oriental shows a strong similarity to the Eocene flora at Florissant.

The eight person research party worked on-site at El Cielo from October 15 to 25, 2003. The field research consisted of collecting and identifying plants for a random census along four elevation transects of 1000 m^2 each on the eastern face of the Sierra Madre Oriental at 750 meters, 1250 meters, 1750 meters, and 2000 meters. The plant communities along this elevation gradient range from tropical forest in the lowlands, through the northernmost cloud forest at mid-elevations, and into pine-oak forests at higher elevations. Preliminary analysis indicates that the flora of this region shares many taxa in common with the fossil plants from Florissant, although many more unshared taxa are also present. The greatest similarity is with the cloud forest and the humid pine-oak forest. Unusual co-occurrences in these modern forests, such as that of fir and palm growing together, represent taxa that are also known in the fossil record at Florissant. It should be emphasized, however, that the Eocene forest at Florissant also contains taxa that are endemic to Asia or western North America today, and the forests of Mexico provide only one of several important floristic regions for comparison.

Working conditions during our field excursion were primitive and at some localities challenging. The local limestone terrain has many small but treacherous sink holes and sharp ridges, many of which were crossed by the random transect lines. For several nights, the group stayed at field station accommodations in the remote mountainous village of San Jose. Meals were prepared by a local family, and transport in the field was by local drivers with 4X4 vehicles, traveling along some very rough mountain roads.

The specimens that were collected are currently drying in the herbarium at Universidad Autonoma Tamaulipas in Ciudad Victoria, and will be brought into the U.S. within several weeks. Duplicates of the herbarium specimens will distributed among several institutions, including the University of Arizona, the Missouri Botanical Garden, Florissant Fossil Beds National Monument, and the National Herbarium in Mexico City. As the research progresses, we also plan to make physiognomic comparisons of the modern and Eocene plants based on an analysis of leaf morphometrics. The information obtained by the project will be of use in interpreting the paleoenvironment at Florissant, and will also benefit the managers of El Cielo Biosphere Reserve, which is a participant in the NPS-CONANP sister parks program.

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Additional photographs of this project are online at
http://eeb37.biosci.arizona.edu/~brian/Mexico_Web_Pics/Mexico_Web_Pics.html

Field work in rural Mexico has some nice delights, such as the local family who prepared our meals, including copious servings of delicious hand-crafted tortillas prepared on an open fire stove.

Name the Fossil Park

This fossil byrozoan is being etched from the limestone that is critical for the formation of the primary feature for which this park was established. Located in the Black Hills of South Dakota this park is best known for having the best examples of a geological formation known as boxwork. Answer on bottom of page 8.

Zion National Park Paleontological Survey continued from page 1

vertebra was found during our survey. The Petrified Forest Member is, as its name suggests, famous for preserving fossil wood and trees. Several areas within Zion are well known for their petrified "forests." We took care in trying to record these sites, as they are among the most sensitive of the paleontological resources within Zion, being vulnerable to theft and vandalism. The Petrified Forest Member is also an important bone-bearing member and is the rock unit having the most potential for significant vertebrate body fossils. Our survey located fragmentary remains of phytosaurs, aetosaurs, and metoposaurs. The most significant find was an isolated ornithischian dinosaur tooth. Ornithischian dinosaurs are rare in Triassic rocks worldwide and this tooth represents the oldest herbivorous dinosaur recovered from Utah. In general, the paleontology of the Chinle Formation in southwestern Utah is poorly known compared with other southwestern states, such as Arizona and New Mexico. Our baseline work is bound to increase research interest in the Chinle of this region and the excellent exposures in Zion National Park can be an important focus of this work.

While we investigated all the fossil-bearing strata located within the park, we focused our field survey primarily on the vertebrate fossil-bearing strata. Sites were recorded using hand-held Global Positioning Satellite (GPS) units that were unavailable to previous researchers. We have used the information gained from these surveys, and similar surveys done in correlative strata in neighboring regions, to create Paleontological Sensitivity Maps (DeBlieux et al., 2003). We used of 7.5 minute geologic quadrangle maps, recently completed by UGS geologists, to create these sensitivity maps using Geographic Information Systems (GIS) software. On these maps we rank the formations based on the potential for scientifically important paleontological discoveries. These maps are intended as tools to provide park managers with a framework with which to make informed decisions regarding the management and protection of fossil resources. Our ability to create these fine-resolution sensitivity maps was made possible by the existence of the new geologic quadrangle maps and demonstrates the importance of detailed geologic mapping in the National Parks Through our efforts, with assistance from NPS hydrologist Dave Sharrow, NPS paleontologist Vince Santucci, and staff of Zion National Park, over 120 new fossil localities have been located within the park. These sites provide avenues for further scientific work and visitor education and enable us to make informed predictions about the distribution of fossils in the sedimentary rocks of the park.

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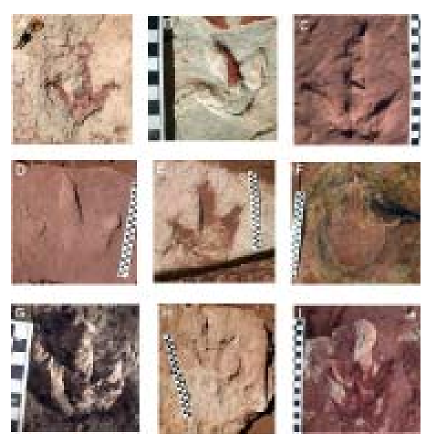

A sampling of dinosaur tracks found in the Whitmore Point Member of the Moenave Formation and the Kayenta Formation of Zion National Park. Scale bar is in centimeters.

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Answer to Name the Fossil Park
Wind Cave National Park

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U.S. Department of the Interior

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Paleontology Program
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Reconstruction of the skeleton of *Subhyracodon*. From Osborn 1898

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