



# Park Paleontology



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Geologic Resources Division, Paleontology Program

## A New Specimen of *Stagonolepis* (Aetosauria: Crurotarsi) from Petrified Forest National Park, Arizona

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Recent fieldwork in conjunction with an inventory of paleontological resources in Petrified Forest National Park (PFNP) has resulted in the discovery of a possibly complete skeleton of the aetosaur, *Stagonolepis wellsi*. Aetosaurs were large, herbivorous, heavily armored reptiles common in late Triassic terrestrial sediments. They comprise a major portion of the faunas of the Chinle Formation of Petrified Forest National Park.

Preliminary investigation of the specimen suggests that close to 100 individual elements are present, mostly armor plates. Numerous non-armor elements are present as well including a portion of the pelvis, several vertebrae, and a few ribs. The skeleton is about 2.5 meters in length and was recovered from mudstone layers just below the Sonsela Member of the Chinle Formation near Battleship Rock in the southern end of the Park.

This new specimen is of importance due to the fact that associated skeletons, including aetosaurs, are very rare in Chinle sediments. Only one other relatively complete (more than 50% of elements present) aetosaur skeleton, *Desmatosuchus haplocerus*, has been recovered to date from Arizona. Correlative strata in Texas have produced a second *Desmatosuchus* specimen as well as the type specimen of *Stagonolepis wellsi*. While a large amount of associated aetosaur material has been recovered from other sites in the southwestern United States, these four specimens, along with another, *Typhothorax coccinarum* from New Mexico, constitute the only relatively complete aetosaur skeletons known to date from North America.

As a result of the lack of whole specimens, reconstruction of these animals has mainly been from isolated elements. This specimen will allow for deterministic comparisons with

isolated aetosaur elements previously assigned to *S. wellsi* and to critically analyze past artistic reconstructions for this animal.

### Additional Reading

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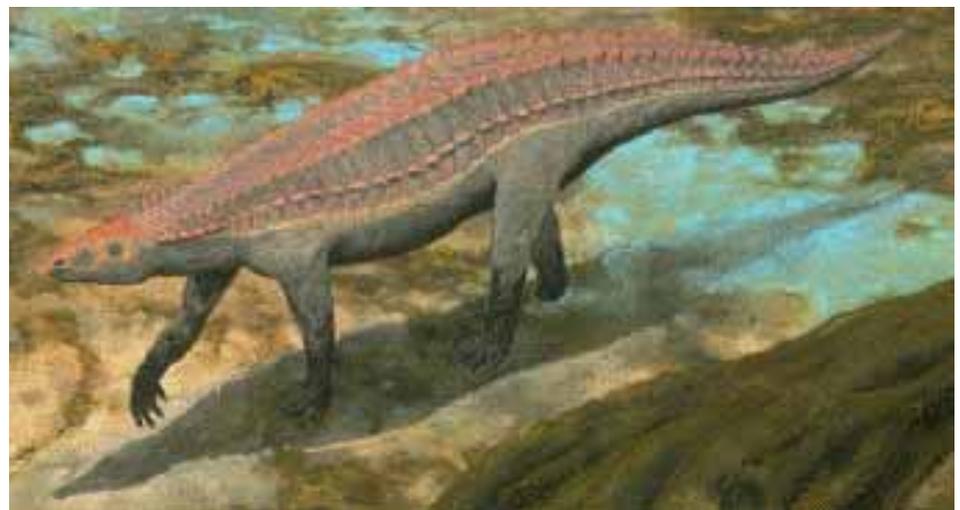
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*Stagonolepis wellsi* reconstruction by Douglas Henderson from Dawn of the Dinosaurs (Long, Houk and Henderson, 1998)

# Palynology of the Aquicludes of Fossil Gulch, Hagerman Fossils Beds National Monument, Hagerman, Idaho

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Initial results of an evaluation of the pollen and spore microflora entrapped within the shales of the aquicludes associated with the famous Fossil Gulch at the Hagerman Fossil Beds National Monument, Hagerman, Idaho. Indicates a diversity of plant types. Fossil Gulch is best known for the location of the quarry that produced over 200 individuals of the Hagerman horse, *Equus simplicidens*, a late Pliocene (3.5 million years before present) zebra-like species, extensively quarried from the locality since the 1930s. The shales of the aquicludes are within the late Pliocene (early Blancan) Glenns Ferry Formation and appear to represent a locally unique sedimentary environment. The sediments of the Glenns Ferry Formation sampled are exposed on the west bank of the Snake River (GPS N 42° 49.406', W 114° 56.192').

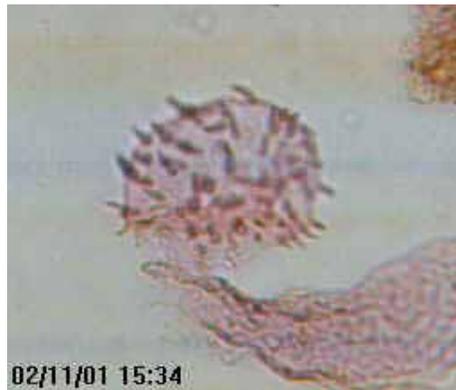
Five samples were taken from shales of the aquicludes (elevation 3100') located approximately 200 feet below the Horse Quarry (elevation 3300'). The interest in the pollen and spore content of the sediments is interesting in that it sheds some light on the character of the local flora at the time contemporary with the Hagerman Horse (*Equus simplicidens*). The sediments of aquicludes are not the sediments within which the vertebrates were entombed.

The data was compiled for each of the five samples collected in the preliminary investigation. The analysis looked at the composite flora as if it was one sample. The presence of the various diatoms, *Pediastrum*, and other algal forms, added to the recovery of water lily pollen, tells us the sediments were from clear, cool, oligotrophic ponds. The ponds were surrounded by high grass prairie or meadow. Surprisingly, only a few grains of sage (*Artemisia*) and ragweed (*Ambrosia*) were recovered. Some of the expected riparian (river corridor) hardwood species were found including oaks (*Quercoidites*), holly (*Illexpollenite*), willow (*Salixpollenites*), poplar (*Inaperturopollenites*), and hemlock (*Tsugaepollenites*). The recovery of fir (*Abietinaepollenites*), pine (*Pinuspollenites*), and spruce (*Piceapollenites*) indicate airborne and water borne input from the surrounding coniferous forest.

The overall impression is that the primary community associated with the formation of the aquicludes was an upland wet meadow surrounding biogenically (beaver) or geologically (lava flow) created oligotrophic ponds.



The dark bands in the middle of the picture are aquicludes or pond deposits. They are in the Glenns Ferry Formation found in Hagerman Fossil Beds National Monument.



02/11/01 15:34  
Pollen grain of the water lily, *Nuphar*.



02/12/01 09:51  
Fir pollen, *Abies*, recovered from the aquicludes at Hagerman Fossil Beds National Monument.

## Additional Reading

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## Fossil Pollen and Spores

The study of fossil pollen and spores is called palynology. Most pollen found as fossils has been transported by wind rather than by insects. The pollen of coniferous trees such as pine and spruce are common examples of wind-dispersed pollen. This pollen "rain" often includes the pollen from many different types of plants. When deposited in a pond or a low oxygen environment the different types of pollen will be preserved. The relative abundance of each pollen type provides an indication of the relative abundance of different types of plants in the area. After preparing the samples, palynologists collect a subsample and count the number of grains of each type of pollen. Changes in the proportion of different types of pollen and spores through the stratigraphic sequence is presented in a pollen diagram. The diagram can provide information about changes in the environment.

# Emergency Fossil Salvage Collection of the Titanotheres Graveyards, Badlands National Park: A tragic story with a happy ending

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Brontotheres (Titanotheres), the first badlands fossils to be described, are considered the largest and most impressive of the early mammals preserved at Badlands National Park. These creatures were about the size of an Indian elephant and had huge blunt paired horns on their snouts. The South Unit at Badlands contains many of the historic collecting and research areas within the park, dating back to scientific surveys in the late 1800's.

On October 26, 1999, a park ranger discovered recent illegal diggings at the remote Titanotheres Graveyard locality within the South Unit at Badlands National Park. Follow-up surveys documented over 18 poaching sites within the graveyards. The poachers were never caught. Park staff have created a baseline GIS layer of the site and are presently patrolling the site once a week.

The park received a three year grant through the NRPP program to stabilize, excavate, prepare and document the Titanotheres graveyard locality. Park staff will work with field crews from the South Dakota School of Mines and Technology (Carrie Herbel P.I.) and the Denver Museum of Nature and Science (Russell Graham P.I.). Excavations will start in August of 2002 and will continue for 5 weeks. With the assistance of our cooperating partners, we will maintain a minimum field crew of 10-15 volunteers to be on site for a field season of 5 weeks each year. We will also hire two on-site crew bosses, one NPS employee to serve as park liaison and provide direct project oversight and logistical support, and the other (from the cooperating institution) to supervise volunteer crews. We will also hire a seasonal law enforcement ranger to protect the open quarry site and the workers for the duration of the excavation each year (The quarry will be covered with gravel at the end of each field season to protect the site until the next season). A base camp consisting of field shelters, sleeping tents, and portable toilets will be set up at the site.

Fossil specimens will be prepared, curated and studied at both cooperating institutions. Due to the remoteness of the site, the majority of funding is directed towards logistics. Two institutions are needed to provide a large enough volunteer crews to carry out the excavations. The Denver Museum will focus on questions on depositional environments and will compare the site to discoveries made at Bones Galore, a late Eocene site on the



General View of the Titanotheres Graveyard at Badlands National Park.

Pawnee Grasslands in North Eastern Colorado. The focus of the South Dakota School of Mines will be on biostratigraphy. At present we don't fully understand what mechanisms created the Titanotheres Graveyards.

The first objective is to identify the extent of the bone bed by a surface survey. A site datum will be selected, its position recorded via GPS and a total station. A 1 meter sq. grid system set along a North/South and East/West transect will also be set up over the site. All surface specimens will be collected from each grid cell and labeled with the grid cell coordinates. All specimens eroding out on the surface will be salvaged. Each specimen will receive a unique field number so that it can be linked to all attribute data. The site will also be extensively photographed to record the positions of the bones. Quarry operations will not begin until all surface collecting and stabilization is completed.

Microstratigraphic units will be defined and documented for each quarried specimen. Emmett Evanoff working under the Denver Museum will determine the overall geologic setting and stratigraphic horizons represented at the site. The graveyards are located within the Crazy Johnson and Peanut Peak Members of the Chadron Formation which was described by Clark as a huge river system flowing east from the Black Hills during the late Eocene (Red River Valley Complex). The Site is lateral to a series of stacked channel-belt deposits that occur to the northeast.

These channel-belt deposits are ribbon to sheet sandstone units that show lateral accretion stratification and locally abundant, medium-scale, trough crossbed sets. The trough crossbeds and the elongation of the sandstone ribbon deposits indicate a north-west to southeast trend of the streams. The detailed alluvial architecture of these deposits will determine where the Titanotheres Graveyard site occurs relative to the channels and its paleogeomorphic setting in the original flood plain. The distribution of sandstone and mudrock deposits in the general area will be mapped and numerous detailed sections using proximal overbank sheet sandstones as marker units will be described. These and other marker units (paleosol horizons or other persistent units) will be traced throughout the region with concentration of study on the stratigraphic positioning of the Titanotheres Graveyard. Each channel-belt deposit will be studied to determine the internal architecture of the channel-belt deposits, the form of the original channels and the directions of the paleocurrent flows.

Fossil specimens from the Titanotheres Graveyard will make an ideal exhibit for the Lakota Heritage and Education Center being planned near the South Unit, or the Ben Reifel Visitor Center at Badlands National Park, which is presently undergoing exhibit redesign. If a partial skeleton is collected, then casts of the material currently in the collections will be made in order to complete

Continued on page 4

the specimen. It is hoped that at least one complete titanotheres specimen will be collected during this 3-year effort.

The South Unit at Badlands National Park is located on the Pine Ridge Indian Reservation. The memorandum of Agreement between the Oglala Sioux Tribe and the National Park Service for managing the park's South Unit (on the Pine Ridge Reservation), states that "The Service shall ... provide for the care, maintenance, preservation and restoration of features prehistoric, historic, scientific or scenic interest..." The memorandum of agreement states that Badlands staff will manage the South Unit using the standards and guidelines of the National Park Service. Under this agreement, we don't feel there will be a major conflict to operate a scientific quarry on tribal land.

Developing a scientific quarry is a proactive method in dealing with a very serious law enforcement problem. The information gained from this approach will be passed on to other paleontology parks and land management agencies. Fossil poaching plagues all land management agencies that contain paleontological resources within their boundaries. This project will create a "presence" within a normally remote area sending a message to fossil thieves that Badlands National Park is actively protecting its fossil resources.

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Catfish skull in place at the Smithsonian Horse Quarry, Hagerman Fossil Beds National Monument

## A Newly Discovered Catfish Skull from the Smithsonian Horse Quarry, Hagerman Fossil Beds National Monument

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Hagerman Fossil Beds National Monument has recently (Fall 2001) finished a three-year comprehensive survey to locate and document all fossil-bearing localities within the Monument. The end result of this ground survey yielded large numbers of Pliocene aged (Blancan Land Mammal Age) vertebrate and invertebrate fossils. While Hagerman Fossil Beds is most famous for its Smithsonian Horse Quarry and *Equus simplicidens* (Hagerman horse), a wide variety of other taxa are also found there. Sites throughout the Monument continually produce great quantities of fossil material other than the horse.

Near the end of the 2001 field season a remarkable discovery was made. Protruding from the sandstone wall of the Smithsonian Horse Quarry was a nearly complete bull-head catfish skull (*Amiurus vespertinus*). While there are no native catfish west of the continental divide today this extinct catfish is known to have existed in the Pliocene-Pleistocene deposits of ancestral Lake Idaho and its tributaries in Idaho and eastern Oregon. Remains of this catfish are readily found throughout the Monument but nearly always as isolated bones. Earlier researchers described this catfish based on isolated skull bones, as no complete skeletons or skulls had

been recovered. Once this new specimen is removed from its plaster cast and the matrix removed, it may well prove to be the most complete *Amiurus vespertinus* specimen recovered to date. A complete skull will give paleontologists an important understanding of the osteology of this relatively unknown fish.

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## Preliminary Report on Recent Discoveries during a Paleontological Survey in Aniakchak National Monument and Preserve – 2001

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Numerous stops were made during the float trip. Much of the sampling has not yet been analyzed and will likely prove fruitful, but significant results were obtained through field observations and are discussed here. We climbed the wall of the caldera near the

Gates and discovered numerous plant-bearing deposits between the volcanic layers that the caldera is famous for. Given that volcanoes last for only a few thousand years volcanic rocks are the best for determining dates, these fossil deposits represent an opportunity to investigate rates of floral succession in this area. Examination of the Jurassic units in the Park revealed several invertebrate fossil localities but no evidence of a depositional system similar to that observed at Ukak Falls in Katmai National Park.

The most notable find of the trip was the discovery of a three-toed dinosaur footprint along the coast of the Park in the Late Cretaceous Chignik Formation. This track is the first evidence of Cretaceous dinosaur remains from the Alaska Peninsula and the age

of the track is approximately the same as the spectacular dinosaur finds on the North Slope. Given the shape of the track and its age, this track was likely made by a hadrosaur, or duck-billed dinosaur. Associated with the three-toed track are two other impressions that may prove to be prints made by the hands of this animal. While performing a salmon survey with NPS personnel in mid-September also made a latex mold of the track. The mold is in the Dallas Museum of Natural History and we were successful in making a plaster cast of the track so that a physical impression of the footprint is now available for study. The plaster specimen in conjunction with photographs taken on site will be used to describe the specimen for scientific publication by the author of this survey report.

## NPS Paleontologists Participate in Discovery Channel Show: Walking with Prehistoric Beasts

The recent show on the Discovery Channel, *Walking with Prehistoric Beasts*, included an interview with Scott Foss, museum technician at John Day Fossil Beds. Scott recently completed his doctorate on a group of animals known as entelodonts (see side bar) entitled: Systematics and Paleobiology of the Entelodontidae (Mammalia, Artiodactyla), in the Department of Biological Sciences, Northern Illinois University in DeKalb, Illinois. During his interview on the show Scott in describing these animals said, "I've always imagined these as being creatures that have an 'attitude'. They would walk into a room and say 'I'm Here'".



Scott Foss, museum technician, John Day Fossil Beds, with his favorite fossil, the entelodont, *Dinohyus*, which he now calls *Daenodon*, found at Agate Fossil Beds.

While a relatively recent addition as a permanent employee at John Day, Scott has had a long association with the NPS and worked as a seasonal at both Badlands National Park and John Day Fossil Beds National Monument.

Greg McDonald, paleontology program coordinator, in the Geologic Resources Division, was a scientific consultant for the ground sloth featured in the show.

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### What are Entelodonts?

Entelodonts are an extinct group of "pig-like" hoofed mammals that lived in North America between 39 and 19 million years ago. They are probably best known for their unusual flanges that extend ventrally from the cheek bones and the knob-like protuberances on the ventral portion of the mandible. Entelodonts are interpreted to be the "top-scavengers" of their time and probably ate everything from tubers to meat. The chipped enamel on their large teeth, together with the massive chewing and biting muscles supports an interpretation that these animals were also bone crushers. Imagine a pig the size of a bison that filled an ecological niche somewhere between a modern grizzly bear and a hyena.

Large numbers of entelodonts have been discovered in Badlands National Park and Agate and John Day Fossil Beds. The "Pig Dig" at Badlands and the Agate Springs Quarries at Agate Fossil Beds are two of the most important fossil quarries that have yielded complete entelodont specimens.



Excavation of the neck of *Alamosaurus* at Big Bend National Park. Tony Fiorillo with notebook.

## Remains of the Last of the Sauropod Dinosaurs Excavated at Big Bend National Park

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In June of 1997, a member of a joint DMNH-UTD (Dallas Museum of Natural History (DMNH), and the University of Texas at Dallas (UTD) field party discovered the weathered remains of the sacrum of a large sauropod dinosaur in the Javelina Formation (Late Cretaceous: Maastrichtian) at Big Bend National Park. Given the stratigraphic setting of the specimen, this specimen is tentatively assigned to the genus *Alamosaurus* as it is the only sauropod dinosaur recorded from the Late Cretaceous of North America.

*Alamosaurus* seems to have had a restricted geographic range, found only in the southwestern United States and Mexico. Unfortunately given the significance of this animal it is poorly known from complete skeletal material.

Subsequent work at the site resulted in the discovery of an articulated string of nine neck vertebrae. These vertebrae represent the first articulated neck known of *Alamosaurus*, thereby justifying a large-scale excavation. NPS staff took the lead on securing appropriate protocols for the excavation, while also handling all media contacts. Bell Helicopter provided use of one of their helicopters and a helicopter crew for the operation.

After ten days of field excavation to ready the dinosaur neck for extraction, the helicopter crew successfully lifted each of the vertebrae from the site and deposited them on a flatbed

truck parked some distance away. These field jackets were then driven to the Dallas Museum of Natural History.

Careful preparation of the specimen is needed before final study. Visitors to the Museum can view the progress of the project through the public window into the fossil laboratory. The preparation component of the project is expected to take two to three years. Additional work at the site includes a plan for spot checking a map generated by ground-penetrating radar (GPR). The GPR work suggests that several other bones of this skeleton remain to be excavated. This second site is in the same general area as the above project and the specimens recovered are also from the Javelina Formation. This site is significant for two reasons. First, it is the first bonebed containing the remains of *Alamosaurus*, and second, the sauropod remains are all from juveniles. The depositional setting at this site is that of a shallow lake.

*Alamosaurus* is the only taxon recorded from this site. Based on the number of femora, there are at least three individuals represented. Comparison of limb element length of specimens from this site with those of adults shows these juveniles are approximately 50%-60% adult size, or approximately 10 to 13 meters long. Outcrop pattern is poor in this area but the current stratigraphic approximation is that this site is 60 meters above the contact with the underlying Aguja Formation.

A second project by the same partnership as the above has completed the field component of a second *Alamosaurus* project within Big

Bend National Park. The site of deposition is an approximately 67 million -year-old lake bed. Abundant charophyte fossils indicate deposition in shallow, relatively clear, alkaline waters. The lake bottom was fine mud. Bones are dispersed through a two meter interval but are concentrated along the base of the unit. Many limb bones have high angle plunges that in some extreme instances approach vertical. This bone orientation pattern, the contorted nature of the entombing sediments, and the suggestion of large sauropod footprints at the upper contact of the bone-bearing unit suggests that this site experienced bioturbation (dinoturbation) probably by adult sauropods. Results of this project were presented at the annual meeting of the Society of Vertebrate Paleontology in 2001.

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A helicopter was used to lift the plaster jackets containing the neck vertebrae of *Alamosaurus* and fly them out of the wilderness area in the park where they were found.

# Museum of Geology, South Dakota School of Mines and Technology Mounts Skeleton of *Archaeotherium* for Badlands National Park

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Since 1993, the Big Pig Dig has proven to be one of the more significant paleontological finds in recent years at Badlands National Park. It also has developed into a major visitor education center, attracting between 5,000 and 8,000 visitors per year. Each field season, new visitor support features have been added to enhance the overall visitor experience at the site. Working in cooperation with the National Park Service, the South Dakota School of Mines and Technology has developed a cast of an *Archaeotherium* skeleton which will go on display at the dig site this summer.

The cast will serve as an interpretative model of the pig-like animals that once lived in the area approximately 33 million years ago. Tourists will be able to better visualize these

In addition, this project has benefited the Museum of Geology by allowing stabilization of the mounted skeleton that has been on display for approximately 60 years. The skeleton was in the process of breakdown due to high temperatures (due to the lighting) and stress on the skeleton by the mount. An additional cast will be made for remounting in the display at the Museum of Geology.



Original museum mount of *Archaeotherium* from Badlands National Park on display at the Museum of Geology, South Dakota School of Mines and Technology, Rapid City.

The second cast will be made using supplies currently available within the Museum's preparation laboratory. A group of volunteers have offered to make the second cast and complete it by December 2002. The original skeleton is now stabilized and will be stored within the Museum collections in a protected manner using Ethafoam and stable bedding jackets.

Undergraduate students comprised the labor pool to complete this project. Under the supervision of Ms. Carrie Herbel, Collections Manager and Preparator and Daniel Lien, South Dakota School of Mines undergraduate student, many students obtained valuable experience to do such work, a commonplace thing for many natural history museums.

## Procedure

The overall casting process proved to be very long and involved. Each step required an enormous amount of problem solving and often required more time than was originally planned. The following is a list of steps that were followed to complete the project.

1. The original skeleton was dismantled from the exhibit in the Museum of Geology exhibit hall.
2. Once the bones were removed from exhibit, they were stabilized in preparation for molding.
3. The molding process of the skeleton was set up in such a way to limit the amount of stress on each bone within the skeleton.
4. Using rubber latex, the skeleton was molded. Cheesecloth was used to strengthen the latex. Plaster mother molds were made around the latex molds in order to retain the shape of the rubber. The bones were removed from the molds.
5. The skeleton was cast from the latex molds using Super Hard 4:1 Epoxy Resin (Tap Plastics), a resin well known for its strength and durability.
6. The casts were prepared for mounting by inserting metal rods and drilling screw holes into the casts.
7. The cast was mounted on a metal framework and sturdy base.
8. The cast was painted using acrylic paint.
9. The finished mount will be delivered to Badlands National Park.



David Lien with cast of skeleton of *Archaeotherium* he and the Museum of Geology team produced for Badlands National Park



## Did You Know?

That four parks are the location for their respective state fossils?

The state fossil of Arizona is *Araucarioxylon arizonicum* which is found at Petrified Forest National Park.

The fossil fish, *Knightsia eocaena*, the state fossil of Wyoming and is a common fossil at Fossil Butte National Monument.

Hagerman Fossil Beds National Monument is the home of the "Smithsonian Horse Quarry" where over 200 individuals of the "Hagerman Horse", *Equus simplicidens*, the Idaho State Fossil have been found.

John Day Fossil Beds in Oregon contains many fossils of the fossil dawn redwood, *Metasequoia*, the state fossil of Oregon.

# Papers Given At Recent Meetings

The following papers and abstracts by NPS staff were presented at the Sixth Fossil Resource Conference held in Grand Junction, Colorado, September 10-14, 2001.

## Papers

Benton, R.C., E. Evanoff, C.L. Herbel, and D.O. Terry Jr. 2001. Baseline Mapping of fossil bone beds at Badlands National Park. Proceedings of the 6<sup>th</sup> Fossil Resource Conference. V.L. Santucci and L. McClelland (eds.). Geological Resources Division Technical Report NPS/NRGRD/GRDTR-01/01:85-94.

Fiorillo, A.R., V.L. Santucci, and R.A. Gangloff. 2001. Establishing baseline paleontological resource data for research and management needs: Lessons learned from the National Park Service Alaska Region. Proceedings of the 6<sup>th</sup> Fossil Resource Conference. V.L. Santucci and L. McClelland (eds.). Geological Resources Division Technical Report NPS/NRGRD/GRDTR-01/01:123-129.

Gibbons, S. and H.G. McDonald. 2001. Fossil sites as National Natural Landmarks: Recognition as an approach to protection of an important resource. Proceedings of the 6<sup>th</sup> Fossil Resource Conference. V.L. Santucci and L. McClelland (eds.). Geological Resources Division Technical Report NPS/NRGRD/GRDTR-01/01:130-136.

Hunt, A.P. and V.L. Santucci. 2001. An unusual tetrapod track morphology from the Permian Coconino Sandstone, Grand Canyon National Park, Arizona. Proceedings of the 6<sup>th</sup> Fossil Resource Conference. V.L. Santucci and L. McClelland (eds.). Geological Resources Division Technical Report NPS/NRGRD/GRDTR-01/01:44-47.

Scott, R.L., V.L. Santucci, and T. Connors. 2001. An inventory of paleontological resources from the national parks and monuments in Colorado. Proceedings of the 6<sup>th</sup> Fossil Resource Conference. V.L. Santucci and L. McClelland (eds.). Geological Resources Division Technical Report NPS/NRGRD/GRDTR-01/01:178-202.

## Abstracts

Bell, G.L. Jr. 2001. Guadalupian Series, a global stratotype section (GSSP) for the Middle Permian in Guadalupe Mountains, National Park, Texas.

Benton, R.C., E. Evanoff, C.L. Herbel, and D.O. Terry Jr. Baseline mapping of fossil bone beds at Badlands National Park: a first in park history.

Benton, R.C. Fossils and fire: a case study in Badlands National Park.

Connors, T. National Park Service Geologic Resource Inventory.

Cook, A. H.W. Meyer, and B.A. Drummond. Demonstration of a new database to update the taxonomy of fossil insects and plants from Florissant, Colorado.

Elder, A.S. How paleo collections can compete with other disciplines for cataloging money or what I learned as a SEPA panel member.

Foss, S.E. and V.J. Naylor. Fossil resources at Scotts Bluff National Monument: a recent paleontological survey of the Orellan White River Beds.

Foss, S.E. and T.J. Fremd. Partners in managing fossil resources in the John Day Basin.

Fremd, T.J. Collaborative science in temporally extensive basins.

Fremd, T.J. and S.J. Rickabaugh. Preliminary paleontological reconnaissance of the Frederika Formation, Wrangell - St. Elias Mountains, Alaska.

Fremd, T.J. Viewing the Miocene from the "Anthropocene": cultural interference in natural areas with "Deep Time" perspectives.

Gensler, P.A., B. Lorkowski, and N. Farmer. A three-dimensional correlation between depositional environments and fossil localities at Hagerman Fossil Beds National Monument, southern Idaho.

Grenard, D.G., H.W. Meyer, T.W. Henry, E. Evanoff, and D. Vardiman. The Gold Belt National Scenic Byway, Colorado: a partnership for geological interpretation.

King, J., T.J. Fremd, and J. Zancanella. Sorefoot Creek Locality: Combining vertebrate paleontology research, education, and stewardship.

Lutz-Ryan, L.C., H.W. Meyer, and P. Thorpe. Project P.I.C.K.: a partnership for paleontological education resource management and research.

Madsen, S.K., G.E. Burroughs, and A.S. Elder. Silica and respirable dust exposures in the field and lab - a case study.

Meyer, H.W. Sharing paleontological resource management ideas across international boundaries.

Miller, S.J. and R. Knudson. The *Stenomylus* Quarry at Agate Fossil Beds National Monument: history, science, and resource management.

Prado V., I. and H.W. Meyer. Paleontological Resources in Peru.

Rodeck, J.H., H.W. Meyer, and T.A. Ulrich. New shelters for the protection of petrified trees at Florissant Fossil Beds National Monument.

Santucci, V.L. Paleontological resource inventories in the national parks.

Smith, M.E., T.J. Fremd, L. M. Vella and S.E. Foss. The role of the conservation laboratory in the preservation and curation of fossil resources.

Vella, L. M., S.E. Foss, and T.J. Fremd. Efficient and accurate paleontological research and curation using data links.

The following papers based on research done in national parks were presented at the 2001 annual meeting of the Society of Vertebrate Paleontology held at Montana State University in Bozeman, Montana. Abstracts of the papers were published in the supplement to the *Journal of Vertebrate Paleontology* 21(3).

Benton, R.C. Comparative taphonomy of Holocene microvertebrate faunas preserved in fissure fill versus shelter cave deposits.

Black, S.A., C.L. Herbel, and R.C. Benton. Bone Beds in the Lower Scenic Member, Brule Formation (Oligocene), Badlands National Park, South Dakota.

Chure, D.J. A new sauropod with a well preserved skull from the Cedar Mountain Fm. (Cretaceous) of Dinosaur National Monument, UT.

Fiorillo, A.R. and H. Montgomery. Depositional setting and paleoecological significance of a new sauropod bonebed in the Javelina Formation (Cretaceous) of Big Bend Park, Texas.

Fremd, T.J. Assemblages and interbasin correlations in the Pacific Northwest.

Hadly, E.A., C.J. Conroy, and J.M. Zinck. Genetic variation of montane voles: the present is not a key to the past.

Sankey, J.T. Late Cretaceous theropod dinosaurs from new microvertebrate sites, Big Bend National Park, Texas.

Wagner, J.R., and T.M. Lehman. A new species of *Kritosaurus* from the Cretaceous of Big Bend National Park, Brewster County, Texas.

Papers presented at the North American Paleontological Convention held at the University of California, Berkeley June 26 - July 1, 2001 published in Program and Abstracts North American Paleontological Convention. *PaleoBios* 21 (2) supplement.

Albright, L.B., T.J. Fremd, M.O. Woodburne, C.C. Swisher, and B.J. MacFadden. Toward a revision of the chronostratigraphy of the John Day Formation, Oregon.

Bell, G.L. Jr. and C.J. Crow. Fabric patterns of the Permian (Guadalupian) Middle and Upper Capitan Reef, Texas and New Mexico, USA: a progress report.

Bryant, H.N. and T.J. Fremd. The evolutionary history of the Nimravidae (Carnivora) in the John Day Basin of Oregon.

Bryant, L, M. O'Neill, L. Kuizon, H.G. McDonald, S. Shelton, and T.J Fremd. Fossil futures: preserving fossils from public lands - panel discussion with representatives of federal land management agencies.

Foss, S.E. and T.J. Fremd. Biostratigraphy of the Entelodontidae (Mammalia: Artiodactyla) from the John Day Basin, Oregon.

Fremd, T.J. Appraising the significance of complex assemblages and data defragmentation: an example from the volcanoclastics of eastern Oregon.

Hannibal, J.T. and H.G. McDonald. Three-dimensionally preserved specimens of the crayfish *Pacifastacus* and crayfish gastroliths from the Pliocene of Idaho.

Hanson, D.A. and T.J. Fremd. A John Day step-child - the southern basin faunal assemblages.

Kohn, M.J., J. Miselis, and T.J. Fremd. Oxygen isotope systematics of fossil equid teeth from central and southeastern Oregon over the last 27 ma.

Lander, B.E. and T.J. Fremd. Late Whitneyan, Arikareean, and earliest Hemingfordian oreodonts (Mammalia: Artiodactyla: Agriochoeridae and Oreodontidae) from the John Day Formation of central Oregon.

Martin, J.E. and T.J. Fremd. Revision of the lithostratigraphy of the Hemphillian Rattlesnake units of central Oregon.

Meyer, H.W. and S. Manchester. The Oligocene Bridge Creek Flora, John Day Formation, Oregon.



The current members of the John Day Associates at the North American Paleontological Convention, Berkeley, California, June 2001. Originally started by J.C. Merriam when he realized that the research possibilities surpassed his scientific abilities and lifespan, the John Day Associates are a group of research scientists who study the paleobiology, paleopedology, paleoecology, geology, paleobiogeography, geochronology, and paleogeochronology of John Day Basin Deposits. A symposium entitled: *Cenozoic Paleontology and Stratigraphy of the John Day Basin, Oregon USA* featured 18 papers that brought to bear the latest advancements in the knowledge of paleontology and geology in the John Day Basin.

Pajak, A.F. III, T.J. Fremd, and D. Hoy. Microvertebrates from a new Arikareean local fauna, John Day Formation, Oregon, with biostratigraphic and taphonomic implications.

Smith, M.E., T.J. Fremd, and R.C. Wood. Discovery of a cranium of *Stylemys* (Reptilia: Chelonia) from the Turtle Cove Member of the John Day Formation, central Oregon.

Zancanella, J., S.E. Foss, and T.J. Fremd. Inter-agency cooperative management of fossil resources in the John Day Basin, Oregon.

Papers presented at the Annual Meetings of the Geological Society of America, Boston, Massachusetts, November 1-10, 2001.

Crow, C.J. and G.L. Bell Jr. Vertical growth form of *Gigantosporgia*: a new lithologic reef fabric from the Middle Capitan Limestone (Permian: Guadalupian), West Texas, USA. Geological Society of America, Abstracts 33(6):A-13.

Lutz-Ryan, L.C., H.W. Meyer, A. Kinchloe, and P. Thorpe. Project P.I.C.K.: A Partnership for Paleontological Education, Resource Management, and Research. Geological Society of America, Abstracts 33(6):A-34.

## Recent Literature on Park Paleontology Resources

### Publication

Evanoff, E., K.M. Gregory-Wodzicki, and K.R. Johnson (eds.) 2001. Fossil flora and stratigraphy of the Florissant Formation, Colorado. Proceedings of the Denver Museum of Nature and Science Series 4, Number 1: 216 pp.

Santucci, V.L., J. Kenworthy, and R. Kerbo. 2001. An inventory of paleontological resources associated with National Park Service caves. Technical Report NPS/NRGRD/GRDTR-01/02:50 pp.

Proceedings of the 6th Fossil Resource Conference. 2001. V. L. Santucci and L. McClelland (eds.). Technical Report NPS/NRGRD/GRDTR-01/01

### Available from

Available for purchase from the Denver Museum of Nature and Science. 2001 Colorado, Blvd. Denver, Colorado 80205-5798 303 370-6444 ([www.dmns.org](http://www.dmns.org)). Cost is \$19.95, with a \$4.95 shipping charge for the first copy and an additional shipping charge of \$1.00 for each additional copy

Can be obtained by contacting either the Cave Resource Coordinator or Paleontology Program Coordinator, Geologic Resources Division, National Park Service, P.O. Box 25287, Denver, Colorado 80225

Can be obtained by contacting the Paleontology Program Coordinator, Geologic Resources Division, National Park Service, P.O. Box 25287, Denver, Colorado 80225

## Paleo Parks



Map showing National Park Service units that have fossils. The current list of parks totals 150.

### Summary – Survey of Fossils in Parks

#### Greg McDonald

Paleontology Program Coordinator  
Geologic Resources Division  
National Park Service  
Denver, Colorado

The paleontology program conducted a survey of parks to determine what is needed to help parks provide better care for their fossil resources and aid in establishing program priorities. The summary to the paleo survey provided below is based on responses from 141 parks. Eighty-three parks indicated they had fossil resources but only 20 indicated that fossils were specifically mentioned in the park's General Management Plan (GMP).

Only 3 parks in the survey have filled out the standard NPS fossil locality form for all known fossil localities within the park, but 22 parks have indicated that fossils sites are one of the layers in the park GIS.

Eighteen parks have partnerships (MOU, MOA or Cooperative Agreements) with universities or museums related to their fossil resources.

Fossils are mentioned or included in interpretative programs at 41 parks.

The status of fossils in park collections need to be reexamined. While only 31 parks said that they have fossils catalogued in ANCS+ at the park, 42 said their fossils were properly stabilized, preserved and stored. Thirty-eight parks have fossils from the park housed in non-NPS repositories.

Currently there are 32 parks which have issued research permits related to fossils in

the park but only 8 parks have identified research needs related to paleontology in the new automated research permit system.

In response to the question as to park needs for technical assistance with its fossil resources, 77 indicated that they did need specific types of technical assistance and 58 parks indicated that they needed assistance in writing PMIS statements to secure funding for projects related to its fossil resources.

#### Specific needs are as follows:

Scoping to Identify Park Needs 59

Protection 20

Stabilization 13

Inventory and Monitoring 59

Collection and Storage 28

Interpretation 32

Facilitating Research 38

Other (Finding/Locating Sites) 2

#### Interested in helping parks with their paleontological resources?

The Geoscientists in Parks (GIP) program is looking for individuals interested in helping parks with their paleontological resources in the areas of research, resource management and interpretation. Positions are listed at the web site <http://www2.nature.nps.gov/grd/geojob/index.htm>

To apply for a research permit at any park you can access the application on line at <http://science.nature.nps.gov/research>

#### **Additional Reading**

Bayless, J. and N. Henderson. 2001. The Online Launch is Up. *Park Science* 21(1):39-40.

## Florissant Fossil Beds National Monument Participates in Colorado Digitization Project

#### Herbert W. Meyer

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Florissant Fossil Beds National Monument has spent the past two years as a primary partner in a project sponsored and funded by the Colorado Digitization Project (CDP). As a partner in this project, it has been possible to expand the digitized literature and collections data for the Monument's new databases and website.

Literature and collections dealing with the Florissant fossils are widely scattered. There are about 40,000 specimens in 20 museums in North America and Europe. Almost all of these are non-NPS collections that were made during the later 1800s and early 1900s, and were described in about 500 publications. In a previous project, the Monument's paleontologist visited all of the important museums with Florissant collections in order to compile collections data and complete photography. Each specimen was then correlated with every publication that had referenced the specimen. These collections and publications include all of the type specimens upon which the 1,700 species from

Florissant are based, almost all of which are unique to this site. It is important to compile and integrate this information into an accessible database in order to facilitate research.

During the CDP portion of the project, the Monument was able to scan 4,000 of the 12,000 pages of relevant publications and over 7,000 photographic slides of type and published fossils. These digital images have been added to the database archives, and it will be possible to directly correlate a fossil's catalog data with the new photographic images as well as the digitized copies of the publication pages on which the fossil was described. Many of these fossils, even the type specimens, were never illustrated in publication, and are available as photographic images for the first time in the new database. This new integrative database provides the capability to conduct fully integrated searches to access both collections and publications. This makes it possible to easily retrieve information and to conduct complex inquiries about the taxonomic diversity of the paleontological resources from Florissant. The participation in the CDP project has also made all of the Monument's data available to the CDP master database, which assures that the data will be protected in a non-NPS data repository.



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Copies may be printed from the internet for free distribution.

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Skull of the entelodont *Daeodon* (formerly known as *Dinohyus*) found at Agate Fossil Beds from the collections of the Carnegie Museum of Natural History (CM 1594). Illustration from Peterson (1909)