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Geologic Resources Division, Paleontology Program

New Dinosaur Film Distributed to National Parks

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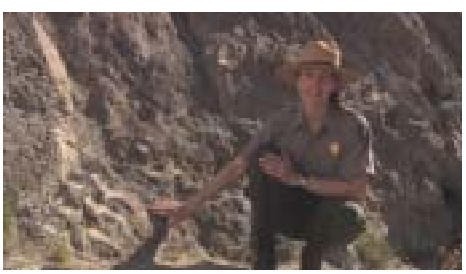
Last summer, the Discovery Channel released a new animated special, WHEN DINOSAURS ROAMED AMERICA, where each species came to life through cutting-edge animation. With the help of the NPS Geologic Resources Division and Dinosaur National Monument, Discovery Channel, a Proud Partner of America's National Parks, has modified the film for use by dinosaur related National Parks across the county. This animated special gives a guided tour of North American dinosaurs from the Triassic Period (220-200 million years ago) through the upper Jurassic Period (150 million years ago) to the middle Cretaceous Period (92 million years ago) and the late Cretaceous Period (65 million years ago).

Intended to be shown at visitor center kiosks, auditorium presentations, and ranger-led seminars, the film informs visitors about the wide array of dinosaur fossils found in our National Parks. The film also draws on lessons learned from the demise of the dinosaurs to teach visitors about the importance of land preservation in preventing species extinction. In addition, the film reminds visitors to leave all fossils in the park so that we can continue to further our knowledge of dinosaurs and their evolution.



Ingrid Nixon, a ranger at Glacier Bay National Park, shown here with a string of dinosaur vertebrae, was the host for the video. Courtesy of Discovery Communications.

The film was produced at Dinosaur National Monument in consultation with Greg McDonald, Paleontology Program Coordinator, NPS Geologic Resources Division, and hosted by Ingrid Nixon, Glacier Bay National Park. To receive the film, Parks were required to submit a short application detailing the extent of their dinosaur related programs and visitations. The National Park Foundation and the Discovery Channel hope the film educates and informs visitors about the importance of National Parks in dinosaur research, in addition to enhancing their overall National Park experience. The new dinosaur-themed film was made available by the National Park Foundation through the generous support of Discovery Communications, Inc., a Proud Partner of America's National Parks.

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A herd of *Triceratops* one of the scences from the video When Dinosaurs Roamed America. Courtesy of Discovery Communications.

Discovery Communications, Inc.

As a Proud Partner of America's National Parks, Discovery Communications, Inc. is harnessing its core business skills to bring new and varied National Park experiences to the public, particularly to a public that might not visit a Park in any other way. Reaching over 650 million subscribers worldwide through its 14 global television brands, Discovery Communications, Inc. is the ideal visual-media partner for the National Parks.

Discovery's mission as a global, real-world media company is not just to entertain, but also to educate. Part of the Discovery experience includes a public mission dedicated to harnessing the tools of the Information Age and bringing its full potential to people all around the world.

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Fossils as an Investment Strategy

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Since 1990 the number of commercial fossil dealers and the availability of fossils to private collectors has increased substantially. Commercial dealers have long claimed that fossils are an excellent investment opportunity, and other sources, including The New York Times (September 15, 1996; "Natural History at Unnatural Prices"), have remarked that fossils outperformed other investment options between 1970 and 1995. In 1990 a commercial dealer printed a catalog listing "Four Good Reasons to Invest in Fossils". These reasons included: "As a straightforward investment opportunity, fossils outperform many other options". The primary focus of our research was to compare fossils, as an investment, to several other common investment strategies.

We collected over 800 selling prices in 1991, 1996, and 2001 from commercial dealers and private sellers to establish a mean commercial value for five different fossils. We compare this change in value to the performance of a certificate of deposit and the SNP 500.

Why did you follow these fossils?

Each fossil was chosen for study because it met the following criteria: 1) the fossil was commercially abundant during each time period and the fossils were numerous enough to permit comparison with fossils of similar size and condition (and furthermore, the influence of taphonomy on the value could be eliminated); 2) the fossils were, and are, in demand by collectors but not necessarily by universities and museums. Research-quality fossils tend to be rare enough that determining a value is difficult.

Several commercial dealers advertise these particular fossils as being ideal for display and investment, making the selected fossils a representative portfolio.

What fossils were included in this study?

The Diplomystus sp. fish fossil was selected for study because it is commercially available and commonly used as a display fossil by interior decorators. All fossils in this study were from the Green River Formation in Lincoln County, Wyoming. Selling price varies directly with fossil length and only complete specimens between 5.5- and 6.5 inches in length were recorded.

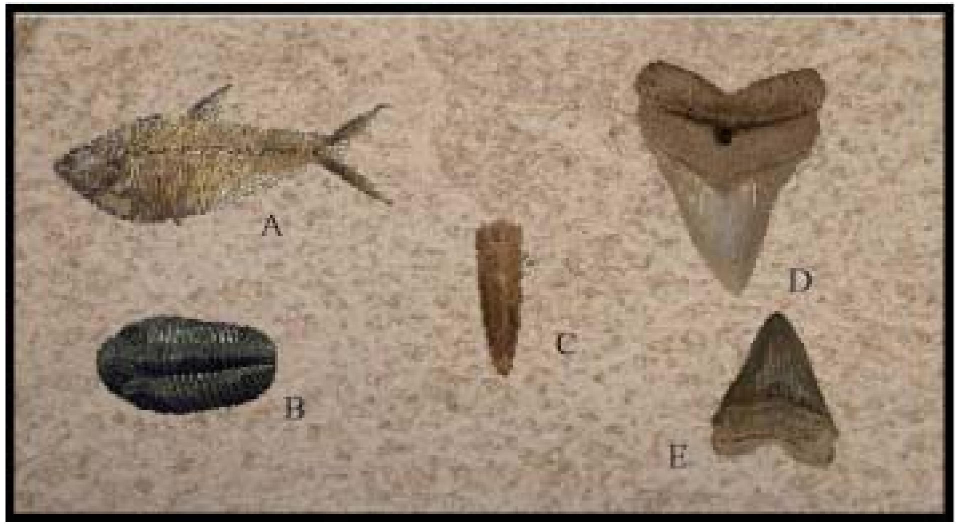


Figure 1. The fossils tracked in this study: A) *Diplomystus* sp., B) "*Phacops africanus*", C) *Spinosaurus* tooth, D) 6-inch *C. megalodon* tooth, E) 4-inch *C. megalodon* tooth.

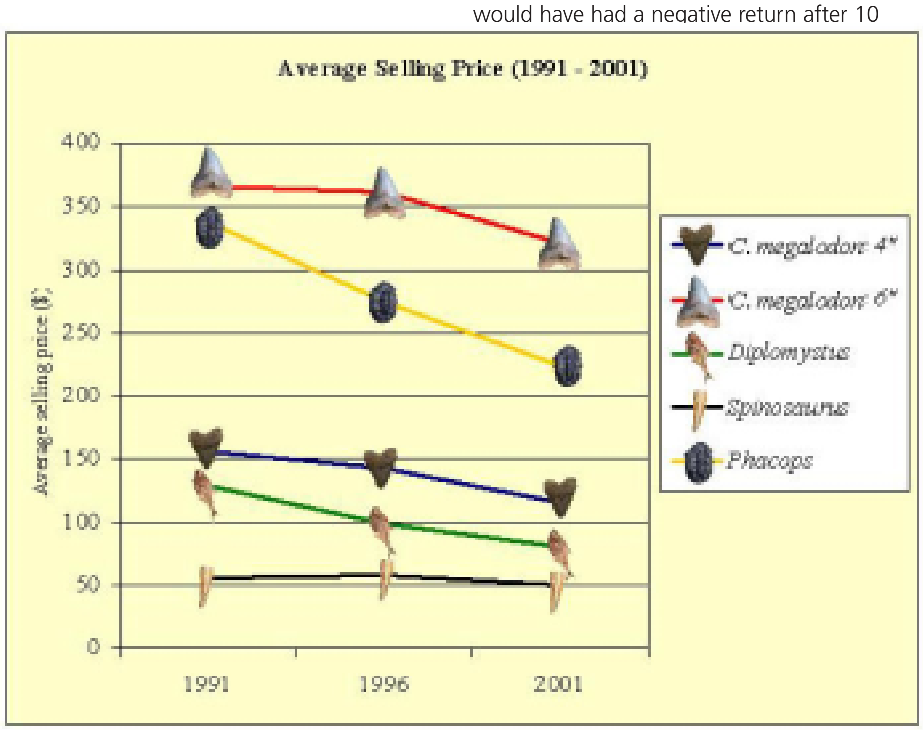
"*Phacops africanus*", a large Moroccan trilobite, was also identified by sellers as Phacops rana africanus, Drotops megalomanicus, and Phacops megalomanicus. Our data set included only trilobites on matrix with full articulation, visible eyes, and minimal enrollment. All specimens were between 4.5 and 6-inches in length and were in good condition with minimal restoration. Commercial dealers consider this trilobite the "most marketable" of all trilobite taxa (http://www. geocities.com/ trilobitologist/ Mar2001.html).

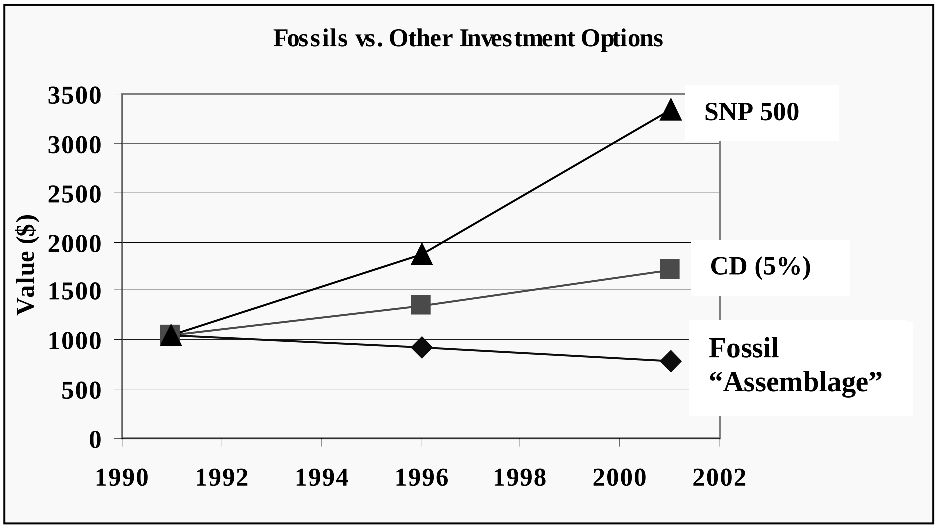
The *Spinosaurus* dinosaur teeth are also Moroccan. These are currently the most abundant dinosaur teeth at trade shows. When fossils were encased in a Riker Mount the value of the mount was deducted from the price. All dinosaur teeth were between 1.5 and 2-inches in length and unrestored.

C. megalodon teeth formed two sub-groups in this study: those varying in size between 3.5 and 4.5-inches in length and those between 5.5 and 6.5-inches in length. *C. megalodon* is the most common marine vertebrate fossil at trade shows. Commercial dealers commonly grade the fossils according to size, tip damage, enamel condition, root loss and source. All prices in this study came from teeth with excellent root and enamel condition with well-defined serrations and no tip damage. The New York Times (September 15, 1996) cited *C. megalodon* as an example of a fossil that outperformed equivalent investments in the stock market for the period 1970 – 1996.

How well did the fossils compete with other investments?

An investment in any of the fossil groups would have had a negative return after 10





years. The trilobite suffered the largest decrease in selling price, falling steadily from $338 in 1991 to $275 in 1996 to $223 in 2001. While the dinosaur and larger shark teeth fell approximately 10% in value the other fossils returned only 75 cents for each dollar invested. The total "assemblage" value of the fossils (one fossil purchased from each category) fell from $1052 in 1991 to $932 in 1996 to $788 in 2001. In comparison, a stock investment of $1052 in 1991 (based on the SNP 500) would have returned $1876.05 in 1996 and $3333.78 in 2001. Had the initial investment been used to purchase a certificate of deposit at a 5% rate of return the $1052 would have yielded $1342.64 in 1996 and $1713.59 in 2001.

Why the decrease in fossil values?

The largest misconception held by many private fossil collectors and potential investors is that the supply of fossils is severely constrained— perfectly inelastic, in economic terms— and that this supply constraint will lead to rising values.

However, the supply of fossils, that is the number of fossils available in the marketplace, is actually increasing, which is having the opposite effect on values. Although The New York Times (February 15, 1994; "Clash on Fossil Sales Shadows a Trade Fair") described a "boom in fossil sales and prices", the increased supply of many fossils has driven prices down. The supply of *C. megalodon* teeth has increased in the past decade as commercial collectors have recovered vast quantities from the rivers around Charleston, South Carolina.

Both supply and availability of the Moroccan trilobite have also increased. Before 1991 the supply of such fossils was limited to a few large commercial dealers (e.g., Paleosearch, Inc., Black Hills Institute of Geological Research, and Prehistoric Journeys, Inc.) and sales were primarily through printed catalogs and trade shows. The existence of a relatively small number of suppliers can produce a monopoly effect wherein higher prices result from "take it or leave it" approach to selling.

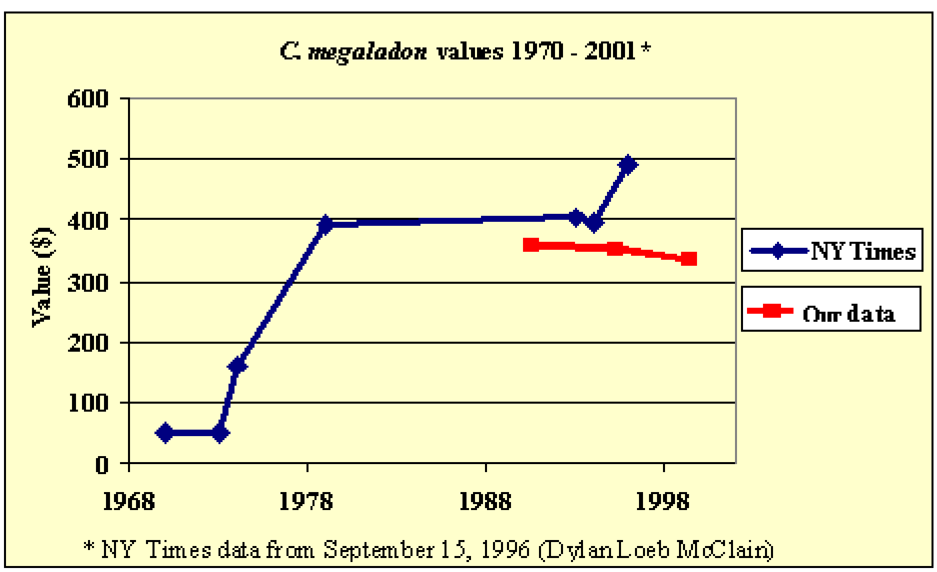
By 2001, however, the Internet made such fossils significantly easier to find and compare, and greatly increased the number of sellers and buyers in the marketplace. Sellers and buyers may now trade across great distances in a relatively costless environment. This is analogous to an increase in the market supply of fossils, which exerts downward pressure on prices. Furthermore, the Internet has significantly lowered the search costs involved in the purchase of fossils. Buyers may now gather price information from greater numbers of potential sellers without incurring significant cost. This breaks any potential supply monopolies, and brings greater competition to the marketplace as sellers now compete with each other not just locally or regionally, but nationally and even internationally. As sellers compete for business, greater competition leads to lower prices for buyers.

Despite the general downward trend in fossil values, there are instances where dramatic gains may occur. However, these gains are typically short-lived, and often traceable to a particular occurrence that temporarily raises demand for that fossil class. For example, the value of insects preserved in amber spiked with the release of Universal Studios' Jurassic Park, but has now returned to the point where they perform on par with the SNP 500.

In 1995 The New York Times (September 15) compared the change in selling price between a *C. megalodon* tooth and fragments of the African Zagami (Mars) meteorite. Both prices increased remarkably compared with stock investments between 1970 and 1995. The value of the shark tooth increased dramatically, thanks to the release of the Peter Benchley novel and Universal Studios' movie Jaws. The meteorite price remained consistent with the stock values until 1995 and the NASA press release concerning the possible discovery of Martian microfossils. However, the meteorite value is distinct from the shark tooth due to the extremely limited number of fragments (from a single meteorite source) that are available.

Fossils are inherently a limited resource and, as such, their supply will eventually be reduced. However, the degree to which this supply is limited remains difficult to quantify. As shown with the *C. megalodon* teeth, amber specimens, and meteorite fragments, the attention of the fossil-buying public shifts rapidly. Fossils may yield high, short-term returns but their long-term investment potential appears to be poor. Even short-term investing is dangerous as media sources may drive up fossil prices in one circumstance (amber and Jurassic Park) but not another (*Spinosaurus* teeth and Jurassic Park III).

The value of the five fossils in this study decreased by 24% over the ten-year sampling interval. Increased supply and availability, especially via the Internet, are primarily responsible for this decline. Although the highly publicized sale of unique fossils such as the Tyrannosaurus "Sue" leads the public to believe fossils are increasing in value, our findings suggest that the fossils most in demand by collectors have decreased in value over the past 10 years.



RAILROADS, TOURISM AND FOSSILS

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Early historical archives associated with western exploration and expansion in North America are punctuated with a few isolated references to fossil discoveries. Mountain man Jim Bridger first reported on the "peetrified birds, a singin' peetrified songs, in peetrified trees" in Yellowstone. Fur traders such as Alexander Culbertson collected fossil mammal remains from the *mauvaises terres* (badlands) in the Dakota Territory. In a few pioneer diaries there are brief entries regarding fossils and other petrifications that were observed on the westward journeys. Likewise, the construction of transcontinental railroads resulted in the discovery of new fossil localities.

Fossil, Wyoming, with Fossil Butte (now within the Monument named after it) in the background. Photo taken around late 1800's or early 1900's. Courtesy of Green River Historical Museum.

During the construction of the Union Pacific Railroad in 1868, fossilized fish were unearthed along a cut four miles west of Green River City, Wyoming. Two Union Pacific Railroad employees, A.W. Hillard and L. E. Rickseeker, are credited for the discovery of the site referred to as "Fish Cut". Fossils from this locality were originally presented to Ferdinand Hayden and later forwarded to paleontologist E.D. Cope. The "Fish Cut" is referenced in Hayden's 1871 report along with Cope's description of the fossil fish (Cope, 1870; Hayden, 1871).

The 1884 publication *The Pacific Tourist* both describes and illustrates the "Fish Cut" stating, "This place will eventually be a popular resort for those who are seeking for fossiliferous remains..." (Shearer, 1884). The publication further reports the sale of the abundant fossil specimens by local businesses in Green River City. An exhibit currently at the Sweetwater County Historical Museum in Green River, Wyoming, displays a small card from the 1870s advertising the sale of fossil specimens by the businessman S.I. Field.

The excavation of the railroad bed in 1868, just west of Green River City, Wyoming. During the excavation, fossil fish were found in the ancient lake sediments (now referred to as the Green River Fm.). The site has been referred to as "Fish Cut" since its discovery and is referenced in both scientific reports (Hayden Survey Reports) and popular publications. Courtesy of Green River Historical Museum.

In an effort to link the Union Pacific Railroad to the Pacific Northwest, the Oregon Shortline Railroad began laying track from Granger, Wyoming in 1881. During that year a section of track was extended as far as Sage, Wyoming, and the town of Fossil was founded as a station for servicing the trains near Twin Creek, Wyoming. Settlers began to arrive at Fossil in 1884 claiming land and constructing buildings. Eventually a hotel, saloon, train station and a store with post office were built at Fossil. By the turn of the century the Fossil train stop was known as a place to purchase fossils. Today the town of Fossil is a ghost town just outside the boundary of Fossil Butte National Monument.

In northern Arizona the Sante Fe Railroad established a depot at the small town of Adamana, a stop once referenced as "The Gateway to the Petrified Forest". At its peak, the town boasted thirty families, a post office, school, trading post, and the Adamana Hotel. Railroad passengers and cross-country travelers would spend the night at the hotel and visit the "Petrified Forest" by touring car.

In 1905, conservationist John Muir visited Adamana and the surrounding "Painted Desert" and "Petrified Forest". Muir observed wagonloads of petrified wood emerge from the "Forest". According to biographer Thurman Wilkins (1995), "Muir was disturbed by the Santa Fe Railroad's practice of carting petrified logs away to be hacked and polished into baubles for the tourist trade." A second Muir biographer, Frederick Turner (2000) wrote, "... vandals dynamited the petrified logs to get at their crystallized innards, and at Adamana a mill had been set up to crush logs into abrasives."

After Muir's visit to Adamana and the "Petrified Forest", he wrote to President Teddy Roosevelt regarding the commercial exploitation of the petrified wood. A few months after Congress passed the Antiquities Act, Roosevelt used this legislation to proclaim Petrified Forest National Monument. This was the second national monument established under the Antiquities Act.

Today the Sante Fe Railroad bisects Petrified Forest National Park, the train stop at Adamana is now a ghost town, and the old Adamana Hotel was destroyed in a fire during 1965. Whereas, the National Park Service strives to protect the "Petrified Forest" for future generations. There are likely other examples of fossil discovery related to the expansion of railroads across the American West.

Additional Reading

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PLEISTOCENE VERTEBRATE FOSSILS FROM SLAUGHTER CANYON CAVE, CARLSBAD CAVERNS NATIONAL PARK

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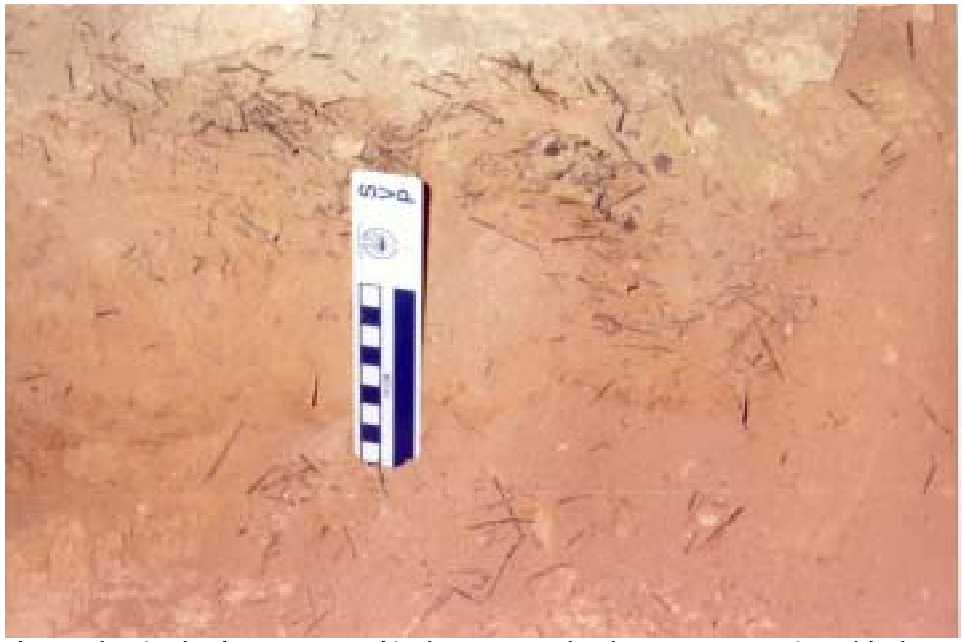
Over the weekend of April 12-14, 2002, a field crew led by Gary Morgan, curator of paleontology at the New Mexico Museum of Natural History (NMMNH), conducted excavations of the richly fossiliferous Pleistocene bat guano deposits in Slaughter Canyon Cave (also known as New Cave) in Carlsbad Caverns National Park (CAVE) in southern New Mexico. In addition to Gary, the field crew consisted of Carol Belski, Patty Daw, Glenda Dawson, and Rick Toomey. Rick is the cave specialist at Kartchner Caverns State Park in Arizona and a well known expert on Pleistocene cave faunas. We were ably assisted by three CAVE employees, cave specialist Dale Pate and rangers Tom Bemis and Stan Allison. The crew collected a total of 21 bags of fossiliferous sediment from two test pits in different areas of the cave. Because the fossils consist primarily of tiny bat bones, the loose guano was carefully excavated and put into nylon bags for transport to the NMMNH in Albuquerque for screenwashing.

Rick Toomey, Gary Morgan, and Dale Pate (left to right) measuring the stratigraphic section of the guano in Slaughter Canyon Cave.



Closeup showing bat bones preserved in the guano at Slaughter Canyon Cave in Carlsbad Caverns National Park. These include the bones of the extinct free-tail bat *Tadarida constantinei.*

The fossiliferous guano deposits in Slaughter Canyon Cave are well known, and are mentioned by CAVE rangers during public tours of the cave. Cave visitors are led through one of the deep trenches left behind by miners in the 1950s who dug the guano for fertilizer, which was sent in rail cars to southern California to be used on the citrus groves. Despite the abundance of fossil bones, surprisingly little paleontological research has been conducted in Slaughter Canyon Cave. The most important paper on fossils from this cave was written in 1960 for the Journal of Mammalogy by Barbara Lawrence (she called it New Cave) in which she described an extinct species of free-tailed bat *Tadarida constantinei*. The fossils were collected by and named for a well-known bat expert, Denny Constantine.

The vast majority of fossils from Slaughter Canyon Cave, numbering in the thousands of bones, belong to the extinct bat *Tadarida constantinei*. However, there are ten other species of vertebrates represented in the fauna, including: the desert tortoise *Gopherus agassizi*, a lizard, a snake, a large raptorial bird, a species of the bat *Myotis*, the desert cottontail rabbit *Sylvilagus auduboni*, the pocket mouse *Perognathus,* the woodrat *Neotoma*, the extinct pronghorn antelope *Capromeryx minor*, and a large canivore-possibly the short-faced bear *Arctodus simus*. Gary Morgan and several volunteers at the NMMNH are still screenwashing and sorting fossiliferous sediment from the cave, so more species should be added to the faunal list. Other ongoing research in Slaughter Canyon Cave by Victor Polyak, Donald McFarlane, and Joyce Lundberg indicates that the fossil deposits are older than 40,000 years Before Present, which is much older than was previously thought.

Additional Reading

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DID YOU KNOW?

The oldest skeleton of a bat is from *Icaronycteris*. It was found in the Eocene Green River Formation which is the same formation famous for its fossil fish such as those found at Fossil Butte National Monument in Wyoming.

Field Note: The Halgaito Shale of Glen Canyon National Monument September 2002

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ERA	PERIOD	MILLION OF YEARS AGO	FOUR COURNERS FM. NAME
CENOZOIC	Quaternary	0-1.6	-NA- soil, sand, and gravel
	Tertiary 1.6-65		-NA- terrace gravels, diatremes, igneous intrusions
MESOZOIC	Cretaceous	65-135	Mesaverde Group
			Mancos Shale
			Dakota Sandstone
			Cedar Mtn./ Burro Canyon
	Jurassic	135-205	Morrison Fm.
			Entrada Sandstone
			Carmel/Wanakah Fm.
			Kayenta Fm.
			Moenave Fm.
			Wingate Fm.
	Triassic	205-250	Chinle Fm.
			Moenkopi Fm.
PALEOZOIC	Permian	250-290	Cutler Group
			DeChelly Sandstone
			Organ Rock Shale
			Cedar Mesa Sandstone
	Pennsylvanian	325-290	**Halgaito Shale**
			Hermosa Group
			Honaker Trail Fm.
	(Rocks not exposed)		Paradox Fm.
			Pinkerton Trail Fm.
			Molas Fm.
	Mississippian	325-355	Leadville/Redwall Fm.
	Devonian	355-410	Ouray Limestone
			Elbert Fm.
	Silurian	410-438	rocks missing
	Ordovician	438-510	rocks missing
	Cambrian	510-570	Ignacio-Lynch Fms.
PRECAMBRIAN	Upper 570-2,500		-NA - quartzite/granite
	Lower 2,500-4,500?		-NA- metamorphic/granite

Figure 1: Geologic time scale showing formations of the Four Corners area, the Halgaito Shale is highlighted. From Baars, 1995.

Numerous exposures of the Pennsylvanian- Permian Cutler Group are known from throughout the Four Corners region of the United States. Some of the most dramatic outcrops are located just outside the small town of Mexican Hat in southeastern Utah, as well as in Monument Valley in nearby northeastern Arizona. In this region, the white to pale brown, bluff forming Cedar Mesa Formation is underlain by the less resistant, red, sandy siltstones and shales of the Halgaito Shale (Figure 1). During the first two weeks of September 2002, paleontologists from southern California ventured into the portions of Glen Canyon National National Recreation Area north of the San Juan River in southeastern Utah, near Mexican Hat, to search for new localities within the Halgaito.

The Halgaito Shale was originally thought to be Permian in age, but recent publications have reinterpreted the Halgaito as spanning the Pennsylvanian- Permian boundary (Baars, 1991, 1995). The 2002 Valley of the Gods Expedition was the first field component of an ongoing study that will attempt to determine where the Pennsylvanian-Permian boundary can be defined faunally throughout the exposed Halgaito. With data from this and subsequent field excursions to the region, we hope to better understand the early radiation and diversification of amniotes.

During the 2002 visit, our field team identified several vertebrate fossil localities while enjoying some of the most spectacular vistas North America has to offer. One new fossil locality was discovered within the boundaries of the Glen Canyon National Recreation Area, in a limestone pebble conglomerate channel near the base of the Halgaito Shale. This locality contained abundant teeth of the extinct xenacanth shark *Orthacanthus*. Dr. Stuart Sumida from the Department of Biology at California State University, San Bernardino (CSUSB) located the channel and provided preliminary identifications of the fossils therein. The locality was immediately nicknamed "Darwin's Shark Tooth Bed" in honor of Dr. Sumida's 14 month old son, Darwin, who made his first-ever fossil find at the site: a tooth of *Orthacanthus* (Figure 2).

Macrofossils recovered from "Darwin's Shark Tooth Bed", along with fossil material from the nearby Valley of the Gods, is currently undergoing preparation and more detailed identification in southern California. The matrix from this material is being saved for later acid reduction in an attempt to recover conodonts and fusilinids that will assist us in determining where the Pennsylvanian-Permian boundary falls in the Halgaito Shale. Future field expeditions will endeavor to more fully document the stratigraphy of the region, as well as identifying additional fossil-bearing horizons in the Halgaito Shale.

Acknowledgements:
Grateful thanks are extended to the field team of the 2002 Valley of the Gods Expedition, including: Dr. Stuart S. Sumida, Dr. Elizabeth Rega, Gavan Albright and Ken C. Noriega of CSUSB; Eric Scott of the San Bernardino County Museum; Henry C. Ballard of the George C. Page Museum; and of course Darwin Sumida of Clan Sumida. All of these individuals provided invaluable help in the field. Special thanks go to Dr. Sumida for his mentoring.

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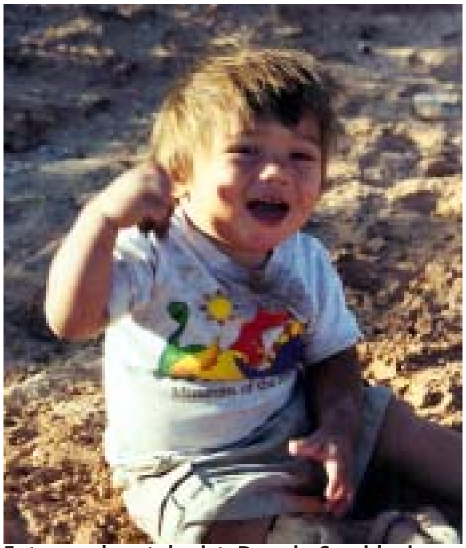

Future paleontologist, Darwin Sumida, in the field at Glen Canyon National Recreation area.

WHAT IS AN ORTHACANTHUS?

Orthacanthus was an ancient freshwater shark. It belongs to a group of sharks known as the Xenthacanths (strange spine) that are distinguished by a long dorsal spine protruding from the back of the head. The double forked teeth are another unique characteristic of the group. The body is long and ribbon-like giving it the appearance of an eel. A full grown *Orthacanthus* is believed to have grown to 10 feet in length.

http://www.sharkfriends.com/paleo3.html

http://www.discovery.com/exp/prehistoricsharks/gallery3.html

NPS Paleontologists Visit Site in Hungary

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The Hungarian National Park Directorates are a complex system of 10 regions managing hundreds of properties with varying levels of oversight. Some of these enjoy full national protection while others are largely run by local authorities, often with a lesser interest in preservation. As a result of a request from the Hungarian government, Greg McDonald and Ted Fremd travelled to a remote area near the Slovakian border to visit Hungary's only park established for fossil resources. Tuff samples were collected for accurate dating, the exhibits and display media were scrutinized, curatorial programs were analyzed, and a variety of cooperative efforts initiated.

The Ipolytarnoc localities, managed within the Bukk National Park Directorate, are an important component of geological history that have been preserved and made available for public appreciation. Attempts to preserve and intrepret these sites go back over 160 years. More recent preservation work included constructing large buildings to cover the trackways during the soviet occupation. In addition to the myriad of fossil localities, the area is encapsulated by excellent forests and natural beauty accessible by a variety of trails. The Geological Study Trail itself, leading as it does to the footprint sandstone through a beautiful natural ravine, heavily vegetated by trees and many forms of understory plants and fungi, would in and of itself command attention as a worthwhile natural trail. This, in turn, is on the inner circumference of a large area for which natural walkways have been developed that meander through the forest where one can encounter deer, wild boar, native vegetation, birds, and evidence of much more. These are made more accessible from observation towers and a variety of comfortable picnic groves from which one can contemplate the present natural scene and contrast the modern ecosystems with those entombed in the sediments underfoot. Modern deer and boars bound over the petrified remnants of their ancestral clades.

The state of preservation of the materials is excellent. Some of the plant fossils are amongst the finest to be found anywhere. While it is the case that the largest of the trees (an enormous pine which was the first to be discovered) has been sampled extensively, it has been enhanced by the earliest cultural remnants of attempts to preserve it, dating from 1866 and earlier (itself an interesting historical footnote in the conservation of fossils in situ). It must be emphasized that this specimen is only one of many such fossil trees and the fact that this particular specimen has been culturally altered does not reduce the values inherent in the wood assemblages. The footprints and associated trace fossils themselves are in excellent condition, needing little if any additional treatment as a result of a foresighted effort to construct the shelters. In twenty years the shelters themselves will be of historical interest, given the surprising attention and focus of resources on geological materials in this place and time. Regarding the world-class footprint sandstone, it is conceivable that additional consolidants could be introduced into portions of the matrix where some flaking and spalling might be expected to occur, but that does not appear to be necessary at this time. All of the other fossil materials are to be found

An intriguing carnivore footprint, probably an amphicyonid preserved at Ipolytarnoc.

Site Director Imre Szarvas at the entrance to the excellent Geological Study Path at Ipolytarnoc.

in excellent condition and are eminently suitable for greater recognition.

The site is exceptionally well managed. Public facilities, including geological and biological discovery trails, picnic areas, interpretive signs, and in situ displays of fossils are very well designed and enjoyed by visitors. The majority of these were developed with a bare minimum of funding, making up in creativity what has been lacking from appropriated funds.
An extremely well conceived center for research, curation, and education has been newly refinished and is available for use. Comfortable quarters, spatious lecture and conference facilities, and a large curatorial space are situated within a beautifully landscaped area protected from unauthorized use. These accomodations would be counted amongst the finest of their kind within the USNPS and will help facilitate more scientific and educational work.

Finally, our host treated us to an absolutely exceptional visit. The gracious and courteous manner in which we were hosted defies brief description, but exceeds anything any of us have experienced anywhere. Expecting typical housing conditions, we found deluxe accomodations; fearing deteriorating fossil exposures, we found well-cared for materials and facilities; anticipating normal interpretive media, we observed outstanding exhibits. We learned a great deal and were able to impart some of the lessons we have learned from the development of the NPS paleontological programs. We look forward to returning to these and other internationally renowned sites to further the global preservation and appreciation of fossil resources.

Ted Fremd and volunteer Skylar Rickabaugh sampling "The Miraculous Andesite" for Single Crystal Laser Fusion Argon dating.

A well-preserved *Quercus* leaf as found in the associated tuffs at Ipolytarnoc.

Carbon 14 Date Back on Walrus Skull from Cape Hatteras

Thanks to a grant from the National Park Foundationthe walrus skull from Cape Hatteras National Seashore reported in the last issue of the Park Paleontology Newsletter has been dated using carbon 14. The skull was sent to Stafford Research Laboratories in Boulder, Colorado where a small sample of the tusk was removed for analysis. The sample was treatedto remove all impurities and non organic material. The purified sample was then sent to Lawrence Livermore Laboratories. The age of the walrus is 36,760 ± 570 radiocarbon years before present.

Tom Stafford of Stafford Research Laboratories removing sample from the tusk of the Cape Hatteras walrus for carbon 14 dating.

Recent Literature on Park Paleontology Resources

The following papers based on fossils from national parks were presented at the annual meetings of the Society of Vertebrate Paleontology at Norman, Oklahoma.

Carpenter, M.C. 2002. *Vulpes vulpes* (Red Fox) remains from Stanton's Cave, Arizona: first known record from the Grand Canyon. Journal of Vertebrate Paleontology 22(3):41A.

Cavin, J.L., D.B. Lien, C.L. Herbel, S.L. Johnson and G.E. Knauss. 2002. A flora and faunal list of specimens recovered from the Big Pig Dig, Badlands National Park, South Dakota. Journal of Vertebrate Paleontology 22(3):42A.

Draus, E.R. and D.R. Prothero. 2002. Magnetic stratigraphy of the Middle Miocene (Early Barstovian) Mascall Formation, Central Oregon. Journal of Vertebrate Paleontology 22(3):49A

WHAT IS CARBON 14 DATING?

The most common form of carbon is carbon 12, it has 6 protons and 6 neutrons in the nucleus of the atom. Carbon 14 differs by having 8 neutrons which makes it unstable or radioactive. Carbon 14 is formed when a nitrogen 14 atom is hit by cosmic radiation. While alive, plants and animals incorporate these isotopes of carbon into their tissues at the ratio found in the atmosphere. Carbon 12 makes up 99% of the carbon and carbon 14 is less than 1%. Upon death, the carbon 14 in their tissues begins to decay. The half life or amount of time it takes for half of the carbon 14 to decay is 5, 570 years. By measuring the remaining amount of carbon 14, the age of the fossil can be determined. This method can be used to date material ranging in age from a few hundred years to about 50,000 years. The use of carbon 14 permits the determination of age directly from a fossil.

Fiorillo, A.R. 2002. The first record of a Cretaceous dinosaur from western Alaska: implications for understanding the paleosrctic. Journal of Vertebrate
Paleontology 22(3):53A.

Foss, S.E., T.J. Fremd, and M.E. Smith. 2002. Integrating current curation concepts into the design of a new paleontological curation and research facility at John Day Fossil Beds National Monument, Oregon. Journal of Vertebrate Paleontology 22(3):54A

Fremd, T.J. 2002. Measuring local geographic variability in early Arikareean mammalian assemblages. Journal of Vertebrate Paleontology 22(3):55A.

Hadly, E. and M. Van Tuinen. 2002. Late Holocene abundance patterns of grebes and waterfowl from Lamar Cave, Yellowstone National Park, Wyoming. Journal of Vertebrate Paleontology 22(3):61A.

Haist, B., V. Santucci, and A. Aase. 2002. The history of vertebrate paleontological fieldwork in Fossil Basin, Wyoming. Journal of Vertebrate Paleontology 22(3):62A.

Hoffman, J. and D. Prothero. 2002. Magnetic stratigraphy of the Upper Miocene (Early Hemphillian) Rattlesnake Formation, Central Oregon. Journal of Vertebrate Paleontology 22(3):66A.

Hunt, A.L. and V. Santucci. 2002. Reassessment of Late Paleozoic tetrapod tracks from Gand Canyon National Park, Arizona. Journal of Vertebrate Paleontology 22(3):68A.

Hunt, R.M. Jr. and E. Stepleton. 2002. Lithostratigraphy and biochronology of the Upper John Day Beds in the Haystack Valley and Kimberly areas, John Day River Valley, Oregon. Journal of Vertebrate Paleontology 22(3):68A.

Johnson, S.L., J.L. Cavin, and D.B. Lien. 2002. Age determination of *Archaeotherium mortoni* from tooth measurements, Pig Dig Quarry, Badlands National Park, South Dakota. Journal of Vertebrate Paleontology 22(3):72A.

Parker, W.G., S. Clements, D.T. Woody, and K. Beppler-Dorn. 2002. Triassic Park first year results of the paleontological inventory of Petrified Forest National Park, Arizona. Journal of Vertebrate Paleontology 22(3):94A.

Retallack, G.J. 2002. Early Miocene (Hemingfordian) appearance of sod grasslands and arid, summer-dry climate in central Oregon. Journal of Vertebrate Paleontology 22(3):99A.

Ruez, D.R. Jr. 2002. New specimens and new interpretations of the Hagerman insectivorans. Journal of Vertebrate Paleontology 22(3):101A.

Smith, J.A., S. Sampson, M. Loewen and V. Santucci. 2002. Trackway evidence of possible gregarious behavior in large theropods from the Lower Jurassic Moenave Formation of Zion National Park. Journal of Vertebrate Paleontology 22(3):108A.

Spaeth, P., Y. Chan, C. Conroy, and E. Hadly. 2002. Ancient gene-flow: post-glacial colonization of Yellowstone National Park, Wyoming, USA. Journal of Vertebrate Paleontology 22(3):110A.

Steele, T.E. and E. A. Hadly. 2002. Ecological differences between two late Holocene sites from Yellowstone National Park, Wyoming, USA. Journal of Vertebrate Paleontology 22(3):111A.

Swift, S.L. 2002. A mid-Holocene fauna from a Ringtail carnivore den, western Grand Canyon. Journal of Vertebrate Paleontology 22(3):113A.

Other papers presented at the Society of Vvertebrate Paleontology meetings by NPS paleontologists.

Bell, G.L. Jr. 2002. The questionable monophyly of Mosasauridae. Journal of Vertebrate Paleontology 22(3):35A.

Madsen, S.K. 2002. Work-related injuries and illnesses related to preparation and fieldwork. Journal of Vertebrate Paleontology 22(3):82A.

Santucci, V.L. 2002. Theft and vandalism of vertebrate tracksites: challenges of in situ management and protection. Journal of Vertebrate Paleontology 22(3):103A.

Schubert, B.W., R.W. Graham, and H.G. McDonald. 2002. The late Pleistocene paleoecology of two extinct taxa: Jefferson's ground sloth (*Megalonyx jeffersonii*) and elk-moose (*Cervalces scotti*). Journal of Vertebrate Paleontology 22(3):104A.

The following papers were presented at the annual meetings of the Geological Society of America in Denver, Colorado

Amato, T.J. Jr., H.P. Buchheim, R.A. Cushman Jr. and R.E. Biaggi. 2002. Climate change, salinity gradient or marginal freshwater lagoon? The story behind a unique fossiliferous unit of the Green River Formation in Fossil Basin, Wyoming. Geological Society of America Abstracts with Programs 34(6):555.

Austin, S.A. and K.P. Wise. 2002. Regionally extensive mass kill of large orthocone nautiloids, Redwall Limestone (Lower Mississippian), Grand Canyon National Park, Arizona. Geological Society of America Abstracts with Programs 34(6):423.

Bell, G.L. Jr., C.J. Crow, J.K. Rigby, and D. Derickson. 2002. Newly recognized reef fabric from the Middle Capitan reefs (Middle Permian), Guadalupe Mountains, Texas. Geological Society of America Abstracts with Programs 34(6):356.

Benton, R.C. 2002. Emergency salvage collection of fossils at the Titanothere bone bed, Badlands National Park. Geological Society of America Abstracts with Programs 34(6):539.

Biaggi, R.E., H.P. Buchheim, and R.A. Cushman Jr. 2002. Paleoecology and depositional environments during the early depostional phase of Fossil Lake, Green River Formation, Wyoming. Geological Society of America Abstracts with Programs 34(6):557.

Brezinski, D.K., J.E. Repetski and J.F. Taylor. 2002. Middle Cambrian to Upper Ordovician stratigraphy and paleontology along the Chesapeake and Ohio Canal National Historical Park, western Maryland. Geological Society of America Abstracts with Programs 34(6):423.

Cushman, R.A. Jr. 2002. Vegetational history and age of the Green River Formation in Fossil Basin, Wyoming. Geological Society of America Abstracts with Programs 34(6):480.

Foss, S.E. and V.J. Naylor. 2002. Paleontology at Scotts Bluff National Monument: a recent paleontological survey of the Orellan White River Beds. Geological Society of America Abstracts with Programs 34(6):539.

Fremd, T. 2002. Paleontological landscape and timescape management in the National Park Service. Geological Society of America Abstracts with Programs 34(6):539.

Gunnell, G.F., W.S. Bartels, and J.-P. Zonneveld. 2002. Stratigraphy, vertebrate paleontology, and paleoecology of the Wastach Formation, Fossil Butte National Monument, Wyoming. Geological Society of America Abstracts with Programs 34(6):557.

Herbel, C.L., R.C. Benton and S.A. Black. 2002. Bone Bed surveys: making use of the data. Geological Society of America Abstracts with Programs 34(6):539.

Jennings, D.S., V.L. Santucci, H.P. Buchheim, and S.T. Hasiotis. 2002. A preliminary inventory and assessment of ichnofossils from the Green River Formation. Geological Society of America Abstracts with Programs 34(6):556.

Karlstrom, K.E. L.J. Crossey and M.L. Williams. 2002. The Trail of Time at Grand Canyon: a progress report. Geological Society of America Abstracts with Programs 34(6):540.

Answer to Can You Identify the Fossil on Page 11.

These are stromatolites found in Glacier National Park.

Koch, A.L., V.L. Santucci, and H.G. McDonald. 2002. Developing paleontological resource monitoring strategies for the National Park Service. Geological Society of America Abstracts with Programs 34(6):422.

Main, D.J. and A.R. Fiorillo. 2002. Results of the ground penetrting radar mapping technique at a dinosaur quarry in Big Bend National Park. Geological Society of America Abstracts with Programs 34(6):539.

Manchester, S.R., and P.R. Kester Jr. 2002. Paleobotanical investigation of the Green River lacustrine flora of Fossil Butte, Wyoming. Geological Society of America Abstracts with Programs 34(6):480.

Meyer, H.W., L. Lutz-Ryan, M.S. Wasson, A. Cook, A.E. Kinchloe, and B.A. Drummond III. 2002. Research and educational applications of a web-based paleontological database for Florissant Fossil Beds National Monument. Geological Society of America Abstracts with Programs 34(6):423.

Moe, A.P., and D.M. Smith. 2002. Using fossilized diptera from the Florissant Formation as paleoenvironmental indicators. Geological Society of America Abstracts with Programs 34(6):102.

Parker, W.G, S. Clements, D.T. Woody and K. Beppler-Dorn. 2002. First year results of the ongoing paleontological inventory of Petrified Forest National Park, Arizona. Geological Society of America Abstracts with Programs 34(6):539.

Stefos, M. and R. Jorstad. 2002. A palynological investigation in Yellowstone National Park: the undergraduate perspective. Geological Society of America Abstracts with Programs 34(6):540.

Tracy, K.H. 2002. Grand Teton National Park paleontological survey. Geological Society of America Abstracts with Programs 34(6):423.

Whitmore, J.h., L. Brand, and H.P. Buchheim. 2002. Implications of modern fish taphonomy for the preservation states and depositional environments of fossil fish, Fossil Butte Member, Green River Formation, southwestern Wyoming. Geological Society of America Abstracts with Programs 34(6):556.

Woodcock, D.W. and N. Kalodimos. 2002. The tree molds at Pu'Uhonua O Honaunau: late persistence of coastal loulu (*Pritcharia*) palms. Geological Society of America Abstracts with Programs 34(6):540.

Other Recent Publications on Fossils from National Parks

Agenbroad, L.D. 2002. New Localities, Chronology and Comparisons for the Pygmy Mammoth (*Mammuthus exilis*):1994-1998. Pp. 518-524 In H. Browne and H. Cheney (eds.). Proceedings of the Fifth Channel Islands Symposium. USDI-Mineral Management Service and the Santa Barbara Museum of Natural History Vol. 2.

Lehman, T.M. and A.B. Coulson. 2002. A juvenile specimen of the sauropod dinosaur *Alamosaurus sanjuanensis* from the Upper Cretaceous of Big Bend National Park, Texas. Journal of Paleontology 76(1):156-172.

O'Brien, N.R., H.W. Meyer, K. Reilly, A.M. Ross, and S. Maguire. 2002. Microbial taphonomic processes in the fossilization of insects and plants in the late Eocene Florissant Formation, Colorado. Rocky Mountain Geology 37(1):1-11.

Schwimmer, D.R. 2002. King of the Crocodylians. The Paleobiology of *Deinosuchus*. Indiana University Press, Bloomington and Indianapolis: 221 pp.

Tykoski, R.S., Rowe, T.B., Ketcham, R.A., and Colbert, M.W. 2002. *Calsoyasuchus valliceps*: a new crocodyliform from the Early Jurassic Kayenta Formation of Arizona. Journal of Vertebrate Paleontology 22(3): 593-611.

Wheeler, E.A. and S.R. Manchester. 2002. Woods of the Eocene Nut Beds Flora, Clarno Formation, Oregon, USA. International Association of Wood Anatomists Journal, Supplement 3, 188 pp.

DID YOU KNOW?

The 1922 movie "Monsters of the Past" documenting the Carnegie excavations at Dinosaur National Monument is the earliest film footage ever taken of collecting fossil vertebrates.

The Society of Vertebrate Paleontology, the Paleontological Society, and the American Geological Institute have just published a book entitled - **Dinosaurs: The Science Behind The Stories**. Edited by Judith G. Scotchmoor, Dale A. Springer, Brent H. Breithaupt, and Anthony R. Fiorillo

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Raising the Dead: Excavating Dinosaurs.

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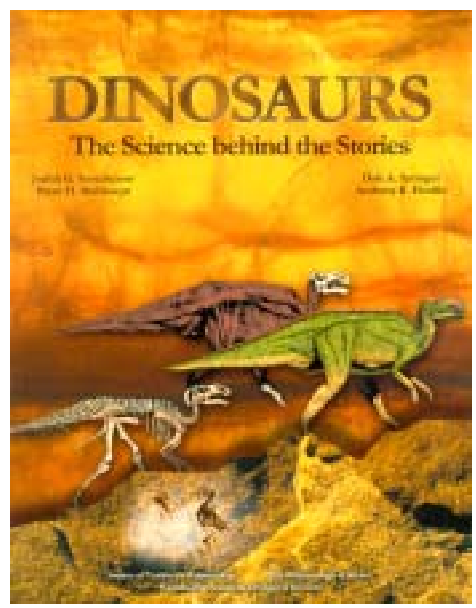
Cost S29.95

The book can be ordered from the American Geological Institute, 4220 King Street, Alexandria, Virginia 22302. (703) 379-2480. It can also be ordered through their web site at www.agiweb.org.



Courtesy of American Geological Institute

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CAN YOU IDENTIFY THE FOSSIL?
Name the fossil and the park

Answer on page 9