Palæontological Society
Alberta Bulletin

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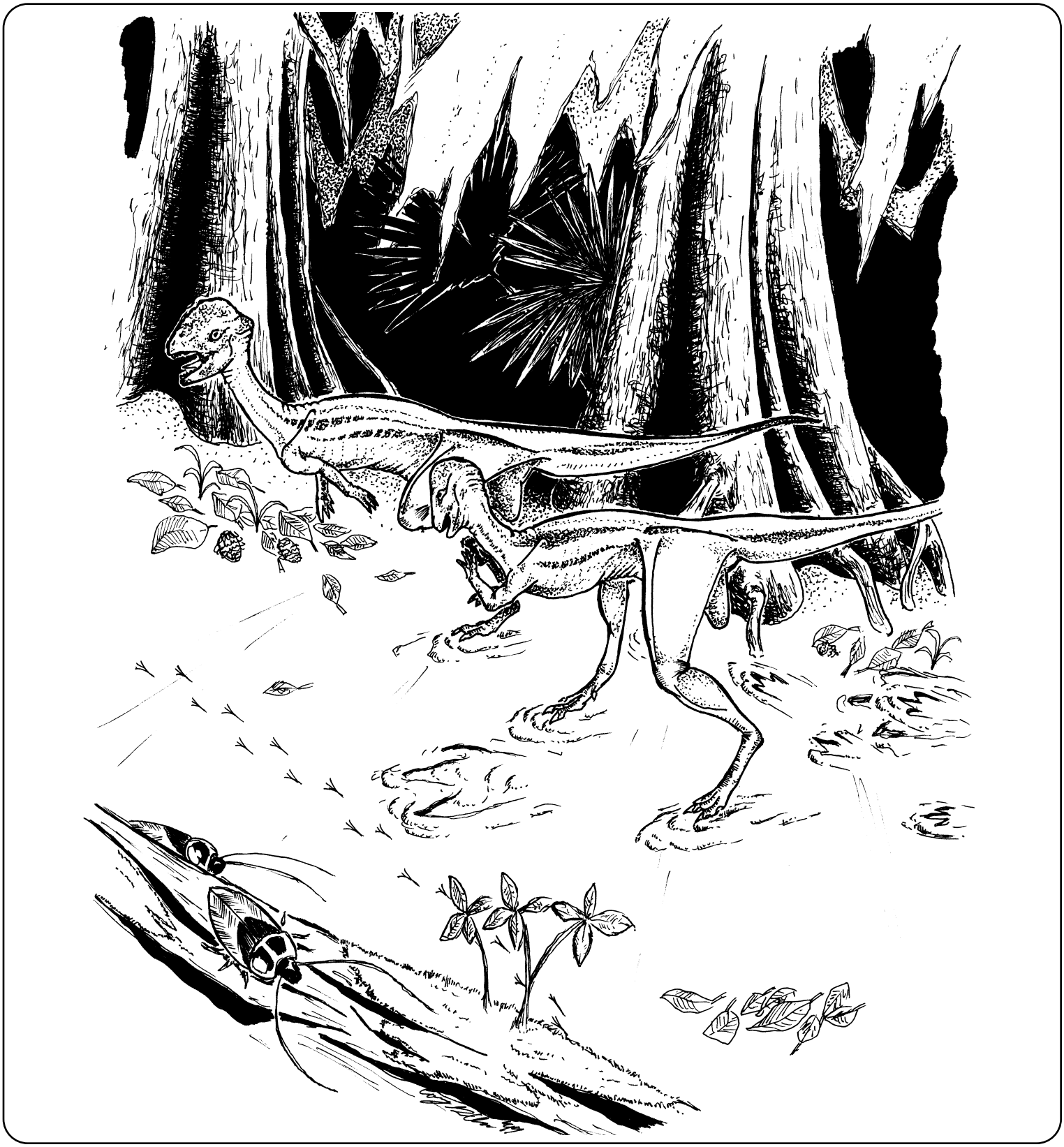

ALBERTA PALÆONTOLOGICAL SOCIETY

The Society was incorporated in 1986, as a non-profit organization formed to:

a. Promote the science of palæontology through study and education.
b. Make contributions to the science by:
   1) discovery
   2) collection
   3) description
   4) education of the general public
   5) preservation of material for study and the future
c. Provide information and expertise to other collectors.
d. Work with professionals at museums and universities to add to the palæontological collections of the province (preserve Alberta's heritage).

MEMBERSHIP: Any person with a sincere interest in palæontology is eligible to present their application for membership in the Society. (Please enclose membership dues with your request for application.)

Single membership	$15.00 annually
Family or Institution	$20.00 annually

THE *BULLETIN* WILL BE PUBLISHED QUARTERLY: March, June, September and December. Deadline for submitting material for publication is the 15th of the month prior to publication.

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UPCOMING APS MEETINGS

Except where noted otherwise, meetings take place at **7:30** P.M., in Room **B108**,
Mount Royal College: 4825 Richard Road SW, Calgary, Alberta

Friday, December 17, 1999—Special Event: see back cover of this issue.

Saturday, January 22, 2000—Special Event: see back cover of this issue.

February 18, 1999—(Program to be announced.)

March 17, 1999—Darla Zelenitsky, University of Calgary: *Dinosaur Eggs.*

ON THE COVER: A pair of pachycephalosaurs, *Stegoceras validum* (Late Cretaceous, Alberta).
Art by APS Member Cory Gross © 1998.

1999 Field Trip Reports

by Keith Mychaluk

Wolf Coulee and Princess, Alberta (June 19 and 20)

Twenty-five members, including seven children, enjoyed a successful two-day field trip to Wolf Coulee and Princess, Alberta. Members joined us from as far away as La Palma, California (**Steven & Kris Moskowitz**) and Salt Spring Island, B.C (**Susan Huber**). Both Upper Cretaceous sites are located just south of Dinosaur Provincial Park, near Brooks, Alberta, within the Judith River Group. Although much of the Alberta summer was wet this year, we enjoyed clear, sunny weather for the entire trip.

On Saturday **Wayne Braunberger** introduced us to a well-documented microvertebrate fossil site in Wolf Coulee. The site, designated as "Bonebed 120" in the literature, yielded a surprising amount of fossil material, considering the popularity of the site. Members collected teeth from crocodiles, theropods, fish and rays as well as vertebrae from champsosaurs and fish. Some members even found a few very rare mammal teeth. I was fortunate enough to collect two ankylosaur teeth and a large (8 cm long) *Albertosaurus* tooth. Saturday evening several members enjoyed dinner at the Patricia Hotel BBQ Pit, in nearby Patricia, where patrons can cook their own 16-ounce steaks over a large open flame grill. No tofu burgers served here!

On Sunday morning we gathered once again at the Dinosaur Corner gas station outside of Patricia and drove out to Princess. The Princess sites are located near a large gas pipeline compressor station operated by TransCanada Pipelines (formerly Nova). Although there are several large coulees throughout the Princess area, many of them are covered in short prairie grass, thereby limiting exposure of Cretaceous outcrops. A lot of hiking and exploring was required to find exposures and fossils. However, most members were successful in locating small sites containing a mix of both micro- and macrovertebrate fossils, including hadrosaur vertebrae. **Roslyn Osztian** collected some skull fragments that she was planning to have identified. **Wayne Braunberger** discovered a portion of a turtle skull. I collected three 3 cm long theropod teeth and one small (0.75 cm long) raptor tooth.

Korite Minerals Ltd. Ammolite Quarry, Magrath, Alberta (July 17)

The Alberta Palæontological Society was very fortunate this year in having the opportunity not only to visit, but to collect at the Korite Minerals Ltd. Ammolite quarry site near Magrath. Our group of thirty-six members, including eight children, was only the second to have a formal tour of Korite's operation in twenty years (the first was a group attending the AAPG Annual Convention in Calgary, in 1982). Myself and two professors from the University of Calgary (Drs. A.A. Levinson and R.L. Hall) are currently working on a paper on Ammolite to be published in *Gems & Gemology* early next year. While working on the paper we arranged for the APS to tour the quarry site in July.

Korite extracts the gemstone Ammolite from a rare variety of ammonite shell found only in the Bearpaw Formation shales of southern Alberta (Upper Cretaceous). Korite's two large quarries supply approximately 90% of all commercially available Ammolite gemstones (used in rings, necklaces and pendants). Members enjoyed a highly educational field trip led by Korite's president Pierre Pare. Everyone was very impressed with Pierre's informative presentations throughout the day. Members were even allowed to collect pieces of very colourful ammonite shell (*Placenticeras meeki*) as well as *Baculites* and bivalves (*Arctica* and *Inoceramus*). A couple of very large ammonites (the size of a car tire) were found within very heavy concretionary ironstone matrix. Each took two or three people to lift!

Thanks again to Pierre for a fantastic day!

On the following day rain cancelled our plans to visit the Blood Reserve Formation outcrops near Monarch, Alberta (this site was previously visited by the Society on July 16, 1994.)

Burgess Shale, Yoho National Park, British Columbia (August 21)

On August 21, fourteen APS members participated in the Parks Canada guided hike to the Burgess Shale, arguably the most important fossil locality in the world. Starting at the thundering Takakkaw waterfall, our guides, David Moore and Carole Augereau, led us up 760 metres in elevation to the Walcott Quarry site in the Stephen Formation, past some of the most beautiful mountain scenery in the world. Breathtaking views of Emerald Lake and alpine glaciers were witnessed all day long. Local inhabitants, including several

pikas, marmots and squirrels, greeted us along the way. Our guides stopped many times to provide historical and ecological presentations on the local area. The long hike lasted about ten hours (round trip).

Once at the top, we found Dr. Desmond Collins and three of his crew from the Royal Ontario Museum working at the quarry. Just that day they had found a portion of an *Anomalocaris*, the first such example recovered from that site. Dr. Collins presented many excellent fossils as well as the current environmental and evolutionary interpretations of the Burgess Shale. Dr. Collins has a very limited field season at the quarry due to the high elevation (2400 metres above sea level). Typically the site is snowed-in from late September to early July, so we would like to thank Dr. Collins for taking the time to speak with our group. This was Dr. Collins' sixteenth year excavating at the Walcott Quarry.

As one of Canada's ten UNESCO World Heritage Sites, fossil-collecting was not allowed. However, there were many opportunities to observe and photograph the half-a-billion year-old fossils. In addition to some soft-bodied fossils, members found several complete and incomplete trilobites, branching sponges, algal filaments, worm tubes and brachiopods.

Next summer, the APS plans a return trip to Field, B.C. to visit the Mount Stephen trilobite beds across the valley from the Burgess Shale site.

1999 Field Trip Expense Report, and Changes to Field Trip Procedures

This was the first year that the APS began charging members to attend field trips. The nominal $5.00 per membership charge was designed to offset the cost of researching, photocopying and printing the field trip guides for each trip. I am happy to report that we collected almost enough money to pay for the field trip guides.

$175.00 was collected from participants of the Wolf Coulee and Korite Quarry field trips (*note:* not all members paid). It was decided not to charge members $5.00 for the Burgess Shale trip, since those participating had already paid $45.00 per person to Parks Canada.

The cost of printing the guides for all three trips totalled $188.13.

Costs could be kept lower if those who had signed up for trips but failed to appear would take the time to call and inform me that they would not be able to attend. Originally over thirty memberships (50 people) were signed up for the Wolf Coulee trip alone, but only 25 attended. I ended up with about 10 or 20 extra field guides for the Wolf Coulee and Korite Quarry field trips.

As a result, there will be some changes for next year's field trips. The $5.00 per membership user fee for field trips will now be collected in advance (i.e. the day you sign up). The fee will be refundable up to two weeks prior to each trip. The field trip guide will then go to press within the two weeks prior to each trip, whereby the $5.00 fee becomes non-refundable. Hopefully, this will solve two problems: first, we should be able to cut down on the number of unnecessary copies of field trip guides. Second, we hope to cut back on the number of people who opt out of the trips at the last minute. Hopefully the non-refundable two week period prior to each trip will accomplish that. The dates for our three field trips are published four to six months in advance—please plan ahead. Unlike this year, in the 2000 field season there will be no exemptions for paying the $5.00 fee. These changes were all unanimously approved in a recent executive meeting.

Also, please note that the Field Trip Coordinator (that's me!) **is NOT responsible for arranging rides to and from field trips.** To assist members trying to arrange car pools, a list of field trip participants who have signed up for trips will be published in the March and June *Bulletin*. Please read the details of each trip in the *Bulletin*. Once published, **there will be no changes to the itinerary for each trip.** Returning calls to thirty or more people per trip regarding such things as "Has the meeting place changed?" or "What day is the Wolf Coulee trip?" is not my idea of fun on a Saturday afternoon. Let's just say I have a lot more respect for how much work my predecessor (**Les Fazekas**) put into this job! My hat's off to you, Les!

Preliminary ideas for next year's field trips include a four or five day trip to Montana (including stops at Hell Creek and Glendive); a guided hike up to the Mount Stephen trilobite beds near Field, B.C.; and a trip to the Onefour area of southeastern Alberta. Watch for details in upcoming *Bulletin*s.

Welcome New Members!

Arden Bashforth, Calgary, AB
Ann Berezowski, Calgary, AB
Christine Bovaird, Calgary, AB
Graeme Dales, Calgary, AB
Karl Friedman, Coquitlam, BC
Gabrielle Lyon, Chicago, IL
George Madge, Calgary, AB
Robert Mason, Calgary, AB *(more on Page 7!)*

Dinosaurs on Drifting Continents: New Evidence from Africa, with Dr. Paul Sereno

by Mona Marsovsky

At the Jenkins Theatre of Mount Royal College on Thursday, September 16, 1999, Dr. Paul Sereno of the University of Chicago gave a fascinating talk describing his three African expeditions. Dr. Sereno's presentation was sponsored by the Alberta Palæontological Society, the University of Calgary and Mount Royal College. Special thanks are due to members of the APS executive, and in particular, APS Programs Director ***Dr. Kris Vasudevan*** *for his remarkable efforts in arranging this presentation.*

When dinosaurs first appeared as metre-long, bipedal animals 230 million years ago, all the continents were connected in a single land mass, known as Pangæa. This supercontinent split in two, forming Laurasia, the northern continent, and a southern continent, Gondwana. By the end of the dinosaur age the Atlantic Ocean had opened between the Americas and Europe/Africa.

The dinosaurs of Africa have not yet been studied thoroughly. Eric Stromer, a professor from Munich, Germany, described *Spinosaurus* and *Carcharodontosaurus* in 1915. Only one dinosaur from Africa was ever mounted, namely *Spinosaurus,* with its 1.5 metre high neural spines. Unfortunately all those African fossils were lost during World War II, when the Munich museum was bombed.

In 1993 Dr. Sereno mounted an expedition to explore the Sahara desert with its 130 million year old Cretaceous rocks. These rocks formed when South America and Africa were still connected and the Atlantic Ocean was just beginning to form.

Six overloaded Land Rovers carrying the personnel, plus enough supplies for twenty-two people for four months, started from London, and passed through Algeria, crossing 1600 kilometres of open Sahara desert. The Global Positioning System (GPS) was not yet complete, so a compass was required to supplement the GPS readings.

A local nomad led them to fossils: a sauropod skeleton consisting of backbone and limbs, at the edge of a 640 kilometre long dune field (an *erg*) in western Algeria. In an increasingly difficult and unstable political climate, the group negotiated the excavation. After approval was won, only twenty-six days were left to excavate. However, the sauropod was too large to remove in less than one month. So the group found another specimen, also a sauropod, and began removing its 7 tonnes of material. On the second day at this new site, they found the foot claw of a 130 million year old (Early Cretaceous) theropod, which they named *Afrovenator*. This was the first theropod animal of that age known from Africa. This specimen resembled *Allosaurus*, a North American Jurassic dinosaur. *Afrovenator* seemed to be a Jurassic dinosaur that had survived into the Cretaceous. It appears as if this lineage of theropods continued into the Cretaceous in the southern continent.

In 1995 Dr. Sereno led a second expedition into Africa. This time they took a different route which started in France and then crossed Spain and Morocco to arrive in the western Sahara, where French abbots had found fossils in the 1940s. Dinosaur fossils had been discovered in the 130 kilometre long, 60 metre high cliffs, which were capped by hard limestone. The cliff represents an ancient delta deposit, so both terrestrial and marine fossils were found.

This trip was the most physically demanding of Dr. Sereno's African expeditions. The constant climbing of the vertical cliffs took a toll, both on the people and their boots (truck tire treads were epoxied to the boot bottoms when the original soles disintegrated after only half of the season was complete).

Fossils were rare at this locality. The biggest finds after three weeks were fossil shrimps and crabs and only fragments of dinosaur bones. After forty days in the field, a dinosaur toe bone was discovered. Then *Deltadromæosaurus*—a slender, long-limbed theropod, was found. This specimen was the size of an allosaur, but was not yet mature. The animal probably reached the size of an albertosaur but most closely resembled *Ornitholestes,* from Utah's Morrison Formation. Traces of small dinosaurs and an enormous crocodile, with a 1.8 metre long skull, were also found. 150 metres up the cliff face, Dr. Sereno found a *Carcharodontosaurus* skull. This specimen, with skull and teeth comparable in size to that of a *T. rex*, had huge openings in the skull, hollow bones and a very narrow snout. A CT scan of the brain cavity later showed that the cerebellum—the thinking part of the brain—would have been about half the size of a tyrannosaur's, even though the overall skull size

was about the same. Based on this brain size comparison, Dr. Sereno has grouped carcharodontosaurids in a group separate from tyrannosaurids. Dr. Sereno likened the tyrannosaurs to overgrown raptors, rather than as descendants of *Allosaurus*.

In 1997, Dr. Sereno's expedition landed in Ghana and drove north 3200 kilometres to the very sparsely inhabited Ténéré Desert. All water had to be carried by the expedition. On day six, David Rioco, a palæontologist from Montana, found a 33 centimetre long thumb claw plus a fibula from a predatory dinosaur exposed at the surface. This led them to a total of 400 pieces from a single skeleton, which made up 70% of the 11 metre long animal.

This dinosaur had a very narrow, 1.2 metre long skull containing over 120 cylindrical teeth. The larger teeth were in the front, unlike those in tyrannosaurs. Its 1.2 metre long forelimbs were probably stronger than those of any other predator. Its flexible neck, hooked arms, and cylindrical teeth would have helped this dinosaur catch fish. *Suchomimus*, "crocodile mimic," was found in fresh water river beds with the fossils of four species of large fish—lungfish, gar, shark and coelacanth. Because this dinosaur had no big spines, its closest relative was probably *Baryonyx*, found in England. This suggests a land link between Europe and Africa at a time when the northern and southern continents were thought to have been separated.

Also found nearby were the bones of a 12.8 metre long crocodile with a 1.8 metre long skull. A full mount of *Suchomimus* is currently on display at the Chicago Children's Museum. A large mural by APS member **Mike Skrepnick** graces the wall. Kids can excavate a model of the *Suchomimus* bones (i.e. sweep sand away from rubber bone fragments) and learn about Dr. Sereno's 1997 expedition.

After completing the excavation of *Suchomimus*, Dr. Sereno's group returned to the site first found during the 1993 expedition. They discovered that the "large sauropod" was really two animals. An adult specimen lay on top of a juvenile. The juvenile's bones showed teeth marks and several *Afrovenator* teeth were found nearby. They gathered 20 tonnes of fossils.

This sauropod doesn't fit into any of the four recognized families of sauropods (titanosaurids, diplodocids, camarasaurids and brachiosaurids). Its broad teeth, short neck with twelve vertebrae, and non-bifurcate vertebrae make it a survivor of a primitive stock. This specimen will be officially announced to the public in early November, 1999. [*The new sauropod has since been named* Jobaria

Dr. Sereno with members of the Special Program organizing group (left to right): John Cox, Science Department, Mount Royal College; Keith Mychaluk, APS Events Coordinator; Wayne Braunberger, APS Past-President; Dr. Kris Vasudevan, APS Program Coordinator; Dr. Paul Sereno; Gabrielle Lyon (Mrs. Sereno); Cory Gross, APS Vice President; Vaclav Marsovsky, APS President. *–Photography by Amanda Lockhart.*

tiguidensis– *ed.*]

It took preparators at the University of Chicago all of 1998 and part of 1999 to prepare the specimen. After preparation and study, the fossils will be returned to their country of origin. Dr. Sereno thinks that this dinosaur was the dominant sauropod of its time in Africa.

During the Cretaceous, there was almost no volcanic activity in Africa, so dating the fossils is approximate—plus or minus 10 million years.

Dr. Sereno is planning to return to Africa in 2000. The National Geographic Society will be broadcasting a film on Dr. Sereno's African expeditions this November. ❑

Dr. Sereno speaks on the Evolution of Dinosaurs

by Harold Whittaker

Lecture by Dr. Paul C. Sereno, University of Chicago, at the University of Calgary, September 16, 1999

Dr. Sereno opened his talk by stating that a lot can be learned from dinosaurs, which were the dominant terrestrial land animals for 150 million years. Prior to 30 years ago, knowledge of dinosaurs was limited by the quantity of specimens and the distribution of collecting sites. Since this time, global collections have improved greatly, allowing for an information "explosion." With new evidence in hand, inferences can be made about dinosaur radiation and extinction. Comparisons can also be made with the more recent mammalian radiation after the demise of the dinosaurs. Dr. Sereno's work on African dinosaurs has added greatly to the research.

During this past 30 years, much has been learned about dinosaurs, including geographic ranges, eggshell microstructure, nesting patterns, and epidermal structures such as downy filaments and feathers. In addition, analysis of bone microstructure and isotopic composition has shed light on embryonic and post-hatching growth patterns and thermophysiology. Footprint and track sites have yielded new clues regarding posture, locomotion and herding among large-bodied herbivores. The main lines of dinosaurian descent have been charted, placing dinosaurs in phylogenetic context.

Dr. Sereno spoke about the impact this enriched understanding of dinosaurs has had on the study of large-scale evolutionary patterns. What triggers or drives major replacements in the history of life? How do novel and demanding functional capabilities, such as powered flight, first evolve? How does the breakup of a supercontinent affect land-based life? He stated that the critical evidence resides in the fossil record—in the structure, timing, and geography of evolutionary radiations such as that of the dinosaurs.

The ascendancy of dinosaurs on land transpired rapidly some 215 million years ago. They spread across Pangæa, beginning the age of the dinosaurs. Virtually all animals of this time period, inhabiting dry land habitats, and one metre or more in length were dinosaurs. Recent discoveries from 230 million-year-old rocks provide evidence that a dinosaur land radiation had already started by this time. The ancestral dinosaur was a bipedal carnivore closely resembling the 1-metre-long early theropod *Eoraptor*. The early dinosaurs were limited in diversity and abundance.

The dinosaur replacement of a wide variety of terrestrial tetrapods appears to be the result of opportunistic replacement rather than a competitive advantage. Dr. Sereno noted that this pattern is broadly similar to the replacement of nonavian dinosaurs by therian mammals at the end of the Cretaceous. Additional recent evidence also implies that other factors influencing extinction were occurring, such as global climatic change and extraterrestrial impacts. Dr. Sereno notes in his article, appearing in the June, 1999 edition of *Science*:

"Although the timing of the Triassic extinction remains less resolved than events at the end of the Cretaceous, dinosaurian and mammalian radiations cannot be explained as the result of niche subdivision, increased competition, or specialization. These two great land radiations constitute opportunistic infilling of vacant ecospace after global changes. The dinosaurian radiation occurred slower and was more restricted in adaptive scope than that of therian mammals. A notable exception was the evolution of birds from small-bodied predatory dinosaurs, which involved a dramatic decrease in body size. Recurring phylogenetic trends among dinosaurs include, to the contrary, increase in body size."

Dr. Sereno revealed that "There is no evidence for co-evolution between predators and prey or

between herbivores and flowering plants. As the major land masses drifted apart, dinosaurian biogeography was moulded more by regional extinction and intercontinental dispersal than by the breakup sequence of Pangæa."

Reference

Sereno, Paul C. 1999. *Science*, No. 284, p. 2137–2147.

Program Summary

October 15, 1999
A Brief History of Landscape Evolution, Palæoclimate, and Palæontology in the Mackenzie Delta Area, from a Micropalæontologist's Point of View, with Dr. David H. McNeil, Geological Survey of Canada.

[*The Editor was unable to attend this program. Following is a biography of the speaker, and an abstract of his talk, kindly provided by Dr. McNeil.*]

Dave McNeil was born in Regina and educated at the universities of Regina and Saskatchewan. He received his Ph.D. in 1977 from the U. of S. based on a dissertation on the microfossils and stratigraphy of the Manitoba Escarpment. His thesis was published in 1981 as Special Publication 21 of the Geological Association of Canada. Dr. McNeil joined the Geological Survey of Canada in 1977 and has been employed with the Survey since that time as a micropalæontologist/research scientist. His areas of research interest include many aspects of Mesozoic and Cenozoic foraminifera from western Canada and the Canadian Arctic.

Dave first travelled to the Mackenzie Delta area as a summer student employed by Shell Canada in 1970 and was impressed by the natural beauty and geological challenges of the area. The following year he was a senior geological assistant with the Geological Survey of Canada and helped map the Upper Cretaceous and Tertiary rocks of the Yukon Coastal Plain and neighbouring Richardson Mountains. Since then he has made several field trips to the Arctic collecting Mesozoic and Cenozoic microfossils, but has concentrated most of his efforts on resolving the biostratigraphy of the Mackenzie-Beaufort Basin by analyzing samples from hydrocarbon exploration wells in the area.

Activity in the Arctic tapered off during the 1990s and his research in that area culminated with several major publications including: (1) a monograph on Cretaceous and Tertiary foraminifera, (2) biostratigraphic contributions to the geological atlas of the Beaufort-Mackenzie Basin, and (3) applications of microfossils for thermal maturity studies and basin analysis. His current research is centred around Cretaceous microfossils in the Western Canada Sedimentary Basin, mostly in central Saskatchewan, where microfossils occur in Cretaceous sediments interbedded with diamond-bearing kimberlite rocks. Recent exploration activity for gas hydrates and natural gas in the Mackenzie Delta may necessitate further microfossil research in the Arctic.

Program Abstract

The Beaufort-Mackenzie Sedimentary Basin has a long geological history, dating back 100 million years, but the focus in this presentation is on the events of the Late Cenozoic from about 15 million years ago (m.y.a.) to the present, a time of great climatic and physiographic change in the Arctic.

Approximately 15 m.y.a., Arctic climates were much warmer than today, as indicated by plant fossils. The climate deteriorated through the late Miocene to an abrupt change at about 5 m.y.a. Paleontological evidence of this climatic change can be found in fossil palynomorphs (pollen, spores) and microfossils (foraminifera). A regional surface of erosion marks the point of climatic and biotic change. This palæosurface can be mapped from deep within the subsurface of the Beaufort Sea, south beneath the Mackenzie, and emerges on land where erosional remnants are preserved today on both sides of the Mackenzie Delta, including terrace remnants in the Richardson Mountains to the west. The first records of microfossil life preserved in sediments above the palæosurface indicate that a completely new microfauna emerged.

Dating the emergence of this new assemblage is difficult, but several lines of evidence point to the mid-Pliocene, about 3.5–2.5 m.y.a. Climatic deterioration culminated with alpine glaciation beginning at approximately 2.6–2.9 m.y.a. and continental glaciations much later. Continental glaciation led to a rearrangement of the Late Cenozoic drainage patterns and the establishment of the modern Mackenzie River Delta at about 12.5 thousand years ago. ❑

More New Members!

Robert Moody, Airdrie, AB
Alex Morrison, Airdrie, AB
Jessie Niles, Millarville, AB
Guy Santucci, Cranbrook, BC
Elizabeth Scott, Calgary, AB
Paul Sereno, Chicago, IL
Herb Treslove, Calgary, AB

The Fossil Bird Quarries of Liaoning, China

Article and photographs by Vaclav Marsovsky

[Vaclav and Mona visited the Liaoning fossil site earlier this year. This article is based on their experience at the site –ed.]

The small farming village of Sihetun, one hour southeast of the coal mining centre of Beipiao (population over 100,000) has become a centre of attention in recent years due to the fossil birds and feathered dinosaurs found there. The quarries have been producing plant, insect and fish fossils for many years.

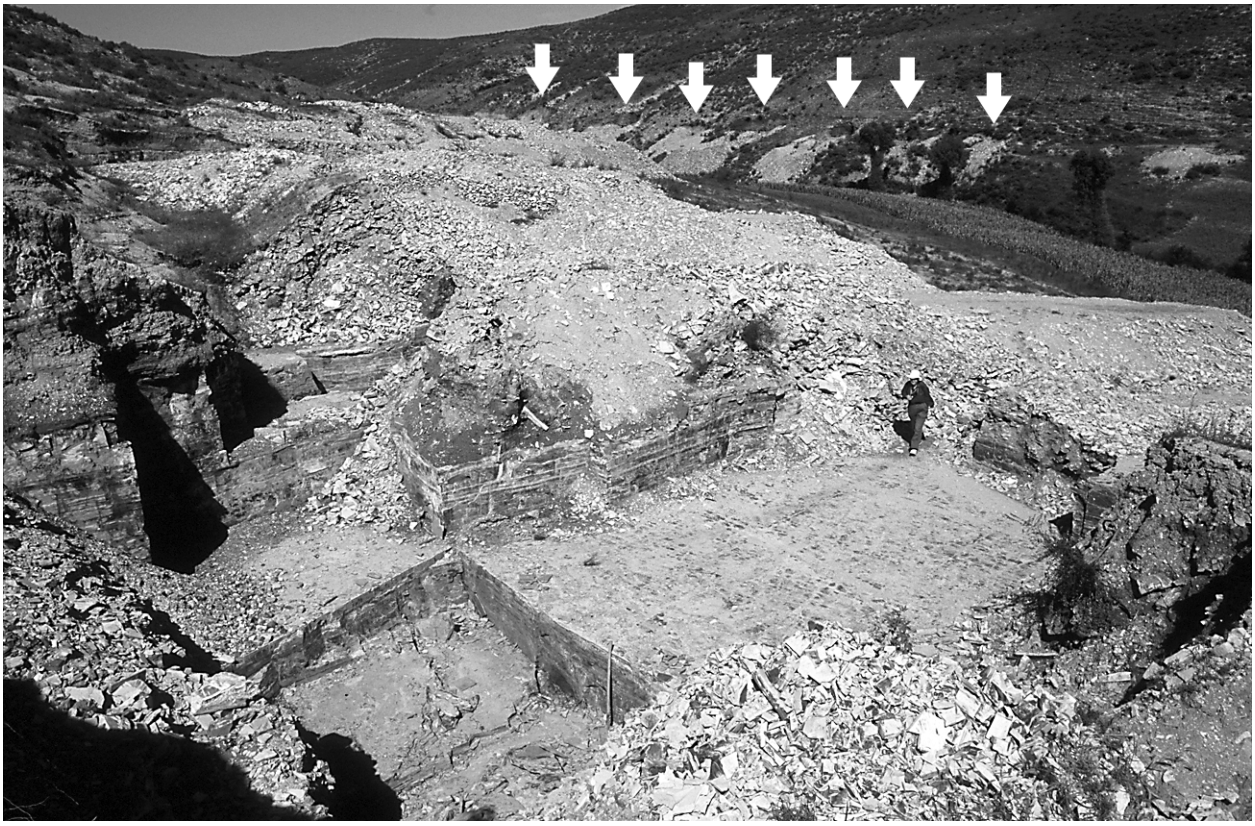
The sites are typically located near a small farming village. The villages themselves are separated by a few kilometres. When the farmers are not growing corn, they are digging up fossils to supplement their incomes. The quarries are usually small, isolated pits dug into the side of a hill. The pits follow the contour of the hill as the farmers look for a particular layer. The further into the hill the pit has been dug, the higher the cliff at the back. Some cliffs are as much as 15 metres high, all dug by hand. A typical village site may comprise fifty pits spread over a one square kilometre area, an indication of a long history of excavating.

After finding thousands of *Confuciusornis* birds, the farmers have learned to recognize a bird layer in the stratigraphic column. The fossil-bearing beds are hundreds of metres thick but the farmers don't waste their time in the common conchostracan ("clam-shrimp") layers. The bird layer is only a few centimetres thick. The feathered dinosaurs, non-feathered dinosaurs like psittacosaurs, and true birds like *Confuciusornis* are said to come out of the same layer.

Only a few feathered dinosaurs have been found and their location is based on information volunteered by the farmers. This information is gathered after the fact, and can lead to inaccuracies. I am not aware of any photographs with a feathered dinosaur shown *in situ*, in its original relationship to the beds. Many readers have probably seen the photographs in *National Geographic* magazine of the bedding. To a visitor, the bedding all looks the same, as the various shades of brown repeat themselves. As a reference, there is an igneous layer half a kilometre from the quarries which has been dated as Late Jurassic. This is the nearest layer that can be dated. The bird layer lies well above this. A clay layer next to the igneous layer shows signs of being baked. The farmers know instinctively where the bird layer is…and they are very sure of themselves, too—they excavated in great haste to get to the bird layer. Not all hills in the area have this magical bird layer. On a hill across the valley, farmers were digging for a particular "fish layer."

Quarrying operations near Sihetun—workers in lowest cut (midground) are preparing to slab "bird layer".

The birds are found using two basic methods. If the layering is thick—say 5 to 10 centimetres—a thick slab is removed from the quarry, then a wedge is driven into the edge to split the slab. Sometimes the edge shows a dark brown streak in the normally pale sediment, a clue that there could be something interesting inside. This is how *Sinosauropteryx prima* was found. It resulted in a slab and counter slab. Hardly any preparation work was necessary as the fossil was sheared through the bone and the proto-feathers.



Fossil quarries abound near Sihetun—arrows indicate a line of additional small quarries along the side this valley, about 3 km. from Sihetun. The quarries follow a layer rich in fish and insect fossils.

The second method, which leaves less to chance, is used when the bedding is thin—say 3 millimetres. When the bird layer is reached (or just above it), a small scraper is run over the horizontal bedding surface. The deposit flakes off in thin sheets a few millimetres thick. The workers carefully examine the surface and look for ripples which will be a sign of the three-dimensional fossil below. When a bird is detected, a slab large enough to get the whole bird is removed by cutting around it. A sheet of plywood is used to support the slab and keep it from flexing and cracking. For those who had a chance to see it, the *Confuciusornis* being prepared this past summer at the Royal Tyrrell Museum's public viewing area was in a slab of this kind. Before preparation work had started, you could see the ripples on the surface telegraphing the fossil below.

The most important finds always seem to come into the hands of the Chinese museums from farmers in bits and pieces of incomplete specimens; for example, recent segnosaur, *Beipiaosaurus* and feathered *Dromæosaurus*. I have wondered why more effort is not made to go back to find the rest of the pieces. Perhaps there is more that can be salvaged.

By official policy, only three museums in China are allowed to collect fossil birds—namely, the Institute of Vertebrate Palæontology and Palæoanthropology (IVPP) in Beijing, the Geological Museum in Beijing and the Nanjing Institute of Geology and Palæontology. There are also small local museums such as the Yizhou Museum, near the quarries, where small collections are kept. These smaller museums have a relationship with the national museums. The more common fossils are sold commercially.

Information Tidbits:

• It takes one person about three months to prepare a *Confuciusornis* bird.

• The bird fossils are prepared using a tool like a fine pin-vise to flake off bits of the matrix.

• The Liaoning matrix has the same colour, consistency and characteristics as the McAbee beds in British Columbia. [*Bulletin*, Sept. 1995, p. 4–5]. That should not be surprising since both are lake deposits derived from volcanic ash—but the Liaoning beds are three times older.

• Fossil plants from Liaoning—dominated by ferns, cycads and ginkgoes—look exactly the same as those from Grassy Mountain, Alberta. [*Bulletin*, Sept. 1998, p. 3]. That is not surprising, since they

Vague ripples on the surface of a slab in a Beipiao fossil shop hint at the fine psittacosaur specimen beneath.

are of identical age, dated at the Cretaceous/ Jurassic boundary…now we just need to find some feathered dinosaurs in Alberta!

• Some of the oldest angiosperms (flowering plants) have been found at Liaoning. The origin of flowering plants is thought to be linked to the co-evolution of pollinating insects. This link seems to be supported, as fossil flies with the right kind of nectar-sucking mouth parts have been found together with the plants at Liaoning.

• Conchostracans ("clam-shrimps") are the most common fossils in Liaoning. They are small fresh water crustaceans, about 1 centimetre in size. The animal lives between two valves that resemble a clam shell. They still exist today in all latitudes, rest in the silt on the bottom and are filter feeders.

• Even a large sauropod has been found in the lake deposits of Liaoning! A section of the neck is on display at the Yizhou Museum. I presume the carcass floated out on to the lake and sank to the bottom to become fossilized.

• The occurrence of fossil birds found in pairs seems to be more common than one would expect. Why should two birds come to rest on the lake bottom at the same time, and so close to each other?

• Some signs to look for to distinguish a feathered dinosaur from a bird: teeth in the mouth vs. no teeth, tail vs. no tail. ❑

Night of the Flying Dinosaurs

by Vaclav Marsovsky

Flying dinosaurs were the focus of this year's Honorary Address organized by The Canadian Society of Petroleum Geologists. It was held at the Jubilee Auditorium in Calgary on November 3, 1999.

The Alberta Palæontological Society is thankful to the CSPG Honorary Address Committee for providing space for us in the display area and for having us participate in the event. The APS had a staffed display booth to promote the Society. Other professional societies and the Royal Tyrrell Museum were also present.

The day consisted of an afternoon session for school children, while the evening session was for the general public of all ages.

Two speakers presented talks. The first speaker was the naturalist and television personality, John Acorn, "The Nature Nut." He presented a musical and sometimes humorous side to the link between birds and dinosaurs. He talked about the parallels in nature of the raising of the young, migrations, and how flight had arisen four times in the history of evolution. The first flyers were the insects, about 300 million years ago; then pterosaurs who used skin for wings; then birds with feathers; and lastly mammals with skin wings—the bats. John Acorn also tackled the question: "could dinosaurs have been hot blooded?" He again looked into parallels in nature today and talked about the hot blooded insects, (the flapping of wings generates heat) and the shivering of pythons around eggs to generate heat. Lastly, John talked about the function of feathers as insulation to keep heat in or keep heat out. He again turned to examples in nature using the analogy of spines on a cactus.

The second speaker was Dr. Philip Currie, a dinosaur expert at the Royal Tyrrell Museum. Dr. Currie made a scientific and yet general comparison of characteristics between birds and dino-

saurs—the *Tröodon* brain case and its bird characteristics; similarities between bird and dinosaur eggshell; the structure of the feet and the presence of a wishbone in theropods were just some of the comparisons made to support the theory that birds evolved from dinosaurs. There is no other group of animals found in the fossil record as close to birds that could have given rise to birds.

Dr. Currie also talked about the feathered dinosaurs recently coming out of Liaoning, China. He presented his view on how the proto-feathers or filaments can get preserved only as a halo around the body when sandwiched in mud. The feathers covering the body rot away with the flesh and may not be preserved like the stains left behind by internal organs.

Based on the diversity of theropods found associated with feather impressions, speculations have been made that young Tyrannosaurs could have had feathers to control their body temperature. Feathers are thought to have evolved for insulation and display first and later became instruments of flight. ❑

Review

by Les Adler

Into the Dinosaurs' Graveyard—Canadian Digs and Discoveries by David Spalding, Foreword by Dr. Philip Currie. Doubleday Canada, 305 p., $37.

In September, I collected the APS mail and was confronted with a $2.00 fee to collect a parcel. It contained this book, donated to our APS library from Doubleday Canada. In October I met with David Spalding, who lives on Pender Island, B.C., and in November I met with Dr. Currie, who lives in Drumheller. They both graciously agreed to autograph this copy in appropriate locations, with a message in each case.

David Spalding used to be a head curator at the Provincial Museum in Edmonton and hired Phil Currie to do dinosaur research. David's fossil program went on to become the Royal Tyrrell Museum of Palæontology.

Briefly, this history book tells the stories of the dinosaur hunters—a variety of colourful characters, the important finds they made in Canada and abroad, and the role they have played in establishing Canada's dinosaur science heritage. The book tells of the collaboration and tension between the British, Americans and Canadians; easterners and westerners; scientists and ministers; the rise and fall of universities, museums and programs, providing insights into the Canadian psyche.

In his foreword, Dr. Currie asserts that: "David Spalding has probed deep into the archives of many of the finest museums in the world for information on the collection of dinosaurs and possibly there is no one else in the world who knows as much about this subject."

The inside covers consist of a map of stratigraphic and dinosaur locations and exhibits across Canada, with an emphasis on Alberta, Nova Scotia, Saskatchewan, Prince Edward Island and the Arctic. David Spalding provides twenty-eight of his own photographs. There are thirteen chapters, a glossary, and lists of books, audiotapes, bibliographies, videos and e-mail addresses.

At the front, you will find a curse: "For the unknown civil servant who kept the card index to correspondence of the Geological Survey of Canada…but threw away the letters!"

It takes about ten hours to read this enjoyable book and as there will be about twenty people ahead of you, you can expect to obtain the APS copy in about two years time! ❑

Fossils in the News

The Yukon News, September 8, 1999

Dinosaur footprints found

WHITEHORSE, Yukon—Two Alaskan scientists, Roland Gangloff and Kevin May, of the University of Alaska Museum, in Fairbanks, have discovered an important dinosaur track site in the Faro-Ross River region of the Yukon. The Cretaceous-age site includes a trackway of four footprints, and numerous individual prints. The location is being kept secret, for protection from vandals.

Yukon palæontologist Dr. John Storer says the discoverers were very lucky. "They felt if they got rock of about the right age they might have a chance. Their noses were very, very good." Dinosaur remains are not common in the Yukon. The only previous record was three small bones of a hadrosaur, found in the Bonnet Plume Valley, east of the Dempster Highway. Dr. Storer is hopeful that other fossil remains may be found in the vicinity of the dinosaur tracks, such as plant impressions.

(More Fossil News on Page 13)

Strange Prairie Rattlesnake Behaviours: Part II

by Samuel Richter

[*This is the final part of Sam's two part article. Part I was published in the September 1999 issue. –ed.*]

For female rattlesnakes, pregnancy is tough: a large store of energy is required. A female goes from hibernation, to not eating while gestating the young, then back into hibernation. Several or more years will be required for her to double her weight so she can again be receptive. Pregnant females spend much of their time staying extra warm, by basking in the sun, to speed up development of the offspring by maintaining optimum metabolism. The gestation period has many variables but is timed for the birth to be in the late summer. Birth takes three to five hours, with the young appearing at intervals of fifteen to forty-five minutes.

Depending on the size of the mother there could be anywhere from one to fifteen young, with an average somewhere between six and ten. The young are enclosed in a thin transparent membrane from which they escape within minutes. These babies are fully developed, complete with potent venom, and are 18–25 cm long, with an aggressive attitude. Their venom is up to twelve times more lethal per drop than in mature adults. They hang around until after their first skin is shed, in a week to ten days, and then disperse. The survival rate is low with up to 60% not surviving the first winter and a mortality of up to 50% of the remainder in each of the following years. Likely no more than two make it to sexual maturity—three or four years for males and four to seven years for females.

Rattlesnakes are well equipped to prey on elusive small rodents that are agile, quick, have acute senses and sharp claws and teeth. Rattlesnakes bear on their face the two characteristic pits that explain the family name: pit viper. A viper is a snake that uses venom, not poison. The 5 mm deep pit is divided into an inner and outer chamber by a thin membrane less than 0.025 mm thick. The pink layer seen inside the pit is the membrane, not the bottom of the pit. The inner chamber is small and connects to the outside by a small pore in front of the eye. There are muscles around the pore that can close it off for unknown reasons. Radiant heat hits the membrane which is supplied with many nerve endings, about 500–1500 per square millimetre, coming from a branch of the trigeminal cranial nerve. These nerve endings are thermoreceptors for infrared radiation only and consist of tree-like structures of uninsulated nerve fibres. Any change to a warm or cold object causes a response. Rapid, 0.1 second warming by as little as 0.002°C at the nerve endings generates nerve impulses, going to the same part of the brain that processes vision signals.

Variations in ambient air temperature are not detected, only rapid changes in infrared radiation, warmer or colder than before, is discriminated for. This is how the system compensates for background radiation from the sun or hot ground, so that it isn't swamped by high radiation, because otherwise some animals would be invisible. Some tests have shown that they can detect a difference of 0.2°C in radiation at 40 cm, with even greater sensitivity at closer distances. A relatively cool device at 10°C, giving off much less radiation than a warm mammal, and appearing for only one-half of a second at 40 cm, is easily detected. Infrared radiation from a mammal body has its peak wavelength around 10,000 nanometres, which is longer than visible red light but shorter than radar waves. These pits allow the snake to get accurate information for range, position and size of prey, even in total darkness.

A pit viper's chemosensory hunting skills are thought to be the most acute in the animal kingdom. Odour detection is critical, being used to find food, females, and in detecting predators. In the fraction of a second the strike takes, the snake gets the distinct odour signature of that particular individual. One flick of the tongue picks up the airborne molecules. When the tongue is withdrawn into the mouth, the odour molecules are cleaned from the tongue tips onto pads on the floor of the mouth. These pads are then pressed against the roof of the mouth, transferring the odour molecules to the Jacobson's organs. These are lined with nerve endings linked to the brain by a branch of the same nerve that connects the nostrils to the brain. The generated nerve pulses create a chemical memory in the brain and it will now track down the prey like a bloodhound.

In lab experiments, the scent of the bitten prey has been diluted thousands of times, and the rattlesnake even delayed in starting after the prey, but the rattlesnake has always found the trail and followed it to the now dead prey. The use of injected

venom and the regular and special sense of smell allow the rattlesnake to avoid being clawed or bitten while getting lunch.

APS members often come in contact with these snakes. Some small snakes in the grass have accidentally been stepped on and squashed. Big ones were seen at the Pinhorn Ranch last summer. The south facing bluff at Wolf Coulee has produced shed skins, and snakes were seen among the rocks. Red Rock Coulee had two appear on one fossil hunt. Dinosaur Park is doing a study on rattlers in the park using radio telemetry. These snakes are considered endangered and are on the protected list. Lethbridge posts "snake crossing" signs on the road in a subdivision near the wintering dens.

Fossil evidence for snakes is generally not very informative. Most snake fossils consist only of isolated vertebrae, with an occasional bone from the skull. Snake skeletons are delicate, and are easily destroyed, resulting in isolated and widely scattered bones. Generally the skulls are absent, or only a bit of the skull is found. Five vertebrae and ten ribs is all there is of a boa of the family Madstoia from about 55 million years ago (m.y.a.), which may have reached 9 metres in length. This is on display at the American Museum of Natural History, in New York. Exceptions to the scattered bones rule include an almost complete skeleton of what could be a primitive snake related to boids and pipe snakes that was found in Argentina. A mud slide buried this snake alive. This is the oldest fossil definitely identified as a snake and is from the Upper Cretaceous (80 m.y.a.). It is named *Dinilysia*. Much older fossils than this are more likely to be from legless lizards than from snakes. An excellent articulated boa, *Boavus occidentalis*, was found in sediment from the Middle Eocene (45 m.y.a.) in Wyoming. The period from 5 to 23 m.y.a. (Miocene) is believed to be the period of the greatest diversification in snakes. Most snakes found in rocks of this epoch are assignable to modern groups. Viper fossils have been found that are thought to be about 22–30 million years old. American pit vipers are about 10 million years old. Rattlesnake fossils go back 4–5 million years. Two extinct species are *Crotalus potterensis* from California and *C. gigantus* from Florida.

Most snake fossils consist only of isolated vertebrae

Further Reading

Ernst, Carl H. 1992. *Venomous Reptiles of North America*. Smithsonian Press, 236 p. ❑

Fossils in the News

(Continued from Page 11)

The Globe and Mail, August 30, 1999

New dinosaur find may be rarest of tyrannosaurs

DRUMHELLER—This article, by *Globe* "Science Reporter" Kim Honey, who is clearly out of his or her depth (at one point the dinosaur is described as a "massive mammal"), reports the discovery of a complete skeleton of a *Daspletosaurus*, found last fall in Dinosaur Provincial Park.

According to Dr. Philip Currie, of the Tyrrell Museum, there are only about five specimens of *Daspletosaurus* with both the skull and postcranial skeleton known in the world, which would make this an especially valuable find. The new skeleton will help to establish the anatomical differences between the apparently more massive *Daspletosaurus* and its contemporaries, *Albertosaurus* and *Gorgosaurus.*

Dr. Currie also suspects that the new specimen may represent a different species than the type specimen of *Daspletosaurus*, excavated by Charles Sternberg in 1921, and described by Dr. Dale Russell in 1970. The original *Daspletosaurus* was recovered from the Oldman Formation, which underlies (and is significantly older than) the Dinosaur Park Formation, from which the latest skeleton was recovered. The two formations were also deposited under different environmental conditions. "Clearly the animals are different," says Dr. Currie. "The one found in the upper formation—the new one—has a much longer skull, a longer snout on the skull."

The Edmonton Journal, October 29, 1999

Fossils found from time when "rhinos" ruled the Arctic

AXEL HEIBERG ISLAND, Nunavut—Rare fossils of vertebrate animals have been recovered from four locations on Axel Heiberg Island in the Canadian Arctic. The fossils, collected by palæontologists John Storer and Jaelyn Eberle, include teeth of a brontothere (a large, rhino-like mammal), alligators and remains representing three different families of turtles. The bluish-weathering brontothere teeth were first spotted by palæobotanist Dr. James Basinger of the University of Saskatchewan.

The newly discovered fossils complement the now famous plant-fossil evidence for a semi-tropical climate in the far north during the

Miocene epoch, 38 to 45 million years ago [Bulletin, *June 1991, Sept. 1999*]. The rarity of animal fossils in these beds may be due to acidic soil that was not conducive to bone preservation.

The Globe and Mail, September 29, 1999

Fossil upsets theories on mammal roots

OKLAHOMA CITY (Reuters)—The fossil jaws of a small, shrewlike mammal, found on a ranch near Billings, Montana, are throwing into question the geographic origin of placental mammals.

Prior to the discovery of *Montanalestes keebleri*, by Dr. Richard Cifelli, of the University of Oklahoma, placental mammals were thought to have originated in Asia. The *Montanalestes* fossils were found in Lower Cretaceous rocks (110 million years old), the same age as the earliest known Asian fossils of placental mammals. According to Cifelli, "this thing is so primitive that it's a structural ancestor to anything that follows."

The National Post, October 19, 1999

Hairy mammoth exhumed intact for first time from Siberian ice

PARIS—A flurry of articles appeared in late October describing the discovery and excavation of a supposedly complete, frozen mammoth, along with the inevitable speculation about DNA cloning to bring the beast back from extinction.

An expedition including French and Russian scientists excavated the mammoth from the permafrost of northern Siberia, near the town of Khatanga. The expedition and helicopter airlift of the still ice-encased mammoth—tusks protruding from the frozen mass—was funded in part by the Discovery Channel, which will air a special documentary, *Raising the Mammoth*, on March 12, 2000. The 20,000 year-old fossil, called "Zharkov," for the local family who found it, was transported to a cold, underground cave in Khatanga, where it will be slowly defrosted, using hair driers.

The Calgary Herald, November 3, 1999

Scientists unearth biggest dino on record

OKLAHOMA CITY (Reuters)—This year's titleholder of "Biggest Dinosaur Ever" appears to be an Early Cretaceous sauropod from Oklahoma, dubbed *Sauroposeidon* ("Earthquake God Lizard"). The size of this monster, estimated to have stood 18 metres tall and weighed 60 tonnes, is based on a few neck bones, excavated in southeastern Oklahoma in 1994. University of Oklahoma palæontologist Dr. Richard Cifelli reports that the neck bones are each 1.2 metres long, and most closely resemble those of *Brachiosaurus,* to which the new sauropod is probably related. Cifelli's team CAT-scanned the neck bones, revealing that the huge bones were filled with air pockets, providing a compromise between size and weight. Anatomically, *Sauroposeidon* appears to have been more specialized than *Brachiosaurus*, and it was one of the last representatives of the giant sauropods in North America. A description of *Sauroposeidon* is scheduled for publication in the *Journal of Vertebrate Paleontology*, in March 2000.

The Calgary Sun, November 4, 1999

World's oldest vertebrates found

CHENGJIANG, China—Fossils of what may the oldest known vertebrate animals have been recovered from the famous Chengjiang fossil beds, similar in age and content to the Canadian Burgess Shale. Two 6-centimetre long fish-like creatures were found in the rocks, dated to about 530 million years old, or Middle Cambrian, according to Cambridge University palæontologist Simon Conway Morris. The oldest previously known vertebrate organisms were from Late Cambrian rocks. The implication of this discovery, says Conway Morris, is that "the so-called Cambrian explosion was more abrupt and dramatic than we thought."

CNN.com, September 30, 1999

Scientists uncover proof of Neanderthal cannibalism

WASHINGTON (AP)—The question of whether or not Neanderthal man practised cannibalism has been a topic of controversy since early in this century, when bones bearing cut-marks were found in eastern Europe. Now, a team of French and American palæontologists has found seemingly irrefutable evidence of cannibalism on bones found in a French cave. Bones of six individuals, including children, where found mixed among animal bones, all of which showed the marks of preparation for food: defleshing cut marks, smashed skulls, limb bones smashed with a hammerstone, on a stone anvil, for removal of marrow. Since the human and animal bones all show the same tool marks, the evidence appears solid. Speculation now centres on the reasons for the cannibalism. ❑

Thanks to: Les Adler, Vaclav Marsovsky, Trudy Martin, Sam Richter, Kris Vasudevan.

Mark Your Calendar!

Two Upcoming Special Events

Presented by the

Alberta Palæontological Society

Friday, December 17, 1999
7:30 P.M.

Dr. Alan Hildebrand

University of Calgary

The Chicxulub Impact:
The Dinosaurs Didn't Have a Chance

Nickle Theatre, Mount Royal College, Calgary

Saturday, January 22, 2000
10:00 A.M. to 5:00 P.M.

Fourth Annual Workshop & Poster Session

Featuring displays and short talks by

The Alberta Palæontological Society
Mount Royal College
University of Calgary
Geological Survey of Canada
Royal Tyrrell Museum of Palæontology

Lower level of Mount Royal College, Calgary

Public Welcome Free Admission