Alberta Palæontological Society Bulletin

VOLUME 14 • NUMBER 1 MARCH 1999

ALBERTA PALÆONTOLOGICAL SOCIETY

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

a. Promote the science of palaeontology 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 palaeontological collections of the province (preserve Alberta's heritage).

MEMBERSHIP: Any person with a sincere interest in palaeontology 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

Meetings take place at **7:30** p.m., in Room **B108**,
Mount Royal College: 4825 Richard Road SW, Calgary, Alberta

April 16, 1999—Michael Ryan, University of Calgary:
Horned Dinosaurs from the North American Western Interior: New Research and Taxa
May 21, 1999—Dr. Kris Vasudevan, LITHOPROBE, University of Calgary:
The Hominid Family Tree: A Fossil Perspective
June, July, August, 1999—No meetings. See field trip announcements in March and June *Bulletin*.

ON THE COVER: *Dromaeosaurus albertensis* (Cretaceous, Alberta) noshing on some freshwater clams.
Art by APS Member Cory Gross © 1999.

1999 Field Trips

NOTE: Non-members and unaccompanied minors will NOT be allowed to attend field trips. For further information on all trips, contact Keith Mychaluk (403) 228-3211.

Field Trip 99-1: Saturday & Sunday, June 19 & 20, Princess & Wolf Coulee, Alberta

Meeting Time & Place: Saturday, June 19 at 9:30 A.M. at the Dinosaur Corner gas station near the entrance to Dinosaur Provincial Park (Highway 544, just south of Patricia, AB). Allow 3-4 hours driving time from Calgary.

Local Road Conditions: Gravel and dirt roads; passable with most vehicles in dry conditions (no large potholes). Only recommend four-wheel drive in wet weather.

Itinerary: Collecting Late Cretaceous vertebrate fossils from the Judith River Formation, such as champsosaur vertebrae, ray teeth, gar-pike fish scales, dinosaur bones, etc. The Saturday portion of the trip will include exploration of a coulee near the Princess gas plant. The microvertebrate sites in Wolf Coulee will be visited on Sunday.

What to bring: Weather conditions always change at a moment's notice in Alberta, so be prepared for wet or dry conditions. Bring good hiking boots, sunscreen, mosquito repellent and plenty of water.

Accommodations: Excellent camping facilities in nearby Dinosaur Provincial Park (reservations recommended). Several motels to choose from in Brooks, AB.

Warning: This is rattlesnake country so please take the necessary precautions (please, no pets!). Parents, please watch over your little ones.

Field Trip 99-2: Saturday & Sunday, July 17 & 18, Korite Ltd. ammonite quarry, southern Alberta

On Saturday, an educational tour of the Korite ammonite quarrying operation (Cretaceous, Bearpaw Fm.), south of Lethbridge, will be conducted. Some collecting *might* be allowed, but all material will be inspected by the quarry operator. One or more nearby collecting localities will be visited on Sunday.

Field Trip 99-3: Saturday or Sunday, August 21 or 22, Burgess Shale/Mt. Stephen Trilobite Beds, Yoho, B.C.

NOTE: Due to booking requirements with Parks Canada, the date of this field trip may have to be changed to the weekend prior or the weekend after the dates given above. Keep in touch with Keith for last-minute updates.

Guided tours of the Cambrian Burgess Shale (Walcott Quarry) and/or the Mount Stephen Trilobite Beds are being arranged with Parks Canada. **Fees of $45 (Burgess Shale) or $25 (Mt. Stephen) per person are charged for these tours, both of which involve very strenuous hikes of several hours one-way. Only physically fit persons with appropriate footwear should consider attending. Collecting is strictly prohibited!** Attendance (minimum/maximum) in each tour is limited by Parks Canada, so the number of members planning to attend will dictate which tours will be held. **Please contact Keith Mychaluk (403) 228-3211 as soon as possible if you are interested in participating.**

Sign-up sheets will be made available at all general meetings. Out-of-town members please call Keith to sign up. ❑

In Memoriam

We are saddened to report the passing of long-time APS member **Emmette Wallace**, on March 14, 1999, in Austin, Texas. Emmette and wife **Jean Wallace** (editor of the Austin Paleontological Society's *Paleo Newsletter*) have been members of our Society since 1986, its year of inception. They were regular attendees and exhibitors at the Calgary Rock and Lapidary Club's annual Show.

Emmette's enthusiasm for palaeontology and his generosity are well known. His name is listed as a donor no less than twenty-four times in the Society's fossil collection catalogue, and he has contributed many specimens to private collections. Another recent act of generosity was his donation of a large number of canvas collecting bags to Society members (*Bulletin*, September 1997). Emmette was known to many as an especially enthusiastic student of brachiopods and echinoids.

Emmette Wallace will be fondly remembered, and much missed by our Society membership. We extend our sincerest sympathies to his family and friends, and especially to his wife, Jean. ❑

Program Summary

by Howard Allen

December 18, 1998
Jaws of Death, Arms of Barney: Tyrannosaurids in Action, with Eric Snively, University of Calgary

Eric Snively is a graduate student working on his master's degree at the University of Calgary, under Drs. Philip Currie and Anthony Russell. He received his B.A. in biology from the University of California at Berkeley. His thesis work is concerned with an anatomical study of tyrannosaurs.

The tyrannosaurids are a group of theropod (bipedal, meat-eating) dinosaurs of the saurischian ("lizard-hipped") group. A number have been found with furculas, or wishbones, providing evidence for a relationship with birds. The tyrannosaurs filled an ecological role as top predators during the Cretaceous Period.

The earliest tyrannosaurs found so far have been from Asia, for example *Alioramus* of Mongolia. From Asia they apparently spread to North America. Other Asian tyrannosaurs include *Alectrosaurus* and *Tarbosaurus*. In Alberta, tyrannosaurs have been found in Cretaceous rocks of three main formations. In the earliest rocks, at Dinosaur Provincial Park (Judith River Fm.), *Gorgosaurus* and *Daspletosaurus* are found. In the younger rocks of the Horseshoe Canyon Fm., around Drumheller, *Gorgosaurus* has been replaced by *Albertosaurus*, while *Daspletosaurus* is still present. In the youngest rocks, of the Scollard Formation in the Huxley area, *Tyrannosaurus rex* is found. Rocks of equivalent age, in the Montana Hell Creek Formation contain the small tyrannosaur *Nannotyrannus*.

Speed and size are of primary importance for the "gee-whiz" crowd. Tyrannosaur running speed is controversial; Eric thinks that the animals' leg muscles were probably up to the task of high-speed running, but whether or not the bones could sustain such weights at high speed is questionable. The legs of tyrannosaurs were very strong, with long bones, which suggests speed. The metatarsal bones of the foot may have spread apart on impact, like a spring, cushioning the animals' weight, which would be a good adaptation for running.

As far as size is concerned, there are a number of large theropod dinosaurs vying for the "biggest killer of all time" title. *Carcharodontosaurus* of Africa may have been slightly larger than North America's *T. rex*. *Giganotosaurus*, of South America, was probably bigger than the average *T. rex*. Neither of these two animals belonged to the tyrannosaurid group. Notre Dame University palaeontologist Keith Rigby's "*Tyrannosaurus imperator,*" recently found in Montana, has been estimated to be bigger than *Giganotosaurus*, but the evidence is flimsy, and based on incomplete remains. Skeletal interpretation suggests that female tyrannosaurs were bigger than males.

Other important aspects of tyrannosaur anatomy include massive muscle attachment scars on the wide skull, which indicates very powerful jaw and neck muscles, for crunching through bones and for side-to-side and backward ripping action. Fossils from the Black Hills show that *T. rex* could bite right through the femur of a prey animal. Tyrannosaur arms, in contrast to their legs and jaws, were very small and weak: probably stronger than human arms, but not by much.

Behavioural interpretations are very tentative. The *Albertosaurus* bonebed recently rediscovered by Dr. Currie north of Drumheller suggests possible social and/or pack-hunting behaviour. The predator vs. scavenger controversy is another hot topic. Forward-facing eye-sockets indicate stereoscopic vision, which would have been an advantage to a predator, in allowing accurately-placed bites. The powerful legs, jaws and neck muscles suggest—but don't prove—running down and subduing struggling victims. A large predator probably wouldn't pass up the opportunity to scavenge a dead carcass. Healed bite-marks on *Edmontosaurus* bones suggests attack by an active predator, and also puts into question another theory: that the saliva of tyrannosaurs may have been septic, (like that of the modern Komodo dragon), causing its victims to die slowly of infection.

January 15, 1999
Third Annual APS Workshop and Poster Presentation

Our third "Workshop and Poster Session" was once again a great success. The following members presented displays in two classrooms:

Jessica and Jennifer Evans: Ammonites.

Roger and Darlene Arthurs: Invertebrates in the Upper Banff Formation at Moose Mountain, AB.

Joe LeBlanc: Palaeozoic shark teeth.

Wayne Braunberger: Molluscan biostratigraphy of the Cardium Formation, Alberta.

[*Continued on Page 12…*]

Essential Publications on Cretaceous Dinosaurs

by Joseph LeBlanc

ANOTHER 300-page dinosaur book! What book? Almost any recent title will do. How much nitty-gritty new information is there? A third of the book rambles…and rambles (yawn) about the history of dino discoveries; another third promotes almost fanatical acceptance of trendy theories (the asteroid extinction, birds-are-dinosaurs, etc.). Somewhere in the remaining third will be a narrative devoted to the tribulations and personalities on a dinosaur dig or expedition. Frustratingly, only a dribble of actual new science will be provided on dinosaurs. Yes, it may be an entertaining 300-page read but (excuse the pun) where is the "Meat on the Bones"? Certainly not in most popular works to be found on bookstore shelves.

The Meat on the Bones will be found in scientific publications. The nitty-gritty stuff often collects dust in the periodicals section of large public, university and government (GSC, USGS) libraries. Want to read the original description of *Hadrosaurus*? Distinguish a *Dromaeosaurus* tooth from that of a small *Albertosaurus*? Find a sketch of a ceratopsian caudal vertebra?

Below are some of the most useful sources on Cretaceous dinosaurs. This list only touches on the vast body of literature that has been generated in dinosaur research. Many universities, provincial and state surveys, museums, etc. have produced excellent publications. These are too numerous to include in my selection of essential reading.

Palaeontological Society—Nineteenth century publications are a gold mine of original drawings of the first dinosaurs. Owen's descriptions of *Iguanodon*, *Megalosaurus*, et al. are essential reads. Superb sketches of most bones.

Geological Magazine—Concise descriptions of species by Marsh, Brown and others. Essential for sorting through early taxonomy. Especially rich in dinosaur material prior to the 1920s.

Quarterly Journal of the Geological Society—Much of the writing and descriptions of Owen, Huxley, Woodward and others provided the basis for future vertebrate studies.

American Journal of Science—Dozens of articles on early dinosaur discoveries in the North American west. First descriptions of many type species. Marsh was a major contributor.

American Museum of Natural History—Excellent for small monographs with extensive sketches of dinosaur and other vertebrate osteology. Tyrannosaurid descriptions by Osborne.

Smithsonian Institution—Few works on dinosaurs, but this is the source for an essential seminal publication by Leidy, with a lengthy description and sketches of *Hadrosaurus foulki*.

Geological Survey of Canada—Mandatory publications for understanding Cretaceous dinosaurs. Monographs by Lambe on *Gorgosaurus* and *Edmontosaurus*. Cope was an early contributor.

Royal Society of Canada—Sternberg, Parks and others are frequent contributors. Parks later produces important work on *Kritosaurus* in ***University of Toronto Studies***.

United States Geological Survey—Early publications describe important discoveries. Hatcher's monograph on ceratopsians is essential reading. Often quoted is Gilmore's work on *Brachyceratops*.

Geological Society of America—Various publications. Try and sift through Lull & Wright's descriptions of North American hadrosaurs.

Ottawa Naturalist—Much overlooked work contains early descriptions of Canadian dinosaurs by Lambe and later by Sternberg, under its revised name, the ***Canadian Field Naturalist***.

Journal of Paleontology—Dozens of dinosaur articles. Often leading-edge discoveries. Sternberg was a frequent contributor.

Journal of Vertebrate Paleontology—A recent publication that offers cutting-edge updates on dinosaur research.

Canadian Journal of Earth Sciences—Articles by Russell, Currie and other "moderns." Special editions devoted to Asian expeditions contribute to understanding the Cretaceous dinosaurs outside of North America.

Hundreds of articles have been devoted to understanding Cretaceous dinosaurs. Pursue these sources. Answers will be found to many questions on Cretaceous dinosaur taxonomy, anatomy, biology and ecology. The dinosaur enthusiast can tap into a fountain of knowledge to make intelligent conclusions in a field that is often more speculation than science. ❑

Moon River: a nice song and a great place to go fossiling

by Robin Sweeten

Fossiling in Georgia can be exciting —and rewarding. One popular site is at a saltwater tidal pool of the Moon River in Georgia, outside of Savannah. (Yes, this is the Moon River made famous by the song.) The tidal pool is conveniently located right off the road on Diamond Causeway, which leads to Skidaway Island State Park. At low tide, the tidal pool area surrenders its cache of Quaternary treasures. There is an abundance of shark and ray material as well as that of drumfish, barracuda and whale.

My friend Nina Cox introduced me to this spot. Nina lives in Savannah and has collected fossils there for years. My experience at this site has been meagre at best. Nina, on the other hand, has made once-in-a-lifetime finds—not once, but twice!

While inspecting the banks she noticed an angular edge protruding from the dirt. She dug it out and was rewarded with an eight-inch *Carcharodon megalodon* tooth in perfect condition. Some time later she uncovered an equally impressive six-incher. It is easy to see why Georgia's state fossil is the shark tooth.

The allure of this spot is that you never know what will materialize. Mundane outings can quickly turn exhilarating. However, not all adrenaline producers are good. Fossiling in Georgia requires a constant vigilance for alligators and snakes. Nina considers a long stick a necessary piece of equipment. Poking around with the stick may reveal unpleasant surprises lurking on the grassy banks—better the stick than one of your body parts!

Soon my husband and I will be making our yearly pilgrimage to Savannah to visit our friends. Our itinerary always has two important entries: dinner at "Love's" on the Ogeechee River is a must, and one day is allocated to fossiling with Nina. Perhaps this will be my lucky outing. If not, my visit to Moon River will still be enjoyable. I will not complain about a relaxing day of 74° (23°C) in the middle of winter.

As a side note, I researched occurrences of snake bites as well as alligator and shark attacks in Georgia. The statistics* reflect only a slight risk:

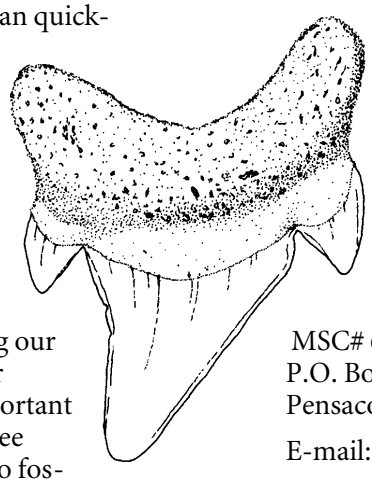
1990–1995: 1 confirmed non-fatal shark attack (I personally know of two others in more recent history—one was a close call for a friend of ours).

1988–1995: 5 confirmed alligator attacks, resulting in 1 fatality.

1959–1990: 341 confirmed lightning strikes, resulting in 75 fatalities.

I could not locate any information on snake bites…hmmmm…I think I'll still carry a stick!

* Source of data: *International Shark Attack File*, 3 February, 1998



[*Robin, our roving reporter in the USA, is working on articles about fossiling in the states of Missouri and Virginia. Her next adventure will appear in the June* Bulletin*. Members wishing to correspond can reach her at her new forwarding address:*

Robin Sweeten
MSC# 6843
P.O. Box 2428
Pensacola, FL 32513

E-mail: **rsweeten@starpower.net**

Says Robin: "I'd love to hear from you!" – ed.] ❑

The Jurassic Foundation

by Mona Marsovsky

On October 3, 1998 the Jurassic Foundation held its inaugural meeting during the SVP (Society of Vertebrate Paleontology) conference in Snowbird, Utah. This new non-profit society is dedicated to funding international dinosaur research and education, from the Triassic to the Cretaceous. The seed money for this foundation is coming from the revenues from the *Jurassic Park/Lost World* Exhibits which are under license by Universal Studios and Amblin Dreamworks and Entertainment. Both these exhibits travel to various museums presenting real science (not the movie version) and interactive displays. Phil Currie is President of The Jurassic Foundation with notable palaeontologists Cathy Forster and Jack Horner on the Board of Directors. Another member of the board, Don Lessem, noted that this society will endeavour to put all its money directly to science, with essentially zero overhead.

Dick Costello of Universal Studios described how the initial travelling museum exhibit started with the first *Jurassic Park* movie four years ago. That exhibit incorporated the idea that its revenues should go to science. Since then about 1 million dollars has gone to science. Next summer in Orlando, the Islands of Adventure will be opening and will include—you guessed it—a "Jurassic Island." Dick mentioned that a third *Jurassic Park* film is in the works, and perhaps a third edition of the *Jurassic Park* Exhibit.

Starting in January, 1999, the Jurassic Foundation will be accepting proposals for research. The grants of $1000 to $5000 will be awarded in March, 1999. The foundation will concentrate on funding those researchers who have difficulty obtaining funding, including researchers overseas.

The Jurassic Foundation is currently applying for charitable status in both Canada and the United States. They are looking for donations, funding ideas, volunteers and research proposals. Contact Phil's wife, Eva Koppelhus at the Royal Tyrrell Museum (call toll-free: 310-0000 and dial 823-7707 or e-mail: **rtmp@dns.magtech.ab.ca**) for more information or to lend a hand in this worthwhile endeavour. ❑

Vancouver Society planning "Last field trip of Millennium"

Events Coordinator Keith Mychaluk is in contact with the Vancouver Paleontological Society, who are planning a major, 10-day field trip to eastern B.C., this summer. The trip will run from August 3 to 12, and will be open to **members only** of the British Columbia Paleontological Alliance. APS members who are interested in this field trip should consider joining one of the B.C. clubs. Estimated cost for the trip: $180–$400.Tentative itinerary:

August 3, 1999 (Tuesday)—Leave Vancouver, by car pool. Lunch in Merritt, on to Vernon. Tour Ruby's Museum, 2 hours. Supper in Revelstoke. On to Golden to either a motel or campground.

Wed. 4th—To Field, Burgess Shale Interpretive Centre, two hours. Lunch, back to Golden, on to Invermere. Stops of interest include Cambrian–Devonian rocks. Dinner at Invermere, meet billets.

Thurs. 5th—Meet at Invermere museum, packed for Diana Lake overnight trip. Convoy to trailhead and hike to lake. Lunch and set up camp. Off to the fossil beds—scrambling, collecting, studying stratigraphy. Evening around a campfire, comparing finds and discussion.

Fri. 6th—Pack lunch and back to fossil beds. Adventurous types may want to explore geology. Hike out late afternoon, back to Invermere.

Sat. 7th—Meet at museum, with experts from Calgary GSC and Tyrrell Museum for "Ask an Expert" day. Evening picnic and beach.

Sun. 8th—Meet at museum. To Mt. Tegart graptolite beds. If time, visit Sholinder's Rock Shop in Windermere.

Mon. 9th—To Cranbrook via Ft. Steele with stops of interest. Trilobite beds, T. and J. Bokor as hosts. One or two days here. Night in Cranbrook.

Tues. 10th or Wed. 11th—Back to Vancouver, via Highway 3. Spend last night (or two nights) in Princeton at Eocene lake beds.

For more information, contact:

Daryl Fuller, **Daryl.Fuller@BCHydro.bc.ca**

or apply to: **Membership Secretary, Vancouver Paleontological Society, Centerpoint P.O. Box 19653, Vancouver, BC, V8T 4E7** ❑

Raising sauropods for fun and profit

Part 2

by Sam Richter

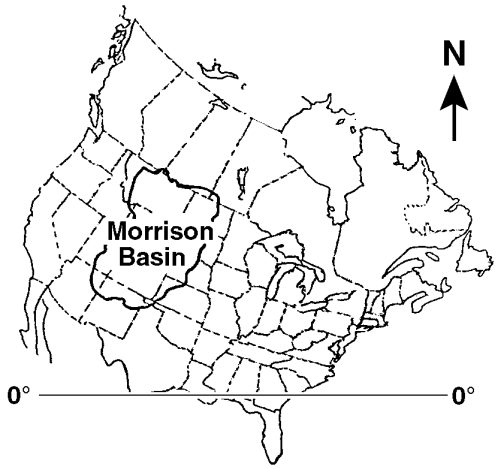
Bertha, a big brontosaur, bogged down in the mud at Como Bluff, Wyoming. She was likely going for a drink of water and was not paying attention to where she was stepping. Most animals and birds need water every day. Nature never makes allowances for failing to be vigilant. Later, mud washed in and finished covering her, nicely preserving her lower bones. Some of her bones are now on display in the Tate Museum at Casper, Wyoming.

Fossil bone quarries at Como Bluff extend for some eleven kilometres, with 24 different bone layers. The Morrison Formation is exposed here because the top of an anticlinal fold has been eroded. Present day mapping reveals that about 75% of the formation is still buried and most of the rest has been eroded. The exposures available for possible fossil finds make up less than 1% of the total.

The Morrison Formation was formed from sediments which were deposited in the Late Jurassic. This formation covered some one million square kilometres, which today is all or part of eleven states and three provinces, with a midpoint in Wyoming. At that time this great interior plain was just above sea level. The inland Sundance Sea had retreated, leaving behind a broad undulating landscape with level, usually dry, floodplain valleys. World climate was much warmer than it is now. The Morrison was mostly a hot steamy place, like the lower Amazon of today, with numerous lakes and rivers surrounded by dense tropical vegetation. Sometimes catastrophic monsoons and hurricanes buried many plants and animals. The tumbling action of bodies being tossed around by violent water possibly twisted the heads off of big dinosaurs, because heads are seldom found. The climate and plant material available at that time made it a paradise for big sauropods and other vertebrate genera to live out their long lives together.

Bob Bakker suggests not putting fossil material from Como in a shirt or back pocket and leaving it there all day. Many Lower Morrison sandstones contain uranium minerals, washed in from somewhere; mainly near-black uraninite (uranium oxide) and "yellowcake" carnotite (hydrated potassium uranium vanadate). These ores are much later in age than the Morrison. They likely came from Tertiary igneous intrusives. Uranium-rich secondary minerals were then distributed by ground water to concentrate at their present mineable sites known as "pods." Fossil bones and plants had an amazing affinity to concentrate these radioactive minerals, from 10,000 to 100,000 times more than that found in the surrounding matrix.

Sauropods reached their peak in the Late Jurassic. Their remains are found on all continents except Antarctica, which can't be searched because of ice. About 90 recognized genera and 150 species are known. They were long-lived as a group, ranging from the Late Jurassic to the Late Cretaceous. So far, only five genera are represented by complete skeletons and only twelve specimens had preserved skulls with them. Most remains are fragmentary and consist of some vertebrae or teeth. Good sauropod skeletons are hard to get. Digging them out and preparing the bones consumes an enormous amount of resources. A big bone from Bertha's leg can easily take seven months work before being ready for display.



The origin of sauropods is controversial, complicated, unclear and even a marvelous mystery. They suddenly appear thirty million years after the beginning of the Jurassic Period. How extraordinary and different the sauropods are from any living animal! How difficult it is to understand them! Why was being extra-large an advantage and not a disadvantage? There's been lots of twisting and dancing to jam them somehow into the popular but obsolete theory of gradual changes…natural selection. Sudden major changes that occur to fauna are not, and cannot, be accomodated by the theory.

An avian dinosaur changing into an eagle must do so very quickly. All the necessary parts that make a bird an eagle: ripping beak, sharp talons, strong wings, eagle eyes and brain, meat digesting system; all have to be there and be usable immediately. Otherwise the "would be" eagle will receive its just reward…as instant maggot food!

Brontosaurs had it good for at least six million years. They were extraordinarily well adapted to function superbly in their environment. Describing these big dinosaurs as "pea brained imbeciles" is absolutely invalid. Just exactly how many brain neurons are needed to excel at eating, sleeping, and rolling in the dirt? Relative brain size has no bearing on how well a creature does in its environment and can only be of cursory interest.

Vern Johnson, a semi-retired rancher, was trying to figure out whether these big brontosaurs could survive and thrive in our climate, using present day plants as food. Leaning against the showcase holding Bertha's skull bits, he looked for teeth capable of chewing, grinding, or mashing tough vegetation. Not a tooth, not even empty socket holes for these teeth, could he see. This limits the usable food to those plants that are soft and succulent, needing little or no processing in the mouth to make them digestible.

The teeth that are in the jaw are only in the front round part that connects the left and right jaw bones together. These teeth appear similar to his small pinky finger with a small space between them. The longest tooth was from his pinky nail tip to about the second finger joint. Some teeth are chipped, some are broken and some are missing. Good thing for Bertha that her teeth were continually being replaced throughout her life. Prehensile lips to grab things and a long tongue, like a giraffe's, would be assets in food handling. Vern's feed supplier, XL Feeds, makes large food pellets for ostriches and emus that would be suitable nutrition for a Bertha; no chewing is required to make them digestible. This method of supplying food is both simple and economic.

Vern speculated about those gizzard stones (gastroliths) found with the sauropod remains. In birds, stones or grit are unnecessary for digestion and only marginally improve digestive efficiency. Birds will do just fine without them. However, they do show definite pleasure when given free access to appropriately sized grit. Crushed granite is the usual grit; it can also be crushed quartz.

Egg layers that require more calcium should get access to crushed limestone or oyster shell. Gastric juices break these down releasing usable calcium.

The gizzard uses the grit to help churn the digestive juices into the mixture and assist in preventing unwanted settling and segregation of the material by density. The gizzard is very muscular, with a hard interior lining, capable of putting a powerful crushing squeeze on its contents. The contraction cycle time in ducks is about three per minute. The first part of the intestine after the gizzard determines whether the mix is suitable for digestion. If not, it pumps the mix back into the gizzard for further processing.

Gastroliths get highly polished from being rubbed against each other with gastric juices as a lubricant. The super-polished stones have a greasy-waxy feel to them. How these stones were selected by Bertha is unknown. No calipers were needed in checking the stones for optimum size range. Swiss army knives were not carried by Bertha or her friends to check selected stones for an optimum hardness of 7—quartz. Yet these gastroliths fall into a limited size range and are quartz!

Tate Museum curator, Kent Sundell, thought the claws on the three inner toes (equivalent to our big toe plus the next two) of each back foot had several uses. They could be used in marking its territory, as a dog does; as a traction aid in going up slippery slopes; and to anchor the back end when snapping the tail with real intent to injure something. The claw on each front foot is located in the same place as our thumb is on our hand. Spreading the front legs apart would dig these claws into the ground, anchoring the front end. With the body anchored down, maximum tail force could be generated. No slip-sliding reaction of the body. Sliding around reduces the power that could be put into the tail swing.

The intended target might not even see the tip of an eighty-two-bone, fifteen-metre long tail, coming at it with hyper speed and energy.

The tail has immense muscle attachment sites on the tail bones near the hips. The intended target might not even see the tip of an eighty-two-bone, fifteen-metre long tail, coming at it with hyper speed and energy. These smashes could come from ground level upward, or at any angle, even from directly overhead. Knees would be destroyed, leg bones and ribs broken and vertebrae crushed. A smack to the head could be quick death! The last forty bones—about seven metres— of the tail are made up of short jointless bones with V-shaped

ends. Hour-glass shaped cartilage filled the joint between successive bones and gave this part of the tail surprising flexibility. Elastic tendons on all sides of these bones strengthened them and helped prevent bone breakage. Here, there are no muscles and few nerves are needed. The bones taper down until the last two metres are the diameter of a garden hose. A formidable weapon against predators big and small! The three tail-end bones on display show some damage and healing.

Nine pairs of bones reinforcing the belly were found with Bertha. These belly stiffeners (gastralia) are also found in some present-day animals. The small diameter bones are found on the underside of the gut. They aren't attached to anything, just embedded in the muscles. A stiffened belly likely has to do with more effective respiration. In 1896, O. C. Marsh pointed out gastralia in sauropods. These fragile looking bone structures are also found in some tyrannosaurids.

Vern took a quick look at some of the other specimens on display. Then on to Laramie, Wyoming to have a look at the only full-sized brontosaur skeleton on display west of the Mississippi. ❑

Fossils in the News

The Sunday Telegraph (London)
October 25, 1998

Jurassic marine reptile found in fenland clay pit

WHITTLESEY, UK—Amateur palaeontologist Alan Dawn spotted part of a rib sticking out of a Cambridgeshire clay pit, and called in the experts. Excavation of the site, near Peterborough, revealed that the rib was attached to a nearly complete Jurassic plesiosaur skeleton, belonging to a new genus and species. Named *Pachycostasaurus dawni* ("Dawn's thick-ribbed lizard") by researchers from the Universities of Derby, Leicester and Portsmouth, the specimen is believed to represent a juvenile (approx. 3 metres long) short-necked plesiosaur, and is distinguished by its very large, thick ribs. Deep tooth-marks on the skeleton reveal that it was either killed or scavenged by some other carnivorous animal.

Mr. Dawn is a prolific fossil hunter, having recently discovered—also near Peterborough—the tusks, legs, and lower jaw (with teeth) of a 117,000 year-old ice-age elephant.

Calgary Herald, November 25, 1998

T-Rex to terrorize London

LONDON, UK—An enormous, animated model of a *Tyrannosaurus rex* is giving London city councillors headaches as they decide whether or not to let it rampage in Trafalgar Square. The American-built model—all 17 tonnes of it—was airlifted to the UK in two pieces, to advertise the IMAX film, *T-Rex: Back to the Cretaceous.** Officials are worried that the huge weight could punch holes in the roadway, possibly damaging a network of tunnels under the square. They also fear that the model, which nods its head, waves its arms, roars, and moves at up to 25 km/h, could trample innocent Londoners if it gets out of control. A plan to let the monster proceed down Regent Street was nixed, for fear of tearing down the Christmas lighting.

* In a number of related articles, film critics have been nearly unanimous in giving *T-Rex: Back to the Cretaceous* (which was partly filmed in Alberta's badlands) a big thumb up for the breath-taking special effects, and a big thumb down for bad acting, bad writing, and a flimsy plot.

Calgary Herald, November 29, 1998

Primate remains could push back humanity's appearance in Asia

YANGON, Myanmar (AP)—This brief and badly researched item documents the discovery in Myanmar (Burma) of 40-million-year-old primate bones, including an upper jaw with teeth. According to the article this fossil discovery, made by a Japanese-Myanmar team, "could lead to a better understanding of when man appeared in Asia." [*If "man" evolved in Africa, from 3 to 4 million-year-old australopithecines like "Lucy" and the South African specimen documented elsewhere in this* Bulletin*, it's hard to see how this 40-million year old primate find relates to "man's" appearance in Asia, which couldn't have occurred before "man" evolved! –ed.*]

The latest primate discovery, named *Pondaungia*, complements a 1997 discovery in Myanmar of the lower jaw of another primate, *Amphipithecus*.

The Globe and Mail, December 9, 1998

Three-million-year-old skeleton of hominid found in South Africa

JOHANNESBURG—Much excitement has been generated by the discovery of a nearly complete skeleton of a human ancestor in a South African

cave. The bones, estimated to be about 3 million years old, are among the oldest found in this part of Africa. [*Two similar articles in other papers contain inconsistent ages for this discovery ("more than three million years"*—Calgary Herald; *"3.5 million"*—National Post*) and for the age of the famous "Lucy" fossil from Ethiopia, to which this latest find is being compared ("3.2 million"* — National Post; *"3.75 million"*—Calgary Herald*), leaving much uncertainty as to which of these fossils is older –ed.*]

The specimen was found in several pieces, in a South African cave, by University of Witwatersrand palaeoanthropologist Ron Clarke and his crew, after painstaking excavation under dark, damp and generally unpleasant conditions. The skeleton should reveal much about the anatomy, walking habits and general behaviour of this early ape-man, and shed light on the evolution of modern humans.

The National Post, December 11, 1998

Prehistoric El Niño was an asteroid

WASHINGTON (Reuters)—Evidence that an asteroid slammed into Earth 3.3 million years ago has turned up in southeastern Argentina. Fragments of glassy rock, called scoria, have been found in soil by a team led by planetary geologist Peter Schultz, of Brown University. This scoria is similar to material found around known impact craters.

The timing of the alleged impact coincides with the extinction of giant armadillos, ground sloths and a large carnivorous bird. Schultz's team surmises that the impact may have sent up dust and water vapour that cooled the regional climate, perhaps triggering the extinctions of the local faunas.

Calgary Herald, December 17, 1998

Previously unknown dinosaur found by amateurs in France

MARSEILLES—Chalk up another one for the amateurs! Fossil hunters Patrick and Annie Mechin discovered the remains of a small (1.8 metre), Late Cretaceous (70 ma) theropod dinosaur in the hills at Fox-Amphoux, near Marseilles, in the south of France. Palaeontologists have so far unearthed teeth, a backbone and humerus of the animal, dubbed *Variraptor mechinorum*, and related to the Asian *Velociraptor* and North American *Utahraptor*. Also found were bones of herbivorous dinosaurs showing tooth-marks from a predatory dinosaur.

Previous accomplishments of the Mechins, who have been hunting French fossils for 25 years, include the discovery of a giant running bird, *Gargantuavis*, and a tortoise, *Foxemys*. Hints of future discoveries have already turned up: near the *Variraptor* site, the Mechins found an imprint of a jawbone three times the size of *Variraptor*'s, "with teeth like 'sabre blades'."

The Calgary Sun, December 18, 1998

Crocs ruled Arctic in 90 million BC

WASHINGTON (AP)—Researchers at the University of Rochester (New York) announced in the journal *Science* the discovery of champsosaur bones at a locality in the Canadian arctic, some 1000 km. from the North Pole. Bones of the crocodile-like champsosaur [*which are common in Alberta –ed.*], were found in association with fish and turtle fossils, says Rochester geophysicist John Tarduno, senior author of the study. Of the Cretaceous arctic climate, Tarduno says: "we think it was typical of what Florida is now." According to David Weishampel, of Johns Hopkins University, this is currently the most northerly record of champsosaurs.

The National Post, January 22, 1999

Beware of the turbo dinosaurs

WASHINGTON (Reuters)—Recent studies of a baby theropod dinosaur fossil from Italy reinforce the idea that, while probably cold-blooded reptiles, the theropod (bipedal, meat-eating) dinosaurs were likely very fast, dangerous animals. The fossil, of a flattened, dog-sized *Scipionyx*, shows well-preserved internal organs, including intestines, liver and some muscles. The animal's internal organization resembled that of a diaphragm-breathing creature, like humans and other mammals, implying a large breathing capacity, to support an active metabolism. They were "certainly not slow or sluggish," says Nicholas Geist of Oregon State University, who worked with John Ruben and a team at the Museo Civico di Storia Naturale, in Milan. According to Geist, these theropod dinosaurs had much more stamina than, say, a crocodile: "What you have is a turbocharged reptile."

But despite their active metabolism, the dinosaurs were still cold-blooded, and would have suffered adversely from low temperatures. Ruben believes that a cooling climate in the latter part of the Cretaceous period was the death-knell for the dinosaurs, which, he says, "were beginning to lose

diversity and disappear a good six to eight million years before the asteroid hit…I would suggest that one reason might be that these were very highly specialized cold-blooded animals that could not survive easily in an environment that was becoming seasonally cooler."

The National Post, February 17, 1999

Texas fossil challenges theory on dinosaurs

DALLAS (Dallas Morning News)—95-million-year-old dinosaur fossils discovered by an amateur palaeontologist at Flower Mound, Texas, may have thrown a monkey-wrench into the theory that the hadrosaurs (duck-billed dinosaurs) evolved first in Asia, then migrated to North America across a northern land-bridge. The fossils, discovered by Gary Byrd in 1994, include a toe bone and the animal's skull, which has been described by Southern Methodist University grad student Jason Head. Head has named the dinosaur *Protohadros byrdi.*

The idea that hadrosaurs evolved in Asia was based on fragmentary fossils of the same age, from that continent. But now, says SMU palaeontologist Louis Jacobs, "there's as much evidence that they could have evolved in North America as in Asia." This interpretation is not without controversy. Dr. Catherine Forster, of the State University of New York, in Stony Brook, thinks that *Protohadros* really belongs in the iguanodontid group, which was ancestral to the hadrosaurs, and thus doesn't qualify as a true hadrosaur. "When does a hadrosaur become a hadrosaur out of all this iguanodontian stuff?" she asks. But back at SMU, Jason Head points out that this is mostly a semantic argument—whatever group you want to put it in, the new *Protohadros* is still a member of a group that gave rise to the later hadrosaurs. "Everything we think about hadrosaurid evolution is about to fall apart."

Calgary Herald, March 11, 1999

Mammal fossil found in Africa

JOHANNESBURG (AP)—The skull of a 260 million-year-old (Permian), sheep-sized animal has been discovered in South Africa.

Anomocephalus africanus is the most primitive known representative of a group of animals called anomodonts, thought to be ancestral to mammals. The specimen was found by Drs. Bruce Rubidge and Sean Modesto, a Canadian researcher. According to Rubidge, "it has reinforced the idea that the distant ancestors of mammals actually came from South Africa."

Calgary Herald, March 11, 1999

Dinosaur grand-daddy gets a Husky moniker

DRUMHELLER—This article [*scooped three months earlier by the* APS Bulletin*!—see Program Summary, December 1998 –ed.*] announces the discovery of *Sikannisuchus huskyi*, a Triassic marine archosaur, by a Tyrrell Museum team led by Dr. Betsy Nicholls. The animal is named in honour of Husky Oil Ltd., which lent crucial logistical and financial support to the project, including its initial discovery by Husky geophysicists in the Rocky Mountains near Fort St. John, B.C. The discovery of the fossil in marine rocks near the Sikanni Chief River (hence *Sikannisuchus*—literally "Sikanni crocodile") is very significant, as archosaurs, which are thought to have been ancestral to both crocodiles and dinosaurs, were previously thought to have been land-dwelling animals.

Remains of the 4-metre long animal include jaws; part of the skull; some large, serrated teeth; vertebrae; and bony plates underlying the skin. The fossils are described and illustrated in the *Canadian Journal of Earth Sciences*, due out soon. Dr. Nicholls plans to return to the Sikanni Chief area this summer for more collecting.

[*Thanks to Les Adler, Trudy Martin, Keith Mychaluk, Roslyn Osztian and Sam Richter*] ❑

Bulletin index now available

A comprehensive index to the APS *Bulletin*, including all issues from March 1986 (Volume 1, Number 1) to the current issue, is available in digital form. The index includes all articles, reports, executive messages, reviews, and various notices—even advertisements. It is searchable by volume/number/year; author; title; article type; subject keywords; names (of people); and scientific names (binomial: genus and species).

The index is available as a FileMaker Pro™ 3.0 database file for Macintosh or Windows, or as tab-delimited text (ASCII). Any APS member may request a free copy by email, or by supplying a 3.5" floppy disc. Contact the Editor (see Page 1). ❑

[***Program Summary**…continued from Page 3*]

Andy and Tammy Godard: Central and southern Alberta dinosaur fossils.

Roslyn Osztian: The pineal "eye" in reptiles.

Len Hills: Ancient buffalo fossil—a recent finding.

As well, a number of scientists from the Royal Tyrrell Museum and the University of Calgary provided excellent poster displays on the following topics:

Lisa Holmstrom: The Burgess Shale.

Paul A. Johnston: A new interpretation of alleged mosasaur bite-marks on Upper Cretaceous ammonites from Southern Alberta.

Paul A. Johnston: A new interpretation of alleged lizard eggs from Upper Cretaceous *Protoceratops* beds in the Gobi Desert.

Russell Hall: *Seirocrinus subangularis*: A Jurassic crinoid from southern Alberta.

Shayne Tolman, Len Hills and Paul McNeil: St. Mary Reservoir Holocene fauna.

Darla Zelenitsky, Len Hills and Chris de Buhr: Dinosaur eggs and eggshells from Alberta.

Charles Henderson: Conodont biostratigraphy and tectonics of the Middle Pennsylvanian to Lower Triassic of Western Canada.

[*The editor, who was absent from these proceedings, has obtained a partial set of notes detailing the presentations at the January program. It is hoped that if the rest of the notes become available, a summary of the workshop presentations can be published in the June* Bulletin.]

February 19, 1999
A Step Through Time: an Historical Look at Dinosaur Stance and Gait, with Paul McNeil, University of Calgary

Paul McNeil is a PhD. student in the Department of Geology and Geophysics, University of Calgary. He obtained an undergraduate degree in Engineering Geophysics at Queen's University, Kingston. His current thesis work is on the biomechanics of dinosaur locomotion, under the supervision of Dr. Philip Currie and Dr. Len Hills.

The following notes are from an abstract of the presentation, provided by Paul McNeil:

Since their scientific discovery in the early 1800s dinosaurs have fascinated both scientists and the general public alike. Even in the earliest publications the unique mixture of reptilian and mammalian characteristics that define the skeleton of dinosaurs was recognized, and this fueled speculation on how they stood, walked, ran and lived.

Interestingly, the earliest reconstructions were of lively, active animals living much as modern mammals do today. These advanced "mammal-like" reptile reconstructions were used both for and against arguments in the debate between Europe's leading naturalists about the new evolutionary theories arising in the time of Darwin.

Active reconstructions continued when Joseph Leidy's discovery of the first complete dinosaur skeleton in New Jersey in 1858—a hadrosaur— revealed that some dinosaurs were bipedal, walking solely on their hind legs. Similar thought patterns were used in Knight's 1907 painting of an athletic sauropod, *Diplodocus*, and Knight's 1898 sculpture of the fighting theropods *Dryptosaurus*.

By the 1930s, dinosaurs had become sluggish, giant reptiles, barely capable of dragging their large bloated carcasses around the Mesozoic landscape. Hadrosaurs and sauropods were confined to living out their lives in the supporting water of lakes and swamps while theropods could only muster enough energy to scavenge animals that had died of other causes. Active dinosaurs were resurrected in the late 1960s by Ostrom's work on the small theropod *Deinonychus*. This trend toward active, athletic dinosaurs has pervaded modern thought trends and cumulated in the production of modern films such as *Jurassic Park*.

Recent research into dinosaur locomotion involves many areas, for example: bone size and shape comparisons with living animals, trackway analysis, stress and strain analysis, computer modeling, and looking at neural function and control. These different methods of investigation have revealed active animals, living and interacting in dynamic Mesozoic ecosystems. ❑

"Sue-Cam" shows progress on Field Museum's *T. rex*

Web surfers can log onto the Field Museum of Natural History's site in Chicago and watch "real-time" preparation of "Sue," the much-ballyhooed *Tyrannosaurus rex* skeleton from South Dakota. A computer-operated video camera allows internet visitors to pan and zoom the camera as they watch palaeo-lab preparation work from behind a visitors' gallery window.

www.fmnh.org/sue/default_icam.htm ❑

Review

by Les Adler

Preserving the Laetoli Footprints
by Neville Agnew and Martha Demas,
Scientific American, September 1998, p. 44–55.

Many hominid fossils have been found at Hadar and Omo in Ethiopia, at Lake Turkana in Kenya and Olduvai Gorge in Tanzania along the eastern branch of the Great Rift Valley. The Laetoli area is south of Olduvai Gorge in northern Tanzania. Paul I. Abell, a geochemist who had joined Mary Leakey's team in 1978, found what appeared to be a human footprint at the edge of a gully eroded by the Ngaarusi River. This area at Laetoli had already produced thousands of fossilized tracks including footprints of elephants, rhinoceroses and several other extinct mammal species.

Excavations of the Footprint Tuff revealed two parallel trails of hominid footprints extending 27 metres. The volcanic sediments were dated radiometrically as 3.4 – 3.8 million years old. The two northernmost tracks were destroyed by erosion between their discovery in 1978 and reexcavation in 1996.

As often happens in palaeoanthropology, disagreement soon broke out regarding the interpretation of the evidence. Many scientists believe that the tracks had been made by three members of *Australopithecus afarensis*, the type specimen having been found close by. Mary Leakey did not assign these tracks to any species at all. At the end of each field season, Leakey's team reburied the trackway for its protection, but made casts of the best-preserved sections and documented the site fully. Leakey later published a monumental monograph providing an unparalleled record of the African savanna during Pliocene times and a context in which to understand the hominid trackway. Fieldwork ended in 1979. Seeds of *Acacia seyal*, a large tree, were inadvertently introduced with the reburial fill and tree roots threatened the tracks.

The Getty Conservation Institute and the Tanzanian government collaborated in searching for solutions: (1) removal of the tracks was too risky (2) Construction of a shelter was too risky because of the climate. (3) Reexcavation and reburial was chosen and a regional representative from UNESCO was added. The Laetoli trackway is now one of the most thoroughly documented palaeontological sites. An enormous archive of data has been added to the base record compiled during the Leakey field seasons. The material is being integrated into an electronic database developed with the department of Geomatics at the University of Capetown. The trackway is now covered with five layers of sand and soil, the burial layers separated by polypropylene geotextiles and erosion-control matting, then covered by lava boulders to protect the trackway from cattle and other animals. There is also a monitoring trench to check the performance of the geotextiles. Two Masai tribesmen are employed as full-time guards.

The Laetoli site is not open to visitors; a permanent display has been installed at the Olduvai Museum, overlooking the gorge of the Leakeys' discoveries, a short distance off the road that runs from the Ngorongoro caldera to the Serengeti Plain.

Between the Laetoli footprints and Neil Armstrong's footprints on the surface of the moon (humankind's first steps into the cosmos) lies a 3.6 million-year-long evolutionary journey. ❑