ALBERTA • PALAEONTOLOGICAL • SOCIETY

BULLETIN

VOLUME 11 NUMBER 4 DECEMBER 1996

ALBERTA PALAEONTOLOGICAL 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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Requests for missing issues of the *Bulletin* should be addressed to the editor.

UPCOMING APS MEETINGS

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

Friday, December 20—Cretaceous fossils of the Northwest Territories, with Holger Hartmaier.
Friday, January 17—Four display/poster seminars by APS members.
Friday, February 21—Paleoartist Mike Skrepnick, on Mesozoic dinosaur art.
Friday, March 21—An introduction to blastoids, with Howard Allen (tentative).

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ON THE COVER: The Lower Permian amphibian, *Diplocaulus* sp., USA. Art by APS member Cory Gross.

President's Message

by Wayne Braunberger

Once again cold and dark descends across the land. Time to head south? For some, yes. The rest of us head into the basement to prepare and catalogue all our finds from the summer. The winter provides the perfect opportunity to document our fossils and prepare for the coming spring and a new season. If you're really keen to keep collecting, a broom or snow blower may come in handy at this time of year, but personally I would wait for a Chinook.

Discussions at our last executive meeting focused on how to improve the Society and what direction we should take. After much discussion four priority items were decided upon. These priorities include both short and long-term objectives.

1) Membership

Several items are included under membership: meeting structure, member participation, attracting new members, and the *Bulletin.*

The structure of the general meetings will be adjusted to streamline the procedure. These changes, which are minor, will provide opportunities for everyone to participate and hopefully make for a more dynamic meeting.

Participation of the membership concerns two issues. The first is getting people out to the meetings. Part of the problem of low turnout may be the meeting night. Unfortunately we are restricted to Fridays, as the room is in use on other nights. If you're unhappy with the programs or would like to see other things please let us know. The second participation issue concerns volunteering to serve on committees and on the executive. At the present time most of the directors and executive have served for several years and some would like to step down. Volunteering for these positions is important as new ideas are injected into the Society and it spreads the workload amongst several rather than a few.

As many of our members are out of town we would like to see more articles in the *Bulletin*. We're assuming that out-of-province people have joined because they are interested in Alberta palaeontology. At the present time we may not be as informative as we could be. Once again this is probably a participation issue.

2) Advertising

One area where an improvement could be made is in the area of advertising. Over the years we have advertised very little, generally relying on word-of-mouth. In the near future we plan to advertise much more. If anyone has suggestions as to where we should or could advertise please let me know.

3) Workshops - Seminars

Several seminars were held last year which by all accounts were very successful. We would like to hold more in the new year and suggestions for topics would be appreciated. A new idea is to hold workshops on the meeting nights rather than a program. Our first is tentatively planned for the January 17 meeting. The theme will revolve around introducing several fossil groups.

4) Professional Liaison

At the present time we have no real relationship with any of the professional palaeontology organizations in the province (Universities, Geological Survey, or Tyrrell Museum). One of our long term objectives is to improve relations with these groups. Exactly what form this relationship would take is unknown at this time.

These are areas that we think we could do better in. I'm sure that there are some folks who think that we do nothing right and if you're one of these please voice your concerns or join the executive and board of directors. Overall I think the Society is in good shape but we need to move forward. Part of the problem may be that the same people (myself included) have been on the board for a long time and are content to do the same things . I think there is an opportunity to become a "serious" group and make a worthwhile contribution to palaeontology in Alberta as well as maintaining the social aspect for those interested in fossils.

I wish everyone a Merry Christmas and a Happy and Prosperous New Year. ❑

Welcome New Members!

Greg Osiowy, Calgary, AB

Don't forget– pay your dues!

A coloured renewal slip is included with this *Bulletin* for those whose memberships are due to expire.

APS Monthly Seminars and Workshops

by Kris Vasudevan

As Programs Coordinator, I have the responsibility to arrange for speakers for the APS monthly meetings. As I took over the reins from Les Adler in September of this year, I soon found out that Les had already done the bulk of my work for the coming season. I do thank Les Adler for his efforts.

Upcoming General Meeting topics

• December 13, 1996: Holger Hartmaier, APS Member: ***Fossils of the North West Territories***

• January 17, 1997: APS Workshop: four volunteers from the APS will be setting up display areas with their collections, posters, etc. Members and guests attending the meeting will be encouraged to visit all four booths on a time-equitable basis. In the December meeting, names of the volunteers and poster-titles will be announced. Although no competition is intended, there will be a prize for the best display/poster presentation.

• February 21, 1997: Mike Skrepnick, APS Member: ***Triassic, Jurassic and Cretaceous Paleo Art***

• March 21, 1997: Howard Allen, APS Member: ***An Introduction to Blastoids***

• April 18,1997: Vaclav Marsovsky, APS Member: ***Dinotour to Mongolia***

• May 23, 1997: Dr. Gerry Morgan, APS Member: ***Fossil Fish—Evolutionary Path (Episode 3)***

After the summer field trips in June, July and August, the monthly presentations will begin in September 1997. I hope to have a 1997–1998 program schedule in place before the summer recess occurs. In the meantime, I would like to encourage you to come to the monthly meetings to share your paleontological experiences with the rest of the membership. ❑

Program Summary

October 19, 1996: ***Scenery, Geology and Palynology of the High Arctic with Andrew MacRae, University of Calgary***

Andrew MacRae gave the APS an excellent slide presentation of the scenery and the geology of the High Arctic. He captivated the audience by talking about the palynology of late Early Cretaceous (mostly) marine rocks in the Canadian Arctic (Axel Heiberg Island and Ellesmere Island) in a non-technical fashion.

Andrew MacRae grew up in Dartmouth, Nova Scotia and became interested in natural history, particularly fossils, at an early age. The attic of his parents' house is still filled with rocks. He received his B.Sc. in geology from Dalhousie University, which included a study of Cretaceous palynology (the study of fossil pollen, spores, and algae) in volcanic rocks of the Canadian Arctic. Since that time, he has continued his palynological studies in the arctic, particularly where macrofossil techniques are impractical. He received his M.Sc. from the University of Calgary in 1993 for such a study, and is currently finishing his Ph.D., also at the University of Calgary, under the supervision of Dr. Len Hills. In addition to palynological work, Andrew has also applied 3-dimensional computer modelling techniques to the understanding of conodonts, and he has worked on Silurian-age crinoids from Nova Scotia.

Andrew MacRae can be reached at: **macrae@geo.ucalgary.ca**. His home page, at **http://www.geo.ucalgary.ca/~macrae** is full of scientific information and colourful pictures.

– Kris Vasudevan

November 15, 1996: ***Dinosaurs, Classification and Cladistics: an Introduction, with Les Adler, APS Past President.***

Les once again entertained us with an eclectic mix of introductory notes on the classification of ancient and modern organisms, along with humourous personal anecdotes—and several questionable jokes—which enlivened the proceedings. We learned of the 18th century work of Carl Linné of Sweden, creator of the system of binomial nomenclature; the modern "5 kingdom" scheme for the classification of life (which has been recently updated); the basic structure of cladograms, a modern method for working out evolutionary relationships; and the basics of the geological time scale. *– Howard Allen* ❑

1996 SVP Conference: New York City

by Tracy L. Ford

[*Poway, California member Tracy Ford attended the Pterosaur Symposium (Oct. 15), the Society of Vertebrate Paleontologists Conference (Oct. 16–19) and the Continental Jurassic Symposium (Oct. 21–23), all held in New York. This account of his trip first appeared on the CompuServe Dinosaur Forum; following is an edited version –ed.*]

Well, I'm back from my trip. I really enjoyed the SVP Conference and the Continental Jurassic Symposium.

I won't bore you with the plane trips, the subway or taxi rides. I arrived a day early for the SVP, so I could visit the American Museum of Natural History. I visited it years ago and wanted to see what new changes they had made. It is impressive, but there are still a few mistakes. I won't go into them, but I was disappointed to see just how much plaster some of the original specimens have on them.

On Wednesday afternoon there was a pterosaur symposium. It was enjoyable, but nothing really new was said. The SVP itself was very enjoyable for me. I talked to old friends and new. The poster session was very good. The *Gargoylesaurus* (a new ankylosaurid) skull and neck scutes were very interesting, but the new pterosaur from the Argentine Crato Formation is really weird. The crest is like a sail on a sailboat…REALLY!

There was no banquet this year (I hear it was because the unions in New York would have pushed up the price).

The best day was Saturday, a whole day of just dinosaur sessions. The ones that stand out were the new *Spinosaurus* skull material. Just a dentary (similar to the type specimen) and a nasal part of the maxilla, and a whole premaxilla were found. The "snout" is very elongate—much more than in *Baryonyx*. There was also new theropod material from Argentina that looks like the new "archaeopteryxid/dromaeosaurid" from Madagascar.

One of the highlights was seeing pictures of both the part and counterpart of the new "Compsognathid" with feathers, from China. What a find that was! This new genus also was shown at the Jurassic Symposium, but that specimen is a bit larger and the feathers not as well preserved. Chen Pei-ji showed a slide of it during his talk; also some new birds from the same formation. During his talk he ran out of time and just quickly flipped through them (much to the chagrin of the audience), but luckily during the afternoon session he was able to go through them more slowly. There are two new birds (at least): one was small, with teeth and small claws on the fingers. The other specimen was of two birds that showed male and female birds(?). Both were toothless, with large claws. The "male" had two very long "feathers" that came from the tail—very, very beautiful.

The other talks were interesting…many over my head with sedimentology, etc. But all in all I'm really glad I went. ❑

A Summer's Collecting with the APS

by Ron Fortier

I guess the summer is over, and more field trips with the APS will have to wait for next year. I have a fair bit of cataloguing to do on this year's finds.

If not for the seminars (held earlier in the year), I would still be thinking that collecting involved a lot of luck. I know now, it's about 65% knowledge and the rest is up to the weather and a little luck.

The first chance I had to put my new-found knowledge to the test was at Canyon Creek. I even surprised myself: I actually found my first brachiopod, along with other neat stuff. What really surprised me was that I had a good idea of what types of fossils I had found without having to look them up in a book.

Red Rock Coulee was my first formal field trip with the APS that turned out. Weather and time had gotten in the way before. I don't think I'll forget that first-found fish scale or the APS members who showed us a better way of finding the good stuff. My GPS landmark "RRC1" was where I found my first fossil teeth, and where a lot of really nice people were looking for their best finds ever.

Genessee proved to be somewhat of an eye-opener for me. I found myself feeling guilty splitting rocks to find the nice specimens and putting all the ones I destroyed back on the ground. But I did get some very nice plant material. I also found out—on the long walk back—that I was in better shape than my backpack…or maybe it was just overweight.

Dinosaurs are still my favorite animal for collecting, but I do have a drawer in the newly-built sample case for plant and marine fossils. I hope there will be ample room for all the significant finds that I now have thanks to the APS. ❑

Dinotour 1996: The Gobi Desert!

by Vaclav Marsovsky

The Mongolian word for "desert" is "Gobi" and that is where four members of the Alberta Palaeontological Society could be found in September 1996.

Philip Currie, **Mike Skrepnick**, **Vaclav** and **Mona Marsovsky** were participants of the 14-day tour organized by the Dinotour organizing committee and Nomadic Expeditions™ of New Jersey. There were about 20 of us in total.

Clear skies were with us as we left North America over Nome, Alaska on the 11.5 hour flight from Vancouver to Beijing. We had 24 hours in Beijing to get over our jet lag, tour the Forbidden City and then take a two hour flight on Mongolian Airlines (MIAT) to Ulan Bataar (which means "Red Hero"), the capital of Mongolia. By now we were getting good at filling out customs forms, having completed our eighth.

To set the scene, upon landing in Mongolia, the countryside reminded me very much of Alberta and the weather was like Alberta's too. The landscape consists of grass-covered hills with shrubs in the coulees not unlike Nose Hill Park in Calgary. The city, however, was nothing like Calgary. We were greeted by our Mongolian guides, (partners of Nomadic and the official state tourist agents) with a comfortable bus and by the horses grazing freely in the airport's parking lot. On the way to town the road passed by a ger (Mongolian tent) suburb, just one of several that surround the city, and a large coal-burning power plant on the west —upwind—side of town. In addition to electricity, the plant supplies steam to the hundreds of apartment buildings, in large above-ground steam pipes (in need of repair) running all over the city. All along the way one is constantly reminded of the Russian influence: the Russian style architecture, block-style apartment buildings, the cars and buses on the streets, the tank that made it to Berlin, and finally the statue of Lenin in front of our hotel.

The first few days were spent touring the city and taking day drives into the countryside. We visited what most tourists would come to see in Ulan Bataar—the main square (apparently second largest after Tiananmen Square) with tank ruts from the annual military parades; and the Buddhist monasteries. Gandan Monastery in Ulan Bataar is a large functioning monastery which houses approximately 100 lamas. Monasteries had been destroyed and any form of religion was forbidden until 1990. Now they are a national treasure and a destination for tourism.

A highlight on the tour of the capital was a visit to the Natural History Museum. The Palaeontological exhibit is first-rate: all displays looked like real fossils. Signs describing the exhibits were in English in most, but not all cases. The descriptions were very brief; I would have liked to see more. The museum staff spent a few minutes explaining to us the more important exhibits. Phil Currie provided additional commentary.

The top of the Plexiglas case housing the fighting dinosaurs was lifted off for us so we could get better pictures. The fighting dinosaurs found by the Polish Expeditions to the Gobi in the 1970s at Tigrigiin Shiree is unique. It is the only one showing an interaction between two dinosaurs; a snapshot in time 75 million years ago. Tigrigiin Shiree is one of the sites we would be visiting on our tour, which made it even more interesting. The fighting dinosaurs is a mount of a *Velociraptor* lying on its back with its foot in the neck of a *Protoceratops* and the *Protoceratops* with its mouth clamped shut on the *Velociraptor*'s hand.

At the end of Hall #1 was a complete adult ankylosaur… what a beauty!

Other exhibits included nests of eggs from all sorts of different dinosaurs (these were not identified). At the end of Hall #1 was a complete adult ankylosaur, unfortunately also under glass which gave some reflections, but what a beauty! The armour on the front limbs was especially impressive. The specimen had a full set of teeth. Down the length of the tail were three pairs of triangular scutes symmetrically and laterally opposed, ending with a club at the end. The three pairs of scutes were in the position preserved at death and not located where someone thought they ought to be located. Further along in the first hall was a skull of *Protoceratops andrewsi* in perfect condition—we were to see a great deal of this animal's remains in the Gobi.

The next room is where all the Cenozoic mammals were displayed. Of interest to me were the giant long-necked and hornless rhinoceros of the Asian Oligocene, *Indricotherium,* represented by two complete skulls. *Indricotherium* and its relative *Baluchitherium* were the largest mammals to walk the earth, at a weight of 30 tonnes and a height of 5.5 metres at the shoulder.

Next we went to Dinosaur Hall #2, where complete dinosaur skeletons were mounted. The largest dinosaur in the hall was the hadrosaur *Saurolophus angustirostris* at 12 metres long, with a large solid crest on the back of the skull. If this isn't the largest hadrosaur, it must be close. Just slightly smaller were two complete skeletons of *Tarbosaurus bataar.* One had an unusual pose—it was kneeling. These were found by the Russians in the 1940s. I asked how complete the two *Tarbosaurus* skeletons were when they were found. I was expecting a high percentage—maybe 70 or 80%—but the reply I received was that the skeletons were found 100% complete!

In the corner was a *Tarbosaurus* upper jaw and skull turned upside down, with the teeth pointing up. Phil was studying this with much interest; all the mouth parts were in plain and unobstructed view. A large number of the specimens have not been described, so the opportunity was seized to study all we could in the short time available.

Hanging on the wall in Hall #2 were the large front limbs of *Deinocheirus* ("terrible hand") with the foot-long claws. Apparently this may be a huge ornithomimid. Only the front limbs of the animal have ever been found. I first saw this mount of *Deinocheirus* at the British Museum in London, which I presume is a copy of this original specimen. The museum staff were not aware of the display at the British Museum so I was unable to get a background story on this. The last display of interest to me was that of an *Oviraptor philoceratops.* This creature is a biped with a grotesque crest above its face. The skeleton, about 1.2 metres tall, is an upright mount of the dinosaur in a walking pose. An assembly of delicate small bones was almost complete: you really had to look to find the missing bones on the front limbs. I thought it was a wise choice by the museum not to replace the missing bones with those from another animal just to show how complete this one was. The sign accompanying the specimen indicated that it was described by Osborn in the 1920s—it may have been the type specimen for *Oviraptor*.

During our second visit to the museum of Natural History (upon our return from the Gobi), we were taken to the lab, prep and storage area. This was not much of a lab: the room was small, dark, looked unheated and lacked the basic equipment needed for preparation. Although we were told this is the lab, the preparation must take place elsewhere. Lying on the tables were individual bones (mainly limb parts) of a juvenile *Tarbosaurus*; a slab with articulated *Protoceratops* youngsters crawling over each other when death came upon them (found a few years ago by a Japanese expedition); a complete giant of a skull of *Saurolophus*—1.2 metres long; and an ankylosaur tail with 3 pairs of dermal scutes down the tail, just like the one inside the museum.

The rarest specimen in the lab was in a small cardboard box on a bed of cotton wool. This was the embryo of an oviraptorid cradled in half the eggshell, thus exposing its contents to view. Dr. Barsbold, who is the chief palaeontologist in Mongolia, put his hand over the specimen and flipped it over to show us the eggshell texture. The texture was unmistakably the same as we had seen in the Gobi, textured and striated with fine ridges along the length of the egg. The egg shape was elliptical. The embryo in this egg indicates that adult oviraptors sometimes found associated with these eggs were not eating them, but rather taking care of them. The "egg stealer" name will probably not change. A photograph of this embryo appears in the plates section (just before page 147), in Michael Novacek's new book, *Dinosaurs of the Flaming Cliffs*.

Our morning flight with the domestic airline MIAT lasted 90 minutes and took us to the provincial capital Dalandagzad, in the heart of the Gobi. To our surprise the Gobi was green and the land flat, with a long mountain range to the south disappearing on the western horizon. A 20-passenger bus was waiting for us and off we went to the ger camp about an hour to the west. There are several dirt roads leading out of town; however with no signs anywhere, the Mongolian drivers enjoy a great deal of job security. The only way you know where the roads go is by having travelled them.

By mid-afternoon we arrived at the Flaming Cliffs, also called Bayn Dzak. The weather was sunny and warm, at 20°C, and a steady "Gobi" wind was blowing. The Flaming Cliff exposure is only a couple kilometres long, marking a step between the flat land to the south (higher) and the flat land to the north (lower). The bus dropped us off at the top of the cliff. A great view of the red sandstone cliffs and badlands lay below us. Phil provided a brief explanation of what the bone looks like, having visited here once before, and most of us joined him as he climbed down into the badlands.

The entire section is fossiliferous from top to bottom. The bone is white or light coloured, only partially permineralized. This is the Djadochta Formation, Upper Cretaceous. The Djadochta fauna at the Flaming Cliffs has minimal diversity but there is an abundance of material to find. The dinosaurs represented here include *Protoceratops*, *Oviraptor*, *Velociraptor*, tröodontids and ankylosaurs. There are also lizards and small mammals—rodents of the Cretaceous. One will

not find tarbosaurs or hadrosaurs here; they occur in younger formations in the Gobi. There is some speculation that Asia and the northwest corner of North America (west of the interior seaway) were connected by a land bridge during the Cretaceous. This may explain why tyrannosaurids and hadrosaurs are so closely related on the two continents, but it does not explain why the ceratopsians are missing.

Accompanying us was a sedimentologist from the museum who not only provided interpretation of the formation but also was the official state representative providing authorization for us to be at the site. These areas in Mongolia are becoming more protected and supervised. There are plans to pre-serve it for future generations as a reserve or national park.

Bob Bakker was anxious to show us "Skull Alley." There was a *Protoceratops* skull at almost every bend in this narrow coulee… I counted seven…

Shortly after arriving at the cliffs, we bumped into the Dinamation tour led by Dr. Bob Bakker. Bob's group had arrived two days before us and would spend a total of eight days in the Gobi. After two days of prospecting they were able to show us where they had found dinosaurs. Bob was anxious to show us "Skull Alley," a label he had assigned to one of the coulees. Several members of our group followed. There was a *Protoceratops* skull at almost every bend in this narrow coulee, hence the name. I counted seven *Protoceratops* skulls in a distance of about 100 metres at various stages of weathering out of the red sandstone. At the site of the farthest one, Bob whipped out his notebook and began sketching, starting with what was visible and then filling in the rest, ending up with a complete sketch of a *Protoceratops* skull from memory. Then he compared the fossil and the sketch, making the case for his interpretation. He invited us to help them with the excavations and jacketing; however for the time being the Dinotour group was more interested in prospecting and discovering for themselves. We stayed late at the site the first day, returning in the dark to our ger camp about an hour's drive to the southeast. The Dinamation group was staying in twin-size nylon tents at the site. For them the basic necessities included two solar showers (for a group of 20 people) and a WC behind a cloth screen, wide open in the direction of the cliffs…can't beat the view!

Next day we drove the hour to the cliffs in a steady rain. Upon arrival at the site and after a brief talk by the Mongolian sedimentologist the rain stopped. There was no greasy bentonite to worry about; the moist sand does not even stick to shoes and dries quickly.

Phil and Mike's mission this day was to match up pictures taken by the 1920s Roy Chapman Andrews expedition to the cliffs, for a comparison between "then" and "now." The photographs appear in the book called *In search of ancient man, the conquest of Asia.* This will give a sense of the speed of erosion and how much the cliffs have changed in the past 70 years.

Our group spent the day prospecting. Phil found a single *Oviraptor* egg with the top blown off, which he and Bob Bakker excavated together. The egg shell colour is dull yellow and the texture is wrinkled. Some Dinamation members brought their own limited supplies of plaster, burlap, preservative and tools which they were able to lend to get the egg out. A new blue T-shirt was sacrificed as a bandage.

On Day 3 in the Gobi, we drove 2.5 hours west of camp to a site called Tugrigiin Shiree. This is where the Fighting Dinosaurs were found. The site is about as big as the flaming cliffs. Again, it is an escarpment surrounded by almost flat terrain to the north and to the south. The colour of the exposure is like ordinary buff "beach" sand. Apparently it is the same Djadochta Formation, but the colour is very different from the red of the Flaming Cliffs. There was one lonely sand dune at the foot of the escarpment. This was the only sand dune we saw in the Gobi during our entire trip!

In the distance to the south was that long mountain range we had been following since Dalandagzad, plus there was another range of mountains to the west with a few volcanic cones, 40 million years old. Trace fossils of burrowing animals are everywhere. Some look like rebar and have that same dark brown rusty colour; others are smooth and twist, some join together and split again. *Protoceratops* skulls and skeletons were showing up everywhere as soon as we started prospecting.

The Dinamation group, who also came to this site, started working early on one *Protoceratops* skull. The top of the skull was just becoming exposed so the elements had not had time to destroy it …it was in perfect condition. Excavating the sand was easy: it offered about the same resistance as beach sand. The bone was white, while the teeth were light brown in colour with their preserved enamel. The two fangs on each side, two centimetres long, hanging down from the premaxilla were really striking. Perhaps it was their brown colour set against the light coloured

sand still filling the mouth of the dinosaur that made them stand out so. The fangs are an unusual feature, I thought, for a herbivore. The single row of erupted diamond-shaped cheek teeth were different from the familiar ceratopsian battery and reminded me more of *Iguanodon* teeth with their ribbed features. The teeth were single-rooted, like those of hadrosaurs, rather then typical double-rooted ceratopsian teeth, and they were hollow.

Mike found a beautiful piece of a maxilla from a "*Proto*" with most of the teeth intact. This was collected for the museum. Phil found a 30 cm. long varanid lizard but unfortunately the skull was missing. This was also jacketed and collected. The Dinotour members were busy excavating a "*Proto*" in a squatting posture. We partially excavated the skeleton and then abandoned it, when it became clear that it would not be collected.

On the second day at Tugrigiin Shiree the wind picked up, which made the conditions unpleasant. One of our members found a hand of a small theropod. Phil identified it as belonging to *Velociraptor* by the shape of the claw. He and Bob Bakker excavated it together. The Dinamation group found some remains of a baby dinosaur. The vertebral centra were about 3 mm across.

Next day we left for Ulan Bataar with a lizard, egg, "*Proto*" jaw and a mammal skull. The flight back was delayed four hours because the power was off and the pumps to fill the fuel truck were down.

Upon our return to China we spent a few days touring Beijing. We visited the Natural History Museum. The dinosaur hall was filled with casts of a few large dinosaurs. The mammal exhibit on the second floor, on the other hand, had real fossils. This was a good representation of the larger Cenozoic mammals found throughout China. The short-necked giraffes with four horns were interesting. The rest of the museum was filled with pickled animals representing all phyla. On the third floor were pickled *Homo sapiens*.

We also went for a very short visit to the Institute of Vertebrate Palaeontology and Palaeoanthropology (IVPP) in Beijing. We were greeted by Dong Zhiming, one of the top palaeontologists in China, who was involved in the China-Canada Dinosaur Project. The main floor had exhibits of the giants of the Jurassic, and a pickled coelacanth, a metre long. On the second floor were the smaller Cretaceous dinosaurs and the head of the *Mamenchisaurus* reaching the second floor from the floor below. Glass cases contained vertebrate fossils from the Triassic, Jurassic and Cretaceous of China. One case displayed a comparison of various orders of small mammals of the Paleocene. In another case was a complete skeleton plus an additional five skulls of the dicynodont *Lystrosaurus* (a tusked and beaked plant eater) from the early Triassic of China. Dinosaur eggs were also on display.

The tour concluded with a visit to the Great Wall, last of a long string of highlights of the trip.

[*Be sure to attend the April 18 General Meeting, when Vaclav will give us a talk and slide show on his adventures in Mongolia and China. –ed.*] ❑

GPS: the Ground Positioning System

by Ron Fortier

It was my wife Norine who made a strong suggestion that I look into buying a GPS. We do as much hiking and camping as time and weather permit; I guess she doesn't like the feeling of almost being lost. I have tried telling her that you are only lost when you can't find your way home or to the car…so what if it takes a little longer?

It didn't take me long to find the GPS I wanted. After looking in sporting-goods stores and a map store, the Magellan™ 2000 from Canadian Tire was my first choice. It had the right price, a good design, and no moving parts such as an antenna.

In a nutshell, the GPS is just a battery-operated compass that uses satellites to find its position. The hardest thing about getting the thing up and running is the first-time initializing—but what's hard about finding coordinates within 300 miles? A user-entered landmark can be recalled from its memory. For example, at Red Rock Coulee, a fix was taken in the parking lot and given a name. Then down into the coulee we went, for a day of collecting. Any time something of significance was found, a landmark was entered into the GPS memory and named (e.g. "RRC1"). At the end of the day I told the GPS to direct me back to the parking lot. It told me which way to go, using any of four different option screens. The saved landmarks can also be used in the cataloguing of your finds at a later date.

The only real drawback to any GPS is the accuracy: it will not give you pinpoint locations. It can be as much as 30 feet out…but how much closer can you get with a map? ❑

Fossils in the News

Calgary Herald, September 26, 1996:
Boy finds fossil of marine dinosaur

LETHBRIDGE (CP)—The "dinosaur" of this item is actually a mosasaur (marine reptile), fragments of which were spotted by seven year-old Andrew Morgan, while walking his dog along the Oldman River (presumably at or near Lethbridge). The Morgan family contacted the Tyrrell Museum, which sent technician Tim Showalter to investigate. The 70 million year-old skeleton was in fragmentary condition: Showalter recovered teeth, part of a skull, vertebrae, ribs and pelvic bones.

The Globe and Mail, September 11, 1996:
Saskatchewan sees value in prehistoric brontothere

EASTEND, Sask.—It would appear that another scramble for tourist bucks is accompanying the excavation of a 37 million year-old (Oligocene) brontothere skeleton near this southwestern Saskatchewan town. This is the second brontothere skeleton to be found in the area. Tim Tokaryk of the Royal Saskatchewan Museum reports that "we've got almost all the bones…"

The article makes much of an apparent tug-of-war developing over glory and dollars. The province of Saskatchewan is seen to be in competition with Alberta for paleo-prestige ("Scientists emphasized that [no brontotheres] have been found in Alberta…"). Meanwhile, on the local front, the Eastend Historical Museum (home to "several dinosaurs on display") is alleged to be duking it out with the upstart Eastend Fossil Research Station, of recent "Scotty" the *T. rex* fame.

Calgary Herald, August 26 and Sept. 5, 1996:
Fossil earns Husky a spot in dinosaur history

CALGARY—Two articles, the first correctly omitting any reference to dinosaurs, the second once again miscasting a marine reptile as a "dinosaur" (hey—dinosaurs sell papers!), report on the assistance provided by Husky Oil Ltd. of Calgary in the reconnaissance and recovery of vertebrate fossils from northeastern British Columbia. The fossils in question have been identified by Betsy Nicholls, the Royal Tyrrell Museum's marine reptile expert, as bones of a new genus of crocodile-like reptiles of Late Triassic age (220 million years old).

Husky Oil geophysical crews reported finding fossils in the Pink Mountain area, northwest of Fort St. John. Husky volunteered equipment and logistical support, plus a week of helicopter time to Tyrrell Museum field staff. Fossils collected by Betsy Nicholls, Don Brinkman and Xiao-Chun Wu included teeth and skull fragments of a relative of the rauisuchians, a primitive group known previously as land-dwelling carnivores. "It's the first animal of its kind that we've found that lived in the water and not on land," said Nicholls.

Calgary Mirror, October 2, 1996:
Ancient Martians chronicled?

CALGARY—Stanford University chemistry professor Dr. Richard Zare delivered a lecture at the University of Calgary, relating the recent and much-hyped discovery of possible fossil microorganisms and biochemical traces in a meteorite alleged to be from Mars. Zare was a member of the group of scientists who broke what is easily the biggest science story of the year. While research continues, Dr. Zare freely admits that the group's findings are controversial, and could be wrong.

Calgary Herald, August 29, 1996:
Summer's dig uncovers rare sturgeon skeleton

DRUMHELLER—Several finds from the 1996 summer field season of the Royal Tyrrell Museum have been announced:
- A mostly-complete, metre-long sturgeon skeleton, recovered from estuary channel deposits (Upper Cretaceous) in Dinosaur Provincial Park.
- A partial skeleton of an ornithomimid dinosaur was dug up near Trochu, Alberta.
- The hip and legs of Dinosaur Park's biggest *Gorgosaurus.*
- A bonebed, believed to be 250,000 years older than those previously known in Dinosaur Park has been discovered.
- The jaw of a caenagnathid, a "really bizarre" toothless carnivore was found in the park's first systematic excavation of a "multi-generic" bone bed.
- From the same bonebed also came a large theropod, *Daspletosaurus*; and a "beautifully preserved" fossil crocodile skull, one of only three discovered to date in the park.

Calgary Herald, September 9, 1996:
I *told* you it was a comet

OTTAWA—Alan Hildebrand of the Geological Survey of Canada appears to have gone from zero to hero. In the late 1980s his theory that a comet

or asteroid had scored a direct hit on the Yucatan/Caribbean area at the end of the Cretaceous period was met with much scoffing and disbelief. His credibility has been gradually upgraded, however, and he is now part of a team of respected earth scientists from the US, UK, Canada and Mexico who are travelling to Mexico to study the impact site.

The exact size of the crater and the postulated nature of the impacting object have yet to be confirmed. Estimates of the crater's size range from under 180 km. to 320 km. in diameter. It is thought that the impact generated huge volumes of carbon dioxide and sulphur compounds [*see* Bulletin *June 1995, pg. 12 –ed.*] which had profound and lasting effects on Earth's climate and ecosystems.

Calgary Herald, November 4, 1996:
Dinosaurs a big draw

Calgary Herald, November 9, 1996:
Dinosaur art

OKOTOKS—Wow, Mike! Two feature articles in the *Herald* in less than a week (his grinning mug appears in both—once in colour); a CBC radio interview (Nov. 11); and the front page of the *New York Times*! What we've all known for years—that our own **Mike Skrepnick** is one of the planet's best paleo artists—is quickly becoming common knowledge throughout the world. As reported in previous *Bulletin* issues, Mike's talent has enabled him to take up painting as a full-time career. He currently has a two-year backlog on commissioned paintings. Just goes to show…nice guys don't always finish last!

Calgary Herald, October 5, 1996:
65-million-year-old pollen: fossils hold clues to demise of dinosaurs

DRUMHELLER—This is another in a continuing series of feature articles written by staffers at the Royal Tyrrell Museum, this time by collections technician Tim Showalter [*see "Boy finds fossil of marine dinosaur," above*]. Palynologists Dennis Braman, of the Museum, and Art Sweet of the Geological Survey of Canada, in Calgary, have been working for a number of years on the study of fossil pollens and spores deposited at the time of the Cretaceous/Tertiary (K/T) boundary. The microfossils suggest that major changes in the ecology were already happening when the K/T event occurred. Below the K/T boundary layer, pollen is scarce, indicating low levels of plant production. Radical changes in pollen types within the boundary layer show a loss of conifers, suggesting that the forest canopy had been lost. A large "spike" in the number of fern spores also occurs at the boundary. Pollen from flowering plants continues across the boundary, but with a dramatic shift in the species present: insect-borne pollen becomes less common, while wind-borne pollen increases in abundance. The reasons for these changes are not yet apparent, but research continues.

Calgary Herald, November 9, 1996:
Feathered dinosaur offers link to birds

LIAONING Province, China—A spectacular fossil of a dinosaur with downy feathers along its back is being offered as more strong evidence that birds descended from dinosaurs. Dr. Phil Currie of the Royal Tyrrell Museum says: "I think this will be the big thing, more so than anything else, that convinces people that birds came from dinosaurs."

The metre-long fossil, found by farmers on a slab of Lower Cretaceous (125 million year-old) siltstone, is closely related to *Compsognathus*, a small, bipedal carnivore. The fossil site has also produced up to 150 fossil birds which, according to Currie are "exquisite intermediates between modern birds and *Archaeopteryx*, the Jurassic reptile/bird from Germany. The new "feathered dinosaur" fossil shows a dark ridge of "furry" down or feathery bumps running down the animal's back from head to tail. It's thought that the down would have functioned as insulation. ❑

[*Thanks to Les Adler, Trudy Martin, Roslyn Osztian and Sam Richter for clippings –ed.*]

APS E-mail Directory

[*Following is a list of member e-mail addresses and personal web pages. I hope to update the list periodically. If you would like to have your address added or changed, please contact me* via e-mail. Please respect our members' privacy and patience: some of these addresses are employer accounts… no spamming or chain letters. –ed.*]

Names and contact information removed to protect members' privacy.

An Identification Key to the Ribbed Spiriferid Brachiopods of the Upper Banff Formation

by Howard Allen

Introduction

Anyone who has attempted to identify the brachiopods collected at Canyon Creek and other exposures of the upper Banff Formation knows the headaches that can arise when trying to compare less-than perfect specimens to illustrations and descriptions in scholarly papers. Some are obvious no-brainers: *Axiodeaneia usheri* and *Eumetria osagensis* are easy; but these are the exception. In some groups, such as the productids and spiriferids, many species look very much alike to the untrained eye; written descriptions are confusing and don't always appear to match the illustrations. Often the more closely one examines a specimen, the more confusing the process becomes. The worker becomes frustrated and either packs the specimens away for another time, or gives up and resorts to using the ever-popular question marks and "cf." or "sp." qualifiers.

After grinding through many hours of this frustration, I figured that there had to be a better way. I wondered if it would be possible to put together a biological "key" to the various species of ribbed spiriferid brachiopods, one of the most abundant groups in the Banff Formation; since I was just getting more and more bogged down, I decided I might as well spend some time and see what I could come up with.

I admit I was quite pleased with the result. After cranking my spiriferid specimens through the first version of the key, and making some adjustments, I was able to *quickly* identify the vast majority with a high degree of confidence, and the results were very consistent.

The key presented on the following pages was constructed by "boiling down" the descriptions and illustrations in Carter's 1987 GSC Bulletin 378. Many pages could be written just on the strategy and logic that goes into building such a key, but I won't get into that here. Technical terms have been simplified as much as possible; those that couldn't be simplified are included in the glossary. Still, users would be advised to have at least a basic understanding of brachiopod shell anatomy, which can be obtained from texts such as the *Treatise*.

Precautions

In using the key, readers **must** keep the following points in mind, otherwise your identifications will be questionable or worthless:

1) This key is for the identification of *ribbed members of the superfamilies Spiriferacea and Spiriferinacea of the upper Banff Formation* ***only!*** Do NOT attempt to use it for any other types of brachiopods, or for any other formation. It won't work.

2) A good source of magnification must be used in examining specimens. This can be either a good-quality hand lens or a stereo microscope; although all identifying features are external, some are very tiny and require a good, close view.

3) For a full and confident identification, the reference text (Carter, 1987) should be checked for confirmation, after using the key. Some specimens that appear to fall into a "grey area" will require a more careful analysis. Pay special heed to the points listed under step 27 of the key.

Using the key

This is a standard biological key, similar in form to those used in many identification guides for zoology, botany and palaeontology.

To use the key, the reader starts with step 1. If the answer to the first description is "yes," the user either: a) proceeds to the next step listed below; or b) if a species name is given in bold print, assigns the specimen to that species and quits the key; or c) follows any additional directions given with the description. If the answer to the description is "no" then the user proceeds to the step number contained in brackets preceeding the description. This step-by-step process is repeated until either the specimen is identified, or the end of the key is reached.

For example, in this key, say the answer to step 1 is "yes." You then go to step 2; if the answer to 2 is "no," go to step 5. If the result of 5 is "yes," go to 6. If 6 results in a "yes" then your brachiopod is *Verkhotomia jucunda* Carter.

Hopefully collectors will find that this key removes or at least shrinks one of the big stumbling blocks to identification of their Canyon Creek brachiopod specimens. The other big stumbling block, and one that I may tackle in the future, is that presented by the productid brachiopods. This group will probably prove to be a bigger problem, since many of their identifying features are very subtle and require well-preserved specimens, which are not that common in the Banff Formation.

References

Carter, J.L. 1987. Lower Carboniferous brachiopods from the Banff Formation of western Alberta. Geological Survey of Canada, Bulletin 378, 183 p.

Moore, R.C. (ed.) 1965. Treatise on invertebrate paleontology, part H, Brachiopoda, Vols. 1 & 2. Geological Society of America and the University of Kansas Press. ❑

Identification key to the ribbed spiriferid brachiopods of the Upper Banff Formation, reported in Carter, 1987

1 (8) Shell material punctate (requires microscope or strong hand lens; if unable to tell, i.e. specimen is a mould or cast, proceed to 2: if then no match, proceed to 9)

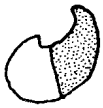
2 (5) Coarsely plicate, zigzag commisure. Strong growth lamellae. *Punctospirifer* sp.

3 (4) Narrow fold and sulcus with no central rib in sulcus or groove on fold: ***Punctospirifer* sp., cf. *P. subtexta* (White)**

4 (27) Distinct rib in center of sulcus: ***Punctospirifer solidirostris* (White)**

5 (27) Shell strongly inflated; distinct, bald fold and sulcus.

6 (7) Pedicle valve hook-shaped in side view: ***Verkhotomia jucunda* Carter**



7 (27) Pedicle valve triangular in side view: ***Syringothyris* cf. *S. hannibalensis* (Swallow)**

8 (1) Shell material impunctate.

9 (10) Fold and sulcus completely lacking in ribs: ***Calvustrigis rutherfordi* (Warren)**

10 (11) Ribs are coarse, low, wide straps; furrows between ribs are reduced to thin, threadlike grooves: ***Skelidorygma bamberi* Carter**

11 (14) Shell not very wing-shaped; rounded extremities.

12 (13) Very pronounced fold and sulcus; in front view, commisure usually reaches or exceeds shell outline: ***Spirifer esplanadensis* Brown**

13 (27) Shallow sulcus and fold; adult shell very large, >4 cm: ***Spirifer mountraensis* Carter**.

14 (17) Shell with few (8–11), large ribs per flank.

15 (16) Rounded extremities; median sulcal rib and 2 lateral sulcal ribs branching from sulcus-bounding ribs: ***Brachythyris* cf. *B. chouteauensis* (Weller)**.

16 (27) Angular extremities; very large sulcus-bounding ribs, very weak or no median sulcal rib: ***Voiseyella texana* (Carter)**.

17 (18) Shell very elongated, wing-shaped; umbo of pedicle valve tiny, barely higher than hinge; very many (>30) fine ribs per flank; shallow fold and sulcus: ***Unispirifer rundlensis* (Warren)**.

18 (19) More than 28 fine, closely-spaced ribs per flank; weak fold and sulcus; sulcal ribs approximately same size as flank ribs: ***Spirifer cascadensis* Warren**.

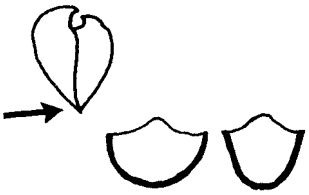
19 (20) Fifteen or fewer unbranched ribs per flank, becoming fine and faint at lateral extremities. 1 or 3 sulcal ribs, usually weakly to moderately defined; if 3, the laterals branch from large, sulcus-bounding ribs; microornament of fine capillae: ***Prospira fessaulacis* Carter**.

20 (26) No branching ribs.

21 (25) Microornament of fine capillae visible under microscope.

Identification key to the ribbed spiriferid brachiopods of the Upper Banff Formation, reported in Carter, 1987

22 (27) Fold and sulcus weakly developed: in side view, articulated specimens show valves meeting anteriorly in a point.

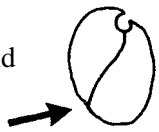


23 (24) In top view, lower outline of shell is semicircular to parabolic.
***Unispirifer greenockensis* (Brown)**.

24 (27) In top view, lower outline of shell is elongate-oval.
***Unispirifer minnewankensis* (Shimer)**.

25 (22) Sulcus-bounding ribs distinctly larger than flank ribs. Sulcus with 1 to 5 ribs, usually 3.
***Prospira* cf. *P. albapinensis* (Hall & Whitfield)**.

26 (22) Some ribs branch; fold and sulcus well developed; in side view, articulated specimens show valves not meeting at a point. Ribs and furrows strongest and most angular posteriorly, becoming lower and more rounded anteriorly.
***Podtsheremia*? *albertensis* (Warren)**.



27 Unable to identify with key; shell may be:
- immature
- poorly preserved (some features not visible)
- an atypical individual (some intermediate features, or pathological)
- a species not documented by Carter
- a non-Banff species (may have fallen from overlying beds in the Rundle Group)
- a new species

Refer to detailed descriptions and compare to illustrations in Carter; grinding of specimen to reveal internal structures may be necessary to identify. If unable to identify, label as: "Spiriferid brachiopod, gen. & sp. indet."

Glossary of terms

Anterior: toward the front, or shell opening.
Brachial valve: the upper valve of the brachiopod shell. Usually slightly to moderately smaller than the pedicle valve and often bears a **fold**.
Capillae: very fine, threadlike ribs superimposed over the regular ribs. Magnification is needed to see these.
Commisure: line representing the seam along which the two halves of the shell come together when closed. The commisure zig-zags on plicate shells.
Flank: portion of the shell between the fold or sulcus and the lateral extremities.
Fold: raised pleat running down the centre of the brachial (upper) valve from beak to anterior edge. (Opposite of **sulcus**.)
Growth lamellae: overlapping layers of shell material expressed on the surface of the shell, produced by incremental shell growth.
Lateral: toward the right or left sides of the shell.
Pedicle valve: lower valve of the brachiopod shell, normally attached via a pedicle (stalk) to the substrate. Usually slightly to moderately larger than the brachial valve, and often bears a **sulcus**.
Plicate: having ribs that consist of accordion-like pleats in the shell (**plicae**), as opposed to standard ribs (**costae**) which consist of raised ridges on top of the otherwise flat shell material.
Posterior: toward the back, or hinge.
Punctate: having shell material that is uniformly covered in extremely fine pores or pits. Magnification is needed to see this.
Sulcal rib: any rib occuring within the sulcus.
Sulcus: trough or depressed pleat running down the centre of the pedicle (lower) valve from beak to anterior edge. (Opposite of **fold**.)
Umbo: early portion of the shell, closest to the hinge, normally tapering to a point (**beak**).

Went There, Did That in 1996

by Les Adler

My year was not as spectacular as that of the members who went to Mongolia or other exotic fossil locations; however I travelled to many locations, photographed outcrops, collected specimens from five geological periods and had three beneficial trades.

Allan Ingelson (former APS member) took me to southeast Alberta and southwest Saskatchewan to examine Bearpaw Formation outcrops. This resulted in half a mosasaur vertebra being collected by myself, mosasaur teeth marks being found by Allan on *Placenticeras* ammonite shell; and mosasaur vertebrae and salamander vertebrae from **Dr. Ron and Mrs. Sharon Steim**.

Later, **Wayne Braunberger** took me to Genessee, Alberta, to collect Paleocene leaves and foliage. **Sam Richter** took me to Iddesleigh, Red Rock Coulee, northern Montana, Grotto Mountain, Canyon Creek, Powderface Trail, an area east of the Livingstone Range, the Adanac Saddle, Waterton Dam, High River and Turner Valley, which resulted in several boxes of material to be cleaned and sorted. I displayed fossils at the Calgary Rock and Lapidary Club show and then visited the Royal Tyrrell Museum. Visitors came from Texas and California to visit my Natural History Collection.

In October I spent several hours for each of five days at the American Museum of Natural History west of Central Park, New York. My contact person was Don Phillips, president of the New York Paleontological Society. He was also mainly responsible for registering members of the Society of Vertebrate Paleontology as they arrived. He was short-handed, so I pitched in and learned how to register the arrivals. Later at a reception hosted by the Board of the Museum **Dr. Phil Currie** showed me his pictures of the compsognathid creature with the "feathers" on its back. I had a problem with this. I asked Phil for copies but he said that he had no spares. I would have liked the pictures to be much larger. **Mike Skrepnick**'s sketch appeared on the front page of the *New York Times*. I was unable to secure a copy (luckily the *Calgary Herald* soon after published a much larger sketch), due to the fact that I couldn't locate a newsagent while I was coping with a Nor'easter and three inches of rain, a flooded subway system and a flooded basement at my accommodations. (Later, I found new accommodations only two blocks from the Museum.)

I hope you don't mind me name-dropping, but I was able to meet several of the world's leading vertebrate palaeontologists in a very friendly manner, including Dr. Bob Bakker, Dr. Wellnhofer (pterosaurs), Dr. Don Brinkman (turtles), Dr. Bell (mosasaurs) and Drs. Carpenter and Kirkland, whom I had met previously on Dinotours.

After attending sessions on turtles, pterosaurs, dinosaurs and mosasaurs I managed to get in some photography at the Statue of Liberty, Ellis Island, top of the World Trade Center, and United Nations Visitor Center. I walked on the Brooklyn Bridge (no, I didn't have enough credit cards with me to buy it), Lincoln Center for the Performing Arts, the grounds of Fordham University, hiked near the Chrysler Building, saw Phil Currie and Eva near Grand Central Station and did a short geological hike in Central Park to see glaciated Precambrian gneisses and schists.

At the SVP sessions we learned about the many spectacular finds in many countries on several continents. It takes about two years for the material to come out in print and until then a scientist cannot publish what he has been told: confidential information. Many gaps are being filled in on classification systems relating to birds and dinosaurs. The American Museum uses a system citing "avian dinosaurs" and "non-avian dinosaurs." Many problems in names have come about because definitions of the 19th century don't jibe with the methods or finds of the late 20th century.

Any members who would like to see my pictures of the trip please call me at 289-9972. ❑

1997 Field Trips

Dates have been set for three field trips to be held in June, July and August of next year:

Trip 97-1: Saturday & Sunday, June 21 & 22

Mountainaire Lodge area, Rocky Mountain Front Ranges, west of Sundre, Alberta.

Trip 97-2: Saturday & Sunday, July 19 & 20

Medicine Hat area, southeastern Alberta.

Trip 97-3: Saturday & Sunday, August 16 & 17

McAbee fossil plant locality, near Cache Creek, south-central British Columbia.

Watch for details in the March '97 *Bulletin*

Review

The Great Museum Makeover by Don Lessem. *Earth*, August 1996, p. 32–41; 10 illustrations.

Several members of the Alberta Palaeontological Society have been visiting museums with spectacular palaeontological displays. For example, Dr. Phil Currie, Mike Skrepnick, Vaclav and Mona Marsovsky have ranged over Asia, Europe and North America. During September and October, I visited two of the following ten museums and flew over three others without landing. The following is a reduced version of Don Lessem's report:

Several museums are reinventing themselves to tell the story of life. What is the museum's mission—teaching science or entertaining visitors? Are the museums to use theatre and special effects, to display fossils or to leave them hidden in back room collections? Don Lessem's Top Ten History of Life Exhibitions (with apologies to David Letterman) are as follows (arranged alphabetically):

1. **Academy of Natural Sciences**, Philadelphia. One of the funny things that happened on the way here was that Edward Cope mounted the head of the marine reptile, *Elasmosaurus* on the wrong end of the skeleton. A geology hall erected here for a million dollars failed to attract visitors. This museum was the first to display a dinosaur skeleton: *Hadrosaurus,* in 1857. The academy has chosen to tackle dinosaurs in academic fashion using art, fossil casts and scientific debate. The staff intends to improve the architecture at a later date with a balcony viewing area.

2. **American Museum of Natural History**, opposite Central Park, New York City. The mother of all museums in a bright new outfit, more original fossil displays than any other museum in the world all arranged to show evolutionary relationships.

In 1989 the museum started a US$30 million makeover of its vertebrate palaeontology section. The mammal and dinosaur halls have been reopened and augmented by an orientation centre and a Hall of Vertebrate Origins. Bright lights and lucite panels adjoin many giant and dynamic skeletons. The correct head is now on *Apatosaurus*'s shoulders and *T. rex* is shown as a stalker. The mammal skeletons are grouped according to significant shared evolutionary relationships. The stupendous fossils, the accessibility of smaller specimens, computers and animation make up for the graduate-level science lesson. (You can easily spend US$70 on guide books to this floor.) *Barosaurus* and *Allosaurus* are reached on the ground floor by the main entrance.

3. **Carnegie Museum of Natural History**, Pittsburgh, Pennsylvania. Walk under giant dinosaur skeletons.

4. **Denver Museum of Natural History**, Colorado. Prehistoric Journey starts with a video followed by a walk to the Envirorama, the result being an entertainment and information session inviting you to return again.

5. **Field Museum**, Chicago, Illinois. This extensive exhibit, "Life Over Time" comprises "DNA to Dinosaurs" and "Teeth, Tusks, Tar pits." According to this report their *Brachiosaurus* is the biggest individual dinosaur displayed anywhere. This is one of the best exhibits anywhere—a delightful palaeontological amusement park.

6. **Houston Museum of Natural Science**, Texas. Bright and handsome dinosaur halls.

7. **Museum of the Rockies**, Bozeman, Montana—top-notch dinosaur displays.

8. **National Museum of Natural History**, Washington, D.C. Impressive mammal displays and a superb Burgess Shale fossil collection.

9. **Royal Ontario Museum**, Toronto. The best collection of Precambrian fossils outside the Smithsonian and a new *Maiasaura* dinosaur preparation lab.

10. **Royal Tyrrell Museum of Palaeontology**, Drumheller, Alberta. Thirty-five assembled dinosaur skeletons under one roof. Trails lead visitors to prospecting areas; those foolhardy enough to pick up a fossil are liable to encounter a stern Mountie. Oil money has dried up temporarily and the computer games are now outdated; there is a lot of fibreglass, and not that much original bone on display. This museum is still a pleasure-dome to examine life in all its splendour. Most of the other museums are now following the Tyrrell's text-light methods.

[***Sam Richter*** *and the reviewer enjoyed a recent visit to the Tyrrell Museum. New dinosaur models appear at the front; the China display was great. The lab has new material and the book shop was well-stocked.*] ❑

–Les Adler