Alberta Palæontological Society Bulletin

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ALBERTA PALÆONTOLOGICAL SOCIETY

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

a. Promote the science of 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	**$20.00 annually**
Family or Institution	**$25.00 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** (or **B101**, across the hall)
Mount Royal College: 4825 Richard Road SW, Calgary, Alberta

Friday, April 16, 2004—Dr. Arthur Sweet, Natural Resources Canada:
"Stories told by plant microfossils: Diamonds, time and palaeoenvironments."
Friday, May 28, 2004—Leslie Eliuk, GeoTours Consulting, Inc.
"Reefs of the Maritimes: Primarily the Jurassic-Cretaceous Abenaki offshore."
June, July, August, 2004—No meetings. See Field Trip Update, Page 7.

ON THE COVER: Alberta fossils! Colonial rugose coral, probably *Siphonodendron* sp., from Lower Carboniferous (340 million years old; Mount Head Formation) rocks of the Rocky Mountain Front Ranges, Alberta. Magnified approximately 2.5 times. Photo by APS member Geoff Barrett. (Copyright ©)

Upcoming Programs

Friday, April 16, 2004, 7:30 p.m., Room B108

Stories told by plant microfossils: Diamonds, time and palaeoenvironments

Speaker: **Dr. Arthur Sweet**
Natural Resources Canada, Calgary

Abstract:
A chaotic mix of clastic xenoliths and finely dispersed clastic material occurs together with kimberlite in diamondiferous diatremes in the Lac de Gras area, Northwest Territories. These clastic fragments are the only remaining record of a now eroded sedimentary cover over the Slave Craton. As in most sedimentary rocks, the clastic xenoliths contain an abundance of microscopic plant fossils, including pollen and spores from terrestrial plants and marine dinoflagellates having a beauty and symmetry that transcends their fraction-of-a-millimetre size. It is hard for these fossils to compete with dinosaurs for the public's interest, even though they are mighty in their age and environmental significance. From them we have learned that between 95 and about 110 million years ago (Ma) the shore of the mid-continental seaway was in the vicinity of Lac de Gras; from between 90 to 85 Ma and again between about 70 to 80 the seaway covered most of the northern Canadian Shield. By 67 Ma the seaway had withdrawn and the resulting terrestrial landscape was similar to that of the latest Cretaceous in southwestern Canada. The similarity of the latest Cretaceous flora throughout western Canada supports the possibility that the range of dinosaurs may have commonly extended into these northern regions, then significantly warmer than at present.

Middle Eocene (about 45 Ma) post-eruptive bedded crater-fill of clays and lignite records a landscape dominated by oak and gymnosperms related to the dawn redwood. At the same time dawn redwoods and spruce, preserved in a fossil forest, dominated the landscape of Axel Heiberg Island, both reflecting a Tertiary temperature maximum with at most only infrequent frosts in the arctic.

Biography:
Art Sweet received a B.Sc. in Geology from the University of Alberta and a Ph.D. from the University of Calgary under the supervision of Dr. L.V. Hills. He joined the Geological Survey of Canada as a palynologist specializing in terrestrial pollen and spores of coal-bearing Jurassic through Tertiary strata. In recent years he has been involved in applying palynology to the Cretaceous-Tertiary boundary, sequence stratigraphic studies, kimberlites, and the Paleocene of Alberta.

Friday, May 28, 2004, 7:30 p.m., Room B108

Reefs of the Maritimes—Primarily the Jurassic-Cretaceous Abenaki offshore

Speaker: **Leslie Eliuk**
GeoTours Consulting Inc., Calgary

Abstract:
Reefs in the Maritimes have a long, complicated and disjointed history since at least two oceans have closed and opened there since the Precambrian. If Gaspé Quebec is included, some of the oldest reefs have spectacular seacoast outcrop exposures of Silurian tropical reefs. Though most of the Carboniferous successor basins are non-marine, there are Windsor Group reefs that have been interpreted as seep deposits. Today, deep-water corals still form thickets and "reefs" that act as nurseries protecting young fish among their branches in channels and gullies at the edge of the Nova Scotia shelf. This talk will give a brief pictorial survey of these reefs of different ages and types. However, it will concentrate on fossil reefs of the Nova Scotia offshore Jurassic-Cretaceous Abenaki Formation with their great variety from microbial-based mud mounds to deep-water sponge reefs to coral-coralline sponge shallow-water reefs.

Carbonate reefs usually are thought of as indicators of clear, shallow, near-tropical waters. But both the history of the Maritimes reefs from Silurian to Recent and the variety of reefs in a single formation, the Abenaki, show that there are very different kinds of reefs in very different climatic, bathymetric and palaeogeographic settings. One does not need to annex the Turks-Caicos or Caymans for a Canadian reef since modern sponge reefs occur off British Columbia and in the high Arctic Ocean and coral thickets occur off Nova Scotia and probably BC as

well. Of course if you want a holiday by warm shallow reefs in clear waters then maybe the Caribbean is still our closest best bet. If we lived 150 million years ago, we wouldn't need to drive or fly south for tropical vacations but simply head a hundred miles or so off Halifax. However we might be surprised to see that sponges and corals then seemed able to get along with the muddy waters of a major delta centred on Sable Island unlike today when nutrients and clays are inimical to coral growth. Now of course one needs to drill 3 to 4 km below the seabed and look at the cuttings, sidewall cores and limited number of whole cores in the ten or so wells drilled at the Late Jurassic continental shelf margin.

Early results are presented from a re-examination of the Abenaki reefs some three decades since Shell Demascota G-32 first drilled them. New wells and continued research on European Jurassic reefs by Reinhold Leinfelder and others allow a better look at the reefs of the Abenaki. EnCana's (PanCanadian) discovery of the 1–2 billion cubic feet Panuke Field between the two oldest wells near the margin and the additional wells associated with that discovery have been particularly helpful in adding more to our knowledge of these mid-Mesozoic reefs. The presence of corals of the modern hexacorals (Order Scleractinia) and the prolific evidence of bioerosion give these reefs a modern aspect but the coralline sponges and proximity in some cases of very argillaceous beds to reefal beds is more problematic. However this juxtaposition may indicate that what are considered classical warm-shallow-water reefs and "atypical" non-tropical and deep (and/or "dirty") water reefs receiving increasing study recently are not that far apart. It does seem to confirm the observation that if a fossil reef actually looks like an *in-situ* build-up with framebuilders in growth position then it is probably anomalous and not a shallow high-energy margin reef. Indeed given enough physical degradation and bioerosion, some reefs may "disappear" before they have a chance to be buried in the rock record.

Biography:

Leslie Eliuk, P.Geol. (B.Sc and. M.Sc University of Alberta). Early retirement in 1999 from Shell Canada after 30 years helping them explore and produce from mostly carbonate reservoirs was short-lived. The 1998 PanCanadian Deep Panuke Field discovery in his beloved Abenaki Formation has meant work helping geologists of EnCana and several other operators look again at the cuttings and core from these Jurassic-Cretaceous carbonates in both old 1974 and new 2003 wells. Thus his intention to go back to university and look more closely at these East Coast carbonates has been helped in the data acquisition and financing by these welcome events but slowed by the requirement for confidentiality and the happy continuing addition of new data to mull over.

Leslie Eliuk's email address: **geotours@shaw.ca** ❑

Program Summary

February 20, 2004

Super deadly killer dinosaurs?* T. rex's *biomechanical truce with incompetence

Speaker: **Eric Snively, University of Calgary**

Abstract:

Tyrannosaurid dinosaurs, including *Albertosaurus* and *Tyrannosaurus rex*, are culturally notorious as avatars of destructive force. Recent research has brought their behaviour into the realm of quantitative testability. Deductions about their predatory ecology are possible, if variably certain. Tyrannosaurids were unusual as the only large carnivorous animals in their habitat. This raises the question of whether and how tyrannosaurid adaptations contributed to monopolization of their niche.

Tyrannosaurids possessed escalating adaptations for dismembering prey, but their bodies and limbs represent compromises for circumventing decreased agility at large sizes. The jaws and neck of *Tyrannosaurus rex* are implicated as uniquely powerful amongst terrestrial vertebrates, with high measured and calculated bite forces and neck muscles that exerted immensely high torque for tearing flesh and bone from prey. As a biped with a mass up to ten tonnes and high turning inertia, catching prey was more problematic. *Tyrannosaurus rex* and other giant carnivorous dinosaurs had bodies proportionally short from nose to tail, which reduced their rotational inertia sufficiently for procuring live food. Uniquely for large predatory theropods, the feet of tyrannosaurids became stronger the harder they tried to maneuver. This paradoxical adaptation probably assisted tyrannosaurids in bringing down comparatively agile or dangerous prey, such as adult pachycephalosaurs, juvenile duckbilled hadrosaurs, and adult horned ceratopsians.

Biography:

Eric Snively received a B.A. in integrative Biology from the University of California at Berkeley and an M.Sc. from the University of Calgary. He has done fieldwork with the Royal Tyrrell Museum the last three summers.

Eric is currently working on a Ph.D. at the University of Calgary with Dr. Anthony Russell. His research involves computer modelling of tyrannosaur and bird neck muscle function and electrical activity of neck muscles in predatory birds. And yes, *T. rex* is the coolest dinosaur by an absurd margin. ❏

Archaeological Society of Alberta

Calgary Centre

Spring talk schedule

Meetings are held monthly at University of Calgary Earth Sciences Building, Room ES162 at 7:30 P.M. Free program—coffee and treat provided. Any questions or concerns please contact: Joanne Braaten at (403) 239-3970 or **kjbraaten@shaw.ca**

Wednesday, April 21, 2004

Speaker: **Alison Landals**, University of Calgary

The Little Bow Reservoir (Mosquito Creek segment) archaeology project

Abstract:

The construction of the Little Bow Reservoir near Champion, Alberta, resulted in a three-year program of archaeological site mitigation for the Mosquito Creek segment of the development zone. This project was undertaken as a joint venture between a consulting firm (FMA) and the Peigan Nation/Treaty 7 Coalition. The project area proved to be amazingly rich in archaeological material, particularly relating to the Contact Period. This paper will present an overview of the most interesting of the sites and preliminary findings. ❏

Look for the Alberta Palaeontological Society and Archaeological Society of Alberta booths at the CRLC Show, May 1 and 2.

Another big success: The 2004 APS Symposium attracted a good crowd, including this future palaeontologist. (Photo: Dan Quinsey)

Library Notes

by Mona Marsovsky, APS Librarian

Invertebrate Identification

Use the following books in the APS library to help identify your invertebrate fossils:

Revision of the families and genera of the Devonian tetracorals by Edwin C. Stumm, The Geological Survey of American (1949).
—pictures and descriptions of the coral families.

Field methods in palaeontology by Samuel J. Nelson, Bulletin of Canadian Petroleum Geology, vol. 13, no. 1 (1965).
—Photos and drawings of a variety of invertebrates, plus schematics that show over which periods the various animals lived.

Genera of the Bivalvia: A systematic and bibliographic catalogue by Harold E. Vokes, Paleontological Research Institution, Ithaca, New York (1980).
—lists the bivalve (clam) genera and references their descriptive papers.

The genus* Heliophyllum *(Anthozoa, Rugosa) in the upper Middle Devonian (Givetian) of New York by William A. Oliver, Jr. and James E. Sorauf, no. 362 (August 20, 2002).
—pictures of corals and references to their descriptive papers

Revision of the genus* Calapoecia *Billings by Ian Cox, Geological Survey of Canada Bulletin 80 (1936).
—some plates showing this type of coral.

Geology of the southern Alberta plains by L.S. Russell and R.W. Landes, Geological Survey of Canada Memoir #221 (1940).
—stratigraphy, maps, fossil illustrations and faunal lists of invertebrates.

Notes on Triassic ammonoids from northeastern British Columbia by F.H. McLearn, Geological Survey of Canada Paper 53-21 (1953).
—lists names but no pictures.

Palaeoecology of the marine Pleistocene faunas of southwestern British Columbia by Frances J.E. Wagner, Geological Survey of Canada Bulletin 52 (1959).
—includes a description, faunal list and one page of pictures of invertebrates including clams & snails.

Catalogue of type invertebrate fossils of the Geological Survey of Canada, Volume 1, by Thomas E. Bolton, Geological Survey of Canada (1960).
—references the publication in which the type specimen was described and where the fossil was found.

Illustrations of Canadian fossils: Triassic of western and arctic Canada by E.T. Tozer, Geological Survey of Canada Paper 62-19 (1962).
—pictures of Triassic Canadian invertebrates.

Stromatolites of the Denault Formation, Marion Lake, coast of Labrador, Newfoundland by J.A. Donaldson, Geological Survey of Canada Bulletin 102 (1963).
—some plates of stromatolites.

Late Upper Jurassic and early Lower Cretaceous fossil zones of the Canadian Western Cordillera, British Columbia by J.A. Jeletzky, Geological Survey of Canada Bulletin 103 (1965).
—lots of clam pictures.

Type lithostrotionid corals from the Mississippian of western Canada by E.W. Bamber, Geological Survey of Canada Bulletin 135 (1966).
—includes plates on corals.

Zonation and correlation of Middle Boreal Bathonian to Lower Callovian (Jurassic) ammonites, Salmon Cache Canyon, Porcupine River, northern Yukon by T.P. Poulton, Geological Survey of Canada Bulletin 358 (1987).
—lots of pictures of ammonites.

Contributions to Canadian paleontology by the Geological Survey of Canada, Bulletin 396 (1989).
—excellent photos of Canadian invertebrates ranging from the Ordovician to the Cretaceous.

Hettangian through Aalenian (Jurassic) guide fossils and biostratigraphy, northern Yukon and adjacent Northwest Territories by T.P. Poulton, Geological Survey of Canada, Bulletin 410 (1991).
—pictures of Jurassic invertebrates, especially ammonites.

The dawn of life in full colour—A collector's introduction to the forms and classifications of fossils of the world by Giovanni Pinna, The World of Nature, Orbis Publishing, London 1972
—photos of invertebrates.

Fossils of the Burgess Shale, a national treasure in Yoho National Park, British Columbia by S. Conway Morris and H.B. Whittington, Canadian Geological

Survey Miscellaneous Report 43, 1985.

—pictures of the Burgess Shale and the fossil animals found therein.

Some Ordovician lingulid brachiopods by G. Winston Sinclair, Sir George Williams College Montreal, transactions of Royal Society of Canada, 3rd series, Section IV, XXXIX (1945).

—pictures of brachiopods. ❑

2004 Field Trip Updates

by Wayne Braunberger, APS Events Director

• Trip 2004-1
Saturday and Sunday, June 26 & 27, 2004
Badlands, southeast Alberta

Pending landowners permission we will visit sites along the South Saskatchewan River north of Medicine Hat.

Registration deadline is June 18, 2004.

• Trip 2004-2
Saturday and Sunday, July 17 & 18, 2004
Alexo, Alberta

Registration deadline is July 9, 2004.

• Trip 2004-2A
Sunday, July 18, 2004
North Saskatchewan River, south of Alexo, Alberta

This trip is for those who would like a challenge. Travel to this location will be by mountain bike along an old forestry road that is no longer driveable by standard vehicles. This will be a long strenuous day involving travelling a considerable distance. An old guide indicates that the one way distance is approximately 16 km (32 km return). If you are interested you should be able to bike long distances over rough terrain and have experience in backcountry cycling. There is no guarantee that we will find the site or any fossils.

Registration deadline is July 9, 2004. There will be no fee for this trip.

• Trip 2004-3
Saturday and Sunday, August 21 & 22, 2004
Limestone Mountain, Alberta

The Limestone Mountain area will allow a number of fossil bearing formations to be examined. At this time access to the area is not confirmed as road conditions are unknown. Further details will be available in the June *Bulletin*.

Registration deadline is August 13, 2004.

• Trip 2004-4
Saturday, September 18, 2004
Ghost River, Alberta

This trip is planned as a one day trip to the Ghost River area to examine the Devonian Yahatinda Formation on “End Mountain.” This will be a continuation of the trip that was made in September of 2000. A long day trip is planned as access to the site is anticipated to be difficult. A long access hike plus a difficult vertical hike is anticipated but the rewards my be outstanding as this is one of the few Devonian plant and fish sites known in the Front Ranges. Further information will be available in the June *Bulletin*.

Registration deadline is September 10, 2004

• Trip 2004-Special (tentative)
Thursday, July 1 to Monday, July 5, 2004
Tumbler Ridge, British Columbia,

This trip is in the planning stages. Exact dates and itinerary have not been confirmed. Besides visiting the sites at Tumbler Ridge a stop at the Tyrrell Museum's Pipestone Creek dinosaur location near Grande Prairie is being considered. If you are interested in this trip please contact me and I will forward information as it becomes available.

If you are registered, you will be contacted before the trip by email or phone. I must receive your registration and accompanying fees on or before the deadline. Late registrations will not be accepted. All trips will be held regardless of weather and number of registrants.

For further information contact:

Wayne Braunberger, APS Events Director, c/o 544 Queensland Place SE, Calgary, Alberta, T2J 4T3.

Phone: (403) 278-5154

Email: **events@albertapaleo.org** ❑

Field Trip Guidelines

by Wayne Braunberger, APS Events Director

The following guidelines have been developed so that you may prepare for the trip and so that everyone may have an enjoyable time. Please contact me with any questions or concerns.

1) Registration

Register early as it makes planning much easier. Remember that **field trips are only open to members of the Society.** The stated deadlines are the last day that registrations will be accepted. After this date the field guides will be printed and any final arrangements will be made. Once you are registered you will receive either by e-mail (preferred) or regular mail all pertinent information regarding meeting time and place, driving times and directions, itinerary and any other information that may be required.

2) Arrive On Time

Plan to arrive at the appropriate time. In order to complete all the paperwork and distribute the field guides in a timely manner you need to arrive before the designated departure time. If you are going to be delayed please let me know. I will provide a contact number (cellular) for use in the field. Most of our field trip areas have cellular coverage.

3) Medical Questionnaire

A medical questionnaire will be included in the information package that is distributed prior to the trip. Inform the field trip leader if you have any medical conditions that they should be aware of in an emergency.

4) Waivers and Informed Consent Forms

Everyone who attends a field trip will be required to complete a Waiver Form if they are over the age of 18. Parents and/or Guardians will be required to complete an Informed Consent Form for any children under the age of 18 or dependents over the age of 18. One form is required for each participant and must be witnessed by the field trip leader or designate. You will not be allowed on the trip if you do not complete the proper form. Copies will be included in the information package that you receive prior to each trip.

5) Be Prepared

Field conditions can vary. While every effort is made to scout locations and inform participants of conditions, be aware that changes can and do occur. Your vehicle should be in good working order and appropriate for the conditions. When necessary we will car pool so that everyone can get to the location. Refer to the article "Personal Safety in the Field" published on page 8 in the June, 2003 APS *Bulletin* for information on items that everyone should have with them. (A copy of this article will also be made available for download from the APS website, **www.albertapaleo.org** on the "Field Trips" page.)

6) Equipment

Proper equipment is a must. Sandals, running shoes or street shoes are not appropriate footwear. It is recommended that you wear a pair of good quality hiking boots that fit well and provide adequate support for your feet and ankles. Proper rock hammers and chisels must be used. Standard carpenters claw hammers are not acceptable and are very dangerous, as they are not intended for hammering on rocks. Hammers manufactured by the Estwing company are recommended and are available at most rock and lapidary shops, geological supply stores and at many hardware stores. Safety glasses or goggles should be worn when hammering or splitting rocks.

7) No Dogs

Please do not bring your dog on field trips. Many people find dogs on trips to be annoying and the dog may become injured in an encounter with a wild animal (coyote, rattlesnake, porcupine) Contact me prior to the trip if you need to bring your dog.

8) No Smoking in the Field

Humans are one of the leading causes of wild fires (both accidental and intentional) and in order to reduce the risk there will be a NO SMOKING policy on APS field trips. We would ask that you only smoke in your vehicle or at the parking lot. Many of the areas we visit are extremely dry and a fire could be devastating to the environment and/or private property. ❏

Research Day at the Royal Tyrrell Museum of Palaeontology

January 31, 2004

by Les Adler

Entrance to the Museum was available about 9:30 A.M. so that registration could start and coffee was also available. Auditorium presentations ran from 10.30 A.M. to 3:45. P.M. with breaks for coffee and lunch. After the presentations there were posters, Museum tours and displays of the Museum's latest discoveries. At the same time there were activities for children—a talk, casting, painting, digging and a movie in the ATCO Tyrrell Learning Centre. Ticket prices were $20 in advance, $25 at the door and $18 for children, advance only with coffee and lunch included.

Compared to a year ago the Museum now has a large ceramic mural at the entrance, the ATCO Learning Centre is functioning, a time pathway has been firmly established through the Palaeozoic, Mesozoic and Cenozoic fossil areas and through the Cretaceous Palaeo-Conservatory. A section has been set up with mostly theropod dinosaurs from Alberta and China. The commercial area has a large stock of designer clothing. With John Acorn's videos in strategic locations, everything about this museum is impressive.

Bruce Naylor, the Museum Director welcomed some 200 visitors and discussed the placing of the provincial museums onto a national agenda for the organizing of programs and finances. A member of the Royal Tyrrell Museum Co-operating Society introduced each speaker who, after his or her presentation, was awarded an item of designer clothing.

Herein follows a review of the auditorium program titled, "Palaeontology across the globe," ranging from the arctic to the antarctic and fossil sites from every continent.

The first presentation was by **Dr. Eva Koppelhus**, titled "Dinosaur Fodder." Eva is a professional palaeobotanist having collected and studied Mesozoic Era fossil plant material in Europe, Greenland, Canada, Mongolia and Argentina. Her studies of dinosaur diet involving Cretaceous fossil plants of Alberta are to lead to publications with descriptions, photos, results, genera and species of the above.

Eva described and showed photos of several macroscopic and microscopic sections and specimens relating to several plant classes. By establishing an inventory of Alberta Cretaceous Period fossil plants she is then able to correlate these to direct fossils connected to dinosaurs such as fragments in between and on the teeth, rarely preserved pieces in dinosaur stomachs and plant material in coprolites (fossil dung) and plant material stuck in dinosaur skin.

Phytoliths, stony or mineral structures secreted by some plants are sorted and identified. A variety of methods are required to identify the fossils. A new method involving isotopes is being refined. Thin sections of spores and horizontal, vertical, tangential and radial sections of wood slices are required for microscopic examination. A small amount of sediment can provide hundreds of specimens of spores and pollen (palynomorphs). Amongst the plants being identified are mosses, lycopods, horsetails, ferns, gymnosperms, conifers and angiosperms. Several specimens appear to be very close to present-day species.

Eva's conclusions are that identified dinosaurs ate cones, seeds, leaves, twigs, flowers and bark from cycads, conifers and flowering plants.

The second presentation was by **Dr. Don Brinkman**, Head Curator and head of the research program on vertebrates. Don is a world-renowned specialist on fossil turtles and is also known for his researches on meso-reptiles and fishes.

Don, with John Tardino of the University of Rochester and Matt Friedman of the University of Cambridge has been studying a supply of fish and reptilian fossils (but no dinosaur material) from the Canadian Arctic. The rock is a siltstone deposited about 94 million years ago when the location was then at latitude 71° N.

The fish are incomplete with many isolated elements, many of which can be either partly or fully identified. Amongst the fish are members of the Amiidae, Lepisosteiformes, Vidalaamiinae, Semionotiformes and Holosteans. There is a huge variety of ganoid scales. Don compares specimens from Axel Heiberg Island of Turonian age with others from the Uzbekistan Turonian age and those of the Dinosaur

Park Formation, Campanian age, of Alberta. Scales are rectangular and ornamented. He is able to match a variety of Cretaceous Period fish with Green River Eocene Epoch and Recent teleostean fish.

Maps have been constructed to show relationships between North American and Asian specimens to show the directions of interchanges and latitudinal patterns with the resulting climatic implications from deduced temperature changes.

Comparing turtle distribution, Asia was dominated by members of the Macrobaenidae family as was North America during the Early Cretaceous Period. During the Late Cretaceous Period the interchange was one-way only. Don has access to the following turtles: *Hangaremys*, early Cretaceous of Mongolia and *Judithemys*, Late Cretaceous Period of Alberta and "Eucryptodire indeterminate." There is also *Aspideretes* of the Trionychidae of Alberta.

Don has also studied the interchange of non-marine aquatic vertebrates. *Champsosaurus*, close to crocodiles, is abundant only in Alberta and Montana; otherwise rare to very rare. The arctic material contains plesiosaur elements and the end of a bird humerus has been collected.

The presence of Amiidae and Lepisosteidae with large *Champsosaurus* indicates high temperatures. The diversity of fossils through the Cretaceous Period at Axel Heiberg Island is linked to changes in climate indicating temperatures during the Turonian Stage reached 12°C.

The third presentation was by **Dr. Dave Eberth** titled "Mexico Rocks." Dave is part of the Parras Basin Dinosaur Project with participants from the United States and Mexico.

The area is at the edge of the Sierra Madre Oriental Range, about 750 km north-northwest from Mexico City, close to the city of Saltillo in the south end of Coahuila State. Parras is at latitude 25°30' N, longitude 102°20' W.

The focus of research is the palaeogeography and palaeoenvironment for the time period of the Cerro del Puebla Formation, part of the Difuntia Group, 83 to 65 million years ago—an 18 million year time slot. The elevation is from 1300 to 1600 m on the high desert with sparse vegetation. It is a very old landscape with scarce shade.

Dave is a sedimentologist experienced in studying rocks, their lithology and fossil content in Europe, Asia and North and South America. In Alberta the Horseshoe Canyon Formation and the Scollard Formation demonstrate changes in climate of cooling, warming and then cooling again. Dinosaurs have been found over a 6000 km distance across Alaska, Alberta, the United States and Mexico. This project is concentrating on the southern occurrence of dinosaurs. The area is rich in a diverse suite of invertebrate, plant and vertebrate fossils. The stratigraphic section is ten times the thickness of Alberta's—2500 m in Mexico, compared to 250 m in Alberta.

Radiometric dating using isotopes is not possible here because there are no suitable volcanic rocks available. However magnetostratigraphy is used with a compass, global positioning system and a staff to measure polarity. Drs. Lerbekmo and Braman from the University of Alberta published reference charts in 2002. Many samples have been taken to construct a composite section to compare against the Gilbert, Gauss, Matyama and Brunhes sequences.

The type section of the Cerro del Puebla Formation, established in the 1960s, is no longer valid and has to be re-established with a new section due to a large residential development having been built over the former rock outcrops.

Dave is studying the implications of sea level change on fossil occurrences and preservation. Three dinosaur zones in the Parras Shale with non-marine to brackish water influences indicate repeated transgressive and regressive cycles. At present there is no indication of the existence of large herds of dinosaurs as in Alberta. There is a large variety of small theropods, ornithopods, large theropods, hadrosaurine, lambeosaurine and ceratopsian dinosaurs. At Los Aguilas in an area of about two square kilometres there is a location with a 70 m long trackway plus dinosaur bones and skin, fish, a mosasaur (possibly *Clidastes*), crocodile and pterosaur.

Sedimentary studies show that this area was a lowland coastal plain with sand and silt flats, minor water channels, no tidal influences and non-forestal, although some trees were present. There are symmetrical ripple-marks indicating shallow water and wind-generated waves with a storm-influenced coastline, similar to present-day areas east of Darwin and around the Gulf of Carpentaria in northern Australia. The diverse invertebrate, plant and vertebrate fossils show that rapid burial took place with a lack of scavengers. The trackways show unexpected traits of walking.

The fourth presentation, which came after lunch was "Triassic Fish" by **Dr. Raoul Mutter** of the University of Alberta, dealing with the biogeographic significance of this fauna. A chart showing Triassic stages was shown then condensed and moved to the right of each illustration. Each fish or group being discussed was matched to one or more of the stages.

Amongst several fish and classes were *Acrodus*, *Latimeria*, *Placopleuris*, *Australosomus*, *Bobastrania* and *Helmolepis*. Fish structure was discussed and eustatic sea levels related to the diversity of fish forms, rift tectonics and volcanicity. A dispersal graph was shown. Maps of the continents in the Late Permian and Early Triassic with extinctions at the end of each of the Permian and Triassic Periods appeared.

Access is available to seven locations worldwide providing seven or eight families of cartilaginous and lobe-finned fishes, some fifteen orders of ray-finned fishes with some sixty-five fossil localities for the Early to Middle Triassic Period. Raoul has available 190 species in 134 genera of the above. The phylogeny of most Triassic fish groups is still unknown. A detailed analysis of biogeographic patterns will help to construct evolutionary scenarios.

The fifth presentation was by **Patrick Druckenmiller** of the University of Calgary: “Mining for reptiles: Plesiosaurs and ichthyosaurs from the Syncrude Oilsands Mine, northeastern Alberta.”

> “The Wabiskaw Member has yielded portions of two ichthyosaurs and seven plesiosaurs.”

The Wabiskaw Member, part of the Clearwater Formation, which overlies the tar-sand bearing McMurray Formation (Cretaceous Period), has been dated at approximately 110 million years old and has yielded portions of two ichthyosaurs and seven plesiosaurs (neither are dinosaurs) with the help of observant equipment operators.

The plesiosaurs have been classified as short-necked with some nineteen vertebrae or long-necked with some seventy-six vertebrae in the neck.

The Holzmaden Shale of Germany, which has produced some ten thousand exceptionally preserved specimens, has helped to establish an evolutionary pattern of first lizard-like ichthyosaurs through to fish-like ichthyosaurs through to tuna-like ichthyosaurs. Ichthyosaurs appeared in the Early Triassic Period and became extinct by the middle of the Cretaceous Period. Plesiosaurs emerged in the Middle Triassic Period and became extinct the same time as the dinosaurs at the end of the Cretaceous Period.

Betsy Nicholls of this museum has been preparing the world’s largest ichthyosaur—23 m long—excavated in British Columbia.

Pat listed in sequence the marine vertebrates collected from the mine. His research objectives are to discover the overall dimensions of these marine reptiles and their phylogeny (relationships) of the plesiosaurs, comparing specimens from the Oxford Clay of the United Kingdom and other global locations with those from the North American Interior Seaway. Using CAT-scan imagery and cladistic analysis of many species, the validity of new hypotheses is being tested. A map of Alberta showing the palaeogeography of the Upper Gething/Ostracod/Wabiskaw interval has been produced.

The sixth presentation was by **Dr. Philip Currie**, Director of Dinosaur Research, who has been featured in Time Magazine as a leading Canadian explorer, a television personality and a well-known speaker on theropod dinosaurs and bird-dinosaur relationships. His topic was “Hunting Dinosaurs in Antarctica.”

Phil reviewed present-day arctic and antarctic dinosaur explorations, several of which he has participated in; some as leader, some as consultant. From the China-Canada Project the palaeogeography indicated that the dinosaurs from the arctic were similar to those found in Alberta. On Axel Heiberg Island the Chinese and Canadian flags flew together with eighteen hours of daylight available for explorations. In 1999 dinosaurs were found on Bylot Island. In 2001 dinosaur footprints were found in Spitzbergen, Greenland and Siberia.

At Dinosaur Cove, southwest of Melbourne, the capital city of Victoria State, Australia, a dangerous and expensive site was excavated for polar dinosaurs of the Cretaceous Period with members of the Royal Tyrrell Museum flown in as advisers.

David Elliot found the *Cryolophosaurus* skeleton originally. In the early 1990s one-third of the skeleton including half the skull had reached the Fryxell Museum at Augustana College, Rock Island, Illinois. A year and a half ago Phil Hammer, with funding from the National Science Foundation of the United States, asked Dr. Philip Currie to accompany him to Antarctica. Phil has cold weather experience and is an experienced excavator of theropod dinosaurs.

Even with only one third of the specimen collected comparisons can be made with *Tyrannosaurus* (Cretaceous Period) and *Allosaurus* (Jurassic Period). From the front *Cryolophosaurus* shows a crest on its head, and is related to carnosaurs. Its age appears to be Early Jurassic (Falla Formation). Dinosaurs of this time slot are scarce. A prosauropod foot was found at this location by accident.

A theropod dinosaur was found at another antarctic location, approximately latitude 63°58' S, longitude 50°94' W. Mount Kirkpatrick, 4528 m above sea level has dinosaurs at about the 4000 m level, latitude 84°45' S longitude 164° E, at the south end of the Queen Alexandra Range of the Transantarctic Mountains, about 650 km north of the South Pole.

When weather conditions permit, a flight on a Hercules transport from New Zealand to McMurdo base takes eight hours. The population ranges from 300 to 25,000. There are also Weddell seals and emperor and adelie penguins. This area is notable for the difficulties Scott and Amundsen experienced from 1902 to 1911.

A version of an igloo was built at a base camp 38 km from Mount Kirkpatrick with survival supplies for one week. The sun shines twenty-four hours a day but during a twenty-eight day period only six days could be used for excavation due to wind and clouds.

A helicopter took the six crew members from the base camp to the outcrop. Three chisels left behind in 1991 were recovered along with twenty bones visible on the hillside, very well preserved, with nice clean breaks. The rock is shipped and then prepared in a laboratory.

Other sites were surveyed by another party close by, using a GPS system. Another mountain in the range has a Triassic amphibian on it. Dynamite was used in the excavation and work with a jackhammer was tiring. It may be possible in about three years time to go after the remaining one-third of the dinosaur.

In the Distance Learning Studio a display was set up consisting of transparent showcases containing actual specimens recently prepared for the museum. The specimens included a large skull piece of a mosasaur from the Blood Reserve of southern Alberta; A hybodontid Lower Triassic fish from Wapiti Lake, British Columbia—practically complete; one of five specimens of the carapace of a *Judithemys sukhanovi* freshwater turtle from Dinosaur Provincial Park; an ankylosaur skull; and the teeth and upper jaw of a spectacularly prepared *Daspletosaurus* theropod dinosaur. ❑

Fossils in the News

Quirks and Quarks,
CBC Radio One, March 6, 2004

Two new species of dinosaurs from Antarctica

WASHINGTON—Two recent expeditions to Antarctica have uncovered the remains of two new and different dinosaurs.

Judd Case of St. Mary's College of California was part of the first team that found a small carnivorous dinosaur about 1.8 m tall. It was found on James Ross Island, off the coast of the Antarctic Peninsula. The sediments in which the fossils were buried are thought to be of a marine nature, dated at about 70 million years old. After death, the animal floated out on a river entering a shallow sea and then it sank and settled to the bottom. Leg and foot bones as well as teeth and parts of the jaw were found. It is probable that the carcass was dismembered by scavengers on land prior to floating out to sea. Enough of the foot bones were found to determine that it did not have the sickle-claw like that of the dromaeosaurids so it is something else. 70 million years ago, this part of Antarctica is thought to have had a warm and rainy climate with abundant plant life, similar to northern California today. It is theorized that the climate was warmed by a southerly oceanic current flowing along the coast of South America, to which Antarctica was still joined.

A second team led by William Hammer of Augustana College in Rock Island, Illinois found the remains of a 200 million-year-old plant-eating dinosaur on top of Mt. Kirkpatrick, 3,900 m high, near the Beardmore Glacier. The area was once a soft river bed. Hammer and colleagues were scouring the area for fossils after having found other new species there in the 1990s. The newly discovered dinosaur is a primitive sauropod—a long-necked, four-legged grazer similar to the better known brachiosaurs. This individual would have been about 30 m long. Parts of the huge pelvis of this animal were found.

Hammer said: "We have so few dinosaur specimens from the whole continent [Antarctica], compared to any other place, that almost anything we find down there is new to science."

It is difficult to find dinosaurs or anything else because most of the ground is covered by snow and ice.

Neither of the two dinosaurs has yet been named.

– *Vaclav Marsovsky*

CNN.com, January 30, 2004.

8 million year old whale fossil found in Maryland USA

SOLOMONS, Maryland—Days after Hurricane Isabel ravaged the cliffs lining St. Mary's River last year, Jeff DiMeglio and his girlfriend went scouring for shark teeth and found what DiMeglio, an amateur fossil collector, recognized as the rib of a whale. [*Alternatively, on the Calvert Museum website, it states that DiMeglio discovered the front end of a skull protruding from the shelly clay layers of the St. Mary's Formation. See* **www.calvertmarinemuseum.com** *for the full story.*]

He immediately covered the findings and contacted a museum. Heavy erosion from the storm had unearthed the complete fossilized skull of what palaeontologists say was an 8 million-year-old whale. The find is important because little is known about whales of that era, said Stephen Godfrey, curator of palaeontology for the Calvert Marine Museum.

The remains were shown to the media at the museum, where scientists are carefully chipping away sediment around the 1.7 m skull with hopes of one day putting it on display.

The hurricane that unearthed the fossil last September was Maryland's worst-ever natural disaster. The storm surge collapsed sea walls exposing parts of the shoreline. The ancient shorelines, the St Mary's Formation, are rich in marine fossils, shells and thousands of prehistoric shark teeth and whale bones.

To free the fossil from the ground, scientists covered the fossil in burlap and plaster creating a hard cast, then called on the Patuxent Naval Air Station to air-lift the fossil out. Scientists recovered the skull including the jaws, several vertebrae, fin, shoulder blade and ribs of the 5.5 m whale.

The fossil was found in an area where the water would have been shallow, and Godfrey believes the whale lived at a time when warm temperatures spread across the Atlantic Ocean. Godfrey thinks it was a baleen whale, but he doesn't know if it was an ancestor of modern baleen whales, like the humpback, or part of an extinct line. There are a few clues to how it may have died. Teeth marks score part of the bone, and the fossilized teeth of sharks also were found among the bones. – *Vaclav Marsovsky*

Internet: www.rmdrc.com, February, 2004

New dinosaur centre to open in Colorado

WOODLAND PARK, Colorado—Triebold Paleontology, Inc. has announced plans to open the Rocky Mountain Dinosaur Resource Center in Woodland Park, Colorado. Triebold, a commercial company that makes and sells casts of dinosaur and other fossils, plans a 1670 square metre visitor and education center with 830 square metres of exhibit space. The new centre is slated to open in Spring 2004.

According to the company's website "Specimens of the land, sea, and air will be represented in this space along with interactive exhibits and interpretive placards." For more information, visit **www.rmdrc.com** – *Dan Quinsey* ❑

Reviews

(*continued from Page 18*)

creature's long tail would have generated extra thrust. Theagarten Lingham-Soliar, who studied mosasaur vertebrae, concluded that only the rear two-thirds of the animal's body undulated when it swam; the forward one-third was stiffened.

Specimens of mosasaurs that have been excavated are about ten times as plentiful as dinosaurs are. Still, questions about them have been difficult to answer. Gordon C. Bell of the Museum of Geology at the South Dakota School of Mines and Technology discovered the bones of two prenatal mosasaur embryos along with the fragmentary remains of the mosasaur *Plioplatecarpus primaevus*. Michael W. Caldwell of the University of Alberta published a description of a fossilized aigialosaur, a precursor of mosasaurs with at least four well-developed embryos, the orientation suggesting birth was tail-first which would have reduced the possibility of drowning. Mosasaur skulls may have acted as a ram for stunning prey, defending against sharks or battling rivals.

This article discusses at length a possible snake-mosasaur connection. The cladistic diagrams presented here show possible connections between mosasaurs, monitor lizards and snakes and also between dinosaurs, pterosaurs, crocodiles, plesiosaurs and ichthyosaurs, lizards, turtles and mammals. ❑

Three Weeks in the Life of *Iberomesornis*

by Jesse Scott (Copyright © 2004)

The following story was written by Jesse Scott, age 6. He was inspired by the four stories and format of the A Moment in Time *series (Philip J. Currie with Eva Koppelhus and Eric P. Felber). Jesse's love of these books prompted him to write a story of his own, which is partially based on fossil evidence, some of which is included at the end of the story.*

He was also inspired by the BBC' s Walking with Dinosaurs *video and its companion books (see bibliography). The characters in Jesse's story are some of the creatures in the video episode* Giant of the Skies.

Jesse's story focuses on a small bird, Iberomesornis, *(eye-BER-oh-mes-OR-nis) whose fossils have been found in Spain. He imagines how these birds might have lived in their environment alongside the dinosaurs who may have or did share their world…*

Chapter 1
A Mating Session

"Squaaawk." A high-pitched noise spread over a lake in Spain. Two male *Iberomesornis* had started a fight trying to win the right to mate. These four-inch and one-ounce birds were definitely not a greatly feared animal on this Early Cretaceous morning.

Another loud squawk came from the trees. The dinosaur *Iguanodon* was feeding below, plucking and tearing at the leaves. These beasts weighed nearly five tons and were around thirty-four feet in length.

Meanwhile, the female *Iberomesornis* watched the two males fight. The clamorous session went on. Their wings were beating rapidly. In the tail bobbing it would certainly be imaginary to catch view of the pygostyle. Finally, one male broke off, being woozy from being knocked on his side. Neither of them had risked an injury. The *Iberomesornis* went to get a drink. Their fairly powerful leg muscles were in use. These carnivores looked for insects. When the female got a dragonfly, the male that won the mating fight rubbed against the female. They had mated.

Chapter 2
Nesting

As *Iberomesornis* were very social animals, particular pecking orders were not definite in this group. For now, the female was laying her eggs. An elderly female had abandoned her egg clutch and juveniles protected them. No babies would be outcast.

It was a few days after the two males had fought for the right to mate. All the females knew where their position was. Sitting on the nest would not be temporary—until the babies hatched.

"Squaaawk, awch, awchea." *Iberomesornis* was afraid of *Concornis* and would not put up a fight against them. The female *Iberomesornis* checked for danger, intimidated by the *Concornis*' threatening calls.

One week later, six babies popped out of the nest. The group was made of twelve *Iberomesornis*.

Chapter 3
Feeding

Two days after the baby birds hatched, the family of *Iberomesornis* were down by the lake. Their beaks were pointed into the air snatching insects.

The babies were still in the nest. Their high-pitched squeaks spread over the lake. Sometimes they got a response, but the *Iberomesornis* adults were now flying over the lake to the lakeshore to eat insects.

Feeding on vegetation were the *Iguanodon*. Their large hands stripped the vegetation. These creatures had also developed a different kind of teeth than the other iguanodonts, allowing them to chew even the toughest plant material. The giant herbivores moved from bush to bush walking on four legs, with the juveniles running even faster on their rear legs. *Iguanodon*s were very suited for walking on four legs, though they ran even faster on two.

Also with the *Iberomesornis* was the nodosaur *Polacanthus*. These creatures do not have clubs, but spikes sticking out of their sides. The animals are about eighteen feet long and weigh two tons. The armor spikes give these dinosaurs a lot of protection. Still, these creatures accompany the *Iguanodon* herds for even more protection.

Polacanthus has a narrow but short head. At five feet high this one feeds on the lower section of the bushes. Though the tail of *Polacanthus* is not very stiff, this one waves it, showing the triangular plates of armor that line the sides of it.

The *Iberomesornis* were risking their lives by going by these giants. They could easily get smashed. But in their search for insects the small birds were extremely good fliers.

The middle claw of the *Iberomesornis* stuck way out, but was not useful for catching insects, but danger was approaching.

Chapter 4
Danger

The *Iguanodon*s had huge thumb spikes to swipe predators, but what was a danger to the *Iberomesornis* was not a danger to them and the *Polacanthus*. Terrified squawks came from the birds.

An ornithomimid named *Pelecanimimus* was racing toward the birds. *Iberomesornis* was its favorite prey. Worse yet, the babies were out of the nest, and at twenty-seven miles per hour the carnivorous creature is easily fast enough to take one of the group. Confused by the intimidating sounds made by the *Pelecanimimus*, the babies headed straight for the predator. The seven foot long and thirty-eight pound carnivore reached down.

"Confused by the intimidating sounds… the babies headed straight for the predator."

The wings of the adult *Iberomesornis* carried them deftly to the sorry sight, but eventually one got too close and the head of the *Pelecanimimus* carried it three feet above the ground. One adult and one juvenile were gone, which lowered the total of the group to eight.

Then suddenly the *Iguanodon* began to speed across the lake on two legs followed by the four-legged *Polacanthus*. The twenty-one foot and one-ton *Utahraptor*s had arrived. These predators can kill anything where they live—even *Iguanodon*s.

The three-inch teeth of the carnivores gleamed in the sunlight. This time they were sprinting for the *Pelecanimimus* who killed the *Iberomesornis*. With five-foot-long strides the *Utahraptor* came swiftly upon the smaller predator. They are almost ready to strike.

Utahraptor also holds twelve-inch sickle claws. These are held upward when running or walking, so the tip can keep sharpened, but are lowered when attacking prey.

Suddenly one of the *Utahraptor*s leaps forward, the jaws opened. The claws are lowered and the leap is finished. The mouth of the powerful carnivore holds the neck of the *Pelecanimimus* while the claws dig into the flesh.

The rest of the *Utahraptor* pack are still sprinting full pelt towards their victim. Then in an enormous flurry of spray one pack member leaps from the water, bending down, grabbing one of the back legs of the *Pelecanimimus*. The sickle claws of the *Utahraptor*s kick with a huge amount of strength while the prey struggles frantically. The *Utahraptor*s can run forty miles per hour and have huge maneuverability. The head of these predators is three feet alone.

The *Utahraptor* have brought the *Pelecanimimus* down with ease. They are ready to feed. Tearing huge chunks of meat from the carcass, the pack uses their vicious techniques again. They will swallow the meat whole. Their teeth are used for grinding bone and attacking prey. They shake their head to help devour pieces of flesh It is six hours since the *Pelecanimimus* was rushing in to kill the *Iberomesornis*. The *Utahraptor*s have just left the kill and there is peace again in the group of birds. They all lay down by the nest. A huge yellow moon rises and the world is soon silent.

Chapter 5
Utahraptor City

A week has passed and it is clear that the days have gone by in violence. The number of the *Iberomesornis* group has been lowered to four—all the babies have been killed by *Pelecanimimus* and now there are tons of *Utahraptor*s in this territory. The *Iberomesornis* mate looks out from a tree at eight *Utahraptor*s rushing in to kill another *Pelecanimimus*. He lowers his head and squawks.

Around him were the three females by the nest. Above him the moon disappeared. It was morning. *Concornis* were already flying, on the lookout for insects. The baby *Iberomesornis* were gone. The females were kicking the nest out of the tree. As it dropped to the ground, a *Pelecanimimus* came to inspect the leaves and twigs for tasty insects, but then a hunting group of *Utahraptor*s sent it running off.

This hunt was to kill *Iguanodon*s. Stalking in the tall grass the *Utahraptor*s close in on their victim, but then the *Iguanodon* start to run. The predators follow right beside, running through the herd attempting to confuse the massive herbivores.

Then a *Utahraptor* leaps onto an *Iguanodon*. The rest follow his move. Avoiding the thumb spikes, they kick with their claws to bring the creature down. They start to feast.

The *Iberomesornis* have flown down to the lake. However, they are not as wary as usual. As a result, they do not notice the approaching *Pelecanimimus* until it is too late. He grabs three of the birds and runs off. One female is alone. It is not a group anymore. The number is one.

Chapter 6
Surviving Struggle

A yellow moon rises. The trees sway in the wind and the white clouds drift across the blue sky. It is a world of peace—a scene of night. Darkness falls over the landscape.

The next morning the female *Iberomesornis* awakens. Her struggles have only started. *Iberomesornis* do not do well on their own. They depend on a group. This female will be lucky to survive. She starts her day and goes down to the lakeside to drink. The *Iguanodon* herd have already gathered and are being closely watched. *Utahraptor*.

The *Iberomesornis* tries to move around the predators, but accidentally the *Utahraptor* pack give the bird a glancing blow as they race at the *Iguanodon*. One *Iguanodon* throws a *Utahraptor* across the path as they tackle him, but the other pack members throw their bodies at the rear of the *Iguanodon* and severely injure the animal, so it eventually dies.

The blow on the *Iberomesornis* has shattered the female's wing. It will be hard to survive.

Chapter 7
Death Ends the Group

The bird lay down, her life ebbing away, and soon two *Utahraptor*s were fighting over the bird's corpse. It was the end of a family—the end of a group. ❑

The Science

Introduction

Iberomesornis was a small bird that could fly very swiftly. This book told the story of one group of these little creatures through their struggles to survive. This section is about the evidence behind this book.

The feathers and pygostyle and more information

No feathers were found of *Iberomesornis*, but feathers of other birds were found in the same deposits. This bird lived in what is now Spain. *Iberomesornis* had a pygostyle—fused vertebrae at the end of the tail. It nested in the trees and means "Spanish intermediate bird." The total length of *Iberomesornis* was around three inches, but the skull has not yet been discovered so it was possibly a little longer.

What lived with *Iberomesornis*?

Concornis (mentioned in Chapters 2 and 5) lived with *Iberomesornis*. This bird was larger than *Iberomesornis*. *Eoalulavis* was also found in the same deposits. These two creatures ate insects like *Iberomesornis*.

The dinosaurs that lived with this bird were quite common. Fossils from *Iguanodon* are found in Spain, showing that it lived alongside *Iberomesornis*. This dinosaur is famous for its long thumb spikes used for self-defence. They would poke attackers. *Iguanodon* is found all over the world.

Pelecanimimus was an ornithomimid with teeth—its usual prey could have been *Iberomesornis* as it lived in the same area as this bird.

Polacanthus also lived alongside *Iberomesornis*. This was in the nodosaur group, relatives of the ankylosaurs, the main difference separating the two is that ankylosaurs had clubs and nodosaurs didn't. Also, most nodosaurs did not have the body armor projecting out like *Polacanthus*, and ankylosaurs did.

It is possible *Utahraptor* could be found in Spain, though it hasn't been yet, because limb bones similar to *Utahraptor* have been found in Spain. Based on this, *Utahraptor* is included in this story. *Utahraptor* is the largest in the sickle claw family, stretching twenty-one feet long and weighing around a ton. Its sickle claw was also the largest, the whole thing being about twelve inches long. This carnivore's jaws were bone crushing, and *Utahraptor* could easily kill an *Iguanodon* or a *Pelecanimimus*.

Neovenator—another predator—was just as savage as *Utahraptor*. This creature lived in Spain and was about thirty feet long and two tons. It could kill an *Iguanodon*, but was not mentioned in this book.

These were just some of the creatures that lived with *Iberomesornis*. The *Polacanthus* were common amongst the herds of *Iguanodon* and the three-inch teeth of *Utahraptor* were terrifying. All this the birds had to put up with. The size of *Iberomesornis* made it hard for this bird to survive.

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Reviews

by Les Adler

Biomechanics—Uphill flight
by Adam Summers, illustrations by Roberto Osti. *Natural History,* December 2003/January 2004, p. 30, 31.

Adam Summers is an assistant professor of ecology and evolutionary biology at the University of California, Irvine, USA.

Four illustrations concern the chukar partridge, Alectoris chukar, in different positions relating to its movements. It does not use its wings when on level ground. When it climbs a steep slope it flaps its wings from roughly its head to its tail generating a force perpendicular to the plane in which the wings move. That force "holds" this animal to the ground giving extra traction to the bird's feet as it climbs. When the bird climbs a vertical surface such as the bark of a tree its wings beat in a more back-to-front fashion, and the force generated has both a horizontal and a vertical component. Although the vertical component is not necessary for climbing a tree trunk—the bird generates enough force for that with its legs alone—the component shows that the bird (or equally, perhaps, a protobird or a feathered dinosaur) can redirect the wing-flapping force merely by altering the plane in which the wings are flapped. Such an ability would have been crucial to the origins of flight, as wings were co-opted to provide thrust instead of traction.

According to Adam, the truly amazing discoveries of feathered fossils in Liaoning Province in northeastern China have enabled paleontologists to identify the group of dinosaurs that gave rise to birds and suggest the origin of feathers. Palaeontologists are still debating one point: How did bipedal but terrestrial archosaurs ("old lizards" including dinosaurs, birds and crocodiles) learn to flap their arms and fly? Hence, biomechanics.

According to the "trees-down" camp, arboreal dinosaurs first evolved the ability to glide off their perch in a tree as "flying lemurs," some frogs, lizards, snakes and squirrels do today. Later the gliders evolved the ability to fly from tree to tree.

Proponents of the trees-down scenario maintain that wings and feathers would have been useful for gliding, even if they preceded such adaptations as the shoulder girdle, the huge pectoral muscles and the peculiar wrist and hand structures that make possible the powered, flapping flight of birds. Detractors point out none of the present-day gliding animals perform even rudimentary flapping, they are all strictly gliders and there is no reason to expect that they ever will be otherwise. Even worse, the dinosaurs most closely related to birds, the unfeathered dromaeosaurs, which include such terrors as *Deinonychus* and the better known *Velociraptor* were terrestrial. Neither the several independently evolved gliders nor the fossil record lend support for a change from gliding to flapping.

A second camp favors a "ground-up" hypothesis. Terrestrial bipedal dinosaurs flapped their "arms" first and later evolved into fliers. Although the fossil record demonstrates that pre-avian dinosaurs were fond of *terra firma*, explanations that require the transition from bald, sprinting dinosaur to feathered, flapping bird are far-fetched. Feathers might have evolved as insulation which would imply that dromaeosaurs were endothermic or warm-blooded. Or maybe feathered arms were useful as a net to catch flying insects, or as a horizontal stabilizer—like a tightrope-walker's pole—for swiftly running predatory bipeds.

Kenneth P. Dial studies the biomechanics of flight at the University of Montana at Missoula and has suggested that flight arose from arm movements intended to push a bird (or a feathered dinosaur) into the ground rather than lift it up, based on observing a chukar partridge running up a slope.

The order Galliformes (from Latin *gallus,* meaning rooster), including partridges, fowl and quail, have broad, stubby wings and fatigued flight muscles. Their chicks hatch ready to run, but not to fly. When threatened by a fox, the bird escapes by fleeing up a steep slope, flapping its wings madly. Dial established that though the remiges (flight feathers) are not long enough to enable takeoff, they improve traction enough for young chukars to climb. Without feathers the birds could not run up slopes steeper than sixty degrees. Fully feathered animals could scamper and flap their way up vertical and slightly overhanging slopes.

Dial constructed two kinds of ramp, smooth and textured, which gave different traction to scrabbling claws. Adult birds and young ones couldn't scale smooth ramps steeper than fifty degrees. The flight feathers, though short on the younger birds nonetheless provided enough vertical lift to make the chicks light on their feet, boosting them up the steeper slopes. Alternatively, the flapping wings could be generating force in the direction of the ramp, increasing the hind-limb traction of the fleeing chicks. The stroke of every chukar's wing beat while running is quite different than that of its wing beat while flying. Instead of flapping the wings from back to belly as other birds do, partridges flap from head to tail.

To test the above hypotheses, Dial and a student, Matthew W. Bundle attached a small accelerometer to the back of a bird and filmed the bird running up a ramp. This confirmed that the flapping wings help a chukar's feet get traction.

This research implies a plausible model for the selective advantage of both the flapping motion and a poorly feathered wing. Lightly feathered dromaeosaurs might have relied on wings for help in climbing steep slopes and even entering trees, just as galliform birds do today. Chukars vary the angle of their wings depending on the slope of the substrate that they are climbing and the angle becomes increasingly similar to that of a flying bird as a chukar climbs slopes of ninety degrees or steeper.

It's not conclusive evidence for the evolution of flight and since behavior doesn't fossilize one can never be certain. For the first time the ground-up proponents have a model that's not so much "off the wall" as up it.

Terrible Lizards of the sea
by Richard Ellis, *Natural History*,
September 2003, p. 36–41.

The following report has been adapted from the book *Sea Dragons: Predators of the prehistoric ocean* (University Press, Kansas). Ellis is a research associate in palaeontology at the American Museum of Natural History in New York.

The first and still the largest specimen of a mosasaur was found in 1780 at Maastrict, Netherlands and is now at Paris, France. Adriaan Camper pointed out its resemblance to lizards of the family Varanidae, such as the monitor lizard. An English geologist called it *Mosasaurus hoffmani*, the Latin name of the Meuse River and "saurus" for it being a lizard and "hoffmani" for the army surgeon who directed the excavation. All relatives in palaeontology then received the suffix "saurus."

Mosasaurs arose about 90 million years ago and flourished for 25 million years and were only distantly related to their terrestrial counterparts, the dinosaurs. In the ocean mosasaurs achieved a commanding position as predators that would not be matched until whales and dolphins appeared on the scene 30 million years later. The proliferation of the mosasaurs followed a dramatic rise in worldwide sea levels when shallow seas covered much of Europe and North America. Sea levels fell once again rendering mosasaur remains accessible in the badlands of the American west.

Mosasaurs evolved in the sea, trading feet for flippers and their tails lengthened and became flattened like those of eels and crocodiles. Whereas their ancestors had laid eggs on land mosasaurs developed the ability to deliver young alive in the water. The lower jaws, which were loosely connected at the front, each had a huge joint in the middle enabling the animals to swallow large prey with a system of continual tooth replacement. In most species the pterygoid bones that made up the hard palate on the roof of the mouth were equipped with teeth that kept slippery fish, squid or other prey from wriggling free after they had been gripped by the jaw teeth.

The long thin shape of a mosasaur enabled it to cut through water with minimal resistance while using its large body surface for propulsion. The end of the

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