Alberta Palæontological Society Bulletin

VOLUME 12 • NUMBER 4 DECEMBER 1997

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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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 19—Wayne Braunberger: "An Introduction to Statistical Methods in Palaeontology"
Friday, January 16, 1998—APS Workshop and Poster Session
Friday, February 20, 1998—Dr. Gerry Morgan, "Evolution of the Cartilaginous Fishes"
Friday, March 20, 1998—Dr. Rolf Ludvigsen, Denman Island Institute for Trilobite Research: "Trilobites"

ON THE COVER: The theropod dinosaur *Troodon formosus*, Late Cretaceous, Alberta. Art by APS member Cory Gross. Copyright © 1997.

President's Message

by Wayne Braunberger

The Salvation of Palaeontology

During the present climate of budget cutbacks and refocusing of priorities, basic scientific research such as palaeontology is under increasing pressure. Both industry and publicly funded research programs are under attack or have been eliminated altogether.

At the present time (to the best of my knowledge) there is no active palaeontological research being carried out by any oil company in Canada: industry palaeontologists have been retired or reassigned. Palaeontological programs at our universities are required to do more with less—people and funds—and the Geological Survey of Canada, once the leading institution for palaeontological research in Canada, has had to deal with drastic budget cuts and serious staff reductions. A number of research programs have been eliminated. Many of the staff reductions at various institutions have come about due to normally scheduled retirements, but these people are not being replaced.

Other institutions and museums across the country are facing the same pressures and seeing the same erosion of budgets and loss of people. Thus, organized professional palaeontology is being severely curtailed or almost eliminated at many institutions. The result, as you can well imagine, is that professional palaeontologists—at least those who are left—are demoralized and spend a large amount of their time trying to secure funding and justify their existence. This does not leave a lot of time for research.

Is there hope for the future? Who will keep palaeontology alive? It falls to the amateur and groups such as the Alberta Palaeontological Society to become, if you will, the "salvation" of palaeontology. But this will not happen overnight and will take some effort on our part. I sense that the attitudes of professionals towards amateurs may be changing (budget cuts tend to get your attention).

It may be useful for future discussions to define how I use the words *professional* and *amateur*, as they may be used in different ways. I define a professional palaeontologist as a person who is engaged in palaeontology as their primary paid occupation and is employed by a university, museum, research institute such as a geological survey, or in a research department in private industry. A professional is not involved in any commercial or entrepreneurial activities such as the buying and selling of fossils. Perhaps a better word would be scientific palaeontologist as many commercial dealers/entrepreneurs would by a strict definition be considered professionals.

An amateur palaeontologist is a person who is engaged in palaeontological activities out of interest, passion, and love of fossils. Many amateurs are the leading experts in some areas of palaeontological research and are "professionals" in every sense except that they are not paid for their work.

In some circles the term amateur is used in a derogatory sense to apply to vandals and other irresponsible individuals who in my view are not really interested in palaeontology. I think this a gross misuse of the word amateur and it should be discontinued, particularly by members of the professional community. We should all be striving to conduct our activities with a measure of professionalism, becoming adept and expert in our areas of interest with mutual respect for each other.

There is a window of opportunity here for us to exploit. Members of the executive have had discussions amongst ourselves and with professional palaeontologists as to what action could and should be taken. At the time of this writing the areas in which action should be taken are:

1) Increasing our profile

At the present time the Society is not that well known outside of our small circle. We have essentially relied on word-of-mouth to attract new members and although the membership is slowly increasing I think that there are a lot more people out there who have a serious interest in palaeontology and are not aware of us. By expanding the membership base we would be more effective as a lobby group and better able to disseminate information. There are at least three things that we could do to raise our profile:

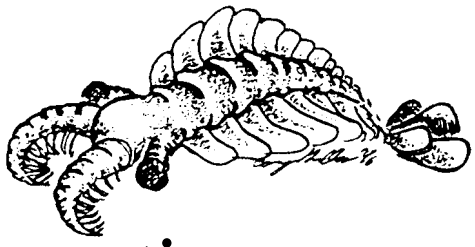
- In the past we have talked about forming chapters or affiliated groups throughout the province. This needs to be pursued vigorously as at present we are essentially a local Calgary group.
- We could and should be participating in or even hosting a palaeontological conference to bring both amateurs and professionals together. Most conferences focus on professional activities but amateurs have much to offer.
- As a Society we should be sponsoring public talks by well-known palaeontologists. This gives a forum for dissemination of information to the general public who may have an interest but it also lets them know that the Alberta Palaeontological Society exists.

2) Education

Since the inception of the Society one of our major objectives has been the education of ourselves and the public. Unfortunately one of the criticisms that is often levelled at amateurs is that they are not properly trained in palaeontological techniques. Through guest speakers, seminars, and field trips we have attempted to rectify this. Education is a continuous process and our efforts in this area could be improved in several areas:

- Our initial seminars were quite successful and we would like to do more. The main drawbacks have been finding an adequate location, qualified instructors, and a person to chair the education committee.
- Field trips should be more educationally oriented rather than just collecting trips. The idea of combining field trips with cooperative projects with a professional institution is being explored.
- As individuals we should be collecting for a purpose rather than just trying to collect one of everything. If you concentrate on a specific fossil group or geographic area you will soon build up a body of valuable work.

As amateurs we cannot sit and wait for the professionals to come to us. We must demonstrate that we have an interest and the capability to be an effective force. Amateur palaeontologists will be the salvation of palaeontology. Are we up to the task? I think so. Over the past ten years the Society has grown, so I know the interest is there. I also know that we have very capable and knowledgeable people in our Society who can do the job. Over the next several months proposals and a plan of action will be developed. Your comments, views, and ideas are needed. **It is up to us!** ❑



Correction

In the September *Bulletin*, an error appears in Vaclav and Mona Marsovsky's article *Dr. Bob Bakker Entertains at the Calgary Zoo*.

A sentence in the fifth paragraph of the second column (page 6) reads: "Since dinosaurs were descended from birds…" The sentence should read: "Since birds were descended from dinosaurs…"

Thanks to **Roslyn Osztian** for pointing out this error. *–V.M.* ❑

Letters…

B.C. Paleontological Alliance

Hi, APS Members:

Dr. Terry Poulton, of the Geological Survey of Canada office in Calgary, told me that some members of the APS might be interested in learning more about the British Columbia Paleontological Alliance (BCPA). Anyone desiring such can contact me in Vancouver at my email address.

(Dr.) Jim Haggart, Vancouver, BC
jhaggart@gsc.nrcan.gc.ca

The Moron Factor

Congratulations on your editorial, *The Moron Factor*. Right on!

The sight of Plaster of Paris seems to be fatal to fossils left unattended. Thirty years ago a couple of friends and I tried to "preserve" some ceratopsid remains which came to light one autumn in the South Saskatchewan River valley, west of Redcliff (we had access permission).

We had the same experience as the Tyrrell people. Never again! Try any other method, but it must not be in any way obvious. Preferably rebury it in some way. Take photos of nearby features. Place some marker—not fluorescent tape—at least 12 m away at a recorded compass bearing, or use four landmarks to help in locating the site in the subsequent season. When you do come with some plaster, all traces of it should be removed. Even small pieces of burlap and plaster crumbs can set off a digging frenzy.

One may want to visit the site again because there may well be more material exposed than was in evidence at the first visit.

We should photograph more, and mark the photos clearly. Look at the Barnum Brown *Albertosaurus* quarry recently rediscovered by P. Currie…the "best" photographs were not even of the actual site!

The assistance that amateurs can/could give to professionals could be very great, but it needs thinking out. Some people could join the APS just to find good fossil localities, and then come in by themselves and exploit them for profit. Fossils and collectors of all sorts need protection. There is a black market out there.

This whole edition of the *Bulletin* was excellent, by the way.

Hope Johnson, LLD, Redcliff, AB
behope@telusplanet.net ❑

DINOTOUR *online*

DINOTOUR's web page is now up and running!

www.rpi.edu/~whiteh/DINOTOUR

Comments and suggestions are gratefully received (Email to Heather Whitehead: whiteh@rpi.edu)

Program Summary

November 21, 1997:

Fossil Buffalo in North America, with Professor Len Hills, Department of Geology and Geophysics, University of Calgary.

Professor Len Hills retraced the history and the fossil record of the North American buffalo, or bison.

The ancestors of North American bison originated in northeast Asia, and migrated across the Bering land bridge into Alaska. Once in North America they evolved rapidly, reducing the number of species and subspecies to five: *Bison latifrons*, *Bison bison antiquus*, *Bison bison occidentalis*, *Bison bison athabascae* (wood buffalo) and *Bison bison bison*, the plains bison. Only the latter two subspecies exist today. The plains bison was estimated to number as many as 60 million at the time of European contact. They were reduced to a few thousand within 100 years.

Dr. Hills pointed out the problems of human encroachment into the territories frequented by wood buffalo for short-term gains. Even recent records of settling the plains bison in the neighbourhood of Wood Buffalo Park in northern Alberta demonstrate the failure of humans in striking an ecological balance in the delicate world of modern day bison.

What I always like about Professor Hills' talks is his simple style of presentation, striking home the roles palaeontologists can play in not only understanding the past but also in exploring the present against the background of the past.

Dr. Hills brought a number of bone specimens for the attendees to inspect, and APS member Andy Godard brought an excellent skull specimen found in the Yukon. *– Kris Vasudevan*

October 17, 1997:

Mechanisms for Professional and Amateur Interaction in Palaeontology, with Dr. Terry Poulton, Geological Survey of Canada.

Dr. Poulton, the Geological Survey's chief palaeontologist in Calgary, discussed ways in which amateur palaeontologists can cooperate with the academic community in making valuable contributions to the science.

Dr. Poulton first outlined the state of palaeontology today, which—in its academic manifestation— is rapidly declining. In Canada, the statistics are grim: the Geological Survey has lost 70% of its palaeontologists; there are currently no paleontologists employed in Quebec and the last Newfoundland palaeontologist is retiring soon. On the industry side, the picture is downright black: no oil company palaeontologist has been hired in Canada in the last two years.

In fact, amateurs comprise the only palaeontological community that is currently thriving.

In Germany and the United Kingdom, there is a strong spirit of cooperation and liaison between scientists and amateurs. Dr. Poulton hopes that a similar atmosphere can develop in Canada. He offered the British Columbia Paleontological Alliance (BCPA) as a good model of how such a partnership can exist. After a visit to members of the BCPA earlier this year, Dr. Poulton returned to Calgary with an enthusiastic desire to encourage a similar alliance in Alberta.

Examples of the BCPA's accomplishments include:

- Important contributions to the biostratigraphy of certain formations on Vancouver Island.
- Sponsorship of a two-day symposium on palaeontology, earlier this year, attended by professionals and amateurs. In many cases, papers presented by amateur experts were as good as those offered by their professional colleagues.
- The release of quality publications, including one on Eocene insects by amateur Bruce Archibald.
- Compilation of fossil resource inventories covering certain areas of British Columbia.
- Contributions to the upcoming Jurassic conference to be held in British Columbia in 1998.

Dr. Poulton pointed out that, while amateurs are becoming the "eyes" of palaeontology—the group most able to explore a region's palaeontological resources—the professional community is needed to inject scientific ideas, and to help steer amateurs from the basic mode of "collecting " (as an end in itself) toward "studying and *data* collection." *– Howard Allen* ❑

Dr. Dale Russell Speaks on Dinosaurs of the Sahara

by Howard Allen

Dinosaur palaeontologist Dr. Dale Russell , North Carolina State University, Raleigh, at the University of Calgary, December 12, 1997.

If the cliché that 8 year-olds are the experts on dinosaurs is true, then Dale Russell is surely one of the senior 8 year-olds in the field. His gleeful ebullience in front of this small noon-hour audience, peppered with graduate students and academics (to whom he was clearly aiming his presentation) was a wonder to behold.

The presentation began with a too-short series of colour slides showing remarkable landscapes and outcrop sections, mainly in Morrocco and Egypt. The rest of the lecture consisted of a random blizzard of black-and-white overhead transparencies showing palaeographic maps, grainy photos Xeroxed from various sources, and pen-and-ink sketches of inscrutable bone fragments. This was accompanied by Russell's breathlessly rapid-fire commentary, broken only by occasional aerial leaps to point out some significant feature at the top of the screen; to pace out, across the width of the lecture theatre, the 12 m wingspan of a pterosaur; and to perform a chicken-walk that would put Chuck Berry to shame.

An early intention by your reporter to take notes was quickly given up as futile. Some of the points I was able to pluck from Dr. Russell's verbal stream of thought were:

• Northern Africa is a vast area of opportunity for palaeontological exploration. There are many thousands of square miles of exposed rocks, many littered with bones and fossils of all types of organisms. Expect many more remarkable discoveries from this region in the near future.

• There was a surprising amount of parallel evolution between northern and southern-hemisphere dinosaur faunas.

• Recent theories that dinosaur faunas may be less diverse in palaeoequatorial regions (due to extreme heat in the ancient climates) are being knocked down by the discovery of remarkable fossils from beds deposited in these very regions. ❑

Fossils in the News

Newsweek, September 29, 1997:

Treasure of the Badlands

MONTANA—Keith Rigby, a professor at Notre Dame University, South Bend, Indiana, and his team found the bones of a giant carnivorous dinosaur earlier this year, possibly a *Tyrannosaurus rex*, south of Glasgow, Montana. [*close to a dig area visited by DINOTOUR 7; see "Dino fossil may break all records,"* Bulletin*, September 1997 – ed.*]

The team ran out of time and covered the bones in mid-August with instructions to the Waltons, who claimed that it was on their land, to protect the site from vandals.

The Waltons, however, began digging in September with Nate Murphy, director of palaeontology at the Phillips County Historical Museum in Malta [*and a consultant to DINOTOUR 7*]. The Waltons told Murphy that Rigby was in Mongolia. Rigby brought in the FBI to investigate the Waltons' claim of ownership. Currently, Rigby does not have a permit for the Glasgow *T. rex*. Case unsettled.

The Washington Post, October 14, 1997:

Utah Fossil Trove Brings Elusive Era to Light

UTAH—Richard L. Cifelli of the University of Oklahoma and his colleagues have reported in the *Proceedings of the National Academy of Sciences* on their excavations about 270 km south-southeast of Provo, Utah in the Cedar Mountain Formation (Cretaceous, about 98 million years old).

With financial support from the National Geographic Society and the National Science Foundation, about 6,000 specimens comprising 72 vertebrate species have been collected. The site has yielded possibly the oldest known *Tyrannosaurus*, the first of the known hadrosaurs, the last of the long-necked sauropods, four new species of marsupials, the oldest North American snakes, as well as fishes, lizards and frogs.

The material lends support to two theories: (1) Many North American dinosaurs evolved from Asian dinosaurs which crossed over on a temporary land bridge, and (2) the development of low-growing flowering plants contributed to the extinction of sauropod dinosaurs. There is a tendency towards smaller body size, away from the "megafauna" of the *Jurassic Park* genre. Cifelli says, "This is the twilight zone of the age of dinosaurs."

The Globe and Mail, October 17, 1997:

The case of the disappearing dinos

DRUMHELLER—Dr. Phil Currie, of the Royal Tyrrell Museum, came across an old report from the Barnum Brown expeditions—in 1910—of an *Albertosaurus* bonebed. But since Brown never recorded the locality of the bonebed, it remained lost to science, until this year.

On a recent visit to the AMNH in New York, Currie examined specimens from the Brown expeditions, which included nine fully articulated right feet of *Albertosaurus*, collected from the mystery locality. An examination of Brown's field notes turned up no clues, so Currie turned to some letters Brown had written to his boss. The letters included a few old photos, supposedly of the *Albertosaurus* quarry, and some panoramas of the badlands near the Brown field camp.

Taking the photos back to Canada, Currie put together a field team (with funding from Dinamation International Society) and this summer went out looking for the lost *Albertosaurus* quarry. They retraced the route of Brown's river raft expedition, and attempted to locate the scenes depicted in the photographs. Currie's knowledge of the badlands topography gave him a hunch that the pictures were likely taken somewhere in the vicinity of Drumheller. By the end of the first day, they realized that the panoramic photos had to have been taken somewhere else, and mislabelled.

This left two snapshots, including one of Brown's 1910 camp, near the *Albertosaurus* quarry. Near the end of the second day (the hottest day of the summer), Currie finally spotted a promising-looking ridge, and climbed up, this time meeting with success. This was the spot where Brown had stood when he photographed the camp in 1910. The following day Currie's team located the "lost" quarry, which had bones scattered everywhere.

An examination of the site suggests that there may be as many as 30 to 40 complete *Albertosaurus* skeletons. The specimens range in length from about four metres to nine metres, indicating a mix of juvenile and adult skeletons. The suggestion is that this great abundance of monospecific bones indicates "pack" behaviour, and perhaps cooperative hunting strategies.

Calgary Herald, November 13, 1997:

T. rex: Made-in-Alberta Imax movie aims to bring dinosaurs into the third dimension

CALGARY—The next dino-thriller to hit the big screen—the *really* big screen—finished filming recently in Calgary.

T. rex: *Back to the Cretaceous*, a 3-D hair-raiser to be shown in Imax theatres is now headed to the Los Angeles computer animation studios for addition of the big stars, the dinosaurs.

Filming of the live backdrops and human actors took place in the Alberta badlands and in Washington state. Actor Peter Horton, of TV's *Thirtysomething* plays the lead role: a palaeontologist whose daughter triggers a paleo-nightmare upon dropping a fossil *T. rex* egg.

The difficulties of filming a feature-length action film with real actors, using the unwieldy Imax equipment was made painfully apparent. The giant cameras can only shoot scenes for 3 minutes, then require 20 minutes to reload the film. This left actors twiddling their thumbs in boredom for hours every day.

If everything stays on schedule, the movie should be playing to 3-D equipped Imax theatres next fall.

Calgary Herald, November 22, 1997:

Diaphragm deflates bird-dinosaur link

OREGON—Palaeontologist John Ruben of Oregon State University was startled when, on examining high-grade photos of a Chinese dinosaur fossil, he spotted traces of what appeared to be internal organs—including a diaphragm separating the heart and lungs from the liver, stomach and other organs.

This suggests to Ruben that the dinosaur's internal anatomy was more like that of a crocodile than a bird: birds don't have diaphragms. If true, it would throw a monkey-wrench into the theory that birds descended from dinosaurs. Birds and dinosaurs could still be related in this scenario, but only through a common ancestor.

The warm blooded/cold blooded debate is also at stake here. According to Ruben, crocodile-type lungs are not efficient enough at exchanging air to support a warm-blooded metabolism. Fight!

Calgary Herald, September 12, 1997:

Canyon Creek Road closed to vehicles

CALGARY—As rumoured in the September *Bulletin*, officials have gated the popular Canyon Creek Road, west of Bragg Creek, to keep people from breaking their necks at the Ice Cave. Those wanting access to the area must now hike or cycle in along the 5.5 km gravel road.

[*Summaries by Les Adler and Howard Allen; thanks to Les Adler, Trudy Martin, Wayne Braunberger and Brian Allen for clippings.*] ❑

Acetic Acid Opens New Paleo Dimensions

by Joe LeBlanc

* Warning: this article uses **acetic** acid. Do not try the following with other types of acids. – J.L.

Acetic acid, or "concentrated vinegar," is my not-so-secret weapon as a fossil enthusiast. This foul-smelling substance unlocks the mysteries of strange beasties such as "ichthyoliths" and "conodonts." Like the acetate peel and the thin section, acetic acid lets both the professional and the amateur palaeontologist peer into the world of the microfossil.

Ichthyoliths?

A fancy word for disarticulated, usually microscopic remains of fish: usually teeth, scales and spines. A great collection of shark teeth can enter your collection through the use of acetic acid. Rare microscopic Palaeozoic teeth, some only a few millimetres in size, become prized possessions. Acetic acid can also free larger shark teeth from stubborn limestone matrix.

Conodonts?

These enigmatic "tooth-like critters" baffled the paleo world for decades. Their use in geology, however, is legendary. [*Recent discoveries have revealed that conodonts are the "teeth" of an extinct worm-like organism, probably a vertebrate – ed.*] Conodonts are index fossils to date rocks. For example: is my rock Devonian or Carboniferous? Initially, this determination may prove impossible due to the absence or poor preservation of macrofossils. Conodonts come to the rescue. Conodonts, if present, can be coaxed out of the rock by acetic acid use. These conodonts can be studied with the microscope, identified to genus or species level, and used to date the rock.

How does it work?

Some fossils, such as those listed above, are composed of the inorganic component *calcium phosphate*. This substance is not seriously dissolved by acetic acid. The rock matrix, usually limestone, is dissolved while leaving the calcium phosphate specimen intact. Other acids, such as hydrochloric, would destroy the calcium phosphate fossils.

The magic potion

We need **10% minimum acetic acid.** Table vinegar is 5% acetic acid and pickling vinegar is 7%. Both are too weak. 10% acetic acid is obtained by mixing 9 parts water with 1 part pure acid. A 10% solution may be available commercially. Pure (100% acid) [*often referred to as "glacial acetic acid" – ed.*] can be obtained at a chemical supply store. Avoid the fumes while mixing. Although acetic acid isn't as volatile and dangerous as some acids (hydrochloric, sulphuric, etc.), it packs a powerful vinegar odour and can quickly "clear the nostrils."

The "Soup"

Acetic acid has been used for decades to extract fossils. The key to success is to create an "acid soup." This soup quickly clings to phosphatic fossils and acts as a buffer against acid etching and brittleness. The recipe is:

• Take a half kilogram of unwanted **limestone** (most fossiliferous rock will do).

• Put this limestone in a plastic container (an ice cream tub is fine), **at least 5 times the volume** of the rock. This minimal size is important to prevent crystal buildup. Fill the container with 10% acetic acid. Let sit five days.

• After five days throw away any undissolved rock. **Do not throw away the solution (liquid)** of acid and dissolved rock. This solution is known as **acid soup**. Strain this soup through a fine steel mesh or cloth. Store in a bottle for future use.

Finding fossils

We can now take a piece of limestone that may contain phosphatic fossils. Put this in a plastic container (again, at least 5 times greater in volume). Cover with 10% acetic acid and **add a few ounces of "acid soup"** (above). Let sit for a week. After this time, add a few ounces of fresh 10% acetic acid (no soup necessary). Let sit for another week.

The rewards

If your rock is acid soluble, small pieces of rock and sand-like particles will remain on the bottom of the container. This sediment should contain fossils. Strain this sediment using a very fine steel mesh or cloth. Do the opposite from making acid soup: **keep the sediment and throw away the solution.** Wash this sediment with clean water and strain again. Place the resulting material on a slip

of white paper or on a glass slide. View under a microscope. Hopefully fossils will appear. Larger pieces (shark teeth) can be studied with a hand lens.

Your collection

Did you find conodonts? ichthyoliths? other strange critters? To keep your new microfossils, take a fine "000" camel paintbrush and slightly wet the tip. The microfossils will cling to the wet bristles and can be positioned on a slide. A water soluble glue, such as gum tragacanth, can be used for mounting. The fossil is now ready to be identified and the slide labelled.

New dimension

Experiment with limestones from different ages and formations. The resulting fossils should offer countless hours of fascination. Hundreds of publications are available to help identify ichthyoliths, conodonts and other small phosphatic fossils. The amateur fossil collector can become a player in the science of palaeontology. ❑

Acting Treasurer's Report

by Les Adler

I would like to thank **Joe LeBlanc** for keeping an accurate set of records and producing regular reports to the executive during the 1994–1997 period. Joe also recommended a fee increase which is slowly providing a workable reserve. **Howard Allen** has been producing an excellent *Bulletin* while keeping down production costs and probably covering some of the expenses out of his own pocket.

Similarly, **Les Fazekas** has been keeping field trip expenses low. **Wayne Braunberger** and **Harvey Negrich** have also assisted in keeping expenses low. Consequently, at the end of 1997 we have a reserve of about $1100. Approximately $500 worth of bills have yet to be presented, but this amount is covered outside of the $1100. In addition, $400 of advance subscriptions for 1998 has been banked. We expect 80 members for 1998 and a budget will appear in the March, 1998 *Bulletin*. ❑

The Saga of Sue: the Final Episode?

As the dust settles on this stranger-than-fiction tale of palaeontology, politics and greed, it's time for a final (we hope) look at the events and their possible legacy. What follows is a compilation of one magazine article, one newspaper article, and a television interview, as reviewed by three intrepid APS members. – ed.

[1] **No bones about it** by Karin Vergoth, *Scientific American*, December 1997, p. 18. [*reviewed by Kris Vasudevan*]

[2] **The Wheeling and Dealing that Snared a Tyrannosaur** by Stevenson Swanson with assistance from Susan Chandler (Chicago) and V. Dion Haynes (Los Angeles). *Chicago Tribune*, October 7, 1997, pp. 1–9. [*reviewed by Les Adler*]

[3] **An interview** aired on WTTW *Chicago Tonight*, October 18, 1997, with two executives of Chicago's Field Museum of Natural History, John McCarter and Peter Crane; and the president of the Society of Vertebrate Paleontology (SVP), Louis L. Jacobs. [*reviewed by Vaclav Marsovsky*]

The find and the fight…

[1]The most complete *Tyrannosaurus rex* skeleton was discovered in 1990 on a South Dakota ranch by Susan Hendrickson, a collector working with the Black Hills Institute of Geological Research (a commercial outfit) in Hill City, SD. The specimen was later named "Sue" in honour of Ms. Hendrickson.

Sue was found on land owned by Maurice Williams, a Cheyenne River Sioux, and was bought from him for $5,000. The courts in the US eventually returned Sue to Williams, but ruled that he could not sell anything found on his land without federal permission. The government auctioned the fossil on his behalf.

The auction…

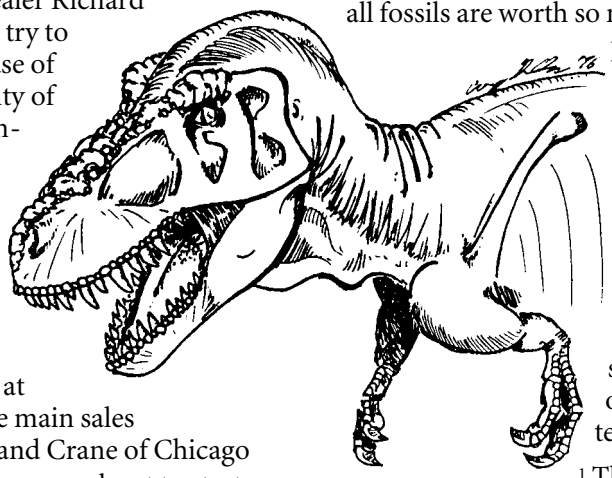
[2]Three top officials of Chicago's Field Museum of Natural History agreed to bid on the *T. rex* fossil nicknamed "Sue" after examining it in June, 1997 at Sotheby's warehouse in East Harlem, New York. John Flynn, head of the museum's geology department stated that the bone is exquisitely preserved.

The museum bought the skeleton for US$8.3 million, most likely the highest price ever paid for a fossil, the most sought-after set of bones in the

170 years of fossil hunting. It had been widely known for months in the museum world that Sue would be sold at auction in October, 1997. The museum's new president, John W. McCarter, Jr., the museum's chief preparator, William Simpson, and John Flynn made the trip in June to view Sue and meet with Sotheby's executives.

Sotheby's pre-auction estimate was US$1 million. McCarter contacted McDonald's, the fast food giant which had already sponsored exhibitions at the museum and received an unqualified immediate enthusiastic response. This was the key to the whole deal. McDonald's and Disney had signed a 10-year marketing pact that committed each of the them to promote the other's products around the world. The two corporate partners are to get life-size replicas of Sue.

Veteran Chicago art dealer Richard Gray advised McCarter to try to negotiate a private purchase of Sue to avoid the uncertainty of an auction. The US government had decided that auctioning Sue was the best way to get a fair price for her legal owner, Maurice Williams, for whom the government held Sue in trust. Gray arranged for a private room at Sotheby's, overlooking the main sales room and kept McCarter and Crane of Chicago out of sight until the bidding was about to start. The bidding started at $500,000 and immediately shot into the millions.



Linked by phone Gray made his first bid at $5.3 million. Within eight minutes the Field Museum became the new owner without anyone knowing who was bidding. Betsy Bennett, director of the North Carolina State Museum of Natural Sciences who dropped out at $7 million said, "Great idea. Great plan, too!"

The spin…

[3]Questions from the *Chicago Tonight* program's host, like "How much was the Museum prepared to pay?"; "How much did each partner contribute?"; "What does each partner get out of this?" were smoothly deflected by the Museum's executives. I suppose we will never know.

[2] "Sue's" notoriety guarantees that it will pull in thousands of admission-paying admirers. After two years of preparation it will go on display at the Field Museum in the year 2000.

One replica will be on display at Dino Land and two will tour around the USA and other countries as part of McDonald's promotion to commemorate the millennium. A fossil preparation laboratory will be built at Dino Land with Field Museum personnel working in public on some of Sue's 300 bones. McDonald's is also paying for the construction of a preparation lab in the museum's main hall at Chicago, open to public view. The California State University system is contributing $US700,000 to cover restoration and study of the bones.

[3]Louis Jacobs of the SVP said that the scientific community is pleased that a public institution got Sue. The upside is that the high cost demonstrates a real interest in fossils. A fossil like Sue "opens windows to lost worlds." He also pointed out that there is a downside. When a fossil sells for so much money, it sets a precedent, and an expectation that all fossils are worth so much. He did not say but perhaps implied that with the high prices, museums cannot compete with private collectors on sales of fossils from private lands, and that the high prices will drive the public and commercial dealers out into public lands to look for fossils to collect and perhaps sell. Jacobs said that fossils on public lands must be protected.

[1] The story of Sue has created much debate over collecting fossils in public lands. Clearly, the skeletal remains of Sue, now in the hands of the Field Museum, have raised an interesting debate between private collectors and professional palaeontologists with the necessary permits to collect them. Louis Jacobs, president of the Society of Vertebrate Paleontology, has a strong statement to make: "What we have to do is use the lesson of Sue to make sure that vertebrate fossils are never allowed to be commercially collected from public lands, because what belongs to the public should not be sold to the public." Terry Wentz of the Black Hills Institute, remarking on Sue going back to public hands, points out, "Just because it went into public hands doesn't necessarily mean that the specimen will be well taken care of. It's the individual people involved with the fossils that make the difference."

With the number of professional palaeontologists dwindling down and with the fossils in private and public lands yet to be discovered, the debate over Sue has just started. ❑

Madagascar's dinosaur fossils on display at Chicago's Field Museum

by Vaclav Marsovsky

Several APS members took in the displays at the Field Museum of Natural History during the annual Society of Vertebrate Paleontology (SVP) conference, which took place in Chicago in October.

A highlight was the collection of Mesozoic fossils collected in Madagascar in 1996 and 1997. These were collected in the Mahajanga Basin near the northwestern coastline of Madagascar. The display consisted mainly of real fossils rather than casts. The matrix still surrounding some fossils in field jackets in the museum's small prep lab is pale buff in colour and the bones are also buff coloured. They have the look of old buffalo bones that have been buried in the badlands and have not yet had a chance to be bleached out in the sun.

On display are:

• Cast of a skull of *Majungasaurus crenatissimus*, a large theropod estimated to be 11 m long, and 80 million years old. The skull was found in pristine condition and is quite complete. This skull has a shortened snout giving it a bulldog appearance and has a certain resemblance to the *Carnotaurus* from Argentina. It has yet to be described but so far has been assigned to the Abeliosaur family which has only been found in the southern continents.

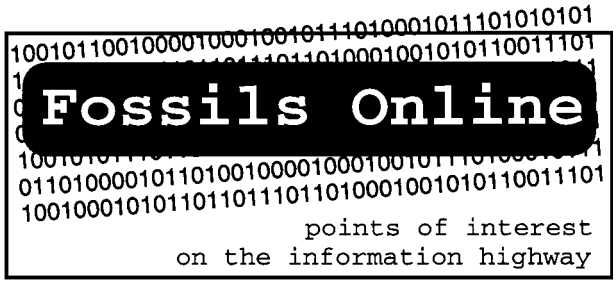
• A 17 cm diameter scute assigned to *Titanosaurus madagascariensis,* a large sauropod (80 million years old). The scute is very porous, woven and fibrous and has a hole on the underside for entry of blood vessels. Since the scutes are rarely found, it is thought that this titanosaur did not have very many on its body. Some artists have shown this dinosaur with just a few rows of scutes running along its back. Palaeontologists have yet to find scutes on the North American titanosaur lineage.

• *Araripesuchus buffetauti.* This small crocodile is about one metre long in total, but the trunk is only about 20 cm long. This is quite a small crocodile, but supposedly an adult. This idea is probably based on the progression of fusing of bones. The limb bones are like toothpicks—very fragile.

• *Mahajangasuchus insignis*, also 80 million years old, and about three metres long. A larger crocodile than *Arraripesuchus* with which it lived side by side. A few teeth of this animal were displayed separately which allowed one to see its unusual features. The peg-like teeth were 5 cm long with the last 1 cm at the tip flaring out to form two opposing ridges. These ridges come together at the tip and the ridges are serrated like theropod teeth.

• A hind limb and part of a pelvis of *Titanosaurus madagascariensis.* This individual would have been 12 m long. I understand the leg was constructed from the different limb elements found in the bone bed and may have come from several individuals.

• A cynodont skull, 230 million years old, 85 cm long and weighing about 6 kg. The skull is in perfect condition. This animal has not yet been named. It ate plants. It has a variety of teeth in its mouth: pointed peg-like incisors and wide, flattened molars for grinding up plants. ❑



Here are a few more web sites to check out:

DINOTOUR web page
www.rpi.edu/~whiteh/DINOTOUR

Dana Geraths, professional paleoartist
www.navicom.com/~paleoart

The *Canadian Rockhound* online magazine
http://pangea.usask.ca/~dfs846/rockhound/home.html

❄ ❄ ❄

New and/or updated member addresses:

Hope Johnson	behope@telusplanet.net
Keith Mychaluk	geology@petromet.com
Betty Quon	betty_quon@becgy.com
Randall Quon	rsquon@cadvision.com

Please respect our members' privacy: no spamming, no mailing lists without permission! ❑

Frayed Scales become Feathers

by Sam Richter

Vern Johnson, a local rancher with greying, short-cropped hair, casually flipped through magazines while waiting his turn in Lionel's barber-shop. A review of a book about evolution looked interesting—*The Growth of Biological Thought*. This is a 975-page history of diversity, evolution, and inheritance, by Ernst Mayer. Skimming through the review, one line used as an example of "soft inheritance" of characteristics, started him thinking: "Frayed Scales became Feathers." This is the popular explanation for the origin of feathers. The proof for this is that some breeds of chicken still have scales on their legs today, believed left over from the evolution of scales to feathers. The popular writer on evolution, Richard Dawkins, states in his book *Climbing Mount Improbable* (page 124), that scales became feathers.

Vern raised chickens and knew that any animal able to fray hard tough scales would be real hell on fragile feathers. That animal would soon have bald spots with infected skin. When his chickens frayed their feathers, new feathers of the same type always replaced the old, they never changed to hair or scales. How did the genes for scales in female egg and the male sperm get changed to genes for feathers?

He had a down-feather parka that helped keep him warm in the cold. Feathers are excellent insulation, but a cold-blooded scaled creature that is now feathered would have problems trying to warm up by moving into the sun. This new animal would not survive long, yet this story of how scales turned into feathers has continued to be told as true for over 125 years!

Vern raised chickens and knew that any animal able to fray tough scales would be real hell on fragile feathers.

There must be an interesting story about this. He would ask his oldest daughter, Tracy. She is the leader of a research team in molecular biology for a major bio-tech outfit. Evolution can be part of molecular biology research and he could count on her for straight answers.

"You are so right, Vern!" The principle behind this story is the basis for many wonderful folklore stories. Remember the story of "How the Leopard got its Spots"? This principle has been used for many centuries to explain the mysterious complexity of Nature. Uncertainty is hard to bear and the human mind goes to great lengths to avoid it. The idea of external forces making permanent changes to an organism introduces order into a confusing Universe. Ideas about inheritance and its physical basis were vague until the recent understanding of how genetics actually work. Evolution contradicts common-sense because it cannot be observed directly but can only be inferred. For a long time the main principle of evolutionary adaptation has been the belief in the inheritance of acquired characteristics.

J.B. de Lamarck formally announced this ancient popular belief as valid in 1809 in France. It is now known as "Lamarckism" or "soft inheritance." The basic concept underlying this belief is that the genetic material (DNA) is not unchangeable or "hard," but is pliable or "soft" and is easily permanently changed to be transmitted to offspring.

"Everything which Nature has caused individuals to acquire or lose as a result of environmental conditions to which their race has been exposed over a long period of time—and consequently, as a result of the effects caused either by the extended use, or disuse, of a particular organ—all this is conveyed by generation to new individuals descending therefrom, provided that the changes acquired are common to both sexes, or to those which produce the young."

This lasting belief is that genetic material is not constant from generation to generation, but may be modified by adapting to the effects of the environment, and by use or disuse of parts of the body.

This concept of the inheritance of newly acquired characteristics was so universally accepted from the ancients to the twentieth century, that there was no need to explain how it occurred. This is an accepted belief today, even after geneticists have demonstrated that the pathway from nucleic acids (DNA) to RNA to body proteins is one way only. There is no way the environment can influence the body proteins to change the organism's DNA. There are still many uses of this principle today, especially in songs and folklore, but in real life it cannot make any changes to offspring.

This popular principle was first lab-tested by

August Weismann in 1893. Twenty-two consecutive generations of mice had their tails cut off. The expected result was that the following generation would be born without tails. But they were always born *with* tails—the popular Lamarckian principle of "soft inheritance" is shown to be invalid.

Testing in the field by shortening lamb tails has been going on for centuries. New lambs insist on having long tails that get dirty. The acquired characteristic by shortening tails has never changed the hereditary makeup for lamb tails. Any permanent changes to an animal explained as being caused by Lamarckism is again shown to be in error.

The large-scale use of a popular but invalid idea can have unforeseen tragic consequences. A surprising application of Lamarckism started in the early 1930s, reached its peak in the 50s, and is still in use today. Before Communism, Russia was a major exporter of agricultural products. Under Communism it became a major importer. This long term change was the result of the application of Socialist-Communist-Lamarckian ideology to agriculture, not bad weather or pests.

Agriculture is the basis for our civilizations. Socialism, where the state owns and controls everything and everyone, is an agricultural disaster everywhere it is used. It alienates the producers with unrealistic quotas set by central planners with little agricultural experience. Failure to meet these quotas can result in penalties for "defrauding" the state. The automatic assumption is that the state's goods were sold or traded for vodka, which sometimes does happen. Central authorities sometimes order the use of inappropriate farming practices, which usually reduce rather than enhance production, but the quota is always ramped upward because of the chronic shortage of food. Bureaucratic enforcers are not sympathetic to the producers' problems, because they know that messengers of bad news often suffer bad things. Inevitable poor results are often fudged to keep Central Control off their backs. Future central planning is then based on these invalid reports.

In 1932, a system of internal passports was designed to prevent farmers and villagers from improving their lot in life by moving to cities. Permits to visit or move are difficult and costly to obtain and violators are treated very harshly. In the first five months of 1997, 1.4 million internal passport checks were conducted in Moscow, even though the Constitution of 1993 guarantees freedom of movement. Slaves to the state are not enthusiastic supporters of the state. Those that can find a way to leave farming permanently, do so. Joining the military is popular. The ever increasing shortage of farm workers is compounding the many problems persistent in Russian agriculture today.

Add the use of Lamarckism to the problems caused by Socialism, and it is soon apparent why Soviet agriculture performs so poorly. T.D. Lysenko, a Russian trained biologist, convinced and received support from the Soviet chiefs during the agriculture crisis of the 30s. His form of Lamarckism would be the miracle that would quickly improve agricultural production. It promised greater, more rapid, and less costly increases. He gained considerable influence under Stalin, being appointed head of the Agronomy Ministries for Biology and Science. Lysenko became known as the "dictator" of Communist biology. Orthodox genetics was outlawed because it was contrary to Communist ideology. A true Socialist state's population could be moulded through "inheritable effort" only, and no other way. This theory is similar to the giraffe's neck being permanently lengthened through its own efforts only and not through any genetic inheritance for a long neck. Many millions have been killed from the erroneous belief that human nature can be perfected by external forces. Humans are the only animal willing to kill or be killed for beliefs made into ideology.

The scientific community was forced to buy into "Lysenkoism" …or else.

The Nobel Prize winning American geneticist, Herman Muller, had accepted the invitation to work in genetics in Russia. He recorded the political rise of Lysenko and the losing struggle by the geneticists. Conditions deteriorated for those working in what was for the rest of the world standard genetics. Muller was forced to abruptly flee Russia. What had been the respectable study of genetics soon came to a standstill. Stalin became convinced that Soviet genetics was superior to Mendelian genetics and that genes and chromosomes did not exist. The scientific community was forced to buy into "Lysenkoism" …or else. The "or else" was at best professional extinction; at worst, imprisonment and death by starvation. By 1948, Lysenko's "iron thumb" insured that all standard geneticists doing genetics in the USSR had been purged. Some died mysteriously.

In 1961 Lysenko was the most politically influential scientific man in the Soviet Union. As president of the All-Union Academy of Science, he ap-

proved this public statement: "The assertion that there are in an organism some minute particles, genes, responsible for the transmission of hereditary traits is pure fantasy without any basis in science."

Lysenko spent major money on creating large plantations for growing warm-climate crops, such as melons and grapes, near cold-climate Moscow. When these crops became cold-hardy, there would be large savings in transport and storage costs. Large-scale planting was done elsewhere in unsuitable cold areas for corn and other warm-climate crops.

"Lysenkoism" is the belief that "soft" inheritable traits can best be acquired when the organism is under stress. This belief meant that wheat grains scattered over the Siberian wasteland would "adapt and grow vigorously." They did not—unfortunately, because many human lives were dependent on a harvest from this experiment.

Stalin died in 1953 and was replaced by Khrushchev, a Lamarck believer, who became involved in agricultural projects with Lysenko. There were many surprises when the warm-climate crops died before becoming cold-hardy. Similar problems occurred with other crops, such as corn, also grown in unsuitable areas. The Russian diet had long ago become short of protein in any form, including meat and milk. This has serious health consequences and Russian life spans decreased significantly. For decades now, the average life span of Russian men has been 58 years—17 years less than men in North America.

It's always DNA to RNA to body protein, never the reverse.

These negative results contributed to the Central Committee's firing of Khrushchev on October 14, 1964, while he was vacationing. Lysenko's doctrine was also officially discredited and efforts were made to reestablish orthodox genetics. However, Lamarckian ideas remained strong in Russian biology. Lysenko and his group retained their titles and academic positions and continued to promote their ideas. Lamarckian experiments continued in Russia, although reduced in magnitude and scope. All ideologies carry with them a particular viewpoint, a sharp focus on certain aspects and a blurred vision elsewhere. A price is always paid for excessive preoccupation with a narrow aspect of reality. The legacy remains; recent changes to Russian agriculture are only superficial and Russian agriculture will continue to struggle with its heritage for a very long time to come. The Wall Street Journal (September 1997) reports that an estimated 60% of the food consumed in Russia today is imported.

Heredity can be confusing. In animals, the environment does not directly change the hereditary makeup. Environmental circumstances do select which inherited tendencies are expressed, but the genetic potential has to be there first. Here is an example of this:

Sex determination in Mississippi alligators results from the temperature which the embryo is at during a critical period in its development. The eggs are laid in a nest of rotting plant material, which generates heat. In the range of 26–30°C, all become female. Between 34–36°C, all become male. Between 31–33°C they can become either. Below 26°C and above 36°C all eggs die. Both sets of genes for male or female exist in each individual. What the temperature does is determine which set of these genes gets used. The understanding of how genes work has made it plain that Lamarckism does not and cannot have the influence on a creature's offspring as claimed. It's always DNA to RNA to body protein, never the reverse.

Darwin used Lamarckism because it was popular, but he wasn't keen on it. He had only one other non-Creationist explanation for changes to organisms. He admitted that a bear swimming up a creek would drown long before it could become a whale.

Why is Darwin popular today? His ideas resonate with our culture and we are comfortable with this. Culture is the lens through which we see the world. It shapes the ideas we use to make sense out of what is happening around us, and how we think the world works. Darwinism is now being used to explain the evolution of many things, from business and scientific ideas to modern art. Some of these explanations would please Lamarck with their use of his principle of acquired characteristics.

Science is not free of culture. In 1962, Thomas Kuhn proposed that scientific theories are systems of belief; interlocking scientific, social and political ideas. Blinkered dogmatism continues until new evidence is overwhelming and a new theory deposes the old. Much of the evidence which apparently supports a theory actually supports its acceptability to scientists and the general community.

Most people, including writers and scientists, are unaware of their biased framework of ideas—silent assumptions. Why some invalid con-

cepts are accepted without question and why others that are obviously true are rejected is puzzling. Popular writers of evolution start off by stating that Lamarckism has definitely been proved to be invalid. Then they come up with eloquent stories using Lamarckism to explain how things have evolved. Most annoying! These writers seem to have a mental block that stops them from realizing that their stories are in the same category as Walt Disney's fairy-tales, no matter how scientific they are made to appear. Apparently these writers are not able to make their evolution occur without using "soft" inheritance. What actually occurred in the distant past will always remain speculative and can never be known or be proved for certain, but "soft" genetics is a definite "NO." Fraying of scales cannot affect the genes for scales and the next generation will again have scales, not feathers or hair.

The perception of how things might have happened is always reality to the individual, even when the idea has proved to be invalid. Human emotions somehow play tricks with the senses and the intellect. This is a normal part of human nature that is not likely to ever change. ❑

Reviews

by Les Adler

What Mitochondrial DNA Says About Human Migrations by Douglas C. Wallace. *Scientific American*, August 1997, p. 46, 47.

In 1997 many scientific magazines have been presenting articles on human-related fossils and DNA interpretations. Several summaries will be presented here in the near future. Overall these articles deal with a seven-million year period and some sixteen species. Confusion arises due to disagreements in conclusions and methods and also to each worker's mind-set.

Dr. Wallace is Director for Molecular Medicine at the Emory University School of Medicine. The map and notes here are different from those produced by palaeoanthropologists from fossils. The dates from this laboratory are also different from the dates obtained by other similar laboratories due to different methods of calculation.

Each of the body's billions of cells contains hundreds of mitochondria each with over 37 genes in DNA loops. Global migrations can be reconstructed through mitochondrial DNA analyses because as women migrated from continent to continent their mitochondrial DNA gradually accumulated one non-deadly mutation after another. Hence, the sequences of base-pairs in mitochondrial DNA on one continent came to differ in distinctive ways from the sequences on other continents.

African populations are oldest because they harbour the greatest mitochondrial DNA variation. Asians, Europeans and the Native American populations display progressively less variation.

1) *Homo sapiens* emerged in Africa approximately 130,000 years ago.

2) The initial migration out of Africa took people to Asia by about 73,000 years ago.

3) Roughly 51,000 years ago another cohort left the Middle East and colonized Europe.

4) About 34,000 years ago some wanderers travelled through Siberia and Alaska and then through North and Central America to South America.

5) About 15,000 years ago a second wave dispersed through the Americas.

6) About 9,500 years ago Siberian exodus to North America.

7) More recently, Eskimos, Aleuts and Pacific islanders.

Early Hominid Fossils from Africa by Meave Leakey and Alan Walker. *Scientific American*, June 1997, p. 74–79.

This is the first of a number of reports on the topic that I will be reviewing in the near future. Consequently this review is more general than the subject matter in this article.

First, a hominid is any upright-walking primate. Scientists classify the immediate ancestors of the genus *Homo* (which includes the current human species *Homo sapiens*) in the genus *Australopithecus* ("southern ape").

Researchers study the various species of *Australopithecus* and how each adapted to its environmental niche, such as grassland, forest, volcano, riverbank, etc.

a) the creatures stood on two legs
b) they had ape-size brains
c) they had thickly enamelled teeth
d) they had strong jaws
e) they had non-projecting canines
f) males were typically larger than females
f) individuals grew and matured rapidly

This article provides two sets of diagrams: one diagram shows current ideas as to time intervals for the existence of four hominid genera which the authors believe are closely connected by similarities in present and fossil bone appearance, function and DNA composition, over a five million year period. This diagram is read from left to right

and is quite different from a cladogram which is read from bottom to top for dinosaurs. Also the nodes are poorly labelled so that it is difficult to find what distinguishes genera and species from each other.

The diagram shows "chimpanzee" directly through 5 million years with a split at 1.8 million years ago for the bonobo (pygmy chimpanzee). *Homo* is shown from 2.3 million years ago to the present. A genus *Ardipithecus* is shown at about 4.4 to 4.2 million years ago. Seven species of *Australopithecus* are shown, from 4 million to 1.3 million years ago. There are many gaps, question marks and disagreements as specimens have yet to be found to answer questions.

The second diagram shows a set of beautifully illustrated shapes of mandibles (jaws), tibia and humeri (leg bones) of chimpanzee, australopithecine and human to show similarities and differences in order to determine their interrelationships and differences and thereby piece together the course of hominid evolution since the lineages of chimpanzees and humans split five or six million years ago.

As you read this material you familiarize yourself as to locations in Kenya, Ethiopia, Chad and South Africa where specimens are now being found and extracted. Laymen are unaware as to the great number of individual fossil hominids available for study and the time that it takes to get the unassailable evidence into print.

As the authors state: "…clearly there is still much more to learn."

Dusk of the Dinosaurs by Michael J. Benton. *Scientific American*, September 1997, pp. 95–97.

This is a review of two recent dinosaur books: T. rex *and the Crater of Doom* by Walter Alvarez (Princeton University Press, 1997, US$24.95) and *The Great Dinosaur Extinction Controversy* by Charles Officer and Jake Page (Addison-Wesley, 1996, US$25).

Alvarez advances his theory that an asteroid brought about the dinosaurs' demise while the other two assert "the Alvarez hypothesis has collapsed under the weight of accumulated geologic and other evidence to the contrary as well as from an increasingly obvious absence of scientific evidence proffered in its support."

Luis W. Alvarez, Walter's father, published a paper in *Science* asserting that a 10 km-wide asteroid hit the Earth 65 million years ago. Herbivores died out, followed by carnivores. The main piece of evidence was the "iridium spike," a high concentration of iridium in sediments near the K/T boundary that appeared to indicate a huge impact.

Scientists opposing the theory stated that:

1) the dinosaurs died out gradually
2) the iridium factor was a local phenomenon
3) Alvarez and his group were physicists and chemists, not geologists
4) the theory had no scientific basis.

The debate mixed science and personalities, hype and hypothesis.

Officer and Page are uncomfortable with the personalities of the theorists. However, iridium spikes have now been found at over 200 localities worldwide along with shocked quartz and stishovite (a high-pressure form of quartz) at some localities. The Chicxulub crater was found in Mexico in 1991. Officer and Page's protestations are weak because they did not use the strong palaeontological evidence that is available. The impact theory still has many holes in it because several other large impacts did not produce extinctions.

Benton suggests that you read Alvarez first for the excellent account of the pro-impact position and then Officer and Page as a spicy account of the politics of science. These two abrasive scientists might have the right ideas.

From Lucy to Language: A family portrait of human ancestors by Donald Johanson and Blake Edgar, with principal photography by David Brill. *Earth*, June 1997, p. 40–47.

This portfolio presents beautifully clear photographs of twelve skulls and most of the skeletons of two genera and seven species. No time line or suggested evolutionary patterns are shown.

1) *Australopithecus africanus*, age about 2.3 million years; the "Taung Child" was found by Raymond Dart in 1925 in South Africa.

2) *Australopithecus afarensis* 3 to 2 million years ago ("Lucy"), found in Ethiopia.

3) *Australopithecus boisei* 1.8 million years ago, a hyper-robust type found by the Leakeys in Tanzania.

4) *Homo erectus* (Peking Man), about 500,000 years ago.

5) *Homo neanderthalensis* with a very large brain, about 50,000 years ago.

6) *Homo heidelbergensis*, European, about 400,000 years ago.

7) *Homo sapiens*, about 100,000 years ago.

Recent indications are that *Homo neanderthalensis* and *Homo sapiens* were not capable of interbreeding but overlapped in time and spatial relationships. ❑