The Paleontograph

A newsletter for those interested in all aspects of Paleontology
Volume 4 Issue 3 June, 2015

From Your Editor

Welcome to our latest issue. My upcoming move to Colorado and sale of my current home have turned my life upside down. It has spelled disaster for this year's collecting but that is life. I will have to make up for it next year (if I'm not too busy fixing up the new place). It is exciting for me, as I'll be much closer to many of my favorite collecting sites and many potential new sites, I hope.

I am concerned about the future of collecting fossils. Opportunities seem to disappear all the time. It is now illegal to sell mammoth material in NY, NJ and soon California. I think 13 other states are working on it also, all in the name of saving elephants. I'm Ok with that but some common sense would be nice. Including non ivory items such as teeth in a ban on ivory does not make much sense. Many imported fossils are disappearing as other countries ban the export of fossils. New public lands rules coming out here, now even ban invertebrate and plant fossils from being collected in some places. We have some further comments in this issue as well as some great articles from Bob.

The Paleontograph was created in 2012 to continue what was originally the newsletter of The New Jersey Paleontological Society. The Paleontograph publishes articles, book reviews, personal accounts, and anything else that relates to Paleontology and fossils. Feel free to submit both technical and non-technical work. We try to appeal to a wide range of people interested in fossils. Articles about localities, specific types of fossils, fossil preparation, shows or events, museum displays, field trips, websites are all welcome.

This newsletter is meant to be one by and for the readers. Issues will come out when there is enough content to fill an issue. I encourage all to submit contributions. It will be interesting, informative and fun to read. It can become whatever the readers and contributors want it to be, so it will be a work in progress. TC, January 2012

Edited by Tom Caggiano and distributed at no charge

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Dinosaur 13--A Film Review

Bob Sheridan, January 24, 2015

"Dinosaur 13" is a 95 minute 2014 documentary film directed by Todd Douglas Miller, which premiered at the 2014 Sundance Film Festival. I recently saw this film on DVD. The topic of the film is the Tyrannosaurus named "Sue" and the legal battles around her in the 1990's. The title comes from the fact that Sue is the 13th discovered specimen of Tyrannosaurus. (One might think "Tyrannosaurus 13" would be a more accurate title.) There are now about 50 specimens, but Sue still remains the most complete, and one of the largest and best preserved.

For those of you who did not follow this case at the time, let me summarize. The Sue specimen was discovered in 1990 near Faith, South Dakota by Susan Hendrickson (hence the nickname of the specimen). Sue lay on land held in trust for Maurice Williams by the federal government. Sue was collected by Peter and Neal Larson of the Black Hills Institute (a commercial fossil company), who paid Williams $5000 for the specimen. After being partly prepared, Sue was seized by the FBI and put in a warehouse at the South Dakota School of Mines. The issue was whether Sue was excavated on land held by the US government, from which it is illegal to remove fossils without special permission. After a protracted legal battle in which four parties claimed ownership of Sue (BHI, Maurice Williams, the Cheyenne River Sioux, and the US government), Sue was release to Maurice Williams, who sold her via auction at Sotheby's in 1997 at a price of $8.6 million. The buyer was the Chicago Field Museum, financed by Disney and McDonalds.

The good news is that Sue ended up at a public institution and went on display in 2000, without the sponsoring corporations taking commercial advantage of it. The Black Hills Institute has collected several excellent specimens of Tyrannosaurus since the late 1990's. The bad news is that Peter Larson was put on trial for a number of crimes unrelated to Sue, was convicted on two out of over 150 charges (having to do with not declaring cash at customs during international trips), and spent two years in a minimum security prison.

At the time, it seemed to almost everyone that the laws about fossil collecting on federal land are completely confusing (fossils could be treated as "land", "minerals", or "archeological artifacts"), the seizure of Sue was illegal, that the prosecution of Peter Larson seemed overzealous, that the judge in the case was prejudiced, and Larson's sentence disproportionate to the charges. It seemed to many a complete miscarriage of justice. One plausible interpretation is that the FBI knew it overreached in seizing Sue and then went on a fishing expedition against BHI to retrospectively justify its actions. On the other hand, there are still some who argue that an example needed to be made lest commercial interests steal fossils that rightfully belong to the people. The case was burdened by its association with a number of broader issues: Should fossils on federal land be available for responsible collection (even by commercial interests) before they erode away, or should they be strictly reserved for the "right people?" Can commercial fossil dealers be good scientists? Will the rising commercial value of fossils spoil things for academic scientists?

All these events and issues are well covered in two excellent books published over 12 years ago (both of which I reviewed for the Paleontograph shortly after publication): "Tyrannosaurus Sue" (2000) and "Rex Appeal" (2002). The latter is written by Peter Larson himself. The PBS science program "Nova" did 60 minute film "Curse of T. rex" in 1997 on the very same topic.

"Dinosaur 13" is an engrossing film, but it clearly is not trying for a balanced view. It takes things almost entirely from the viewpoint of BHI and its local supporters (with which I have a lot of sympathy), although one or two talking heads from the federal side are given a few minutes. Overall, I was disappointed with "Dinosaur 13" because I did not learn anything new. All the film does is rehash the period from 1990-1997, which most people who have any interest in paleontology, and who are old enough to remember the media frenzy from that period, are already aware of.

We are almost 20 years past the original incidents and I feel some additional information should be available at this point. Did anyone invoke the Freedom of Information Act and examine the federal documents concerning the seizure of Sue or the prosecution of Peter Larson? Have federal laws about fossils changed? What do we know about Tyrannosaurus since Sue? These things should have been in "Dinosaur 13" but weren't.

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I would recommend anyone interested in the topic of Sue to skip "Dinosaur 13" and read the two books I mentioned or see the "Nova" episode. All are more balanced and cover more issues.

Sources:

Fiffer, S.
"Tyrannosaurus Sue"
W.H. Freeman and Co., New York. 2000, 248 pages.

Larson, P. and Donnan, K.
"Rex Appeal. The Amazing Story of Sue, the Dinosaur that Changed Science, the Law, and My Life."
Invisible Cities Press, Montpelier, VT. 2002, 404 pages.

"The Walking Whales"--A Review

Bob Sheridan, October 31, 2014

Whales and dolphins are collectively called cetaceans, but for the purposes of this book review I will say "whales." They very unusual mammals in that they never leave the water. (Manatees and dugongs being are only other exception.) Their nostrils are at the top of the head between the eyes. They lack hindlimbs that extend out of the body (although most retain some kind of internal detached bony splints where the pelvis and femur should be). All modern whales are carnivores; some have many peg-like teeth to grab fish, and some have baleen to strain krill from the water. As we will see later, one of the most characteristic details about whale anatomy is in the ear, the physical explanation for the differences being that sounds in water need to be handled differently than in air. In most mammals the middle and inner ear is enclosed in a bony capsule firmly attached to the skull. Three delicate bones in the middle ear transmit vibrations from the eardrum to the inner ear. In whales, the bony capsule is free from the skull and there is a slit-like opening on one side. One edge of the opening is thickened, and this thickening is called the involucrum. There is no eardrum, and the three middle ear bones are thick and probably immobile. Sounds are transmitted to the inner ear mostly through the lower jaw rather than an external ear canal.

Before the mid-1990's, the evolutionary origin of whales was pretty much a complete mystery. Some primitive whales like Basilosaurus and Dorudon were known from the Late Eocene, but these are very much closer to modern whales than to any land mammal (although they still retained tiny external hind limbs). It was one place Creationists had it right when they said that there were no plausible fossil intermediates.

The conventional wisdom before the 1990s was that whales evolved from land-dwelling wolf-sized artiodactyl predators called mesonychids, which lived from the Paleocene to the Eocene. This link was made on the basis that details in the skulls of mesonychids and of primitive whales look similar, particularly in the sharp triangular teeth. Artiodactyls are hoofed mammals with an even number of toes (giraffes, deer, hippos, pigs, etc.). They have a characteristic "double-pulley" ankle bone, the astralgus. Modern artiodactyls are almost all herbivores, but there are many fossil offshoots like the mesonychids that were obvious carnivores. The evolutionary story was that whales went back to the water in search of a new source of prey. Nowadays, regardless of any putative fossil ancestors, we can confirm through genetic analysis that whales are indeed artiodactyls, and that their closest living relative is the hippo.

The story of how many important whale intermediates where identified is covered in a new book "The Walking Whales" by Hans Thewissen. Thewissen himself made the first serendipitous discovery of a fairly complete whale intermediate, Ambulocetus, in Pakistan in 1991 while looking for fossils of land mammals. He also discovered several other key whale intermediates in India and Pakistan subsequent years. These vary in size, shape of the skull, placement of nostrils, and type of teeth. What these animals have in common is that they can clearly get about on land, having four strong limbs, but have an open-capsule inner ear with an involucrum characteristic of whales. Some retain the ear canal (since obviously they needed to receive sounds from the air). Many have denser bones than most artiodactyls, presumably because their lifestyle requires them to be less buoyant in water. The most un-whale like known intermediate is Indohyus, a swift-running deer-like creature the size of a raccoon that is an obvious herbivore. Indohyus suggests another evolutionary path for returning to water.

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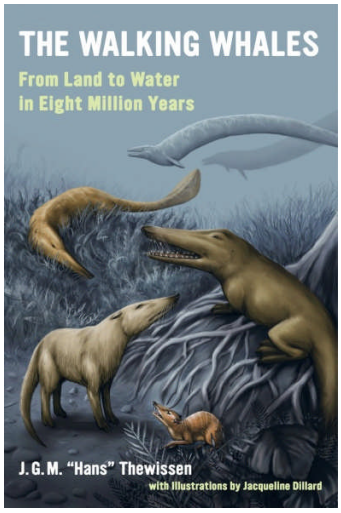
Walking Whales Cont'd

The analogy is with the modern mouse-deer, which dives underwater and stays there for several minutes to evade predators. This set of intermediates makes it seem unlikely that mesonychids are on the path to whales.



"The Walking Whales" is a very nice mixture of story-telling and scientific exposition. There are the sections where Thewissen relates how particular key specimens were collected and/or prepared by himself and a small team. Then there the sections that explain the significance of these specimens (plus the whale intermediates discovered by others) and what can be concluded from them. The latter sections are "semi-technical" in the sense that they are illustrated by the type of diagrams one would normally see in a scientific publication. I found these illustrations very helpful in getting the "big picture." There are also restoration pictures of whale intermediates by paleoartist Jacqueline Dillard. Five genera are on the front cover: Basilosaurus, Ambulocetus, Kutchicetus, Pakicetus, and Indohyus.

My taste usually runs more toward science rather than stories about fossil-collecting adventures, which I sometimes dismiss as "travelog," but Thewissen is an engaging writer on this topic. The story I found most absorbing is how Indohyus was discovered. Indian paleontologist A. Ranga Rao over a period of decades had collected a large amount of material in the same Eocene fossil beds from which many whale intermediates were recovered. As an outsider to mainstream paleontology, however, he was unable to prepare, study, or publish what he had collected, and the material lay in burlap bags in the cellar of his house and in piles in the backyard. After his death from a brain tumor, his widow, German-born Friedlinde Obergfell, lived in seclusion in India in the house she shared with Rao and refused to let any scientist examine the material, fixated on the unrealistic idea that someday her dilapidated house would be an important scientific center for studying Indian fossils. By 2005, Obergfell was quite old, deaf, and distrustful. Thewissen, fearing that the material would ultimately be destroyed by the elements without being studied, persuaded Obergfell that he should take at least a few blocks of the material and look for fossils. Indohyus is one of the discoveries from that incident. Obergfell died in 2007, and unexpectedly appointed Thewissen as the main person to study the fossils left by her husband. A sad story with a happy ending for science.

I usually appreciate reading about aspects of paleontology I was not aware of before. There are some very nice discussions here. For example:

1. The study of the ratio of oxygen-16 to oxygen-18 isotopes in fossils allows one to determine whether a whale intermediate lived in fresh or salt water. Bottom line: Ambulocetus and Pakicetus were probably river dwellers. Protocetus and Remingtonocetus were ocean dwellers.

2. Development of limbs and the shape of the teeth is controlled by specific proteins. One can stain thin slices of dolphin embryos to see which proteins are active at any given time. This can give a clue as to which specific genes were inactivated in whale evolution. Every once in a while a dolphin is born with rear flippers (a specific individual named Haruku lives in a marine park in Japan), and it might be possible to find a genetic difference in those individuals vs. other dolphins.

Overall, I would recommend this book to serious paleo amateurs or professionals. The only negative you could say is that this book emphasizes discoveries made by the author, so if you want a more global treatment of fossil whales, you might have to look elsewhere. However, "Walking Whales" is a good place to start.

Sources:

Thewissen, J.G.M.
"The Walking Whales. From Land to Water in Eight Million Years."
University of California Press, 2014, 245 pages. $35 (hardcover).

Ed. Note: This article was published by The Friends of the Aurora Fossil Museum in their March newsletter and reprinted here with permission of the author. PCS refers to the Potash Corp. mine in Aurora, NC.

Speaking My Mind

Lee Cone

It is interesting and worrisome to see what is happening ever so slowly to our hobby. Chuck Ferrara (Friend's member and president of SWFFS) and I were talking a month ago about some events that have occurred recently that have involved fossil hunters in several states around the country. It appears that we may be seeing a slow encroachment of legal maneuvering directed toward limiting or controlling our hobby and passion for the ancient. We are all aware and we have all been affected by the reduced availability of fossil collecting sites in the southeastern United States and elsewhere. We have seen the progressive and systematic closure of more and more mines that do not allow collecting any more. This is not simply limited to amateur collectors, but extends to professionals as well, both directly and indirectly. Amateur collectors have donated and provided massive quantities of fossil material to museums and universities throughout the world. Based on information provided at last year's NAPC Symposium in Gainesville, Fl. as much as 80% of museum material may be linked in one way or another to amateur discoveries, donations, and a working relationship between both professionals and amateur collectors. It is true that the legal climate in the United States does not lend itself to the exposure that collecting poses to industry, but a few mines still see that intrinsic value and public relations benefit for allowing controlled and supervised collecting. These companies provide such an important and educational value that always extends the amateur to the professional. In the long term it always benefits the universities, museums, and research students who are devoting their lives to the quest of knowledge and furthering our understanding of the natural history of this earth. It is the science that is being lost, the education that does not progress, and the knowledge that fails to be understood. But this is not an article about industry. We are, in fact, indebted to those companies for the wonderful years of collecting experiences that we have had in the past. Though we wish it were different, we must realize that the government, both state and federal, has forced industry to make many of the decisions that have devastated our passion. Fines, penalties, and legal issues make it such a slippery slope for industry, that it makes us appreciate even more the mines that still do continue to allow collecting.

If you believe that the government decisions are logical and well thought out, I ask you to go to the following link:
http://www.smithsonianmag.com/history/kennewick-man-finally-freed-share-his-secrets-180952462/?no-ist=&no-cache=&page=1
and read the entire (three pages) published article in the Smithsonian Magazine about Kennewick Man. If you are like me, you will be horrified at the decisions that were made in that case, which involves one of the most important discoveries ever made relating to the history of mankind in North America. You will share feelings of shock over some of the decisions made, anger over the mishandling of these treasured bones, and a wonder as to how seemingly intelligent individuals could possibly move in the direction, or better said, the lack of direction that they took. You will also be amazed at the incredible scientific discoveries forensic anthropologists and archeologists were able to reach with only miniscule time to study the bones. You will also be disappointed at how much more could have been revealed, if only.....

When you look at individual states, legislation governing fossil collecting varies widely. Fossil collecting in South Carolina and Florida require a license for fossils and antiquities and each state has their own restrictions and limitations on what you may or may not take and where you may collect. Fortunately for me in South Carolina, fossils collected are all keepers, though the museum, rightly so, would like to be notified of unique fossil finds. Because of the rich colonial history of the low country, the hobby license requires filling out two quarterly forms. One (for fossils) goes to the State Museum in Columbia, while a second (of archeological finds) goes to the Maritime Research Division in Charleston. Even local municipalities have created laws restricting the collector. Summerville, SC has an ordinance prohibiting collecting with any digging implement in the drainage ditches. They are serious about fines and enforcing that law. Florida does not allow removal of any Native American artifacts of any kind from its rivers, while South Carolina does. South Carolina requires quarterly reports filed for each and every dive that is made, and failure to complete the reports results in the suspension of the Hobby License. I read yesterday about a man in Port Royal, SC who is facing disciplinary action over non-compliance with the SC Hobby License Division.

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Speaking Cont'd

In Georgia, especially in certain counties, any collector found in creeks or streams collecting any type of Native American artifact will be escorted to jail and fined.

Collecting problems are not limited to the southeast. Bruce Hargreaves sent me an article citing Maryland legislator's attempts to curb fossil shark teeth collecting. Based on my understanding of the e-mail forwarded by the President of the Maryland Gem Society, this legislative attempt is in committee, but the fact that Maryland Bill 713 has even been brought up is disturbing. Apparently by the definition assigned to "ivory", sharks teeth would qualify, as well as mastodon and mammoth material, and there is no distinction in fossil and new. Many of our legislators lack even a basic fundamental understanding of science, yet are writing laws which criminalize the sale or purchase of such fossils. Any members from the Maryland region may contact me for more information and addresses to respond to their legislators. In the far west an Oregon man, a collector of Native American artifacts from childhood, had his entire collection confiscated by agents. I do not know the details but he apparently obtained all of it legally, prior to any of the existing laws. He has never been charged, but he also does not have his collection back. In another case a 91 year old Indiana man had his entire museum quality collection confiscated by the FBI and Bureau of Land Management. Granted he had some amazing specimens, some of which might be considered controversial, but they were obtained by him over a lifetime, before it was illegal to collect them.

Often times, though, the changes in policy are the result of collector abuse of the area, and the disregard of rules established by the land owner. Closure of a mine in Harleyville, SC was the direct result of several collectors who undermined walls creating dangerous and unstable conditions. The Summerville, SC fines were enacted due to collector damage to the drainage ditches. Problems caused by a few can produce devastating effects for many collectors who do respect the sites. Then there is the political fallout levied by lobbyist pressure from environmentalists and special interest groups. Politicians, who spend their career measuring the pulse of the voter, legislate to appease a voting bloc, such as what is happening in Maryland. The consequences of these laws strip away at the available places where fossils exist and can be collected.

We, also, do have an obligation to ourselves, if we wish to continue collecting, to keep an eye on the pulse of our government officials. Many of our officials are easily swayed by vocal groups speaking out for or against certain movements, often without really understanding the science and educational aspect of their actions. We also have a voice and there may be a time in which our collective voices may need to be heard. When PCS had trouble extending their mining permits 7-8 years ago due to environmentalist concerns, it was the Friends members that wrote hundreds of letters in support of PCS to NC senators and congressmen. Our collective voices were strong and may have been the reason that PCS received their expanded mining rights and continue to operate today. We, as individuals, need to keep abreast of what is going on in government at all levels: Federal, State, and local in order to preserve the future of fossil collecting. We cannot remain "the silent majority" and simply watch as we lose more and more ground. We must police ourselves, use common sense, and follow all rules, when we do have access to collecting sites. We must use our voice, as we did for PCS, when we see political anti-fossil bills introduced at the governmental level. Our collective voices will be needed again in the future, and it will likely be needed to raise awareness in support and protection of our passion.

And Now My Turn

Tom Caggiano

Lee's article highlights a problem that we are seeing more and more. The restriction of collecting sites is becoming an epidemic. There are various reasons such as legal liability concerns, abuse by collectors, and just plain stupidity. I recently took a friend out " to see what it would be like to find her own fossil" We went to a hillside of Cretaceous sandstone and picked up a few (literally 3) shark teeth. She was very excited to have collected her first fossil. As we walked back to the car, a ranger pulled up, issued us written warnings and confiscated the three teeth. It was not a park but it was public land. I knew it going in but it was a place that people have been collecting at for a long time and it really was three, tiny, quarter inch teeth. Most of the other teeth had already started to break after being exposed. Based upon the idea that they are "saving the fossils for future generations" many areas that were open to collecting are now being closed. This misconception is actually destroying fossils. As any collector knows, a fossil that gets exposed at the surface soon starts to degrade and eventually turns to dust. For many fossils, even a short time exposed means destruction. New rules are coming for Forest Service, BLM and other lands. Pay attention and voice your opinion.

The Feathered Dinosaur That Flew Like a Bat...or is it a Pterosaur?

Bob Sheridan, May 9, 2015

Once in a while a paleontologist uncovers a specimen so unexpected as to defy belief. A recent example is described by Xu et al. (2015) in this week's Nature. To really appreciate the weirdness of the new find we need a little background. First: There are three types of vertebrate power-fliers we know about: birds, bats, and pterosaurs. There are also many types of living and extinct animals that parachute or glide. Each of the power-fliers approaches flight in a different way. Birds have relatively small hands, but most of their wing surfaces is made of long stiff feathers that are attached to the arm and hand. Bats have enlarged hands and the wing is made of skin stretched between the body and individual fingers. Pterosaurs have an extremely enlarged fourth finger and the wing is a membrane stretching between this finger and the body. Gliding animals also have many ways of creating a large surface to give lift and/or slow them in the air. Flying squirrels have a membrane stretched between the arms and the body. Some frogs have enlarged hands with membranes between the fingers. Some lizards expand their ribcage into a wing. You get the idea: independent solutions to the same problem.

Second bit of background: There are many varieties of feathered theropod dinosaur with many different types of feathers. Only a subset of them (most probably the dromeosaurs) are ancestral to modern birds. Most feathered dinosaurs have shortish arms and obviously could not fly, despite some having modern-looking feathers. Oviraptors and troodonts are examples. Other feathered dinosaurs have long feathers on long arms, and we generally assume these are flying animals, especially if they have asymmetrical vanes on the feathers. Archaeopteryx and Microraptor are examples. Some of the early fliers, like Microraptor, had long feathers on their legs, and the inference is that the legs acted as a secondary wings. We expect, and so far have seen, that all flying theropods to use the same "vaned feathers on arms (or legs)" method as true birds do.

Third bit of background: There is a set of unusual feathered dinosaurs called the Scansoriopterygidae. There are three previous genera described from China: Scansoriopteryx (a juvenile), Epidendrosaurus, and Epidexipteryx. It is not clear whether Scanscoriopteryx is the same as Epidendrosaurus. All are incompletely known. All are fairly small, about sparrow-size. Xu et al. add a fourth, somewhat larger (crow-size), species called *Yi gi* ("strange wing"). To me these specimens resemble a cartoon caricature of oviraptors, with a smallish rounded head (but with teeth), shortish tails, and very large hands. The most unusual thing about them is that the third finger is much larger than the second finger, whereas in most theropods the second (middle) finger is longer. Their feathers are fairly primitive, long, branched stiff filaments, not at all like modern flight feathers.

Now we get to the main part, which is the description of Yi. Yi is from the Upper Jurassic Tiaojishan Formation in China. The most unusual aspect of Yi is that it has an extra, slightly curved, rod-like object, called a "styliform element" by the authors, coming from the vicinity of the wrist. This bone is about the thickness of a finger, but somewhat longer than any of the other fingers. Spectral analysis confirms it is probably a bone rather than soft tissue. Whether it is an unusually enlarged wrist bone or not the same as any previously known bone is not clear. There also appears to be membranous integument linking the styliform element and the rest of the fingers. Melanosomes (pigment containing particles) can be identified on the membrane and feathers of this animal, confirming that the "membrane" is indeed part of the animal's skin. Finding melanosomes on feathers is a common finding for feathered dinosaurs.

Image by Dinostar

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Bat like Dino Cont'd

Having a long finger-like wrist bone is unique for dinosaurs. However, such things are found in flying or gliding animals. For instance in Japanese flying squirrels, there is a bone from the wrist used to extend the "wing" of skin outward. In pterosaurs, a bone from the wrist called the pteroid controls the shape of the front of the wing. So a reasonable inference is that Yi is a flying or gliding animal. The authors recognize that there is not enough preserved membrane to make a definite suggestion on how the styliform element was used, but they diagram three possibilities:

1. The membrane stretches only between the fingers. The analogy is with the gliding frog.
2. The membrane stretches between the fingers and the styliform element, and from the styliform element to the body. The analogy here is the bat.
3. The styliform element is tucked almost parallel to the arm, with the membrane giving a little more surface to the rear edge of the feathered wing. The authors call this the "Maniraptoran Model", but I think of it as "bird wing with trailing edge".

Given the small size of Yi, any of these models is physically plausible. Whichever model turns out correct, the implication is startling: an animal close to the ancestry of birds found a way of flying or gliding unlike that of any other known bird or feathered dinosaur.

Incidentally, I think "Yi" ("wing"), at two letters, is a new record for the shortest dinosaur genus name. The previous one was "Mei" ("sleep soundly"). The longest name, at 23 letters, is probably Micropachycephalosaurus ("tiny thick-headed reptile").

Sources:

Padian, K.
"Dinosaur up in the air."
Nature 2015, 521, 40-41.

Xu, X.; Zheng, X.; Sullivan, C.; Wang, X.; Xing, L.; Wang, Y.; Zhang, X.; O'Conner, J.K.; Zhang, F.; Pan, Y.
"A bizarre Jurassic maniraptoran theropod with preserved evidence of membranous wings."
Nature 2015, 521, 70-73.

Origin of Extinct South American Mammals Revealed by Collagen

Bob Sheridan, March 20, 2015

Ungulates are the group of mammals with hoofs. They are usually divided into two groups: artiodactyls with an even number of toes (pigs, giraffes, deer, hippos), and perissodactyls with an odd number of toes (horses, tapirs, rhinos). DNA sequences have given us enough information to see how living ungulates are related. There are a number of surprises: the close relationship of whales with hippos is probably the most unexpected. The relationship of extinct ungulates is not clear; we cannot extract DNA from their fossils. In particular, extinct South American ungulates are especially problematical. A number of suggestions have been made as to which group of modern ungulates they may belong, but it is hard to decide because these mammals do not anatomically resemble any living group.

Fortunately, DNA is not the only molecule from which one can extract sequence information that informs on how animals are related. About 10 years ago, there were reports that the protein collagen survives in fossils much longer than DNA, and is allegedly present even in dinosaur bones. Collagen is the protein that makes of most of the connective tissue in animals and is very abundant, making up 25% of total protein. Much of the collagen amino acid sequence is information poor, in that all vertebrates have the same repetitive sub-sequence. Fortunately, there are regions that vary between mammals.

Today's story addresses two extinct genera of South American ungulates. Toxodon is a vaguely hippo-like animal that live to the end of the Pleistocene. Macrauchenia is a camel-like animal from the Miocene usually depicted as having a tapir-like trunk. Interestingly, Darwin was the first to discover their fossils on the voyage of the Beagle. Welker et al. (2015) show that it is possible to extract two collagen chains from these animals and sequence them in their entirety via mass spectroscopy. Protein in general does degrade with time, and one can measure the age of protein remains by the amount that the aminoacid glutamine deamidates. In the case of Toxodon and Macrauchenia, the amount of degradation is consistent with the age of the fossils of these animals.

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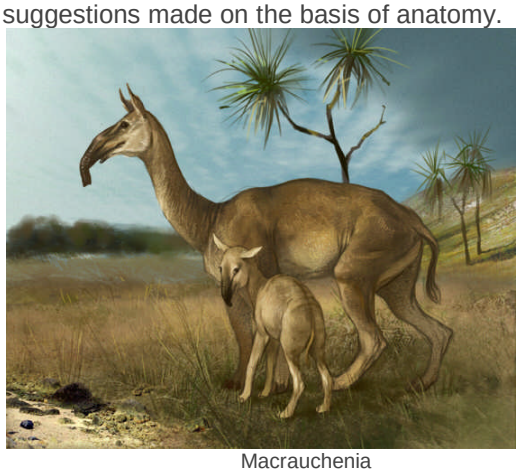
Collagen and Mammals Cont'd

Toxodon Art by Rodrigo Vega

One can then compare the collagen sequences of these two animals with each other and with the collagen sequences of living animals. One surprise is that Toxodon and Macrauchenia are closely related to each other and form a sister group to the perissodactyls. This eliminates several of the suggestions made on the basis of anatomy.



Macrauchenia

Sources:
Welker, F. et al. (there are 31 authors).
"Ancient proteins resolve evolutionary history of Darwin's South American ungulates."
Nature 2015, 522, 81-84.

Color Patterns of Fossil Cone Shells

Bob Sheridan, April 4, 2015

Cone snails are marine gastropods with spiral shells shaped more or less like cones with the narrow part of the cone facing forward. Sometimes the wide end of the cone has a conical spire. Cone snails are found world-wide, although most species are found in the Pacific. Most are a few inches long, but can reach up to 9 inches.

There are three genera, the largest of which, Conus, contains over 700 species. There are two unusual things about cone snails relative to most gastropods. First, they are predators that use venomous hypodermic-like harpoons to kill fish and worms. The venom is one of the most powerful nerve toxins, and has been known to be fatal to humans. Second, the shells are brightly colored and have interesting patterns which vary by species: stripes, spots, splotches, fractal-like nets, etc.

For the most part, the color of extinct animals is something we can know nothing about. However, under special circumstances we can make a reasonable guess. Hendricks (2015) describes how the color of fossil cone shells can be revealed and how that can help classify them. This author studied 358 specimens of previously collected cone shells from two reef formations in the Dominican Republic. The age of the shells is 4.8 to 6 Myr.

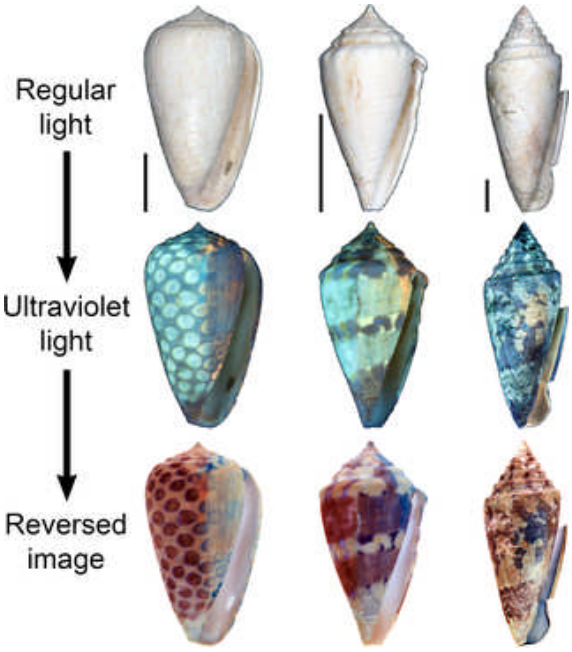
As expected, the fossil cone shells appear white under visible light and no color patterns are visible. It has been known since the 1960s that under ultraviolet light one can see glowing patterns on fossil shells. It appears that oxidation of the shell surface might be necessary for the fluorescence, either by the exposing the fossils to the sun, or by soaking them in bleach. Nowadays, one can photograph the shell glowing under UV, and "invert" the photograph using any photo editing software (light spots become dark, green becomes red, etc.) to obtain an approximation of the color patterns of the living shell. This technique was applied by Hendricks to the fossil cone shells. About half of the specimens showed strong color patterns. Given the color patterns, on can distinguish 28 fossil species, of which 13 cannot be assigned to a living species, and are given names in this paper. This number of species is similar to the diversity of cone snails in the modern Pacific, but much more diverse than expected in the modern Caribbean.

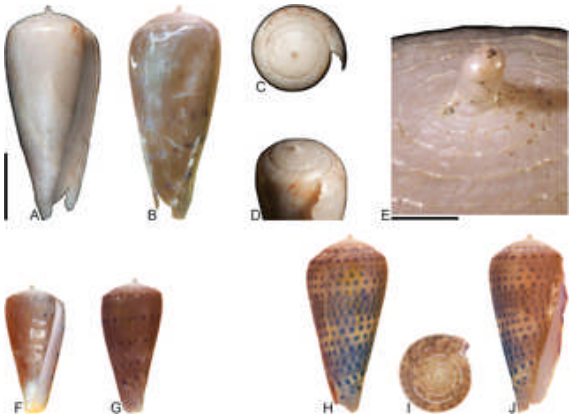
Sources:

Hendricks, J.R.
"Glowing seashells: diversity of fossilized coloration patterns on coral reef-associated cone snail (gastropoda: conidae) shells from the Neogene of the Dominican Republic."
PLoSONE, 2015, 10, e0120924.

Images for Fossil Cone Shells from the Plos one article

Visit the site for many more as well as the captions.





Ed. Note:
The application of new technologies to paleontology is providing some fascinating results and new information. I've been giving fossil fish to a scientist that has been scanning them with a new light source and he is able to see some interesting results.