The Paleontograph

A newsletter for those interested in all aspects of Paleontology
Volume 6 Issue 1 March, 2017

From Your Editor

Welcome to a new volume of The Paleontograph, Volume 6. Time and life flies by very quickly. Soon, I will be a fossil!

The winter here has been mild with many days that don't require many layers to keep warm. I am very much OK with that, although I am sure that winter will give us a few more blasts of cold and snow.

I've been able to spend a good amount of time in my prep lab working on my backlog of work. My friend, Henry Mendosa has been hanging around and helping me in the lab. I will be selling at both the MAPS show and the big show in Edison, NJ next month. If you are in the area and at one of the shows, please stop by and say hello. My business name is Lost World Fossils.

Spring is not long off and I am looking forward to getting out in the field and adding to my backlog of stuff to prep.

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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The Princeton Field Guide to Dinosaurs 2nd Edition--A Review

Bob Sheridan October 23, 2016

In 2010 I reviewed "The Princeton Field Guide to Dinosaurs." This book is now in its second edition. At the time I noted that compilations of dinosaur information like this outdate quickly, but at $35, this field guide would be affordable to buy every few years. I'm sure you won't mind if I repeat most of my earlier review, because the book is basically the same as the first edition. There are about 20 more pages and a few dozen or so new dinosaur species compared to the first edition. The information seems current as of the middle of 2015, for example the more complete Deinocheirus, the revised Spinosaurus, and the resurrection of Brontosaurus as a genus.

The author Greg Paul is a well-known illustrator of dinosaurs. While he does not have formal training as a paleontologist, he has a very deep and broad grasp of the subject of dinosaurs. I own three other of his books. "Predatory Dinosaurs of the World" (1988) is a classic. "Dinosaurs of the Air" (2002) is a comprehensive review of the dinosaur origin of birds. He also edited "The Scientific American Book of Dinosaurs" (2000), which is a collection of "special topics." Paul is the originator of the "white skeleton embedded in a black silhouette" style of drawing prehistoric animals, which has caught on in a big way.

The "Field Guide" seems to be aimed at serious amateurs or professionals. It has a 60-page introductory section on various aspects: What is a Dinosaur?; Dating Dinosaurs; Skin, Feathers, and Color; Disease and Pathologies; Growth; etc. One the one hand, I admire Paul for putting so much information into so few pages. On the other hand, I have to say that he has a "review article" style of writing which is more suited to professional journals than a semi-popular work, so it can be tough going for a popular audience.

The meat of the book is a series of short (many per page) summaries of each dinosaur species: estimated length and possible weight, Fossil Remains (how much of the skeleton is known), Anatomical Characteristics (special features relative to similar dinosaurs), Age (e.g. Late Jurassic), Distribution and Formation (e.g. Central China, Shanghaximiao), Habitat (e.g. "forests and lakes"), and Notes (any other info, e.g. "Thought to be the biggest dromaeosaur"). The genera are arranged cladistically, e.g. a section on theropods has a subsection on avepods, which has a subsection on Allosaurus-like genera. This is in contrast to the usual arrangement by alphabetical order in most encyclopedia-format books. But not to worry, there is a very good index. A large fraction of the entries have a "skeleton in silhouette" drawing which allows the reader to tell at a glance which parts of the skeleton are known. There is sometimes also a detailed drawing of the skull. Sprinkled around the book are color restorations of a single species or "action scenes" with two or more dinosaurs.

There are ~1500 dinosaur species named in the literature, but probably only about half are valid (i.e. there is enough material to tell they are truly distinct, and not juveniles, females, geographic variations, etc. of some other type of dinosaur). The "Field Guide" covers ~750 species. I consider myself a pretty knowledgeable amateur, but I have not heard of the vast majority of the dinosaur genera in this book--which is a good thing. Also, I had no idea there were so many species assigned to each genera. For example, there are 9 species of Psittacosaurus and 11 species of Centrosaurus. I know of a lot of cases where genera could be lumped together, for example, Tarbosaurus is probably an Asian variety of Tyrannosaurus, and Dracorex is probably a juvenile Pachycephalosaurus. It surprised me a little that Paul equates Styracosaurus, Einosaurus, Achelousaurus, and Pachyrhinosaurus with Centrosaurus. These are all ceratopsids with a nose horn, and horns on the frill, but no brow horns; but the shape and number of horns is quite diverse. In the previous edition, Corythosaurus, Lambeosaurus, and Hypacrosaurus were also lumped together. These are all hadrosaurs with tallish crests on their heads, but of different shapes. However in this edition, they are treated separately.

For those dinosaur enthusiasts who like to "read the encyclopedia" as I do, this is a very valuable book at a very good price. A similar book "The Princeton Guide to Prehistoric Mammals" (by Donald Prothero) is going to be released in the next few weeks, and I plan to review it for the Paleontograph.

Sources:

Paul, G.S.
"The Princeton Field Guide to Dinosaurs 2nd Edition."
Princeton University Press, Princeton and Oxford, 2016, 360 pages, $35.

More Controversy Around Tetrapodophis

Bob Sheridan November 5, 2016

Snakes have a number of unique features relative to most reptiles: a very large number of vertebrae (>150), no limbs, no external ears, and a jaw (with hooked teeth) that is essentially unhinged from the rest of the skull. It is very likely that the ancestor of modern snakes was a lizard, but which lizard is not clear. The most suggested candidate have been varanid lizards (modern monitor lizards are examples). It should also be noted that long-bodied legless lizards, which are distinct from snakes in having eyelids and hinged jaws, evolved several times. Many fossils snakes have been identified, the oldest of which is from the Middle Cretaceous. Some have vestigial hindlimbs.

One classical idea about the origin of snakes (specifically about how they ended up limbless) is that their ancestors were marine reptiles, similar to mosasaurs, if not mosasaurs themselves. They supposedly lost their limbs to become better swimmers. Another idea is that snakes are limbless because their ancestors were borrowing land-dwelling lizards, and it is better not to have limbs when crawling through tunnels. Fossil snakes with vestigial hindlimbs have been found in both marine and lake deposits, so we cannot use the "primitive" characteristic of having partial limbs as a way of guessing snake origins.

If the ancestors of snakes are lizards, we would expect to eventually find a snake with all four limbs. Martill et al. (2015) described such an animal in the middle of 2015. The species *Tetrapodophis amplectus* ("four-footed snake") was based on a single, very well preserved specimen presumably from the Crato Formation in Brazil, which is Early Cretaceous in age. The matrix in which is is found is limestone, probably from a lake bottom since it contains the coprolites of a specific fish. This specimen would have been less than a foot long in life.

Tetrapodophis very snake-like in many respects. First it is extremely elongated with 250+ vertebrae. The authors described it has caving a curved lower jaw with small hooked teeth, and an intramandibular joint, allowing each side of the jaw to move independently as in a modern snake Tetrapodophis has features expected for borrowing (as opposed to swimming snakes), including a long head but a short face, plus a cylindrical (as opposed to a flat) tail. The key feature of Tetrapodophis is that it has four limbs that are very tiny compared to the length of the body. One can distinguish the cervical, dorsal, and caudal vertebrae, based on the presence and length of ribs, whereas those regions are hard to tell apart in modern snakes. The positions of the fore and hindlimbs in Tetrapodophis are consistent with where those regions begin and end, as we would expect.

At the time the Tetrapodophis specimen was a matter of controversy. The specimen was supposedly on permanent loan to the Burgermeister-Muller Museum in Solnhopfen, Germany, but before that it was in a private collection for several decades. There were no records about where or when it was collected. The authors assign it to the Crato Formation in Brazil based on the characters of the rock in which it was found, but this could be wrong. Also, it has been illegal to export fossil or archaeological material from Brazil since 1942, so it is possible that Tetrapodophis was exported illegally.

Tetrapodophis has again become a focus of controversy, as indicated by a recent short article in Science (Gramling, 2016). Relevant to the following discussion is how the Tetrapodophis specimen is divided into part and counterpart. The part contains almost all of the specimen, but the counterpart contains the skull and a few ribs. Recently, a group at the University of Alberta has reexamined the details of the skull in the counterpart and dispute that the skull is especially snakelike. Instead they feel Tetrapodophis more closely resembles a dolichosaur, which is a type of Cretaceous marine reptile that can have a very elongated body. If that is the case, the matrix around it cannot be a lake deposit. They presented their conclusions at a recent meeting of the Society of Vertebrate Paleontology in Salt Lake City.

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Snake? Cont'd

It is not particularly surprising that paleontologists would disagree about the interpretation of a specimen. In my mind the fact that Tetrapodophis does not have a skull like a modern snake does not necessarily exclude it from being a snake ancestor, and it is not clear whether dolichosaurs are related to snakes or just unrelated lizards converged onto a snake-like form. That type of "controversy" is very much like the arguments over whether Archaeopteryx is a true bird or a feathered dinosaur very close to the ancestor of birds. It may not be possible to distinguish between those possibilities given the data we have, nor might it matter.

Paleontologists are more perturbed over the fact is that the specimen is no longer available at the Bergermeister-Miller Museum to people who want to study it. The exact reason was not specified in the Science article, but it may be because the private owner has restricted access. There is a general rule that any specimen that is described in the literature will be available for further examination indefinitely, and this seems to be violated for Tetrapodophis. There is a great deal of indignation about this, one person saying that "Tetrapodophis is no longer science" and "It's horrifying... I don't want to mention the name Tetrapodophis ever again."

Sources:

Gramling, C.
"'Four-legged snake' may be ancient lizard instead."
Science 2016, 354, 536-537.

Martill, D.M.; Tischlinger, H.; Longrich, N.R.
"A four-legged snake from the Early Cretaceous of Gondwana."
Science 2015, 349, 416-419.

The Princeton Field Guide to Prehistoric Mammals--A Review

Bob Sheridan November 20, 2016

Prehistoric mammals are not as fascinating to the public as dinosaurs, and we see many fewer popular books covering the topic. Two earlier attempts by professional paleontologists to cover the whole class that stick in my mind are "The Rise of the Mammals" by Michael Benton (1991) and "National Geographic Prehistoric Mammals" by Alan Turner (2004). The latter is memorable because it is illustrated by Mauricio Anton, whose work I greatly admire. In this tradition, but obviously much more up to date, is a new book "The Princeton Field Guide to Prehistoric Mammals" by Donald Prothero. Prothero works at the Natural History Museum of Los Angeles County. He has published a few dozen books on a diversity of biological topics (crytozoology, global warming, the fossil evidence for evolution, etc.), and I have reviewed several for the Paleontograph.

Just a few weeks ago I reviewed "The Princeton Field Guide to Dinosaurs (Second Edition)". This is an illustrated encyclopedia of individual dinosaur species, organized by phylogeny, plus some introductory material. I expected "The Princeton Field Guide to Prehistoric Mammals" to have a similar format. However, as the author explains in the Preface, while there are only several hundred valid dinosaur species, there are several thousand species of living mammals at least a few thousand extinct ones. So TPFGTPM is organized to highlight 15 mammal families, each in its separate chapter, with some of the more important genera emphasized. Aside from the details specific families, there are introductory chapters that include the synapsids (often called "mammal-like reptiles") and mesozoic mammals (who were neither marsupials nor placental mammals). There is a closing chapter on mammal evolution and extinction.

As mentioned above, the organization of the mammal families in this book is done phylogenetically. Some phylogenetic information is gotten by comparing the skeletal anatomy of the mammals (much as is done with dinosaurs), but since relatives of some extinct mammals are still alive, we can also compare DNA sequences. In some cases the anatomic and genetic information lead to different conclusions.

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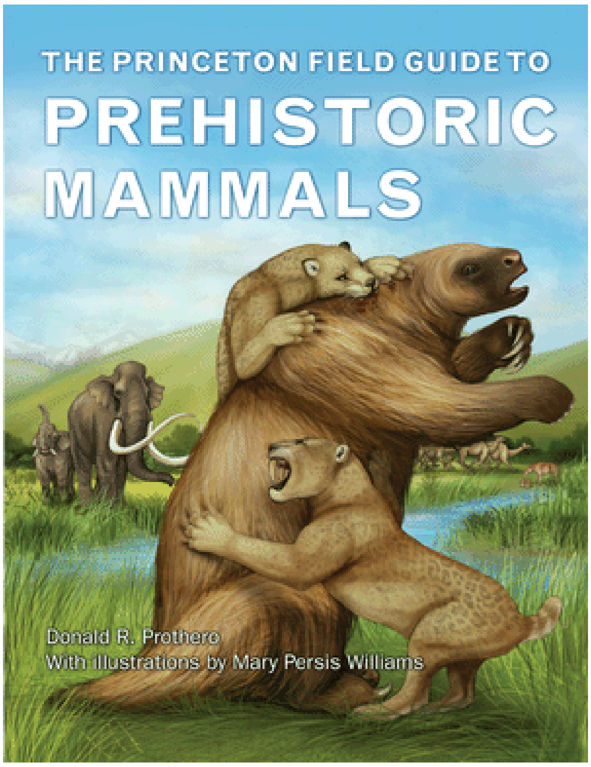
Review Cont'd

Two interesting examples: There is a group of mammals called the Afrotheria, which have a common genetic signature, but do not resemble each other in any significant way: elephants, manatees, hyraxes, and elephant shrews. There is a genetic link between whales and hippos that shows they are more closely related to each other than to other artiodactyls (even-toed hoofed mammals). One consequence is that other artiodactyls once thought to be ancestral to whales, e.g. the wolf-like mesonychids, acquired some of their whale-like anatomical features through convergence.



On that topic, many examples in TPFGTPM show that convergent evolution among mammal groups is extremely common, and the overall body form of mammals is dictated more by their "job" than by their ancestry. For example, there are many versions of the "wolf" (by which we mean a mid-sized pursuit predator) besides the canine version we have today. Most of us know about the "thalacyine (marsupial) wolf" which has been extinct only for decades. Not too many people are aware of the above-mentioned mesonychids (Paleocene through Eocene), which are artiodactyls. They strike us as very strange because there are no extant hoofed predators. There are also the "bear dogs" (Oligocene to Miocene) and creodonts (Eocene to Miocene).

The same thing could be said about "lions", "cows", and "flying squirrels."

One of the most interesting discussions in TPFGTPM is about extinct families that are poorly organized even now. One example is the uintatheres, the rhino- to elephant-sized herbivorous mammals with large tusks and large knobs on their heads. Much of the confusion in this group was brought about circa 1872 by the 19th Century rival paleontologists Edward Drinker Cope and O. C. Marsh. Each of these men named a large number of species in this group, sometimes naming the same animal twice, sometimes giving the different animals the same name, and always ignoring the names created by his rival. While dozens of names were proposed, a hundred years later only a handful are recognized as valid. Even now, though, it is not clear that all animals assigned to the uintatheres are actually related.

TPFGTPM is very heavily illustrated, averaging one illustration per page. There are photographs of fossils, clear diagrams (most of which show phylogenetic relationships), and life restorations. The signature type of illustration for this book is the silhouette of a man surrounded by restorations of one to a dozen species in the specific family under discussion. Most of the life restorations are by Mary Persis Williams, who is a well-known scientific illustrator and blogger.

In most book reviews I usually make a comment about the "sweet spot" for popular books on paleontology (or science in general). I hope a book will present enough technical material to make it interesting for a knowledgable amateur like myself, but not assume I am already aware of fiddly anatomical terms. Also, the more unfamiliar material the better. In TPFGTPM I encountered many families of fossil mammals I had never heard of before. TPFGTPM shows that prehistoric mammals are just as weird and fascinating as dinosaurs, and you should have it in your library.

Sources:

Prothero, D.
"The Princeton Field Guide to Prehistoric Mammals" (Illustrations by Mary Persis Williams) Princeton University Press, Princeton, 2017, 240 pages, $35 (hardcover).

Middle Jurassic Sauropod Tracks from Scotland

Bob Sheridan November 27, 2016

The Middle Jurassic is a period for which there is not an abundance of fossils. Interestingly, Scotland is one place that does have dinosaur bones remains from that time. These are generally isolated bones, enough to identify what group of dinosaurs were present. However, as with other times and locations where body fossils are rare, trace fossils can fill the gap. A report from 2015 (Brusatte et al.) details the most extensive known dinosaur trackway site in Scotland.

This trackway site is on the northern most tip of the Isle of Skye. It is an outcrop of the Duntulm Formation. The age of this formation is Middle Jurassic (~166-168Myr) and probably represents a shallow lagoon; the matrix includes bivalve and algae fossils, as well as shark teeth. At this site there are two exposed time horizons called 9b and 34-35, several meters different in elevation.

Bed 9b preserves some isolated sauropod prints and one tridactyl print (probably an ornithopod given that it is wider than long). Beds 34-35 preserves entire trackways, consisting of sauropod hindfoot (pes) and forefoot (manus) prints. The prints are close to the midline of the trackways, indicating a "narrow-gauge" type of sauropod. Some of the prints are "concave epirelief", i.e. actual depressions in the rock, as is common with most dinosaur footprints. Some are "convex hyporelief", i.e. the casts of infilled tracks that are exposed when the rock around the casts erodes away. Interestingly, in this site it is the convex tracks that show the most detail, for instance the presence of four individual toes and a claw on the first toe. The concave prints are hard to distinguish from natural potholes, except for the fact that they are arranged in trackways. The pes tracks are approximately circular and 70cm in diameter. The manus prints are smaller and oval in outline, and these also show the presence of four toes.

It is possible to assign the sauropod tracks at a family level. We can probably eliminate titanosaurs entirely because most of these have wide-gauge trackways. Advanced neosauropods have narrow-gauge tracks and a large toe claw. However, they also have horseshoe shaped manus prints rather than the elliptical prints seen in the Skye trackways. So we are probably looking at the tracks of a basal advanced sauropod like Cetiosaurus.

Combining the information from the Skye trackways with Middle Jurassic trackways in England, Morocco, and the United States, we know that both wide-gauge and narrow-gauge large sauropods lived by that time in Northern Europe, and that the narrow-gauged sauropods already had some advanced characteristics. This is more than can be surmised from fossil bones.

The authors point out that the Skye tracks are evidence that sauropods lived for many millennia in a lagoon environment and suggest this is somewhat surprising, since we now think of sauropods as suitable for dry land. In retrospect, though, the idea of sauropods living in a brackish or tidal environment should be familiar, because we have known since 2001 about Paralititan, aLate Cretaceous Egyptian titanosaur that lived in coastal mangrove swamps.

Sources:

Brusatte, S.L.; Challands, T.J.; Ross, D.A.; Wilkinson, M.
"Sauropod dinosaur tackways in Middle Jurassic lagoon on the Isle of Skye, Scotland."
Scottish J. Geology, 2015, doi:10.1144/sjg2015-005

Lucy's Arm Strength

Bob Sheridan December 21, 2016

For a fossil that was described almost 40 years ago "Lucy" is the subject of many very recent studies. To remind you, "Lucy" (actual designation AL 288-1) is the first, and most complete specimen of *Australopithecus afarensis* discovered (although, surprisingly she is not the type specimen). She is approximately 3.2 Myr, about 3 ft. tall, and represents an early small-brained human ancestor. The key point of her anatomy is that her pelvis and legs are very close to being modern in that they allow for fully upright walking. However, her arms are proportionately longer compared to modern human arms, and her fingers have a pronounced curve. This has been interpreted as Australopithecus having some ability to climb trees like modern apes. On the other hand, the longer arms could be a left-over from Lucy's ancestry and not imply anything about how she got around.

Ruff et al. (2016) examine the structural properties of the humerus and femur of modern humans, modern apes (chimps, gorillas, orangutan), Lucy, other Australopithecus, and other early human ancestors (e.g*. Homo erectus, Paranthropus boisei*, etc.) to determine if the relative strength of those bones is in line with their supposed use in locomotion. Long bones are basically hollow, with cortical bone on the outside walls giving the bone its strength. Most of the study is based on the thickness of the cortical bone in the diaphysis (long cylindrical portion) of the humerus and femur. These authors also measure the properties of the femoral "neck" (the part that connects the shaft to the ball-like "head"). The assumption here is that the walls of long bones that bear more weight will be thicker relative to the width of the joints, which is being used as a proxy for overall size of the bone. All measures are done by a CT-scan of both modern and fossil bone; where possible, several virtual cross-sections were done along the length of the bones. Not all measurements can be done with all fossil specimens because the humerus and femur may be incomplete or missing.

The thickness of the walls of both humerus and femurs as a function of overall size appears to be greater in chimps than in modern humans, not surprisingly given the muscular strength of chimps. However, more telling is the relative thickness of humerus vs. femur. Chimps have thicker humeri than femurs, and modern humans have the opposite. Also, humans have a larger femoral head and shorter femoral neck relative to overall size. This is pretty much as expected: In humans, the legs bear all the weight. In contrast, chimps hang from their arms and also knuckle-walk with most of their weight on their arms. This confirms that the thickness of the bones is meaningful in terms of locomotion for living hominins. The authors point out that in modern humans that bone thickness reflects usage and not just ancestry. For instance the arm bones of gymnasts tend to have thicker walls, presumably because more than normal stress is being applied to the arms.

Where do the fossil species fit? Lucy and other australopithecines fall midway between modern humans and chimps in terms of humeral vs. femur thickness, while early members of the genus Homo are close to modern humans. On the other hand Lucy has a smaller femoral head relative to the length of the femur than expected in modern humans, while having a knee joint width about the same size as expected for a modern human. Also the absolute thickness of Lucy's humerus and femur relative to their size indicates an overall muscle strength similar to chimps.

Previously we knew from anatomy of the bones that Australopithecus was a mosaic between chimps and modern humans, having human-like legs and more ape-like arms, suggesting they had two modes of locomotion, spending at least some time in the trees. This study, which looks at the strength of the bones, supports this. Interestingly, the very recent idea that Lucy died by falling out of a tree, would be consistent.

Sources:
Ruff, C.B; Burgess, M.L.; Ketcham, R.A.; Kappelman, J.
"Limb Bone Structural Proportions and Locomotor Behavior in A.L. 288-1 ('Lucy')"
PLoS ONE, 2016, 11, e0166095

Feathered Bits in Amber

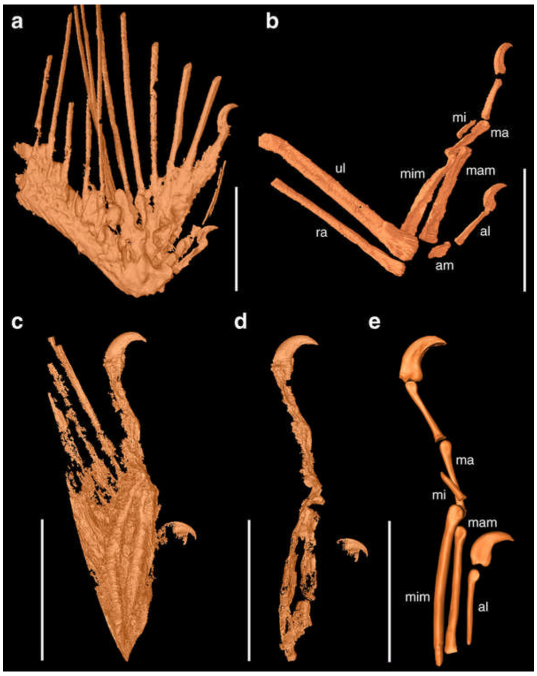
Bob Sheridan December 20, 2016

It is unusual to find feathers in amber. It is even more unusual to have enough parts attached to the amber to tell where the feather came from. Most interesting would be amber from the Mesozoic when birds and feathered dinosaurs were common. While there are many specimens of feathered dinosaurs with feathers preserved as flattened films or impressions in limestone, amber is capable of preserving feathers in three dimensions. In 2016, two papers from the same research collaborators were published that describe feather specimens in mid-Cretaceous Burmese amber.

It would help to have a short refresher on modern feather structure. For flight feathers, there is a central hollow shaft called a rachis. Branching off the rachis are narrow shafts called barbs. Barbs are usually in the same plane. Branching off the barbs are barbules. The barbules have small hooklets that latch onto adjacent barbules, much like velcro. Feathers attached to a bird's wing tip and pointing backward are the "primaries", feathers further back on the wing are the "secondaries." Smaller feathers at the upper part of the arm are called "coverlets."

The classical way of studying amber inclusions is to cut and/or polish a flat surface onto the amber so that the inclusions can be studied using an optical microscope. This works well with amber that is transparent and does not have a lot of non-interesting inclusions like bubbles or plant matter. Nowadays, it is also common to CT scan the specimen as well, and for that the transparency is not such an issue.

Xing et al. (2016A) describe two specimens DIP-V-15100 and DIP-V-15101 from a single piece of amber from the Anbamo site in Kachin Province of Myanmar. This site is dated to ~99Myr. The specimens are tiny (a little longer than 1cm) partial wings. Only the outer parts of the wings are preserved: the forearm and three nearly separate fingers with claws, with some skin and muscle present. The bony finger anatomy is like that of that enantiornithines, a class of birds that went extinct after the Cretaceous; however, one cannot assign the specimen to a specific genus.



DIP-V-15100 has 9 primary and 5 secondary feathers attached, although only the base of them is preserved. The microscopic anatomy of the feathers is visible and they appear to be very much like modern flight feathers. The color of the feathers is generally dark brown, getting whiter toward the thumb. The authors note "claw marks" in the resin, which might imply the bird was still alive when its wing was engulfed.

Some images from the article

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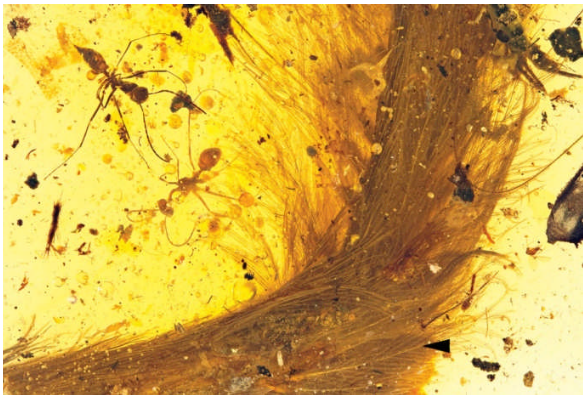
Amber feathers Cont'd

DIP-V-15101 is harder to see because it is in a portion of the amber that is less transparent and the feathers overlap each other more. Attached are 9 primaries, 5 secondaries, and 5 secondaries, and a mass of coverlets. The feathers are darker than in DIP-V-15100. It seems likely to the authors that the wing was no longer attached to the bird when engulfed by resin since the specimen is far from the surface of the amber.

Because these specimens are tiny and yet have mature-appearing flight feathers, the authors presume they represent “precocious birds”, i.e. birds that would be able to fly shortly after hatching.

The second paper (Xing et al. 2016B) describes another amber specimen from the same formation. This specimen, called DIP-V-15103 is a gently curved cylindrical elongated structure 3.6 cm long and about 0.2 cm wide with a dense covering of feathers. CT-scanning shows it contains 8-9 elongated vertebrae. According the the authors, most likely it is the tail of a juvenile feathered dinosaur, although the genus cannot be identified. (Some have argued that it is very hard to exclude a long-tailed bird.) The feathers appear to form two planar “keels”, much like a frond. Each feather is long and pennaceous with a rachis, barbs and barbules. The feathers appear flexible since they are gently curved in random directions; in life the tail would have appeared soft and fluffy. Hooklets are not seen, which is not surprising since there is no need to keep the feather together the way it would be necessary in flight feathers.



The Dino Tail

Melanosomes, which give feathers their color because of the pigment melanin, are not observed in this specimen. However, there is color: the dorsal surface appears dark and the ventral surface appears white. Heat can degrade melanosomes, but if there were that much heat, the amber would certainly degrade also. So that lack of melanosomes is something of a mystery.

Two aspects of these tail feathers that are not seen in modern pennaceous feathers: The rachis and barbs are similar in diameter, whereas in modern feathers the rachis is usually much wider. Also, not only are there barbules coming from the the barbs, but also from the rachis.

The authors suggest this type of feather is previously unobserved in feathered dinosaurs, and that it does not exactly resemble any suggested evolutionary stage of feather development. However, the authors suggest it might be an intermediate between state 3a (rachis with naked barbs) and state 3b (barbs with barbules radiating from a central base). Both stages mentioned lack hooklets.

Sources:

Xing, L.; McKellar, R.C.; Wang, M.; Bai, M.; O’Conner, J.K.; Benton, M.J.; Zhang, J.; Wang, Y.; Tseng, K.; Lockley, M.G.; Li, G.; Zhang, W.; Xu, X. “Mummified precocial bird wings in mid-Cretaceous Burmese amber.”
Nature Comm. 2016, 17: 12089

Xing, L.; McKellar, R.C.; Xu, X.; Li, G.; Bai, M.; Persons, W.S. IV; Miyashita, T.; Benton, M.J.; Zhang, J.; Wolfe, A.P.; Yi, Q.; Tseng, K.; Ran, H.; Currie, P.J.
“A feathered dinosaur tail with primitive plumage trapped in mid-Cretaceous amber.”
Current Biol. 2016, 26, 3352-3360.

Laser Fluorescence and Confusciusornis

Bob Sheridan January 3, 2017

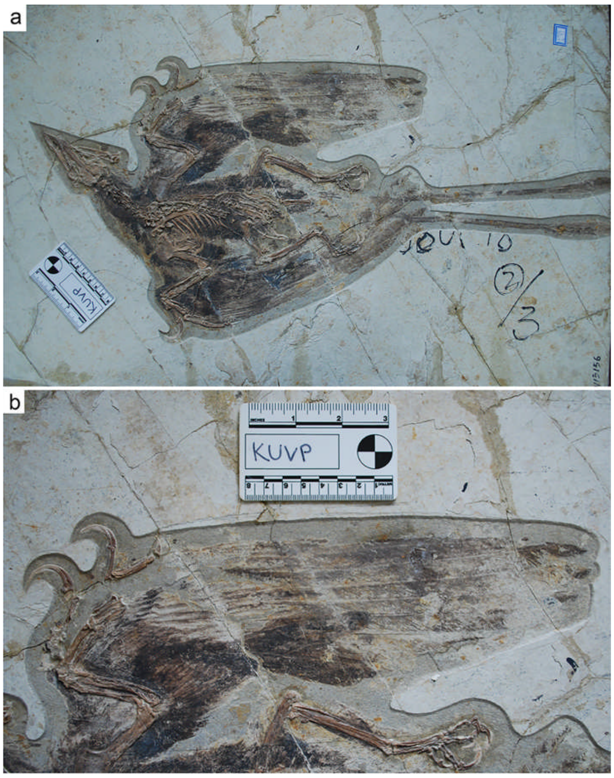
First, what is laser fluorescence? The phenomenon of fluorescence is observed when an object is illuminated with short-wavelength light (say ultraviolet or x-rays) and the object emits visible light. This technique has been applied to fossils in the past, the idea being that any organic material remaining on the fossil will fluoresce brighter than the matrix, such that one can discern the "soft parts" of the fossil animal. In practice, one places the specimen in a dark room with a camera aimed at it. The specimen is then illuminated with, say, a strong UV light, and the camera shutter is left open for a long time. It is necessary to have a filter on the camera that blocks the UV, so the camera detects only the weaker visible light. The short-wavelength light needs to be very intense for this to work with reasonable exposure times, so one uses a laser (for UV) or a synchrotron (for x-rays).

Now a quick review of Confusciusornis, which is the subject of our story. This is a pigeon-size bird from the Early Cretaceous of China. Many hundreds of specimens are preserved with impressions of modern-looking flight feathers. Some specimens have two very long ribbon-like tail feathers. Presumably these are the "males." Confusciusornis has an interesting mixture of derived and primitive bird characteristics. The derived: It is the oldest bird with toothless beak. It also has a very short bony tail. The primitive: It has a rigid dinosaur-like skull, lacks a keel on the sternum, and retains hand claws.

Falk et al. (2016) apply laser fluorescence to two specimens of Confusciusornis: IVPP V13156 and IVPP V13168. These authors pay particular attention to two fleshy features that are not visible except for by fluorescence:

1. The propatagium and postpatagium of the wing. These are the folds of skin in front of and behind the arm bones, respectively. In these specimens the wings are extended, so these should be visible.
2. The pads and scales on the feet.

The propatagium and postpatagium are clearly visible and resemble those of modern birds. This makes the fleshy part of the wings broader than previously thought, similar to the ratio seen in modern forest-dwelling birds. It is thought that in living birds the postpatagium provides some of the lift (in addition to the lift from the feathers), much like an airplane wing.



Reticulate (non-overlapping) scales are clearly seen on the feet, as would be expected in modern birds. The feet appear to have pads on individual toe bones without much padding at the joints. The authors feel this is consistent with Confusciusornis perching on tree branches. Since only the underside of the feet are visible in these specimens we cannot say whether there are scutate (overlapping) scales at the top of the feet.

These observations seem to support the idea of Confusciusornis being a strong flier despite not having a keeled sternum.

Sources:

Falk, A.R.; Kaye, T.G.; Zhou, Z.; Burnham, D.A. "Laser Fluorescence Illuminates the Soft Tissue and Life Habits of the Early Cretaceous Bird Confuciusornis"
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