The Paleontograph

A newsletter for those interested in all aspects of Paleontology
Volume 8 Issue 4 November, 2019

From Your Editor

Welcome to our latest edition. I hope all is well with you. Well, the warm weather is gone, replaced by cooler temps. The holidays will be upon us soon, indeed I'm already seeing XMas stuff in the stores. This time of year has me looking forward to my annual migration to Tucson to see friends, buy and sell fossils and get a break from the cold weather.

I've been busy working in my shop preparing many different fossils. I've picked up some nice pieces this year and I'm excited to get to work on them. My back has been giving me grief and put a kink in my life over the last months but we will keep on moving on.

We have another selection of articles from Bob. There are a couple of reviews included. If you are one of those people that skip over the book reviews you may be missing out. Unlike others, Bob packs tons of background information into his reviews in order to better help you understand what the book may offer. So even if you won't be reading the book, you have an opportunity to learn a lot just from the review.

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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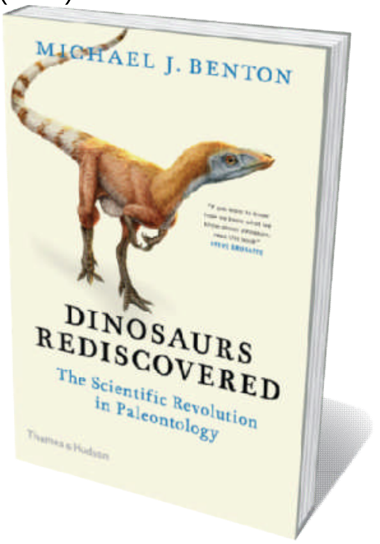
Dinosaurs Rediscovered

Bob Sheridan June 16, 2019

I read almost all dinosaur books written for a popular or semi-popular audience. One new one is "Dinosaurs Rediscovered" by Michael Benton. Benton is a Professor of Vertebrate Paleontology at the University of Bristol. I have been reading his books going back decades. The two I remember the most are "Vertebrate Paleontology" (first edition, 1990) and "When Life Nearly Died" (2003).



The following are the chapter headings:

1. How scientific discoveries are made.
This chapter emphasizes the point that paleontology has moved from "stamp collecting" and "speculation" to a real science based on new discoveries and technologies. Examples are being able to guess the color of dinosaur feathers by examining melanosomes, and being able to estimate maximum dinosaur bite strength by using Finite Element Analysis, which is a computational technique in engineering to estimate stresses in materials.

2. Origin of the dinosaurs
The earliest unambiguous dinosaurs are from the Late Triassic ~230 Myr. This chapter summarizes Benton's work from the 1980s on whether dinosaurs outcompeted other types of reptiles in the Late Triassic or just filled out world emptied by a mass extinction. New to me are bipedal archosaurs like Silesaurus and Asilisaurus. These are probably close to the common ancestor of dinosaurs and pterosaurs. Since Asilisaurus, described in the past few years, is from ~245 Myr., the origin of dinosaurs is probably older than was previously thought.

3. Making the tree
The phylogenetic relationship of dinosaurs (or any other group of genera) is generated today by cladistic methods. The idea of cladistics is that one can generate evolutionary "trees" that show how animals are related. Each tree can be considered an evolutionary hypothesis. The score of a tree is high when animals are grouped by shared anatomical characteristics and the number of evolutionary reversals and convergences is minimized. Since the number of possible trees rises exponentially with the number of animals, even with modern computers it is impossible to score each one. Instead there are computational tricks to find the best-scoring trees quickly. The best-scoring trees are the most supported hypotheses and are considered close to the truth. The final results of the analysis depend on which animals were included, which characteristics are included, and what assumptions one makes in the scoring. Benton was one of the first to explore the idea of "supertrees," i.e. compiling trees generated from other labs and finding the best consensus among them. (I suppose this is analogous to "meta-analysis" in clinical studies.) Traditionally, dinosaurs were divided into "saurichians" and "ornithischians" based on the disposition of their pelvic bones. However, in 2017 an alternative proposal was made based on a large number of other characteristics. At present there probably is not enough information to tell whether the traditional or new hypothesis is correct.

4. Digging up dinosaurs
This chapter reviews the process by which dinosaurs are excavated from the field, studied, and (sometimes) mounted. This is mostly a low-tech endeavor that has not changed much in 150 years. ("Nothing beats a good pair of eyes and some strong shoulders.") One major topic in this chapter is the "Bristol Dinosaur Project," which has been active since 2000. This is a public outreach program from Bristol University. One function is to visit school, with the hope of engaging 7-9 year-olds and 14-15 year olds in science. There are also hands-on projects for undergraduates and volunteers. The mascot for the project is Thecodontosaurus, a small plant-eating dinosaur from Bristol named in 1836.

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Rediscovered Cont'd

5. Breathing, brains, and behavior
This chapter covers a number of topics: Dinosaur physiology as revealed by bone histology, the evidence that birds are descendants of theropod, the arguments as to whether dinosaurs are "warm-blooded," and whether dinosaurs used feathers for "sexual selection." The topic of the size of dinosaur brains always comes up, especially in regard to how that relates to complexity of behavior. Generally speaking, for all vertebrates, the size of the brain is allometric, that is, as the size of the body increases, the size of the brain increases too, but not as fast. Birds and mammals have brains 6-10 times the volume of a reptile of the same body weight. The weight (or volume) of dinosaur brains is about as expected for reptiles scaled up to the size of dinosaurs. However, a few dinosaurs had relative brain sizes approaching that of birds.

6. Jurassic Park (or not)
While it might have been marginally plausible in 1990, the premise of "Jurassic Park" that we could clone dinosaurs by sequencing dinosaur DNA is almost certainly impossible, given that DNA degrades very quickly. Early reports (1990s) of sequencing insect DNA in amber have been refuted; the sequences are from modern DNA contaminants. This chapter also discusses whether the presence of "medullary bone" in dinosaur bones is really indicative of sex—plausible, since female modern birds store calcium for egg-laying as extra-dense bone. Finally, the chapter addresses whether the "soft tissue" (e.g. blood vessels, red corpuscles, etc.) isolated from dinosaur bones by Mary Schweitzer is really the original material. As you might expect, this was very controversial (was it real or some inorganic artifact?). There have been many reinterpretations. However, currently, the best estimate is that the shape of the blood vessels are original, but the proteinaceous material has been chemically altered

7. From baby to giant
There is a physical limit to the size of eggs, i.e. a very large egg would have to have a thick shell to avoid collapsing, but a thick shell would prevent gases from exchanging between the growing embryo and the air, and it would have been impossible for the chick to break out. Thus, dinosaurs had to hatch from smallish eggs (football-size at the largest) and grow rapidly. Given that dinosaur bones contain LAGS (growth rings), we can estimate their age. Given the age and size of the bone, one can generate growth curves for several species, and these tend confirm the rapid growth. CT-scanning allows us to examine dinosaur embryos inside their eggs. Generally speaking the embryo bones are fairly well ossified in the egg, indicating that they probably could move around immediately after hatching, much like modern precocial birds. Given that dinosaurs generally laid a fair number of eggs at a time, and the hatchlings could probably move about on their own, it seems plausible that parental care would be limited, something like what we observed with modern crocodilians. On the other hand, we have specimens that seem to show at least some parental care beyond that, perhaps on the level seen in birds (brooding Oviraptor, cluster of Psittacosaurus babies, etc.).

8. How did dinosaurs eat?
Guesses about what dinosaurs ate comes from a number of classical sources: anatomy of the teeth, tooth marks on the bones of prey, wear on the tooth, microscopic scratches on the teeth, stomach contents, contents of coprolites, etc.. A new science of estimating bite strengths comes from Finite Element Analysis, specifically where in the skull most of the force ends up and, given the strength of bone, how much force could be applied before the bone failed. Another, to me fairly speculative, field of study is the construction of food webs for ancient ecosystems and estimating the probability of "collapse" when a single animal is removed.

9. How did they move and run?
Thanks to some classical work by Neil Alexander in the 1970's we can estimate how fast dinosaurs moved, given the hip height and the spacing of tracks. Almost all dinosaur trackways indicate a slow walk. (Of course tracks are impressed in soft mud, and generally an animal cannot run in mud.) Nowadays, many digital models are made of moving dinosaurs, using the virtual skeletons of dinosaurs, estimated muscle size, known strength of muscle, etc. Tyrannosaurus is usually the favorite target for this kind of study, and models indicate a top speed of 22 miles per hour. Also covered in this chapter is trackway evidence for dinosaurs swimming. Plus there is a discussion of the old "ground-up" vs. "trees-down" ideas about the origin of flight. Given all the early feathered dinosaurs we know about who could probably glide, "trees-down" is looking more plausible.

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10. Mass extinction
Thirty years later, the idea that the Age of Dinosaurs was ended by an asteroid strike seems like an obvious truth, but it was quite controversial when first proposed in 1980. It was only by a slow accretion of evidence over a period of a decade, including the discovery of a crater of the right age, was it accepted. In the 1980's, there was much discussion whether was a periodicity in mass extinctions and whether this was explainable by astronomical phenomena that could perturb comets in the Oort cloud. The remainder of the chapter discusses how many groups of birds and mammals survived the extinction.

This book contains an Afterword on how science differs from speculation in general, and specifically, how dinosaur science has gotten more scientific in recent decades. It also has an amusing four-page compilation of all the ideas put forth explaining the extinction of the dinosaurs. There is no evidence at all for the vast majority of them. There are about eight proposals with some evidence, but only two (impact of an asteroid, eruption of the Deccan Traps) that are considered well-supported.

I have to give this book high marks about presenting semi-technical information in a readable way. Many books claim to be summarizing the latest information about dinosaurs, but in the most cases, since I keep up with the paleontology as a hobby, I find the contents "old news." "Dinosaurs Rediscovered" seems to be a happy exception, and I recommend you read it if you can.

This book is densely illustrated. There are many clear scientific diagrams, and many color plates. One slight complaint: Every time a dinosaur species is mentioned, there is an almost full-page figure of that species with basic information: who named it, where it was found, length, little-known fact, map of the Earth during the geological period. These would be great in an appendix, but I found them somewhat distracting when reading.

Sources:

Benton, M.J.

"Dinosaurs Rediscovered. The Scientific Revolution in Paleontology."

Thames &Hudson, London, 2019, 320, $35 (hardcover)

101 American Fossil Sites You've Gotta See —A Review

Bob Sheridan June 1, 2019

This week in my local public library I came across a book from last year: "101 American Fossil Sites You've Gotta See" by Albert Dickas. Dickas is a former industrial geologist and professor emeritus at the University of Wisconsin. He has dozens of professional publications and several popular books like "101 Geo-sites You've Gotta See" and "Ohio Rocks."

This book is a set of two-page spreads on specific fossil sites in alphabetical order by state. There are between one and four sites per state (Texas has the most). For New Jersey, my home state, we have "Big Brook Preserve" and "Hamburg Stromatolites."

The left page of the spread is text and the right has photographs of the relevant site and/or fossils. The location of each site is given in latitude and longitude to the nearest second. There is a list of 4 or 5 references at the appendix for each site. It's been many years since I have done any collecting out in the field, and this can be a useful book for those who like to do that.

In some Amazon reviews, one criticism is that this compilation includes sites where collecting by the public is allowed at all times, where collecting is allowed only by special permission, and where there is no collecting at all (museums), and one sometimes has to dig into the text to tell which it is. Since the title says "Gotta See" and not "Gotta Collect At," this is not necessarily a valid criticism. The museums are usually the smaller ones outside major cities. (Exceptions are the Denver Museum of Nature and Science and the Peabody Museum.) I had never heard of most of them and they are now on my "bucket list" should I visit those states.

One valid criticism is that, while the latitude and longitude given will in theory get you within a few hundred feet, this is not necessarily useful for most people when one is trying to find these places by car on roads.

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101 Cont'd

One should also be aware that the 101 compilation is maximizing "diversity by state" and not necessarily "diversity by fossil type," in the sense that most of the sites have very common invertebrate fossils one can find nearly anywhere: crinoid stems, brachiopods, trilobites, gastropods, corals, etc. There are, however, those sites with more unique fossils: dinosaurs, mammoths, ichthyosaurs petrified trees, etc.

So overall I am quite lukewarm on this format. If one wanted to list collecting sites, one would certainly include more than 101. Plus the directions on how to get to these sites could be more useful. If one were listing museums, one would certainly list the major ones first.

Sources:

Dickas, A.B.

"101 American Fossil Sites You've Gotta See."
Mountain Press Publishing Company, Missoula Montana, 2018, 248 pages, $25 (paperback)

Another Bird Foot in Amber

Bob Sheridan July 14, 2019

In April I related the work of Xing et al. (2019), who described a dismembered bird foot and partial wing embedded in Burmese amber. Surprisingly, five amber specimens containing parts of birds have been described. Today's story is about the work of Xing et al. (2019A), which describes a sixth such specimen.

The piece of Burmese amber is from Tanai Township, northern Myanmar. It is ~99 Myr. old. The inclusions consist of a partial right hindlimb and left wing tip. The foot contains the pes, fibula, tibiotarsus, and femur, but the femur is not clearly visible because it is covered in soft tissue. The specimen probably was partially decayed before being embedded because skin has sloughed off the foot bones. The foot bones are clearly that of an enantornithine, an early type of modern bird that went extinct after the Cretaceous. The foot is probably that of a near-adult based on the state of fusion of the tarsals and metatarsals.

The authors have given this bird the name *Elektorornis changuani* ("amber bird" and after Chen Guang, the curator at the Hupoge Amber Museum). The curvature of the bones makes it likely that Elektornis was a perching bird.

The most unusual thing about the foot is that the third toe is about twice as long as the others, and that is due to the fact that the third phalange in that toe is extra-long. This feature has never been seen before in any bird, either living or extinct. The authors suggest this claw might have served a function much like the elongated middle finger of the aye-aye, a lemur that uses the elongated finger to fish grubs out of tree bark. Another possibility is that the extra-long finger helped Elekornis climb trees.

Sources:

Xing, L.; McKellar, R.C.; O'Connor, J.K.; Bai, M.; Tseng, K.; Chiappe, L.M.
A fully feathered enantiornithine foot and wing fragment preserved in mid-Cretaceous Burmese amber.
Nature Scientific Reports, 2019, 9: 927.

Xing, L.; O'Connoer, J.K.; Chiappe, L.M.; McKellar, R.C.; Carroll, N.; Hu, H., Bai, M.; Lei, F.
A new eantiornithine bird with unusual pedal proportions found in amber.
Curr. Biol. 2019, 29, 2396-2401.

Assembling the Dinosaur — A Review

Bob Sheridan July 13, 2019

Today's review concerns "Assembling the Dinosaur" by Lukas Rieppel. The major theme for this book is that there was a perfect storm of events that made paleontology great in what is now called the "Gilded Age" (most people define this as the period 1870-1900, but we can extend it into the 1920s). In that time we had the original dinosaur discoveries in the American West, the rise of capitalism in the US, transcontinental telegraphy, the transcontinental railroad, and a public appetite for spectacle.

The author Lukas Rieppel is a professor of history at Brown University, specializing in the history of the earth sciences. This appears to be his first semi-popular book on paleontology, although he has a book "Science and Capitalism: Entangled Histories" and many articles in professional journals. This book seems to have been inspired by Rieppel's graduate dissertation from 2012, which is reviewed at this link: https://dash.harvard.edu/handle/1/10381365

This is the chapter formulation of the book:

1. Prospecting for dinosaurs.

This chapter reviews the original dinosaur discoveries in the American West in 1877 by William Harlow Reed (Wyoming), Arthur Lakes (Colorado) and Oramel Lucas (Colorado) and the negotiations with Yale Paleontologist O.C. Marsh. The motivations of these three men was purely financial; they were paid for digging up the bones and shipping them back east. Negotiations, as with any type of mineral resource, were complex. It was very hard to know what one had before it was dug out of the ground. Sellers had reason to exaggerate the finds, and buyers had every reason to distrust the sellers. Locations were always kept secret, even from the buyer, lest a competitor swoop in. Eventually, eastern museums were able to mount their own expeditions, and the day of the entrepreneurial fossil collector faded within a few decades.

This chapter also covers the back-story of fossil discoveries in England 40 years before. Certainly, people like Mary Anning made a marginal living finding and selling fossils, but for the most part the motivation for discovery was less about money, and more about prestige among gentleman naturalists.

2. Tea with Brontosaurus

This chapter starts with the mounting of the "Brontosaurus" skeleton at the American Museum of Natural History (AMNH) in 1905 and the central theme is what museums are for. Are they places for serious research, places for the education of the public, or places of entertainment? Nowadays, most of us feel that museums can be a balance of all those things at once. However, at one time mounting dinosaur skeletons was considered to be creating a "spectacle" (associated with unsavory characters like P.T. Barnum) and not serious science. One must admit, even now, there is some deception involved. Mounted skeletons may be a composite of bones from more than one individual animal (sometimes of different sizes), contain guesses as to the form of missing parts, etc.

This chapter also gives the background about a proposal in 1869 by naturalist Albert Smith Bickmore to found a museum of natural history in New York City. (After all, most major cities of Europe had one.) This proposal was ultimately successful and resulted in the AMNH we know today, although the current one is not at its original location. In contrast, only a few years before a "Paleozoic Museum" was planned for the new Central Park, and artist Waterhouse Hawkins (who did the dinosaur sculptures for the Crystal Palace exhibit in England) was commissioned to do the sculptures. The work got underway, but ran afoul of corrupt politics of the time when Hawkins denounced Boss Tweed. The original models were destroyed by vandals and this museum never opened.

3. Andrew Carnegie's Diplodocus

Andrew Carnegie is an example of a self-made man from the Gilded Age who spent the first part of his life ruthlessly acquiring wealth (mostly from making steel) and the last part giving it away.
(Bill Gates, I guess, would be the most parallel modern example.) The relevant story for this book is how William Harlow Reed discovered a large sauropod femur in Wyoming and took the story to the local press, probably in a calculated attempt to attract buyers. The press went wild with headlines like "Most Colossal Animal Ever on Earth" and published fanciful pictures of a sauropod leaning upright against a skyscraper. Carnegie read these stories and sent William Holland to Wyoming to buy the specimen. It is a complicated story, but ultimately Carnegie financed the excavation of another, mostly complete, Diplodocus specimen (nicknamed "Dippy") from another different quarry.

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Assembling Cont'd

Previous specimens of Diplodocus were known, but Dippy was the largest known so far; it was given the species name *Diplodocus carnegii*. Casts were prepared at the Carnegie Museum in Pittsburgh and donated to a few dozen museums around the world. It is, thus, probably the most widely known dinosaur specimen so far.

It seems strange to modern ears, but there was much nationalistic sparring about the significance of the Diplodocus donations. In England the attitude seems to have been that it was amusing that the upstart Americans should present a dinosaur to England, where dinosaurs were discovered, and, anyway, Diplodocus was a very stupid dinosaur. It did not help the English to know that Carnegie was born in Scotland. From Germany there was much criticism about the upright stance of the Diplodocus mount because, obviously, reptiles walk with their limbs splayed to the side. Americans, of course, considered the fact that the US contained large dinosaurs as proof that it had arrived as a nation.

4. Accounting for Dinosaurs

Nowadays we are used to large, hierarchical, bureaucratic organizations that keep meticulous accounting records and micromanage their workers from afar. This is a product of the Gilded Age. "Vertical Integration," the concept that one should control all aspects of a process instead of relying on middlemen, is also from that time. The upside of these ideas is that one can control costs, avoid redundancy, and make sure things are done right. The Chicago Field Museum was probably the first museum to keep a central record of specimens and what they cost. O.C. Marsh was probably the first paleontologist who bought into the idea of central control in a big way. The downside of this idea, of which Marsh also provides the example, is that decisions can be made only by a few people, people who have no direct contact with the field work. Also the workers in the field come to resent those who tell them what to do.

5. Exhibiting Extinction

This chapter details some of the more misguided ideas about Darwinian evolution that came from the Gilded Age, partly inspired by the "bone rush". We never hear any more about "racial senescence", the idea that species, like individuals, have a youth, a middle age, and an old age, that inevitably leads to extinction. Similarly "orthogenesis", the idea that evolution in a group of animals has a momentum in one direction, for instance getting larger teeth, until the animals became so dysfunctional that extinction is inevitable. The most famous misinterpretation of biological evolution, self-servingly accepted by the wealthy in that society, is that of "social darwinism." That is, the rich and powerful were in their current station because they deserved it; they were able to out-compete their rivals. Also popular was "eugenics," the idea that the lesser classes were genetically inferior and should be kept from breeding; unfortunately this idea lasted well into the Twentieth Century.

This chapter also proposes the curious idea that exhibiting skeletal mounts with more than one animal, as was planned for some exhibits in the AMNH, or depicting extinct animals working together, as in some Charles R. Knight paintings, somehow implies that large corporate capitalism is good. Seems a stretch to me.

6. Bringing dinosaurs back to life.

The impact of depicting live dinosaurs in popular culture dinosaurs in movies, cartoons, theme parks, etc. The take off point for this discussion is the stop-motion animated dinosaurs in the 1925 movie "The Lost World." The major idea here is that, heretofore, photographs were considered in most people's minds a representation of reality and the idea that a photograph could lie, e.g. by showing a live dinosaur, was a shock. An exaggeration, in my opinion.

This chapter also covers what is called the "Bumpus-Dean Controversy" at the AMNH in 1910. This centered on whether museum exhibits should be arranged so as to best allow scientific study for specialists, or should have an appeal for a mass audience. This clash was so heated it caused a resignation and a long leave-of-absence for the museum director and curator of ichthyology, respectively.

7. Feathered dragons

This covers everything in dinosaur paleontology from the 1920's until now. Basically, the central theme is that the commercial forces that made the US the center of paleontology in the late 19th Century are repeating in China. The fact that China is the home of some amazingly well-preserved feathered dinosaurs certainly does not hurt.

This book is not so much about dinosaurs themselves, but about the history of dinosaur science from a hundred years ago and how it was affected by economic forces.

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Assembling Cont'd

In some previous reviews I argued against books on dinosaurs written by professors who were not professional paleontologists or at least did not have a background in scientific journalism, because such books tend to make arguments that are very based on vague definitions, or have very low standard of proof. Happily, this book is an exception. While I could not buy into every argument linking paleontology with capitalism in America, I could at least see why the arguments were plausible.

Each chapter contains a summary, very useful for me in writing up this review. I wouldn't call this a densely illustrated book; there are about 3 or 4 photographs per chapter, usually depicting a mounted skeleton or a picture of one of the people or places mentioned in the text.

If you are interested in the history of science, "Assembling the Dinosaur" is a good read.

Sources:
Rieppel, L.
"Assembling the Dinosaur. Fossil hunters, tycoons, and the making of a spectacle."
Harvard University Press, Cambridge Mass. 2019, 325 pages $30 (hardcover).

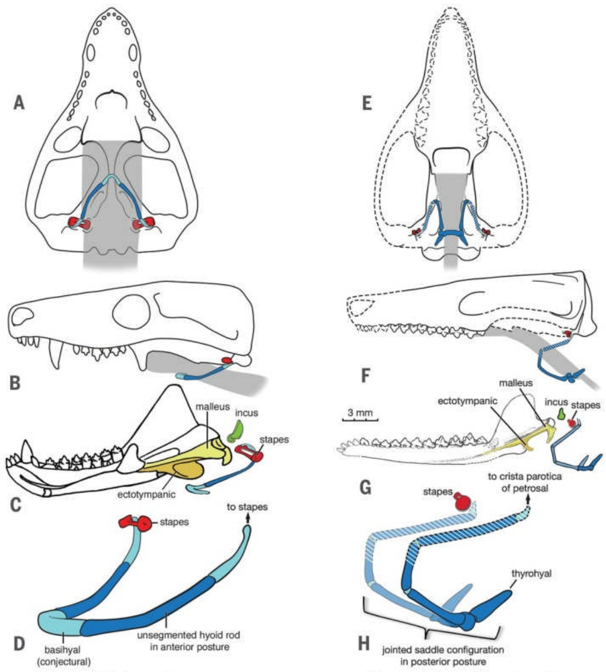
Microdocodon

Bob Sheridan July 20, 2019

This story requires three bits of background concerning the transitions from reptiles to mammals. The first concerns middle ear bones. Reptiles have many bones in their lower jaws. Mammals, in contrast, have only a single bone, the dentary. On the other hand, reptiles have a single bone in the middle ear (the stapes) that directly connects the eardrum to the inner ear. Mammals have three (or four depending on what you count as "middle"): the ectotympanic, malleus, incus, stapes. The ectotympanic provides support for the eardrum, while the malleus, incus connects the eardrum to the stapes. There is much evidence from mammal-like reptiles and basal mammals from the Permian and Triassic that the middle ear bones in mammals are homologous to the bones in the reptile jaw, but attached to the skull rather than the jaw and well behind the jaw joint: ectotympanic=angular, malleus=articular+prearticular, incus=quadrate. One can see with many intermediate stages how the actual joint between the jaw and the skull changed from being between the articular and quadrate to being between the dentary and squamosal.

The second topic is the hyoid bone. This bone exists in the throat area of most tetrapods. It is unique as a bone in that it is not connected to any other bone but is connected by ligaments to muscles of the floor of the mouth, larynx, and tongue. In reptiles and early mammal-like reptiles, the hyoid consists of two separate rods. In birds, the hyoid may be one solid piece and more Y-shaped, with the stem of the Y pointing forward. In advanced mammal-like reptiles like cynodonts, the hyoid is horse-shoe shaped with the arms pointing backwards. In most mammals, the hyoid is build of several separate bones and has an H-shape, and the upright posts of the H being curved out of the plane. This is sometimes called the "saddle" configuration. The thought is that mammals need a complex, flexible hyoid for chewing and swallowing and also for sucking milk. I am not sure how to interpret that for humans. We also swallow and suck as infants, but our hyoid is a simple horse-shoe shaped bone.

As you can imagine, the hyoid is rarely preserved in fossils, it being so small and not articulated with other bones.



Cynodont *Thrinaxodon* Mammaliaform *Microdocodon*

Microdocodon Cont'd
Finally, doconodonts. These are mouse-size "mammaliaforms" (named after Doconodon) known from the Jurassic and Cretaceous of North America. They have unique teeth, with two parallel cusps on the inside and outside edge, probably specialized for eating insects.

A paper by Zhou et al. (2019) describes a new extremely well-preserved doconodont specimen from the Jurassic of China (165 Myr.) which they call *Microdocodon gracilis*. This animal is shrew size (estimated mass 5-9 grams). The hyoid apparatus is partially preserved (the earliest known example), and it appears to be the flexible, H-shape version we expect for mammals. This might imply a mammalian style of swallowing. On the other hand, the ear bones are still very close to the jaw articulation, indicating Microdocodon had not attained full mammalian status in respect to the middle ear.

Sources:
Zhou, C.-F.; Bhullar, B.A.-S.; Neander, A.I.; Martin, T.; Luo, Z.-X.
New Jurassic mamaliaform sheds early light on early evolution of mammal-like hyoid bones.
Science (2019) 365, 276-279.

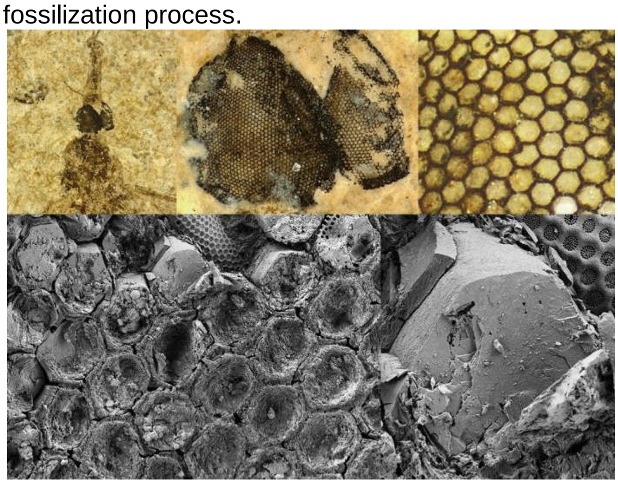
Eyes of the Crane Fly

Bob Sheridan September 17, 2019

The first thing we need for this story is a discussion of the arthropod eye. Most arthropods have compound eyes that are composed of many (thousands to tens of thousands) of units called ommatidia packed tightly together. Each ommatidium is a tapered cylindrical structure several hundred micrometers long and about one-tenth as wide, with a hexagonal cross-section. At the top of the ommatidium is a lens with a rounded top and a conical bottom. Most of the length of the ommatidium is filled with 6-9 long light-sensitive cells packed tightly together. There is usually some kind of pigment-containing cell surrounding the ommatidium that keeps light from leaking from one ommatidium to another. It is thought that those pigments in arthropods are a chemical class called ommachromes, and these are responsible for the yellow to brown color of the eye.

The other thing we need to know about are some modern analytical techniques. One is time-of-flight secondary ion mass spectroscopy or ToF-SIMS. This is a technique of shooting charged particles at a surface and chemically analyzing (by atomic weight) the vapor that comes off. For our purposes, the most interesting thing is that the resolution of the analysis is less than a micrometer, i.e. it can be used to analyze very tiny features, and it can be applied to fossils. Other techniques are various scanning electron microscopy and x-ray CT scanning. The resolution of these is also sub-micrometer.

Now we get to the main story. Lindgren et al. chemically analyze the eyes of 23 fossil specimens of the crane fly from the Fur Formation in Denmark, which is dated to the Eocene (54 Myr). This is a great opportunity to compare the chemical composition of these fossils to that of living crane files. There are two very interesting findings. First the mass spectrum of the pigment surrounding the ommatidia resembles eumelanin more than ommachrome in both fossil and living crane flies. Eumelanin is a pigment that is found in almost all vertebrates and many invertebrates, but this is the first time it is identified in insect eyes, fossil or living. Second, the lenses of the fossil crane flies appear to contain calcite, while the lenses of living crane flies are made of chitin, the same substance forming the cuticle in most arthropods. Much has been made of the fact that trilobites have lenses made of calcite, but this raises the possibility that living trilobites had chitinous lenses like living arthropods, and the calcite in their lenses accumulated as part of the fossilization process.



Sources:

Lindgren, J.; Nilsson, D.E.; Sjovall, P.; Jarenmark, M.; Ito, S.; Wakamatsu, K.; Kear, B.P.; Schultz, B.P.; Sylvestersen, R.L.; Madsen, H.; LaFountain, J.R.Jr.; Alwmark, C.; Eriksson, M.E.; Hall, S.A.; Lindgren, P.; Rodriguez-Mizoso, I.; Ahlberg, P.
"Fossil insect eyes shed light on trilobite optics and the arthropod pigment screen."
Nature 2019, 573, 122-126.

PALEONTOGRAPH ADVERTISMENT & EVENTS PAGE

Ads and events are listed here for free. They must be paleo related and are subject to editorial approval. Submissions can be sent to tomcagg@aol.com

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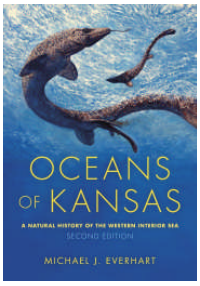
2020 Philadelphia
Mineral Treasures and Fossil Fair
Saturday March 28, 10 am to 5 pm;
Sunday, March 29, 10 am to 4 pm.

Lulu Temple, 5140 Butler Pike, Plymouth Meeting, PA., (PA Turnpike, exit 333; or I-476, exit 20)
Free Parking. Adults: $6.00. Children under 12: $1.00; Uniformed scouts and troop leaders free.

Special Features: On both days a line-up of distinguished professional speakers will be presented. The Academy of Natural Sciences of Philadelphia will present a display of minerals from its collection. In addition, there will be fossil and mineral displays, educational materials, door prizes and a food concession. Thirty dealers will offer fossils, minerals, crystals, and jewelry from all over the world, as well as books, decorative items, and other merchandise. Young visitors can enjoy the annual fossil dig for children, and the kid's corner with free mineral gifts.

Tom Caggiano personal recommendation.



The 2nd Edition of *Oceans of Kansas – A Natural History of the Western Interior Sea* from Indiana University Press. The digital version is available from Amazon. The second edition is updated with new information on fossil discoveries and additional background on the history of paleontology in Kansas. The book has 427 pages, over 200 color photos of fossils by the author .

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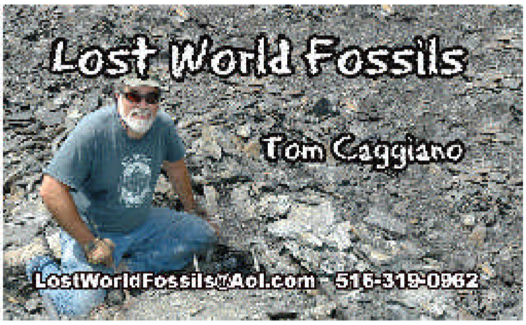
AAPS, The Association of Applied Paleontological Sciences was organized in 1978 to create a professional association of commercial fossil dealers, collectors, enthusiasts, and academic paleontologists for the purpose of promoting ethical collecting practices and cooperative liaisons with researchers, instructors, curators and exhibit managers in the paleontological academic and museum community.

The Paleontograph back issues are archived on the Journal Page of the AAPS website.
https://www.aaps-journal.org/



https://xpopress.com/vendor/profile/1662/lost-world-fossils

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