The Paleontograph

A newsletter for those interested in all aspects of Paleontology
Volume 8 Issue 1 March, 2019

From Your Editor

Welcome to our latest edition. Happy Spring to you all. Well, we made it thru the winter pretty much okay here in CO. The weather here really is pretty nice with the "Bomb Cyclone" being the exception.

I'm excited to be heading back east to the big fossil and mineral show in Edison, NJ., April 3-7. I usually run into many long time friends at this show. My booth "Lost World Fossils" is just inside the entrance. If you make it to the show, please stop by and say hello. I'm the old guy with the white beard.

I have a note on the last page detailing an exciting new arrangement. We will soon have all back and future issues of The Paleontograph archived on the AAPS website.

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 Mammalian Backbone and When It Got That Way.

Bob Sheridan September 23, 2018

Consider the human backbone, which consists of 33 vertebrae. The vertebrae are different depending on where they are along the spine. According to medical knowledge: there are three recognized regions in humans: 7 cervical (neck), 12 thoracic, and 5 lumbar (lower back). In contrast, the vertebrae of amphibians and reptiles tend to be more uniform with less "regionalization." Where in the evolution of mammals did the regionalization arise? A paper by Jones et al. (2018) attempts to answer this question by examining vertebrae from fossil synapsids (mammal-like reptiles), proto-mammals, and extant mammals. Also included are living outgroups like salamanders, lizards, and alligators

The study starts with 3D models of the vertebrae generated via CT-scanning. From each model, one can generate a number of measurements: the length of the centrum, angle for any zygophyses, etc. The methods for determining how different vertebrae are from each other, and deciding how many regions there are in a spine are complicated, but the results seem phylogenetically self-consistent.

For modern amphibians, lizards, and alligators, there appear to be only three regions, which the authors call cervical, anterior, dorsal, and posterior dorsal. What fraction of vertebrae are in each region may vary between these animals. The same three regions are seen for early synapsid pelycosaurs like Dimetrodon and Varanosaurus.

Basal therapsids, like Lystrosaurus and Dicynodon, are the first synapsids to show a new region, the "pectoral," between the cervical and posterior dorsal. The authors speculate that this reflects the change how forelimbs are disposed: from being splayed out to being tucked vertically under the body. A further speculation is that this could have also freed up shoulder muscles to become a muscular diaphragm, making breathing independent from walking.

Cynodonts, for example Thrinaxodon and Kayentherium, are considered proto-mammals. These have the same four regions as the basal therapsids. It is not until crown mammals that there appears a fifth region, the "lumbar" after the posterior dorsal. (As crown mammals, humans really have five regions rather than the three recognized by medicine.)

The fact that these differentiated regions evolved very late in mammal development argues against an older idea "cryptic regionalization," which is that that differentiated vertebrae existed early in aminote evolution. The fact that mammals have different regions in their spines allows the spine to be modular, i.e. allow the different regions to adapt independently.

Sources:

Jones, K.E.; Angielcyzk, K.D.; Polly, F.D.; Head, J.J.; Fernandez, V.; Lungmus, J.K.; Tulga, S.; Pierce, S.E.
"Fossils reveal the complex evolutionary history of the mammalian regionalized spine."
Science 2018, 361, 1240-1252.

Pennisi, E.
"A modular backbone aided the rise of mammals."
Science 2018, 361, pg. 1176.

Hyoid Bones and Dinosaur Tongues

Bob Sheridan September 25, 2018

This story concerns the hyoid bone. One unusual thing about the hyoid is that it does not articulate to other bones, but is connected only to muscle or ligaments. In humans the hyoid bone is U-shaped and sits on top of the larynx with the arms of the U pointing backward. Mouth and tongue muscles attach to the arms from above. In birds, the hyoid is more Y-shaped and much thinner. The stem of Y, called the paraglossum, points forward and anchors the tongue. Woodpeckers are more extreme than most birds in that the arms of the Y bend all the way around the back of the skull and curl over the top. Chameleons have a very complex hyoid with the Y having two arms on each side, and there being joints between the arms and stem of the Y.

Obviously, the complexity of the hyoid is taken as an indication of how far an animal can stick out its tongue. This allows us to make conclusions about fossil animals. A paper by Li et al. (2018) compares the hyoids of extinct and extant archosaurs: alligators, dinosaurs, proto-birds, birds, and pterosaurs. Since the hyoid is a very fragile bone, it is preserved rarely in fossils, and this study considers only about a dozen specimens.

The hyoid in alligators consists of two curved spines that are not fused, i.e. only the arms of the Y are present. Most non-bird dinosaurs have two separate spines. Early birds vary quite a bit. **Cont'd**

Tongues Cont'd
Some have the separate spines, some have the spines connected by cartilage into a V, and in some the bottom of the V is ossified. Some early birds have the full Y-shape bone as in living birds. One inference is that what we consider true dinosaurs (T. rex is always mentioned) could not stick out their tongues very far. Another trend noticed for birds is that the hyoid tends to be forward of the larynx.

There is one example of a pterosaur hyoid, that of Ludodactylus, a crested pterodactyloid from the Early Cretaceous of Brazil. This hyoid has the Y-shape very similar to that found in most modern birds. The thinking is that birds and pterosaurs converged on a lifestyle where they need to stick out their tongues.
Sources:
Li, Z.; Zhou, Z.; Clarke, J.A.
"Convergent evolution of a mobile bony tongue in flighted dinosaurs and pterosaurs."
PLoS ONE 2018, 13, e0198078

The Lungs of Archaeorhynchus

Bob Sheridan October 30, 2018

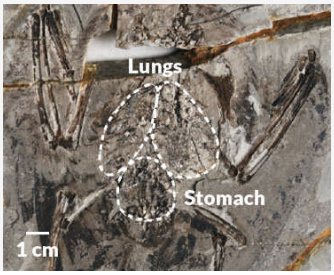
Examples where the internal organs of dinosaurs (other than feathers, stomach contents, etc.) are very rare. I can think of two famous ones from the past twenty years. A specimen of Sciponyx from Italy, nicknamed "Ciro," was described in 1998. It is a juvenile theropod dinosaur with extensive soft tissue preservation in the abdomen, putatively including the intestine, liver, and trachea.

More recently, a Thescelosaurus specimen from South Dakota nicknamed "Willo" was described in 2003. It appeared to have a round object where the heart should be, and the authors claimed that CT-scanning showed interior chambers as expected for a heart.

Of course, any claim of this type is expected to be controversial. The organic material of organs can be replaced by minerals, and in theory the original shape of organs can be preserved like that. However, the major complication is that many types of inorganic staining or mineral concretion can mimic organ-like shapes, but not represent the original organs. For example, a more detailed CT-scanning of Willo's "heart" showed that it was indeed just an inorganic mineral concretion. On the other hand, detailed chemical analysis of Ciro's "organs" make it likely that they are the remains of real organs.

Wang et al. (2018) describe a specimen (STM7-11) of Archaeorhynchus from the Early Cretaceous (~125 Myr) Jiufotang Formation with extensive soft tissue preservation. Archaeorhynchus is a primitive true bird with some advanced features: a beak, a keeled sternum, and a short tail. Gizzard stones are often preserved, indicating a herbivorous diet.

From ScienceNews-



Modern birds have an advanced unidirectional respiratory system which consists of lungs and air sacs. Since some air sacs penetrate bone, one can correlate the presence of air sacs with openings in certain bones. Many dinosaurs (whether closely related to birds or not) show analogous holes in their bones, so it would be expected that primitive birds would have advanced respiratory systems.

The interesting aspect of STM7-11 is that there is a speckled white material in the chest, which the authors maintain represent the lungs:

1. The material is arranged in two "lobes" inside the ribs, with the ribs actually penetrating the material. In modern birds, the lungs are indented by the ribs.
2. Electron microscopy shows that this material has the microscopic appearance of cells with a diameter of ~3 micrometers.

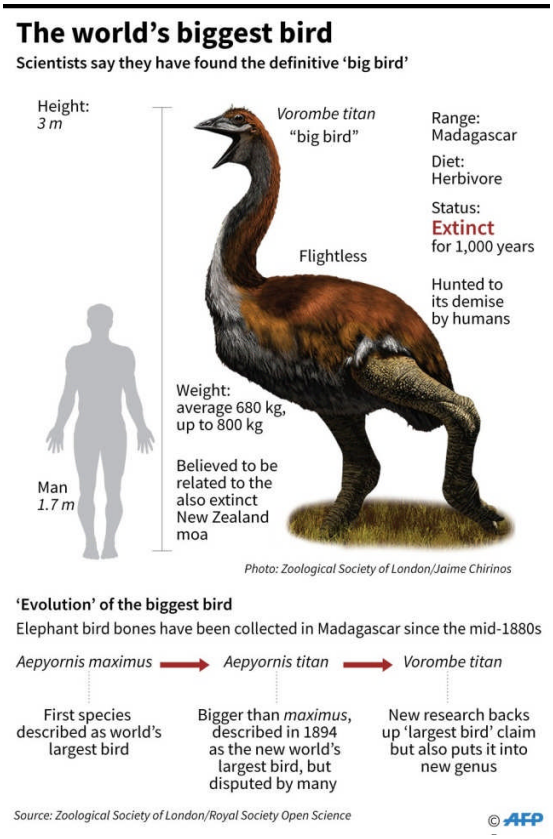
The authors go to great lengths to eliminate alternative explanations such as "matrix" (it is not observed in any other specimen in that formation) and stomach contents (gizzard stones show the position of the stomach is below where the "lungs" are). Another interesting aspect of STM7-11 is the completely preserved feathers, which appear very modern. At the tail, there is a fan-shaped array of feathers with a central "streamer."
Sources:
Wang, X.; O'Conner, J.K.; Maina, J.N.; Pen, Y.; Wang, M.; Wang, Y.; Zheng, X.; Zhou, Z.
"Archaeorhynchus preserving significant soft tissue including probable fossilized lungs."
Proc. Natl. Acad. Sci. USA, 2018, 115, 11555-11560.

Was the Elephant Bird Nocturnal?

Bob Sheridan November 10, 2018

Ratites are an informal class of large flightless birds without keels on their sternum, most of which live in the Southern hemisphere. Some are still living (ostriches, rheas, emus, cassowaries), and some became extinct in historical times (moas, elephant birds) It is now accepted that most of these birds developed their large size and flightlessness from flying ancestors independently. This is in opposition to an idea called “vicariance” where a single type of large flightless bird diverged into different ratites when Gondwana broke up into the current southern continents. It is also recognized from DNA evidence that some living birds like the tinamou (South America) and the kiwi (New Zealand), although not large, are phylogenetically in the family of ratites.

Today’s story is about the elephant bird. There are three genera of elephant birds, which lived on Madagascar in the presence of humans for at least tens of thousands of years, but went extinct in the early 1800s. These are the largest known birds, with a height about 10ft. and an egg weight of about 20 pounds.



Torres and Clarke (2018) compared high-resolution virtual endocasts of ratite brains, which are generated by CT-scanning braincases. This is meaningful exercise because bird brains fill up almost of volume of the braincase. Generally speaking, bird brains are the shape of squashed pears, with the pointy part being toward the front of the skull. The major approach here is to compare the size (either as length or surface area) of two specific lobes of the brain, specifically the olfactory lobe and the optic lobe, to the total size of the cerebral hemisphere. The assumption, which can be verified in living animals, is that the relative size of lobes in different birds tells us something about how important various senses are to the bird. The olfactory lobe is a cylindrical projection at the very front of the brain, and the optic lobes are two bulges on the bottom surface.

Ratites in general tend to have larger olfactory lobes relative to other birds. Among the ratites studied here, the olfactory bulb is largest in the kiwi and brown tinamou, and smallest in the red-winged tinamou. The authors correlate large olfactory bulbs with forested habitat. The optic lobe is smallest in the kiwi, elephant bird, and heavy-footed moa, and largest in the Chilean tinamous.

Kiwis are known to have a nocturnal lifestyle, and they have tiny eyes. The combination of having the largest olfactory lobe and smallest optic lobe among the ratites is consistent with this. It is known that the closest genetic relative to the kiwi is the elephant bird. Given that both have small optic bulbs, one possible inference is that the elephant bird, and the common ancestor of the elephant bird with the kiwi, might have also been nocturnal. This would be unlike the lifestyle for the very large birds we are familiar with, like the ostrich or emu.

I have seen popular reports interpreting this paper to mean that the elephant bird might have been blind. However, this is probably an exaggeration. While the kiwi’s eye sockets are tiny, the elephant bird’s seem to be normal size.

Sources:

Torres, C.R.; Clark, J.A.
Nocturnal giants: evolution of the sensory ecology in elephant birds and other palaeognaths inferred from digital brain reconstructions.
Proc. R. Soc. B 285: 20181540

Neandertals and Early Modern Humans: Not So Different?

Bob Sheridan November 17, 2018

Neandertals (alternative spelling Neanderthal) are an advanced human species that lived in Europe between 400,000 and 30,000 years ago. Much of that time, they were in proximity to early modern humans. Before about 10 years ago the thinking was that Neandertals and modern humans did not interbreed, but after we got the full gene sequence of Neandertals, it was clear that at least some people today have a small percentage of Neandertal genes.

Your typical Neandertal

Neandertals were certainly physically different from anatomically modern humans: longer, lower skulls (although a brain of about the same volume), stockier builds, and shorter legs. Being humans ourselves, we are most often interested in the behavior of other humans, and guesses about Neandertal behavior have varied a lot since their discovery 150 years ago. This is not surprising, since behavior does not fossilize but all we have are inference and speculation. By looking at the variety of opinions scientists have had about Neandertals since their discovery, one can see that the opinions say more about the mindsets of scientists over the years than about Neandertals.

Things we know pretty well about Neandertals, and the behavior traits that are sometimes inferred:
1. They ate a lot of meat. Good hunters.
2. They lived in small groups. Xenophobic?
3. They buried their dead. Spiritual?
4. They cared for their injured. Kind?
5. The occasionally ate each other? Ritualistic or just desperate for food?
6. They had the same stone “tool kit” for 200,000 years. Not innovative?
7. They didn’t produce much “art,” at least not in the same way as modern humans. Not creative? (However, very recently a few examples of Neandertal art or ornamentation have been discovered.)
8. They suffered a lot of injuries.

The last point is part of today’s story. It is generally held that Neandertals lead a trauma-prone life, especially to the head and neck. It is usually assumed this is true because they did close-range hunting. They have been compared to modern rodeo workers, who sustain injury from contact with large animals. It is not clear, however, whether there is something unique about the injuries in Neanderthals, or it just reflects how hard life was at the time.

Beier et al. (2018) did a comparison of cranial injuries of Neandertals and early modern humans who lived about the same time. They examined 114 specimens of Neandertal crania and 90 specimens of Upper Palaeolithic modern humans. The specimens are from Europe, the Middle East, and Western Asia. Of these, 9 Neandertals and 12 modern humans showed signs of injuries on at least one cranial bone. They compared these specimens in a number of ways. The first conclusion from the study is that the more complete the cranial remains, the more likely an injury is to be found. Once this is compensated for, the second conclusion is that the frequency of injuries is about the same in the two groups, so Neandertals are not uniquely injury-prone. The third is that males are more likely to be injured than females, not surprisingly since males were more likely to be hunters or to be involved in violent conflict. The fourth is that, whereas in Neandertals the injured crania more likely belonged to younger people, in early modern humans the injuries were more likely to be in older people. This could mean younger Neandertals would be more likely to be injured, or it could mean they were less likely to live long after being injured.

Another recent paper, Krakostis et al. (2018), addresses the question of how Neandertals used their hands. One usually divides the use of the human hand into “power grip” (e.g. grabbing the handle of a hammer) and a “precision grip” (e.g. holding something between your thumb and forefinger). Since the Neandertal hand was likely more muscular than that of early modern human, it has been argued that Neandertals were not very good at a precision grip; however, this is hard to reconcile with the fact that we can now identify some delicate Neandertal artifacts, including some small stone tools.

Cont'd

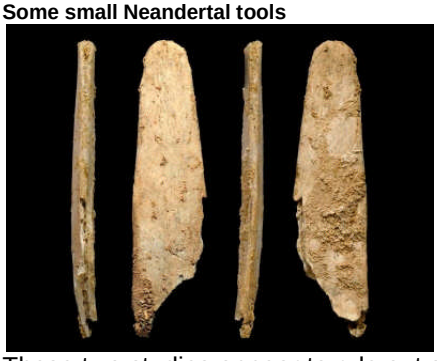
Neandertals Cont'd

The question of grip is addressable by "entheses", i.e. the size and position of muscle scars on hand bones, since different grips use different sets of muscles. We know in modern people that entheses is correlated with the occupation of the person or habitual use of the hand at certain tasks.

These investigators looked at 6 Neandertal specimens, 6 Early modern human specimens, and 45 modern people whose occupation was known: "heavy laborers" (bricklayers, stonemasons, carpenters) and "precision workers" (tailors, shoemakers, joiners, writers, painters, etc.). Entheseal surface areas for each muscle attachment were normalized by the overall size of the bone, and these were projected into three dimensions using principal component analysis.

Unexpectedly, in the lower dimensional space, all Neandertal specimens fell exclusively among the modern precision workers. In contrast, some early modern humans fell among the modern precision workers, and some among the heavy laborers. This means Neandertal hand anatomy was consistent with making more delicate tools, and it might also imply that early modern humans had different types of "jobs."

Some small Neandertal tools



These two studies appear to rule out some ideas about Neandertals having behavior different from modern humans that lived at the same time. However, it should be appreciated that in both cases, the number of samples is necessarily small, and the conclusion is less certain.

Sources:

Beier, J.; Anthes, N.; Wahl, J.; Harvati, K. "Similar cranial trauma prevalence among Neanderthals and Upper Palaeolithic modern humans".
Nature 2018, 563, 686-690.

Karakostis, F.A.; Hotz, G.; Tourloukis, V.; Harvati, K. "Evidence for precision grasping in Neandertal daily activities."
Sci. Adv. 2018, 4, eaat2369.

Dinomania—A Review

Bob Sheridan January 5, 2018

Twenty years ago I read a book "The Last Dinosaur Book" by W.J.T. Mitchell, a professor of English and Art at the University of Chicago. The author discusses the role of dinosaurs as icons in popular culture and how our idea of dinosaurs is dictated by our cultural environment. I found this book annoying in two major ways. First it takes a post-modernist attitude toward science (popular among academics in the 1990s), arguing that we can never really know the truth about dinosaurs because we are too overwhelmed with our own biases. A second big issue is how low the standard for critical thinking is among English professors. For example, Mitchell argues that the television character Barney (played by a man in a purple dinosaur suit resembling Tyrannosaurus), who was very popular with small children the early 90s, is annoying to adults because we expect Tyrannosaurus to be fierce, whereas Barney is gentle and loving. I had small children during the Barney era, it is perfectly obvious to me that there are many alternative explanations for why Barney is annoying that don't involve our ideas of Tyrannosaurus.

This year I read a very similar book: "Dinomania" by Boria Sax. Sax is Lecturer in Literature in Mercy College. The chapters are:

1. Dragon Bones
2. How Dragons Became Dinosaurs
3. Mister Big and Mister Fierce
4. From the Crystal Palace to Jurassic Park
5. The Dinosaur Renaissance
6. The Totem of Modernity
7. Extinction
8. A Dinocentric World

The first chapter summarizes how fossils were interpreted before modern times, and how imaginary creatures (presumably inspired by fossil bones) were depicted in art. In some cases, the imaginary creatures vaguely resemble dinosaurs or can be related to dinosaurs.

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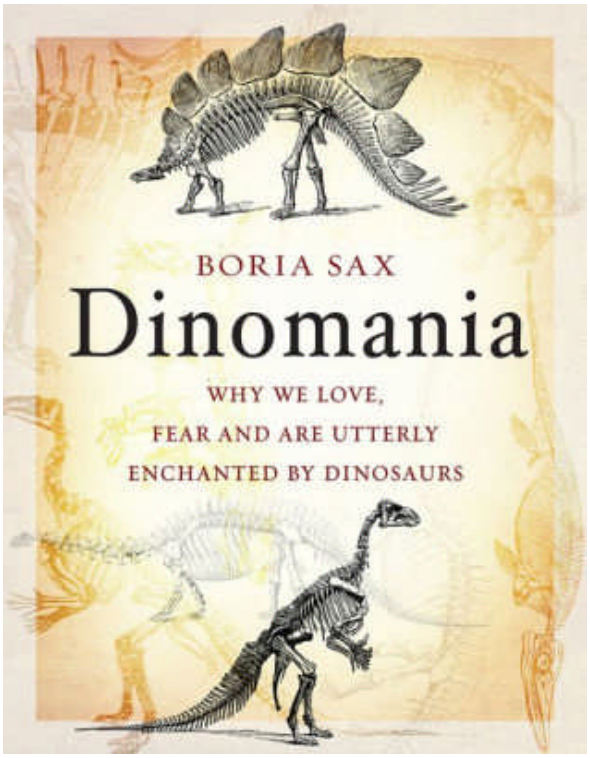
One especially unconvincing example pointed out by Sax is the giant skull in the Heironymus Bosch's painting "The Garden of Early Delights". Sax refers to it as "cow-like," whereas clearly it is a horse skull. In the same painting there is a large white "tree man," which Sax says may be "an early attempt to reconstruct a prehistoric creature on the basis of bones." To me the "tree man" looks like a hollow, house-sized egg with tree trunks for legs, with one of the legs having a very human looking knee. This is fantastical, but not at all prehistoric. For both examples Sax is making the equivalence "big animal" = "dinosaur," and I find that very weak.



The second chapter explains the discovery of Deep Time in the 19th Century. An art convention at the time depicted prehistoric landscapes as Gothic horror shows: dark turbulent skies, crashing waves, and groups of animals attacking each other. Another theme of this chapter is idea that in the 19th Century the psychological role of dragons (and other "evil" reptiles like serpents) was filled by dinosaurs, aquatic reptiles (ichthyosaurs and plesiosaurs), and pterosaurs. If you think all reptiles are equivalent to the human mind, this argument might be plausible, but I don't find it at all convincing.

The third chapter deals with predator/prey pairs, with the underlying theme that humans regard predators as "demonic." Examples given are: Megalosaurus and Iguanodon, Tyrannosaurus and Triceratops, Allosaurus and Barosaurus. I did find an interesting point here. The fact that animals ate each other gave 19th Century natural theology a problem: Nature should reflect the workings of God, but the cruelty of predation was not reconcilable with God's benevolence.

Crystal Palace Dinosaurs are a series of 15 life-size sculptures of prehistoric animals that were first prepared for the Great Exhibition in London in 1851 by artist Waterhouse Hawkins. They represented the best knowledge about dinosaurs at the time, which turned out to be mostly incorrect, since the remains excavated in England were very scrappy. However, this is the first time that dinosaurs entered popular culture in a big way. The sculptures can still be seen today. Waterhouse Hawkins was commissioned to do a similar exhibit in New York, but ran afoul of Tammany Hall, and the sculptures were destroyed before being completed. This chapter also deals with the waves of dinomania following to the Carnegie Diplodocus (~1900) and Sinclair Oil's Dinoland at the New York World's Fair (1964). This chapter is a very good treatment of those topics. The adoption by Sinclair Oil of "Brontosaurus" as a logo was meant to imply "age and quality" with the implication that, like wine, oil is beneficially aging in the Earth. We all know this is purely a marketing gimmick; petroleum has nothing to do with dinosaurs.

The fifth chapter covers two presumed "paradigm shifts" in evolutionary thought: The Dinosaur Renaissance (mostly associated with Robert Bakker in the 1980s) and the idea of Punctuated Equilibrium (mostly associated with Stephen Jay Gould since the early 1970s). The Dinosaur Renaissance is when the perception of dinosaurs changed from cold-blooded, slow-moving reptiles to active warm-blooded animals with complex behavior. Sax argues that the change happened mostly in the realm of paleoart and public perception, and it was not so much of a shift in the way dinosaur paleontologists did their work. The "cold-blooded vs. warm-blooded" debate failed scientifically because it was overly simple: warm-bloodedness, agility, rapid-growth, complex behavior, and "dominance" are not strongly correlated, and all of those properties are not either-or, but can vary in degree. To me, Punctuated Equilibrium has very little to do with dinosaurs specifically, but Sax points out a similarity with the Dinosaur Renaissance in that the idea ultimately was not provable as originally stated since, again, it was overly simplified.

Cont'd

Dinomania Cont'd
Totemism is a system of belief in which humans claim a kinship with an animal or plant and that animal serves as a kind of mascot or symbol for a society. It is very hard for me to get the arguments put forth by Sax about totemism and dinosaurs because "totemism" and "modernity" are very loosely defined. It might have something to do with the fact that dinosaurs (or other reptilian creatures) are often depicted in art as interacting with humans. Or it might have to do with dinosaurs being discovered around the time of the Industrial Revolution. Or it may have to do with the fact that dinosaurs were dominant in their time as humans are now.

The chapter on "Extinction" covers several topics: The proposal by Georges Cuvier that animals could go extinct; this occurred shortly before dinosaurs were discovered. The idea of Charles Lyell that Earth geology was cyclic and that when certain environments come back extinct animals could come back. (This was satirized by a cartoon "Awful Changes" by Henry De la Beche, wherein an ichthyosaur lectures other prehistoric creatures about extinct humans.) The idea that other species could go extinct means that humans could also. However, in the 19th Century there was an idea about human exceptionalism, where "greatness," "achievement," or "superiority" was confused with "immortality." Then there is the idea of "resurrecting" dinosaurs as life-size sculptures, as literary characters, in real life by genetic manipulation of chickens, etc. Finally, there is a discussion about Godzilla.

The last chapter is a rambling discussion of "dinocentrism" vs. "anthropocentrism" in common perception of evolution. An interesting point made here is that if the evolution of life is regarded as progress that will ultimately result in mankind, the dinosaurs seem like a very long interruption. This chapter also contains an interesting thought experiment. If dinosaurs had never evolved, mammals would have developed intelligence 170 Myr. earlier, there would not have been an "interruption" in progress, and human arrogance would have been even more extreme. Of course, in reality, it is a complete oversimplification (although a popularly held one) to equate evolution with "progress."

I get that "The Last Dinosaur Book" and "Dinomania" are not about dinosaurs; they are about what people and popular culture project onto dinosaurs. That is an interesting topic, and I personally am interested in the history of scientific thought. However, neither book does it in a convincing way. The sections that are mostly historical, for example Chapter 4 of "Dinomania," are reasonable. Most of the other chapters, however, contain arguments unconvincing to someone with any amount of critical thinking. It is not enough to make up, and endlessly discuss, associations with dinosaurs based on vague resemblances ("dragons" = "dinosaurs", "snakes" = "dinosaurs", "large animals" = "dinosaurs", "extinct species" = "dinosaurs", etc.). One must also consider and eliminate non-dinosaurian explanations. For instance, let us address the "Garden of Earthly Delights" issue raised in the first chapter. Hypothesis A: Bosch painted a giant horse skull because he was influenced by giant fossil bones. Hypothesis B: Horse skeletons are common in fantastical Renaissance art (Four Horseman of the Apocalypse, etc.) and making a skull bigger makes it scarier. Hypothesis B seems much more plausible to me.

Also, as I went through the book again for the purposes of this review, I found it very hard to summarize the chapters because they contain topics that to me seem mostly unconnected. One bright spot is that this book contains illustrations of historical interest, mostly from the early 19th century, that you might not find elsewhere.

Lesson learned: If you see a dinosaur book where the author has no credentials as a paleontologist, paleoartist, or at least a scientific journalist, it is probably best to steer clear, or at least not pay money for said book. That goes double if the author cannot tell a cow from a horse.

Sources:

Dax, B.
"Dinomania. Why we love, fear and are utterly enchanted by dinosaurs."
Reaktion Books, London, 2018. 264 pages. $30 (hardcover).

Mitchell, W.J.T.
"The Last Dinosaur Book. The Life and Times of a Cultural Icon"
University of Chicago Press, Chicago, 1998. 309 pages.

PALEONTOGRAPH ADVERTISMENT & EVENTS PAGE

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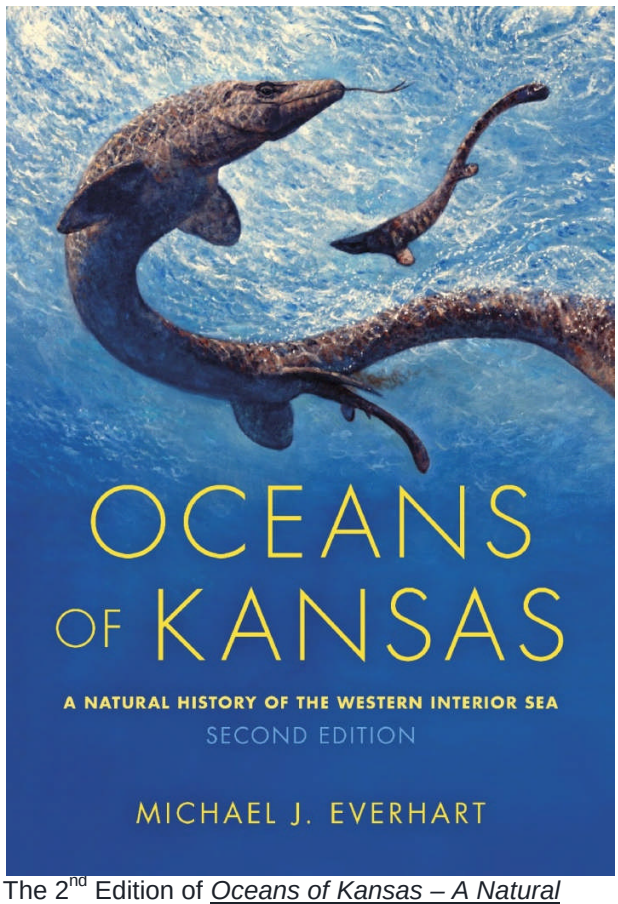
https://www.coliseumshow.com/wp-content/uploads/2018/09/2018DenverColiseumShow-1.png



The 2nd Edition of *Oceans of Kansas – A Natural History of the Western Interior Sea* will be available from Indiana University Press on September 11, 2017. The digital version is already 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 (including Tom Caggiano's dinosaur bones in hand shot), is printed on acid free paper, and weighs in at a hefty 3.6 pounds.

A review from *Copeia*....

"Oceans of Kansas remains the best and only book of its type currently available. Everhart's treatment of extinct marine reptiles synthesizes source materials far more readably than any other recent, nontechnical book-length study of the subject."
—Copeia

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