# The Paleontograph

**A newsletter for those interested in all aspects of Paleontology**
**Volume 11 Issue 3 October, 2022**

## From Your Editor

Welcome to our third edition of the year. I hope this issue finds you and your family healthy and safe.

Fall is here in Colorado. There is a chill in the air and I don't think I'll be out collecting again this year. I made it to Kansas, Wyoming, and Montana this year and enjoyed it all. I just finished the Denver Show and had a good time seeing friends.

I'll keep it short and end here.

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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## Fast Theropod Tracks

***Bob Sheridan December 14, 2021***

How fast could dinosaurs run? Not surprisingly, people are most interested in theropods, in particular Tyrannosaurus. We know that modern bipedal analogs of theropods, the flightless birds, can run very fast; for example the ostrich can run 40 miles per hour. There are two main ways of approaching the speed problem for an extinct animal:

1. Simulating the mechanics of a living animal. This requires estimates of mass, area and strength of muscles, length of limbs, probable step frequency etc. You probably heard the results of a study that concluded Tyrannosaurus was limited to 11 miles per hour.
2. Analyzing trackways. Trackways record the behavior of a real living animal, but analysis still requires assumptions about stride length, hip height, step frequency, etc. Fortunately, there are known scaling relationships between foot length and hip length, between step frequency and the hip length, etc.

While there thousands of dinosaur trackways preserved, all but a handful are consistent with a slow walk. This is not surprising. Footprints are most likely preserved in soft ground, and soft ground is hard to run in. As a consequence, very few preserved trackways say anything about the maximum speed of an animal.

Navarro-Lorbes (2021) reanalyze a set of theropod trackways from Early Cretaceous Spain first described in 1985. Since that time, a few new tracks have been unearthed. The tracks cover an area of about 15 X 15 meters and there are about a dozen individual trackways. Individual footprints are about 30 cm long, which would suggest a hip height of 1.0-1.4 meters, i.e. medium theropods (roughly 6 meters long, 2000 kg) . The authors point out two trackways called La Torre 6A (6 footprints in the trackway) and La Torre 6B (7 footprints in the trackway) which seem to have a large spacing. Alexander's equation is used to calculate speed given only the foot size and spacing: 6.5-10 meters per second for 6A and 8.8-12.4 meters per second for 6B (~20-25 miles per hour). This is about at the maximum estimate of speed from simulated mechanics for animals of the same size.

The authors compare La Torre 6A and La Torre 6B with estimates of speed from 18 published "fast dinosaur" trackways. They seem about average in that class.

Identifying the specific trackmaker is hard. Therapods probably in Spain in the Early Cretaceous are Concavenator, Camarillasaurus, and Genusaurus.

Sources:
Navarro-Lorbés, P.; Ruiz, J.; Díaz-Martínez, I.; Isasmendi, E.; Sáez-Benito, P.; Viera, L.; Pereda-Suberbiola, X.; Torices, A.
"Fast-running theropods tracks from the Early Cretaceous of La Rioja, Spain"
Scientific Reports 2021, 11:23095.

## Giantism in Ichthyosaurs vs. Cetaceans

***Bob Sheridan December 24, 2021***

Ichthyosaurs and cetaceans (whales and dolphins) are comparable in that they evolved from purely terrestrial ancestors and eventually became fully marine. They converged on many adaptive characteristics: nostrils at the top of their heads, streamlined bodies, paddle-like limbs, fluked tails, young being birthed tail-first, etc. The fossil record for ichthyosaurs goes from the earliest Triassic to the mid-Cretaceous (252 Myr to 94 Myr.), although there is a marked drop in diversity at the end of the Triassic. The fossil record for cetaceans starts about 50 Myr and goes to the Present.

Another characteristic of both groups the presence of giant members. Giantism is easier to attain for aquatic than for land animals, in that their weight is largely displaced through buoyancy. For the purposes of this article "gigantic" would mean a length greater than 50 feet. The most extreme example on Earth so far, the blue whale, which is 100 feet long and weighs 100 tons. Baleen (e.g., the blue whale) and toothed cetaceans (e.g., the sperm whale, the killer whale) seem to have developed giantism independently. There are several unrelated ichthyosaurs that have also achieved very large sizes, e.g., Shastasaurus, Shonisaurus, etc.

**Cont'd**

**Giantism Cont'd**

Sander et al. (2021) describe the skull, and humerus, of a new, very large ichthyosaur from the Middle Triassic (247 Myr.) of Nevada, which they name *Cymbospondylus youngorum* ("boat spine" and after Tom and Bonda Young). There are four previously known species of Cymbospondylus. These are already large, with skulls about 3 feet long. Like other early ichthyosaurs, Cymbospondylus has a very eel-like shape with a triangular head and large teeth; to me, it looks superficially more like a mosasaur than the dolphin-like shape of later ichthyosaurs. *Cymbospondylus youngorum* has a skull over six feet long. Using scaling of the humerus relative to other ichthyosaurs of known length, one could estimate a total length of 60 feet for Cymbospondylus, not the longest ichthyosaur specimen, but very large.

The point the authors emphasize is that, given *Cymbospondylus youngorum*, very large ichthyosaurs existed 3 Myr. after the origin of that group. (A caveat to this observation: there were no large ichthyosaurs at the end of the Triassic; large ichthyosaurs developed again only much later in the Cretaceous.) In contrast, very large cetaceans existed only very late in their evolution, about 50 Myr. after their origin. The authors attempt to explain why these creatures might have grown to gigantic size, and why ichthyosaurs and cetaceans are so different in their timing. Some of this depends on having a phylogeny of both ichthyosaur and whale species with good timing and size data on the specimens.

There are several evolutionary models for how animals might increase in size. For example "early burst" suggests that after the origin of the group, it diversifies very fast, producing a wide range of characteristics, one of which is size. "Drift" suggests that the animals start small and slowly evolve large sizes. "Brownian motion" suggests that animals can get larger or smaller with time as in a random walk. "Ornstein-Uhlenbeck" is somewhat like a random walk except that there is a "force" preventing extreme values. The authors feel that the "early burst" model is most consistent with ichthyosaurs, and that there is no particular model that is consistent with cetaceans.

Another approach is to analyze the food available. Large animals require large prey or a very abundant amount of small prey (e.g., krill for filter feeding cetaceans), and that food supply must be stable. The authors do "energy-flux" calculations based on the abundance of fish, ammonoids, and "shelled invertebrates" in the same formation, and conclude there is enough food for giants. Some of these calculations depend on the assumed "metabolic requirements" of ichthyosaurs.

I find the observation of rapid size increase in ichthyosaurs, vs. slow size increase in cetaceans, convincing and interesting. However, given the uncertainties involved in the calculations the authors make, I don't think there is yet anything like a convincing explanation for when gigantism develops and why ichthyosaurs are different from cetaceans. A more convincing study would include other fossil groups that achieve large size and one would need to do control calculations of the food web for those times where there were only small versions of the animals.

One observation not discussed here is that how both the earliest ichthyosaurs (e.g., Cymbospondylus) and cetaceans (e.g., Basilosaurus) had an elongated eel-like shape, whereas later versions had a more bulbous shape.

Sources:

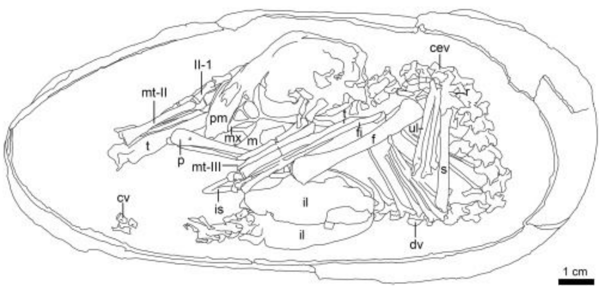
Lene Liebe Delsett, L.L.; Pyenson, N.D.
"Early and fast rise of Mesozoic ocean giants."
Science 2021, 374, 1554-1555.

Sander, P.M.; Griebeler, E.M.; Klein, N.; Juarbe, J.V.; Wintrich, T.; Revell, L.J.; Schmitz, L.
"Early giant reveals faster evolution of large body size in ichthyosaurs than in cetaceans."
Science 2021 374, eabf5787

## Tucking Dinosaur Embryos

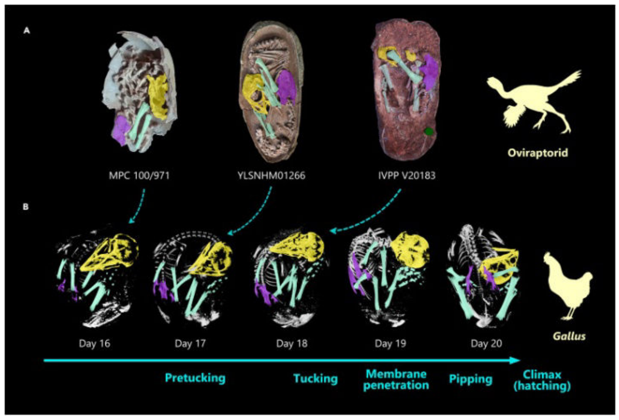
***Bob Sheridan December 26, 2021***

Fossilized dinosaur eggs are pretty common, but embryo skeletons inside the eggs are rare, and articulated skeleton are even more rare. This is actually expected, embryos tend not to be very ossified and the individual bones are not firmly attached to each other. Xing et al. (2021) describe an articulated embryo inside an egg from Late Cretaceous China. The eggs is an elongated oval 17 centimeters long and 8 centimeters wide. The fossil (specimen YLSNHM01266) has been prepared by removing half of the egg along the long axis. CT-scanning is not very useful here because the matrix is about as dense as the bones.




YLSNHM01266 clearly is an oviraptor. The egg closely resembles other oviraptor eggs, and the rounded toothless skull of the embryo is characteristic of oviraptors. Which oviraptor genus the embryo represents is hard to discern because the genera are based on adult specimens. The embryo is curled into a shape resembling the letter C on its side. The tail forms one side of the C, and the spine forms the other side. The pelvis is in the center and the large skull (about 6 centimeters long), resting on the chest, would be at the opening of the C. The legs are tightly tucked. The embryo would have a length of 23 centimeters long if uncurled.

We know much about how extant bird and alligator embryos are curled within their eggs. In chickens, the beak starts resting on the chest, then as the embryo grows, ends up pointing toward the right armpit, and eventually at 20 days incubation is pointing toward the back, where it is used to break out of the egg. The authors equivalence YLSNHM01266 to the “chest-resting” phase. Presumably, this links oviraptors (which are considered bird-like theropods), with modern birds.




Certainly, it is already widely appreciated that birds are descendants of dinosaurs. My feeling is that no further parallels can drawn between dinosaurs and birds based on how the embryos are tucked. It is inevitable that embryos, which grow longer than the longest dimension of the egg they are in, will end up tucked in more or less similar positions. The head has to end up on the chest because there is no room to do otherwise. The legs are flexed for the same reason. Here is my analogy: Both Egyptian and Mayan pyramids are wide at the bottom and narrow at the top, but this doesn’t mean the design of the pyramids is related. It is just a matter of physics: a pile of blocks has to be wider at the bottom to be stable.

The authors admit that YLSNHM01266 is just a starting point to the discussion.

Sources:

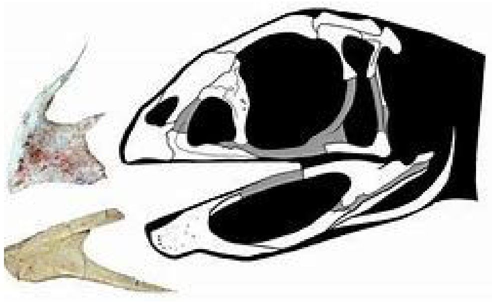
Xing, L.; Niu, K.; Ma, W.; Zelenitsky, D.K.; Yang, T.-Z.; Brusatte, S.L.
“An exquisitely preserved in-ovo theropod dinosaur embryo sheds light on avian-like prehatching postures.”
iScience 2021, 103516.

## Berthasaura

***Bob Sheridan December 22, 2021***

There are several types of theropods (aside from birds) that have completely toothless beaks. Ones that immediately come to mind are the oviraptors and ornithomimids. The thought is that, although most theropods are obligate carnivores, those with beaks are omnivores or herbivores. The theropods mentioned above are fairly advanced Late Cretaceous theropods, not too far from the ancestry of birds. This week I became aware of a new group of Cretaceous theropods called the noasaurs, some of which have toothless beaks. These are smallish slender theropods (typically two meters long) that have very long legs, but very small arms, some with only one or two fingers. Interestingly, noasaurids are a subclass of ceratosaurs (named for Ceratosaurus), which are considered a more "primitive" type of theropod. Noasaurids are closely related to abeliosaurids (most famous example Carnotaurus) that tend to be medium size (6 meters long), but also have small arms. Limusaurus (from China) is probably the previously best known noasaurid because many specimens have been found, including juveniles. Relevant for the discussion today is the fact that juvenile Limusaurus start out with teeth, but the teeth, and eventually the sockets, disappear by adulthood. The fact that some Limusaurus remains sometimes contain gastroliths suggests they might have been herbivorous as adults.

de Souza et al. (2021) describe a new noasaurid from the Early Cretaceous of Brazil which they name *Berthasaura leopoldinae* ("Bertha's reptile" after Bertha Lulia Lutz, a Brazilian zoologist and diplomat, and after Brazilian empress Maria Leopoldina). This is a small animal, about a meter long. The specimen is nearly complete except for some neck and tail vertebrae, and parts of the limbs. The lack of fusion in the skeleton might indicate it is a juvenile. If it is a juvenile, that would be significant, because Berthasaura shows no signs of teeth or sockets, so it might have been toothless from an early age, unlike the situation with Limusaurus. No gastroliths are found with Berthasaura.



Vespersaurus is another noasaurid from the same locality as Berthasaura, incompletely known but definitely with teeth. Since Vespersaurus is more closely related to Berthasaura than is Limusaurus, toothlessness in noasaurs probably evolved independently at least twice.

It can also be noted that Berthasaura is one of the few dinosaur names that end in the feminine "a" instead of "us".

Sources:

de Souza, G.A.; Soares, M.B.; Weinschütz, L.C.; Wilner, E.; Lopes, R.T.; de Araújo, O.M.O.; Kellner, A.W.A
"The first edentulous ceratosaur from South America"
Scientific Reports (2021) 11:22281

## No Sauropods at the Poles?

***Bob Sheridan December 20, 2021***

We have recovered bones and footprints of dinosaurs at the northern and southern polar regions, meaning dinosaurs reached and were able to inhabit the entire Mesozoic world. This implies that at least some dinosaurs were able to live at colder temperatures and exist in darkness for months at a time. Previous workers observed that dinosaur diversity peaked at higher latitudes, whereas nowadays biodiversity is concentrated in the tropics.

**Polar Dinos Cont'd**

Chiarenza et al. (2021) reexamine the distribution of dinosaur clades from the Middle Jurassic to the Latest Cretaceous in terms of paleolatitude, using data from the Paleobiology Database. Specifically they divide dinosaurs into ornithiscians, theropods, and sauropods, and try to confirm the idea that sauropods were limited to land with higher temperatures. It appears that the abundance analysis is done at the level of individual specimens. There are a number of complications that need to be addressed to eliminated the possibility that the apparent distribution of sauropods is controlled by an artifact:

1. Some correction is necessary for the Jurassic, since due to continental drift, the latitude where fossils sites are now is not the same latitude where the animal died.
2. There are more Cretaceous than Jurassic localities, especially at the poles.
3. There is more land (and therefore fossil localities) in the northern hemisphere than southern hemisphere or the equator.
4. Atmospheric modeling needs to be done to estimate the temperature as a function of latitude, and the overall temperature of the Earth changed over time due to global carbon dioxide concentrations.

Points 2 and 3 are addressed by a subsampling approach, although this is not explained very well in the paper.

For the period covered, there are more dinosaur specimens overall at northern (by convention +) and southern (by convention -) paleo mid-latitudes ( +25 to +50 degrees and -25 to -50 degrees) than at the poles (> +50 degrees or < -50 degrees) or at the equatorial regions (-25 to +25 degrees). For comparison, London is at +51 degrees, and Miami is at +26 degrees. It is not until the Middle Cretaceous that any dinosaurs are found near the South Pole, and not until the Late Cretaceous that dinosaurs are found near the North Pole. Interestingly, sauropods never invade the poles over the entire period. Also, the ratio of sauropods in the southern hemisphere relative to the northern hemisphere increases in the Cretaceous. (Consistent with sauropods being rare in North America after the Jurassic.)

Looking at the distribution of dinosaurs, summed over all time periods, as a function of the temperature in a cold month, or precipitation in a dry month, etc., we see that the vast majority of dinosaurs are found in warmer or drier conditions. The point is that, while ornithischians and theropods have a very small number of specimens that lived with cool temperatures (say less than -30 Celsius) or higher rain (say more than 4 millimeters per day), there are zero sauropods under those same conditions. To me this is not necessarily a big difference, but the authors feel the difference is statistically significant.

The authors speculate why sauropods are more sensitive to temperature limits. They might be closer to being ectothermic than other dinosaurs, and they lack insulation. Or ornithischian dinosaurs outcompeted them as herbivores. One plausible reason that was not mentioned is that sauropods could have needed large amounts of food, which would not be available during the darkness of polar winters.

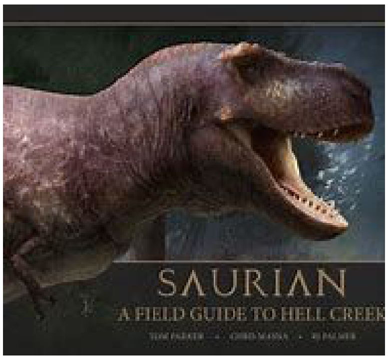
I am somewhat skeptical of these results. It is certainly true that whenever I have heard of a polar dinosaur over decades of following paleontology as a hobby, it was almost always hadrosaur like Ugrunaaluk or small ornithiscians like Leaellynasaura. Occasionally, there would be a theropod like Cryolophosaurus. I never heard of a polar sauropod. However, I have trouble with the explanation for the absence of sauropods at the poles. I did not understand the sampling method used here; it seems plausible to me that the distribution statistics from the Paleobiology Database reflect the availability of fossil localities of suitable ages, rather than where dinosaurs really liked to live at various times in the Mesozoic. The conclusion that sauropods are less suited to cold temperatures than other types of dinosaur depends on some pretty tricky climate models, and the explanations of why they would be less suited seem pretty ad hoc. Finally, it seems strange that the authors divide dinosaurs into only 3 categories. Why not distinguish hadrosaurs (which are common polar dinosaurs) from ceratopsians (which are not). One explanation for that is that the statistics would be worse if more categories were used.

Sources:

Chiarenza, A.A; Mannion, P.D.; Farnsworth, A.; Carrano, M.T.; Varela, S.
"Climatic constraints on the biogeographic history of Mesozoic dinosaurs".
Current Biology 2021, 32, 1-16.

## Saurian—A Review

***Bob Sheridan January 7, 2022***




I saw the book "Saurian" on Amazon about a year ago, but was not able to obtain a copy until now. While I generally like paleoart by itself, I usually buy books that have a reasonable amount of scientific information, so the subtitle "A Field Guide to Hell Creek" is what sold it. At the time, I had a fairly vague idea of the Hell Creek Formation, knowing only that it is found around the state of Montana, and that it has a very good fossil record of Late Cretaceous dinosaurs. Now I know a lot more. The Hell Creek Formation is found in Montana, the Dakotas, and Wyoming and spans the Latest Cretaceous to the Earliest Paleocene. That makes it an excellent place to study the extinction of the dinosaurs. The climate in that area was semi-tropical, much like that of Florida today, despite the high latitude (55 degrees N at the center of the Formation; Copenhagen and Moscow are at 55 degrees). The Formation contains paleoenvironments ranging from deep forests to the shore of the Western Interior Seaway. The dinosaurs Tyrannosaurus, Edmontosaurus, and Triceratops are most abundant, but the range of dinosaurs found there is impressive (dromaeosaurs, pachycephalosaurs, ankylosaurs, etc.). Also, there are many other types of animals: pterosaurs, birds, mosasaurs, turtles, lizards crocodiles, fish, insects, etc. In terms of plants, there are ferns, palms, ginkgos, cycads, conifers, laurels, etc. Truly, an amazing locality.

The text of "Saurian" is written by Tom Parker, and the illustrations are by Chris Masna (short for Masnaghetti) and R.J. Palmer. None of these authors are professional paleontologists, but are science communicators, illustrators, sculptors, or animators. (This reminds me of Silvia and Stephen Czerkas, artists who where writing very scientifically respectable popular books on dinosaurs in the 1990's.) There are five chapter headings:

1. The World of Saurian
2. Local Habitats
3. Flora
4. Fauna
5. Guest Artwork

Each of these chapters are divided into several subchapters. For example, "Fauna" has 10 subchapters. The longest one is "Dinosaurs," and that is subdivided into a dozen sub-subchapters based on the classification of dinosaur. There are several dinosaurs in Hell Creek I have never heard of, which is pretty unusual (in a good way) since I have followed paleontology as a hobby for 35 years now. Each sub-topic gets two or three pages.

As you might expect, 75% of the page area in "Saurian" is illustration, and 25% text. The majority are restorations of animals, plants, or environments, and as you might expect from the beginning paragraph, there are many types of each. Often there is a silhouette of a human for scale with the restorations. (A man and woman appear equally frequently. The woman is pretty generic, but the man has a stout build, a vest, and a wide hat—are they trying for Bob Bakker?) There are many informative diagrams as well. The illustrations are outstanding, about what you might expect in one of those books dedicated to paleoart. There is a common style of art, very detailed and realistic (probably using digital paint techniques), except in the "Guest Artwork" section, where there is more variety due to over a dozen artists contributing.

I did not expect that he last page of "Saurian" would have a "disclaimer" that this book is a companion piece to a video game "Saurian". That game was not yet released when the book was put together in 2019, but seems to be in an "early adopter" state now. You can check out the game at sauriangame.com. That site also has a semi-scientific blog, and many other illustrations and diagrams. Apparently, the idea for all this study is to make the game as scientifically accurate as possible. I have never been a gamer, and a book that was merely "the art of" a game would normally not be attractive to me. However, the value of "Saurian" as a stand-alone popular book on paleontology is so high, the fact that it is a companion book to a game is irrelevant.

Sources:

Parker, T.; Masma, C.; Palmer, R.J. "Saurian. A Field Guide to Hell Creek." TitanBooks, London, 2019, 175 pages, $40 (hardcover).

## How Did Quetzalcoatlus Take Off?

***Bob Sheridan January 7, 2022***

Azhdarchid pterosaurs are among the latest and largest pterosaurs. The most famous is Quetzalcoatlus, which lived in Texas in the Late Cretaceous. The species *Q. northopi* might have had a wingspan of 10 meters, and a height of 6 meters. However, that species is known only from a few arm bones. There is another presumed species *Q. lawsoni*, which is much more completely known, but which is about half the linear dimensions. A little discussion about the overall anatomy of Quetzalcoatlus is needed to understand the mechanics. The head is long and has a narrow toothless beak that comes to a sharp point (it has been compared to the beak of a stork). The neck is about 50% longer than the head, and consists of only about six very elongated cervical vertebrae. The length of the body is less than the length of the head, and the total length of a leg is about twice that of the body. The arms, of course, are as long as the head and neck combined. Still, Quetzalcoatlus has fairly stubby looking wings, because the fourth finger, which forms the wing, is not particularly long compared to most pterosaurs.

Some further discussion is needed about how the wing membranes of pterosaurs work. This is not completely settled for any pterosaur, although there are some fossils with impressions of the wing membrane. One can imagine the wing attached to the ankle of the pterosaur ("bat-like"), to the knee, or to the hip ("bird-like"). Whether the arms and legs could move independently depends on that assumption. It is pretty well established from trackways that pterosaurs walked quadrupedally, i.e. more like bats than birds.

Padian et al. (2021) do an analysis of the range of motion of *Q. lawsoni* given a reconstructed skeleton. Some amount of reconstruction is necessary because not all the bones are completely known and some bones are found squashed flat. Typically the range of motion for a joint involving two bones (say a femur against the tibia in the knee joint) is decided by moving one articulated bone relative to the other until the surfaces are no longer in contact. This usually produces an underestimate of the range of motion since, in life, cartilage caps make the contact surface between the bones larger. It appears that the analysis in this paper is based on physical, rather than digital, models of bones, which is somewhat unusual nowadays. The bones were originally modeled years before by Wann Langston, a paleontologist at the University of Texas.

Most of this paper contains a lot of detail about the range of motion of the neck, arms, and legs. However, what really matters is how these parts function. I will discuss three aspects. These involves some amount of speculation on the part of the authors. However, their suggestions are certainly consistent with the range of motion they determined.

1. The walking gate.
2. How the legs were held in flight.
3. How Quetzalcoatlus launched into flight.

Quadrupedal mammals have a number of gates. For example imagine a walk: left front, right hind, right front, left hind. This would be a problem for Quetzalcoatlus because the distance between the shoulders and hips is small compared to the length of the leg. Also, the arm cannot be moved forward very far compared to the leg because the humerus cannot be rotated very far. Thus, in a mammal-like gate, a leg would be stepping on the arm on the same side unless the arm was moved out of the way. The gate would have to be something like: right arm, right foot, left arm, left foot. Most of the propulsion would come from the legs, and the arms acted more like "ski poles".

A bat holds its legs sidewards during flight. This posture is outside the range of motion for Quetzalcoatlus hips.

**Cont'd**

**Quetzalcoatlus Cont'd**

Rather, it is more likely that the legs where held directly under the body with the knees flexed and the feet pointing backwards, much like a stork in flight. This would, in turn, imply that the wing membrane is not connected to the ankles or the knees, but further up on the body. Otherwise the wing membrane would be folded in an awkward way during flight.

The third topic, launching, is the one that seems to be of interest to the popular press. In launching, a flying animal has to move up and forward. The assumption is that pterosaurs would not be jumping off cliffs or facing into the wind like a kite to get lift without flapping. It is unlikely that Quetzalcoatlus could run fast enough bipedally to get enough lift (as some water birds do). Any pterosaur would be very top-heavy if it stood on its hind legs, and there is no evidence that pterosaurs ever walked bipedally. If we assume flapping is necessary for take-off, there has to be enough vertical room for the wings to flap down without hitting the ground. One method is to push off the ground with the legs while raising the wings and start the flap at the highest point of the jump. This is what most birds do. Bats cannot do this because their legs are to the side of the body and cannot push up effectively. Instead, bats effectively do a push-up with their arms to launch, which is easy because they are small. Previous suggestions for pterosaurs involve a "quad launch," i.e. pushing up with the legs and then pushing forward with the arms. There is an old animation of this for the pterosaur Anhanguera on www.youtube.com/watch?v= ALziqtuLxBQ. The authors suggest that in the case of Quetzalcoatlus, the legs are so long that a high enough jump could be made with the legs alone, starting from a crouched position. This would make the launch very bird-like.

Sources:

Padian, K.; Cunningham, J.R.; Langston. W. JR.; Conway, J.
"Functional morphology of *Quetzalcoatlus* Lawson 1975 (Pterodactyloidea: Azhdarchoidea)"
J. Vert. Paleo. (2021) 41: sup1, 281-251.

## "Paleontology. An Illustrated History"—A Review

***Bob Sheridan March 22, 2022***

As a paleontology hobbyist who also likes the history of Science, I can recommend a new book "Paleontology An Illustrated History." The author David Bainbridge is a science writer, reproductive biologist, and verternary anatomist at the University of Cambridge. He has published several books, but this is the first on paleontology.

There are four chapters, each of which is divided into four subtopics. The topics are generally in chronological order of the discovery, as opposed to the time the fossil organism lived. Most of the subtopics are "special topics", i.e. they concentrate on something specific, e.g. Marsh and Cope, Mary Anning, Luis Leaky, Lyuba the baby mammoth. etc. The "history" starts in ancient Greece, when were interpreted as remains of mythological beasts. It was not until the late 1600s that fossils were recognized as being the remains of past life. Paleontology as a science did not start until the early 19th Century. Some argue it reached its zenith in the second half of the 19th Century after dinosaurs were discovered in the American West. The last chapter of the book covers the modern era from 1980 to 2020, when paleontology started to become a high-tech, information-rich endeavor, using analytical chemistry, CT-scanning, cladistics, etc..

As the title suggests, this is a very illustration-heavy book. I would call this a "coffee table book", except that it is not particularly large (7 X 9.5 inches). There is about 4-5 pages of text per topic, but most of the information is in the captions of the illustrations. The illustrations are equally divided between scientific diagrams from the published literature (which I greatly appreciate), photographs of fossils, photographs of famous paleontologists at work, and restorations depicting the living organism. After following paleontology as a hobby for decades, I have seen some of the illustrations before, but I would say at least half are new to me. Which is a good thing.

Sources:

Bainbridge, D.
"Paleontology. An Illustrated History"
Princeton University Press, Princeton, 2022, 255 pages, $30 (hardcover)

## Feathered Pterosaurs

***Bob Sheridan April 26, 2022***

Feathers were once thought to be possessed only by birds. In the 1990's, it became clear that many theropod dinosaurs had them also. Later, feather-like integument was identified in some ornithiscian dinosaurs. Today's story hints that feathers might be a primitive characteristic of advanced archosaurs, due to their discovery in pterosaurs, a sister group to dinosaurs.

Pterosaurs are, of course, flying reptiles that existed from the Early Jurassic to the Late Cretaceous. It has long been thought that pterosaurs had a kind of "fuzz"on their skin (possibly fur or feathers), and this was thought to hint at thermoregulation in possibly warm-blooded animals. A recent paper by Cincotta (2022) expands the picture. These authors describe a new specimen of tapejarid pterosaur from Early Cretaceous of Brazil. This specimen, consisting only of a cranium, probably represents the genus Tapandactylus. This is a large pterosaur (5 meter wingspan), with a large crest of stretched skin parallel to the axis of the skull. The most interesting aspect of this specimen is that there appear to be small (a few millimeters long) filaments at the back of the crest. Some of these are a single shaft, and some have a central shaft and protruding branches; they resemble primitive types of feathers seen in some dinosaurs. The authors feel they can eliminate the "frayed skin fiber" explanation for the putative feathers. (I am old enough to remember the arguments in the mid-1990s about whether putative dinosaur feathers were frayed skin fibers.)

Examining the feathers and skin further using electron microscopy, the authors find embedded ovoid bodies that they identify as melanosomes. Melanosomes are tiny (10 micrometer) bodies containing pigments. These are found in the skin of reptiles and mammals, and in feathers of modern and fossil dinosaurs/birds. In living animals the shape of the melanosomes (e.g. spherical vs. elongated) is associated with the color of the pigment contained inside, and the assumption is that this is true of fossil animals. Many attempts have been made, therefore, to suggest the coloration of feathered dinosaurs, but those depend on the assumption that the correspondence of shape and a specific pigment is the same in living and extinct animals.

It has been previously suggested that pterosaurs had melanosomes in their skin, but this specimen shows more types than were previously observed. Since the shapes of the melanosomes in skin and feather types are different in Tapandactylus, the authors conclude that this particular pterosaur had more than one color. This obviously implies an additional "display" or "camouflage" function for feathers in pterosaurs, as we see in birds. The popular press exaggerates this to imply pterosaurs were "brightly colored," something that is plausible but we cannot know yet. Some popular accounts even state that pterosaurs could "change color", which is very dubious.

At the very least, this implies the origin of feathers early in the Triassic, before dinosaurs and pterosaurs diverged.

Sources:

Benton, M.J.
"A colorful view of the origin of dinosaur feathers."
Nature, 2022, 604, 630-631

Cincotta, A; Nicolaï, M; Campos, H.B.N.; McNamara, M.; D'Alba, L.; Shawkey, M.D.; Kischlat, E.-E.; Yans, J.; Carleer, R.; Escuillie, F.; Godefroit, P.
"Pterosaur melanosomes support signalling functions for early feathers."
Nature 2022, 604, 684-688.

## "Otherlands" and "A (Very) Short History of Life on Earth"— A Review

***Bob Sheridan February 20, 2022***

This week I read two recent and somewhat similar books in paleontology: "Otherlands" by Thomas Halliday and "A (Very) Short History of Life on Earth" (which I will abbreviate as AVSHOLOE to avoid much typing) by Henry Gee. Thomas Halliday is a paleontologist at the University of Birmingham, specializing in mammals and phylogeny. "Otherlands is his first book." Henry Gee is an editor of the journal Nature and has been writing books with a paleontological theme since the mid-1990's. (One of my favorite Gee books is on a literary subject: "The Science of Middle-Earth.")

**Reviews Cont'd**

Both books attempt to cover a large swath of "deep time". These are the chapters of "Otherlands":

1. Thaw: Northern Plain, Alaska—Pleistocene
2. Origins: Kanapoi, Kenya—Pliocene
3. Deluge: Gargano, Italy—Miocene
4. Homeland: Tinguiririca, Chile—Oligocene
5. Cycles: Seymour Island, Antarctica—Eocene
6. Rebirth: Hell Creek, Montana—Paleocene
7. Signals: Yixian, Liaoning, China—Cretaceous
8. Foundation: Swabia, Germany—Jurassic
9. Contingency: Madyen, Kyrgyzstan—Triassic
10. Seasons: Moradi, Niger—Permian
11. Fuel: Mazon Creek, Illinois—Caboniferous
12. Collaboration: Rhynie, Scotland—Devonian
13. Depths: Yaman-Kasy, Russia—Silurian
14. Transformations: Soom, South Africa—Ordovician
15. Consumers: Chengiang, Yunnan, China—Cambrian
16. Emergence: Ediacara Hills, Australia—Ediacaran
17. 17. Epilog: A Town Called Hope

These are the Chapters of AVSHOLOE:

1. A song of fire and ice (the pre-biotic earth)
2. Animals assemble (the Cambrian period)
3. The backbone begins (the Cambrian to the Devonian)
4. Running around (the rise of vertebrate land animals).
5. Arise amniotes (the rise of reptiles until the end-Permian extinction).

6. Triassic park (the extreme diversity of reptiles in the Mesozoic).
7. Dinosaurs in flight (the origin of bird-like dinosaurs and birds)
8. Those magnificent mammals (synapsids and mammals post the K-T extinction)
9. Planet of the apes (the origin of primates up to hominins).
10. Around the world (the radiation and dispersion of hominins, driven by climate change)
11. The end of prehistory (the origin of modern humans up to the present).
12. The past of the future (how climate and social interaction determines the fate of species)
13. Epilog (the fate of humans as a species)

Clearly "Otherlands" is going for a "you are there" snapshot of a given place and time and includes descriptions of many types of flora and fauna. Plus, it is going backwards in time. Obviously the narative is limited to those locations where the fossil record is exceptionally abundant. AVSHOLOE takes a more traditional forward-in-time look, has a bias toward the well-studied "transitions" in climate and evolution, almost all among large animals. It also follows the classic trope that implies humans are the end-point of the whole journey (something that is considered very old-fashioned nowadays). The epilogs of both books point out that humans are causing drastic changes to the climate and are causing a possible "sixth extinction."

"Otherlands" tends to use some technical terms for fossil groups and the reading is sometimes tough going. However, it tends to include more information a paleontological hobbyist might not be aware of. For example, I forgot that what is now the Mediterranean sea was dry land until it flooded 5.3 Myr. ago, or that seems the most parsimonious explanation. The story told in AVSHOLOE is somewhat familiar to us, and the writing is somewhat more informal.

Both books could be much improved by some illustrations. "Otherlands" has about one illustration per chapter, and for all but two, the illustration is a map of the locality being described. It would be helpful to have some idea of what the plants and animals being described looked like; words alone are often not enough. AVSHOLOE has no illustrations at all.

Sources:

Gee, H.
"A (Very) Short History of Life on Earth. 4.6 Billion Years in 12 Pithy Chapters."
St. Martin's Press, New York, 2021, 280 pages, $25 (hardcover)

Halliday, T.
"Otherlands. A Journey Through Earth's Extinct Worlds."
Random House, New York, 2022, 385 pages, $29 (hardcover)

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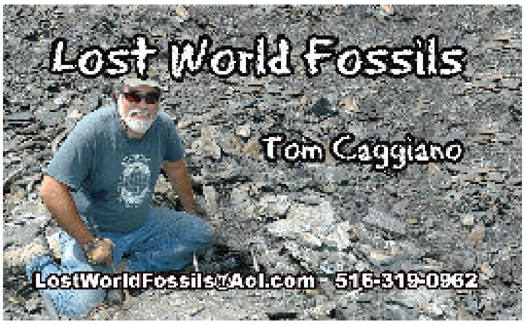


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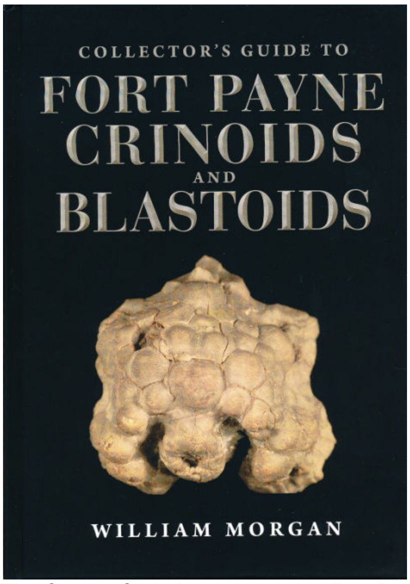


The focus of this book is on the Fort Payne Formation and the fossil crinoids and blastoids, which are found there. Although, it is not widely known outside of academic programs in geology and/or paleontology, the Fort Payne is one the largest Mississippian-age formations in the middle and southeastern United States.
Unlike the crinoids found in the Edwardsville Formation, which are world-renown for their completeness and aesthetic qualities, crinoids from the Fort Payne are rarely complete. Therefore, the first chapter of the book introduces the anatomy and the descriptive terminology essential for identifying crinoids collected from the Fort Payne.
The second chapter of the book introduces the ongoing revision of the classification of crinoids. This process was still ongoing at the time that is book was written.
The third chapter briefly reviews the better known of the fossilfiorous formations found in the Mississippian. More detail is provided for the geology and paleontology of the Fort Payne.
Collections of crinoids and blastoids from the Fort Payne are rarely publically displayed. Therefore, Chapter four proves high quality color photographs of some the best preserved specimens curated at major museums in the United States. In almost every case there are two photographs of each specimen, one unlabeled and a second with key features labeled and identified.
The fifth chapter reviews the morphology of blastoids and discusses the blastoids species currently known from the Fort Payne.

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