The Paleontograph

A newsletter for those interested in all aspects of Paleontology
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From Your Editor

In October of 1995, I became the Interim Editor for The Paleontograph, the newsletter of the New Jersey Paleontological Society. I kept the title for about 4 years hoping a permanent replacement would come along but of course, no. We were putting out 10 issues per year. I held the position until 2012 when NJPS effectively went out of business. At the time I was enjoying the job and Bob Sheridan was enjoying writing articles so we decided to keep publishing on our own. I expanded the mailing list and we currently send to several hundred people.

As the years past, Bob kept up his incredibly prolific pace, I however started to tire and my pace of publishing started to slow and I developed a back log of articles. Last year, Bob and I decided to call it quits. So I hereby offer our last issue. It's been an honor to work with such a smart and talented writer as Bob, and I've enjoyed the kind comments I've received through the years from you the readers. Live long and prosper.

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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Jakapil

Bob Sheridan August 26, 2022

"Thyreophora" is the collective name for ornithischian dinosaurs with skin armor, and it includes stegosaurs and ankylosaurs. These all are herbivores with small teeth and leaf-shaped crowns. Members lived from the mid-Jurassic to the Late Cretaceous. Almost all fossils are from the northern hemisphere. The most famous thyreophorans (e.g., Stegosaurus, Ankylosaurus) are large, robust, and quadrupedal, but the basal members could be small, slender, and even bipedal.

Riguetti et al. (2020) describe a basal thyreophoran from the Late Cretaceous of Argentina. They give this specimen name *Jakapil kaniukura* (from "shield bearer, stone crest" in the Tehuelchean language). This is a fairly fragmented specimen, consisting of a complete mandible, parts of the maxillary, a scapula and bits of the arm, parts of the pelvis and legs, a few vertebrae, and a few bony spikes and oval osteoderms. The entire animal would be 1.4 meters long; it may be a sub-adult. The arm is very small, indicating that this was definitely a bipedal animal. The jaw is very robust and it contains a large predentary bone. The predentary bone is a characteristic of ornithischian dinosaurs and is thought to anchor a toothless beak. This is the first predentary known from a basal thyreophoran. The osteoderms are flatter than in those previously known basal thyreophorans, which usually have some kind of "keel."

Phylogenetic analysis shows Jakapil is anatomically closest to Scelidosaurus, Scutellosaurus, and Emausaurus, which are all basal thyreophorans before the split between stegosaurs and ankylosaurs. Those dinosaurs lived in the mid-Jurassic, while Jakapil lived to the Late Cretaceous, so Jakapil is a very late survivor of that group. Also, Jakapil is the only definitive thyreophoran from South America, and demonstrates thyreophorans had a broader distribution than has been previously realized.

Sources:

Riguetti, F.J.; Apesteguía, S.;Pereda-Suberbiola, X.

"A new Cretaceous thyreophoran from Patagonia supports a South American lineage of armoured dinosaurs."

Scientific Reports 2022, 12:11621

Heart of a Placoderm

Bob Sheridan September 23, 2022

The Gogo Formation in Western Australia is a Lagerstatte that records life from a Devonian reef. The most interesting fossils are found in concretions. The fossils are usually three-dimensional and can contain the remains soft tissue. From this source, there is evidence of fish giving live birth, since structures as delicate as an "umbilical cord" can be seen. There are 50 described species of Gogo fish.

Historically, the preparation of these fossils is done by dissolving the limestone matrix in acid. However, nowadays it is common to do CT-scanning of specimens. Trinajstic et al. (2022) describe a CT-scan of a Gogo placoderm Bothriolenis. Placoderms are armored jawed fish (the most famous of which is probably Dunkleosteus). The entire specimen under study would be about 15 cm long. Authors describe internal organs: heart and attached blood vessels, esophagus, stomach, liver, intestine. The stomach is smooth on the outside but rugose on the inside, as expected. The liver has two lobes. The intestine has a spiral arrangement, as seen in many fish. The structure of the heart seems to be the most interesting finding. As with all fish, it is two-chambered, with an atrium and a ventricle. However, its placement is not in the "chest" as we might expect from modern fish. It is quite far forward and ventral, basically within the mandible, and near the gills. The size of the heart is not discussed, but to my eyes it seems quite small (1 cm) for a fish that size.

Also interesting is what is not there. There is no sign of a swim bladder or lungs. It has been speculated that those might have been a primitive characteristic for fish in general, but this finding means that those characteristics are more derived, probably starting with early bony fish.

Sources:

Trinajstic, K.; Long, J.A.; Sanchez, S.; Boisvert, C.A.; Snitting, D.; Tafforeau, P.; Dupret, V.; Clement, A.M.; Currie, P.D.; Roelofs, B.; Bevitt, J.J.; Lee, M.S.Y.; Ahlberg, P.E.

"Exceptional preservation of organs in Devonian placoderms from the Gogo lagerstätte,"

Science (2022) 377, 1311–1314.

Jeholornis as a Fruit-eater

Bob Sheridan, August 30, 2022

Jeholornis is a primitive turkey-size bird from the Early Cretaceous Jehol formation in China. There are about a hundred known specimens. Jeholornis is primitive in the sense that it retains a theropod-like skull, retains at least few teeth, and has a long bony tail. We have some idea of its diet because some specimens are preserved with seeds in what would be its crop. There are several specimens where feathers have been preserved. Jeholornis has very long modern-looking flight feathers on its wings. There are about five tail feathers on each side confined only to the tip of the tail. The feathers don't overlap, so they give the tail the appearance of a "palm frond." The small size and structure of the feet suggest Jeholornis was not much of a runner, but could perch on branches.

Flowering plants became very common during the Early Cretaceous. Many flowering plants generate fruit which by definition contain seeds. Some modern birds eat fruit and defecate the seeds undigested. Some birds digest seeds, in which case they must dehusk the outer covering from the seed with their beaks, or grind the seeds in their gizzards. It is a matter of interest when the relationship between flowering plants and birds began. Jeholornis is a good place to look because it is an early bird with well-preserved stomach contents.

Hu et al. (2022) propose to deduce the dietary preference of Jeholornis with two approaches:

1. Compare the mandible and cranial shape of Jeholornis with those of modern birds with known dietary preferences.
2. Analyze the apparent seeds fossilized in the guts of Jeholornis.

Given the CT-scan of a new, particularly well-preserved, uncrushed skull of Jeholornis, the authors compared the mandible and cranium against 160 species of living birds and about a dozen species of Mesozoic birds. The living birds are divided into groups by diet: seed-crackers (song birds), seed-crackers (parrots), seed-grinders, fruit-eaters, and "other". Shape characteristics all birds is projected into 3 dimensions. The idea is to see which group of living birds Jeholornis is closest to and to see if Jeholornis is different from other Mesozoic birds. According its mandible shape, Jeholornis falls among fruit-eaters, seed-grinders, and "other"; these groups are not well-distinguished among living birds. According to its cranial shape, Jeholornis is separate from modern seed-crackers. The authors also argue that the teeth of Jeholornis are too small and weak to exert the force necessary to crack seeds. Jeholornis is not much like other Mesozoic birds except that its skull is deep from top to bottom, and it has small eyes and nares, which are primitive dinosaurian characteristics compared to modern birds.

So far, it is not possible to tell whether Jeholornis is a fruit-eater or seed-grinder. Those may be distinguished by looking at the stomach contents of Jeholornis and modern birds by CT-scanning. Modern birds that are seed-grinders have seeds in their guts that are heavily abraded and/or densely packed around large gastroliths. The seeds in Jeholornis appear to be perfectly round and sparsely distributed. Also Jeholornis has relatively small gastroliths.

The authors conclude that Jeholornis could have eaten fruit (although what kind of fruit is not known). This would be the earliest evidence of birds doing so, with the implication that by the Early Cretaceous, fruit eaten by birds was already mechanism by which flowering plants dispersed their seed. It is striking that the shape of the mandible and cranium are not very good ways to distinguish the diet of modern birds. That is probably because birds eat a variety of foods which change with the seasons. The authors say this is probably true of Jeholornis as well.

Sources:

Hu, H.; Wang, Y.; McDonald, P.G.; Wroe, S.; O'Connor, J.K.; Bjarnason, A.;Bevitt, J.J.; Yin, X.; Zheng, X.; Zhou, Z.; Benson, R.B.J.

"Earliest evidence for fruit consumption and potential seed dispersal by birds."

eLife 2022, 11:e74751.

Saccorhytus Revisited

Bob Sheridan August 27, 2022

This story will require a little background. Deuterostomes ("second mouth") is a group of animals that includes chordates (vertebrates, tunicates, etc.) and echinoderms (starfish, sea urchins, etc.), plus possibly some extinct taxa such as vetulicolians, and vetulocystids. The group is named for the fact that during early embryonic development the opening in the blastocyst (the "blastopore") ultimately becomes the anus, while the mouth appears later. Molecular studies seem to support the existence of the deuterostomes as a natural group. Ecdysozoans is the name given to the group containing arthropods, nematodes, tardigrades, velvet worms, penis worms, and some others. Molecular studies also support this as a group. Ecdysozoans tend to grow by shedding their cuticle. They do not have cilia on their surface. Ecdysozoans are protostomes, i.e., where the first opening in the blastocyst is the mouth. Both deuterostomes and protostomes are "bilaterans," i.e. the left and right are mirror images.

The second bit of background is the animal Saccorhytus ("wrinkled sack"). These phosphatized fossils are found in Early Cambrian deposits in southern China. They seem to be a hollow bilaterally-symmetric ellipsoids roughly 1 millimeter in diameter with a large slit-like "mouth" in the middle of the ellipsoid, surrounded by smaller pores and spike-like protrusions. There is no anus or other indication of a digestive system. The popular press likens their appearance to the "minions," just because of their egg-like shape. Specimens are studied by scanning electron microscopy and CT-scanning. They seem to be flexible because different specimens show different deformations, and a reasonable amount of reconstruction needs to be done.

The first description of Saccorhytus was done by Han et al. (2017), and I wrote about this for the Paleontograph. The authors developed an argument that Saccorhytus is an early deuterostome based the fact that Cambrian vetulicolians like Didazoon (China) and Banffia (Burgess Shale), which are thought to be deuterostomes, appear to be bilaterally symmetric hollow tubes with a flexible cuticle. These animals also have protrubances around the mouth similar to those of Saccorhytus. In this interpretation, the conical openings in Saccorhytus are equivalent to the "gill openings" in vetulicolians.

A new paper this year, Liu et al. (2022) reanalyzed another set of better preserved specimens using similar methods. They concluded that some of the "gill openings" are really broken off spikes, which eliminates the resemblance to vetulicolians. Also the skin seems to consist of two layers. Presumably this is a "cuticle" with no cilia, as expected in a ecdysozoan. The spikes around the mouth are similar to those of some known ecdysozoans. Therefore the authors assign Sacchorhytus to the ecdysozoans.

This is what I said in 2017 about the conclusions of Han et al.:

In my mind Saccorhytus is similar to many Cambrian "problematica." It has a few characteristics linking it to other groups of animals, but too few to make the links convincing. I do not find the interpretation of Saccorhytus as a deuterostome compelling, mostly because the characteristics cited (hollow flexible body, bilateral symmetry, small openings, protrubances, etc.) can be found in non-deuterostomes. The fact that it has no anus makes it hard for me to equivalence it to adult deuterostomes, which have a tubular digestive system. It is also hard to eliminate the possibility that Saccorhytus is a larva (perhaps of vetulicolians, perhaps of something else). Finally, to take skepticism to an extreme, except for the bilateral symmetry, the features of Saccorhytus are just as easily interpreted as sponge-like, or algae-like.

I have similar feelings about the new assignment by Liu et al.. Even though a phylogenetic tree is shown, again this depends on interpretation of very few features. The lack of an anus is a strong argument against Sachorhytus being a member of either group of animals. Cnidarians (the group containing jellyfish, corals, etc.) are the only large phylum with only a mouth, but the authors do not attempt to eliminate them as a possibility.

Sources:

Han, J.; Morris, S.C.; Ou, Q.; Shu, D.; Huang, H. "Meiofaunal deuterostomes from the basal Cambrian of Shaanxi (China)."
Nature 2017, 542, 228-231.

Liu, Y.; Carlisle, E.; Zhang, H.; Yang, B.; Steiner, M.; Shao, T.; Duan, B.; Marone, F.; Xiao, S.; Donoghue, P.C.J.
"*Saccorhytus* is an early ecdysozoan and not the earliest deuterostome."
Nature 2022, https://doi.org/10.1038/s41586-022-05107-z

Did Triceratops Fight with His Horns—Revisited

Bob Sheridan September 13, 2022

Today's story is a follow-up on a paper from 2009, so I will repeat some of my write-up in the Paleontograph from that time:

One cannot see a dinosaur special without a mention of Triceratops (and other ceratopsian dinosaurs) engaging in combat with other members of their species, but this is mostly speculation. We know that different ceratopsian species have different frill shapes and densities and different horn arrangements, the two most popular being two long horns over the eyes and a short one on the nose (e.g., Triceratops, Torosaurus) versus tiny horns above the eyes and one large horn on the nose (e.g., Centrosaurus, Styracosaurus). In modern biology when it is observed that closely related species have different "ornamentation," the ornamentation is not so much "functional" as for sexual display and/or identification. The animals may engage in physical contests using the ornaments as weapons against rival males (e.g., the antlers of deer). Alternatively they may merely display the ornaments to rival males and candidate females (e.g., the plumage of birds). So the idea of ceratopsian horns as sexual display devices has almost totally superseded the 19th Century idea that the ceratopsian horns and frills were for defense against predators.

Many ceratopsian frill bones exhibit signs of re-healed injuries, but are these signs of combat among species members, or are they signs of attempted predation, or common accidents, etc.? A paper by Farke et al. (2009) puts the combat idea to a test. The argument is as follows: Triceratops has long brow horns. If it engaged in intraspecific combat, injuries to the frill should be inflicted with the tips of the horns, and the injuries of the victims would be from the cheeks back. In contrast, Centrosaurus has only a long nose horn and all injuries would be at near the snout. On the other hand, if frill injuries were not due to combat, the injuries should have a similar distribution in Triceratops and Ceratosaurus.

Farke et al. counted healed fractures and calluses on skull elements of Triceratops and Ceratosaurus, looking at the bones that are particularly abundant in the fossil record: nasal (the top of the snout, excluding the horn core on the nose), jugal (the cheek), squamosal (side of the frill), and parietal (top of the frill) bones. The frequency of injuries to the nasal, jugal, and parietal bones were about the same for Triceratops and Centrosaurus. However, the frequency of injury to the squamosal bone was higher in Triceratops, which is consistent with combat among Triceratops.

…end of retrospective .

Recently, D'Anastasio et al. (2022) published a histological analysis of a frill wound in one specimen ("Big John") of Triceratops horridus from the Hell Creek Formation. Big John has a keyhole-shaped perforation of the right squamosal. It should be able to distinguish whether the perforation is due to an injury, or a natural reabsorption of bone due to, say, from aging. The bone around the perforation is very "disorganized" and vascularized as opposed to bone further way, which is very dense. Chemical analysis shows the bone near the perforation is rich in sulfur, which can be explained by the presence of glycosaminoglycans, indicative of inflammation. These observations are indicative of remodeled bone that is in the process of mineralization. The conclusion is that the perforation was caused by a wound when the animal was alive, and not, say, postmortem damage. Since bone remodeling is well-studied in mammals, but not in reptiles, it is not easy to estimate how long the perforation was healing before Big John died, but the authors estimate at least six months.

The authors feel the perforation was inflicted from the rear of the frill, although they do not explain why in detail. This would not be expected from the styles of face-to-face jousting one usually assumes for Triceratops. The authors say this study "confirms the existence of intraspecific fighting in Triceratops," but I would not go this far. We know that a perforating wound was made, but there is no direct evidence that it was made on purpose by another Triceratops.

Sources:

D'Anastasio, R.; Cilli, J.; Bacchia, F.; Fanti, F.; Gobbo, G.; Capasso, L.

"Histological and chemical diagnosis of a combat lesion in Triceratops."

Scientific Reports 2022, 12:3941

Farke, A.A.; Wolf E.D.S.; Tanke, D.H.
"Evidence of combat in triceratops."
Plos One 2009, 4, e4252

Do “Hadrosaur Mummies” Depend on Special Conditions?

Bob Sheridan October 14, 2022

Dinosaurs with large patches of preserved skin surrounding the skeleton are not particularly uncommon. Most of these are so-called “hadrosaur mummies,” and most of these are a specific hadrosaur, Edmontosaurus. The first was discovered in Wyoming by Charles Sternberg in 1908. That specimen is in the American Museum of Natural History. Hadrosaur skin is composed of non-overlapping polygonal “tubercles” between 1 and 3 millimeters in size.

The usual explanations about why the skin did not decay and lasted long enough to be mineralized as a fossil is that the carcass desiccated and then was completely buried in quick succession, say by a flood. There are three obvious difficulties with this explanation:
1. The carcass cannot be exposed long enough to be desiccated and be buried before decay sets in.
2. Hadrosaurs did not live in an environment dry enough to desiccate them.
3. Mummies are too common to have been the results of “special conditions” of desiccation and burial.

Drumheller et al. (2022) reexamine an Edmontosaurus mummy (specimen NDGS 2000) from the Hell Creek Formation of North Dakota. The skeleton is complete except for the head and the end of the the tail. Skin is revealed on the right arm, left foot, and the proximal part of the tail. More skin may be revealed when the specimen is prepared further. The specimen is studied by visual inspection and CT-scanning.

These authors note the following about this specimen:

1. The skin is “deflated” around the bones. There are no “internal organs” and little “soft tissue” seen in the CT-scan.
2. Some of the bones have puncture tooth marks. It is not clear what made those marks, but the authors think a crocodylian is the best guess. The skin shows some puncture and tear marks that show no signs of healing.
3. The size of the soil grains around the specimen is not consistent with a high-energy environment such as a flood. There is clay inside the skin. No other animals are buried with the specimen.

The direct inference is that this carcass was breached by scavengers, was exposed long enough for the soft issue to be eaten by insects or decayed by bacteria, and it was never buried by a flood. This suggests that hadrosaur skin is preserved for different reasons: it is naturally resistant to decay and scavengers are not interested in eating it. Nothing special needs to happen for the skin to be preserved and this is way we see so many “mummies”.

Sources:

Drumheller, S.K.; Boyd, C.A.; Barnes, B.M.S.; Householder, M.L. “Biostratinomic alterations of an *Edmontosaurus* ‘mummy’ reveal a pathway for soft tissue preservation without invoking ‘exceptional conditions’” PLoS ONE 2022, 17:e0275240

New Flora and Fauna from the Ediacaran

Bob Sheridan September 29, 2022

Ediacaran biota (named for the Ediacara Hills in Australia where they were first identified) are a group of Precambrian fossil organisms that lived world-wide 600-545 Myr. Most of the fossils are only sediment-filled impressions in rock. Most appear to have very simple symmetrical structures, resembling “fronds," “air-mattresses," “spirals," etc. A few have more complex structures, but these appear fractal in nature, i.e., tubular branches coming off larger branches, which come from even larger branches. Some Ediacaran biota may be groups of organisms that went extinct before the Cambrian. Others might be early versions of groups that lived to the Cambrian. Linking the Ediacaran fauna to any type of later plant or animal by anatomy has been very difficult. However, there are specific cases where a semi-convincing case can be made. Today’s story is about some new examples.

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Ediacaran **Cont'd**

Chai et al. (2022) describe small (0.5 millimeter diameter) sphere-shaped fossils from the Ediacaran (~541 Myr.) Dengying Formation in southern China. Like some other fossils in Precambrian China, these are phosphatized, i.e., the organic parts are preserved by being replaced by calcium phosphate; thus soft parts are preserved in sub-micron resolution. Typically the phosphatized fossils are dissolved out of limestone by acid before they can be studied. Here, the fossils are studied by scanning electron microscopy and micro-CT-scanning. The spheres have an outer layer of club-shaped round-end tubes (presumably cells) about 0.1 millimeter long packed together tightly on their long axis. The inner part of the sphere looks like a set of intertwined filaments about 3 micrometers in diameter that seem to connect at the bottom of the cells. These specimens are given the name species Protocodium siense ("first Codium from China"). As an aside, China has also some famous Precambrian fossils called "Doushantuo embryos" which are spheres of roughly the same size as Protocodium, but composed of more-or-less spherical cells filling the entire volume. Protocodium is very different from these.

The authors link Protocodium with a widely studied Precambrian fossil called Chuaria, which appears to be a sphere few millimeters in diameter (although usually squashed flat as fossils), and is currently thought to be an early multicellular algae. However, the most favored link (as you would expect from the name) is the modern "seaweed" Codium, of which there are many species. Codium has the form of branched tubes a few millimeters in diameter. The tubes have a very similar cross-section to Protocodium in that there appear to be long cells packed together on the outside and an intricate network of filaments on the inside. It is easy to imagine the spherical Protocodium evolving into a tubular form. Codium belongs to a group of green algae called the Bryopsidales, and the authors suggest the origin of that group is in Precambrian, earlier than was previously suspected.

The second story has to do with cnidarians, the modern animal group to which jelly fish, coral, sea anemones, etc., belong. These have two-cell-thick tubular bodies with only a mouth, and they often have stinging cells. Aside from sponges, they are considered one of the first modern phyla to arise. Except for corals, which excrete calcium carbonate, cnidarians are rarely preserved as fossils. Dunn et al. (2022) describe a possible cnidarian fossil from the Ediacaran "Charnwood Forest" in England (557-562 Myr.) The original specimen is an impression on a rock surface, and the study was done on a mold. Next to the specimen are well-studied Ediacaran species such as Chamia and Bradgatia. The specimen is given the name Auroralumina attenboroughii ("dawn light" and after naturalist David Attenborough). This specimen is 20 cm long. It consists of two joined branches (called the periderm) about 1 cm in diameter along most of their length. At the end of each branch is a "cup" or "goblet" about 6 centimeters wide. The orientation of the two cups is different, implying there is some twisting flexibility to the branches. Inside each cup appears to be a set of tentacles. The tentacles are much less clear in impression than the branches, implying that the branches are made of a more rigid material. The restoration resembles two sea anemones sitting in cups on the end of long rigid stalks.

The authors' phylogenetic analysis suggests Auroralumina nests within the medusozans, which is a crown-group cnidarian that includes a medusa-like (e.g., free swimming umbrella shape) form in its life cycle. This group also includes sea anemones that live in soft tubes. Cnidarians that live in tubes of various types (both soft and calcified) are common fossils from the Cambrian. Auroralumina suggests that a modern group of tube-dwelling cnidarians originated in the Ediacaran and gave rise to the Cambrian forms.

Sources:

Chai, S.; Aria, C.; Hua, H.

"A stem group *Codium* alga from the latest Ediacaran of South China provides taxonomic insight into the early diversification of the plant kingdom."

BMC Biology 2022, 20:199

Dunn, F.S.; Kenchington, C.G.; Parry, L.A.; Clark J.W.; Kendall. R.S.; Wilby, P.R.

"A crown-group cnidarian from the Ediacaran of Charnwood Forest, UK." Nature Ecology & Evolution 2022, 6, 1095-1104.

Laflamme, M.

"Lifting the veil on the oldest-known animals."

The Art and Science of the Crystal Palace Dinosaurs—A Review

Bob Sheridan October 11, 2022

As an enthusiast of paleoart and of the history of science, I often read about the Crystal Palace dinosaurs. Crystal Palace Park is a 389 acre area dedicated to the celebration of science and commerce during the period 1854 to 1936. At one end of the park was "The Crystal Palace," a large glass and steel building where exhibits were housed (named after a building from a "Great Exhibition" held in 1851). Part of the park was a 20 acre "Geological Court" which contained about three dozen life-size sculptures of prehistoric animals. The Court was divided into three sections called "Primary," "Secondary," and "Tertiary"—what we would now call "Paleozoic," "Mesozoic," and "Cenozoic." The artist in charge of the project was Waterhouse Hawkins, and he was advised by Richard Owen, the foremost comparative anatomist of the time, and originator of the word "dinosaur." Most of the Park was destroyed in a fire in 1936, but the majority of the sculptures (in various states of repair) still stand 170 years later.

Usually you hear only about the dinosaur sculptures, and in disparaging terms. Specifically, that they were extrapolated from inadequate data (no complete dinosaur skeleton was known at the time) and were heavily influenced by the idea that dinosaurs were enlarged modern reptiles. Thus, the story usually goes, the sculptures are sad relics of a bygone age of ignorance. On the positive side, it is sometimes added, the sculptures caused the first outbreak of "dinomania" in the public.

Those are defensible views, but the truth turns out to be more complicated. Just how complicated is revealed in a new book "The Art and Science of the Crystal Palace Dinosaurs" by Mark P. Witton and Ellinor Michel. Witton is at the School of Earth and Environmental Sciences at the University of Portsmith, UK. He is a freelance artist as well as a paleontologist and has a blog at http://markwitton-com.blogspot.com. I have reviewed three books by him for the Paleontograph: "Pterosaurs" (2013), "The Paleoartist's Handbook" (2018), and "Life Through the Ages II" (2020). Ellinor Michel is an evolutionary biologist and taxonomist at the Natural History Museum London. "The Crystal Palace Dinosaurs" is a "coffee-table book" in that about half of the page are is illustrations: vintage photos of the sculptures, period paintings, and some modern restorations.

The chapters are:

1. Islands covered by strange figures.
2. Ancient worlds through a Victorian lens: planning the Geological Court.
3. Bricks, iron, and tiles: rebuilding the past
4. The sculptures: mammals.
5. The sculptures: Mosasaurus hoffmanni
6. The sculptures: flying reptiles
7. The sculptures: dinosaurs
8. The sculptures: Teleosaurus chapmani
9. The sculptures: enaliosaurs
10. The sculptures: Labyrinthodon
11. The sculptures: Dicynodon
12. The reception and legacy of the Geological Court
13. Past becomes future: the conservation of the Geological Court.

I learned many things from this book. Among the most important is that there were many non-dinosaur sculptures: marine reptiles, pterosaurs, mammals, crocodylians, synapsids, etc. Some of these (ichthyosaurs, plesiosaurs, and mammals) were known almost entirely by the 1850s, so their sculptures are pretty accurate by modern standards. I was surprised to see the number of mammals at the Geological Court (Megaloceros, Megatherium, Paleotherium, and "Anoplotherium"). There were more Cenozoic animals planned, but budgetary concerns for Crystal Palace Park brought an end to the entire project in 1855.

As noted above, the dinosaur sculptures (Iguanodon, Megalosaurus, Hylaeosaurus) are shown as crosses between an iguana and a rhinoceros. This is somewhat ironic since there was enough information at the time to infer that Iguanodon was probably bipedal (because of its smaller arms). On the other hand, these animals were shown with their legs hanging straight below their hips, which is quite cutting edge for the time, correct for dinosaurs, and not at all like modern lizards. Similarly, pterosaurs ("Pterodactylus") were incorrectly depicted as being swan-like in their appearance, having much too small a head for our modern idea of pterosaurs. "Dicynodon" is a total miss. At the time this animal was known only from its skull, with a beak and two downward-pointing tusks. Today we recognize this type of animal as a synapsid (e.g. a mammal ancestor), but in Crystal Park, it is depicted as a turtle, because at the time only turtles were known to have beaks like that! "Laryrinthodon" is a mistaken chimera of amphibian and reptile parts.

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Crystal Palace Cont'd

I should also note that all the marine reptiles (ichthyosaurs, plesiosaurs, mosasaurs) were depicted shuffling on land like seals. This is a convention of paleoart at the time, although now we know these animals were totally marine and never came ashore. Interestingly, these sculptures were to be hidden and revealed by an artificial tide inside the Park, although that turned out too expensive in practice to execute.

In addition to the animals, the Geological Court contained simulated "outcrops" of geological formations (Lias cliff, Chalk cliffs, Old Red Sandstone, etc.) as part of the landscape. This seems strange nowadays, but geology was a new science at the time, so presumably showing the foundational data in the form of rocks seemed important.

No one had attempted life-size dinosaur sculptures before, and new techniques needed to be developed. Some small sculptures where built in a workshop and dragged by sledge to the location, but the larger ones had to be built in place. Nowadays we would use light fiberglass as a material, but at the time the sculptures were made with steel bars, bricks, and cement. Some weight was saved by leaving an open space in the center. Skin detail was added with molds, and the sculptures were painted, although it is sometimes hard to discern now what the original colors were. Given the friable materials, and the fact that the sculptures were outdoors for many decades, it is not surprising that they were susceptible to erosion and vandalism. By now, most individual sculptures have restored and repainted at least a few times. A few sculptures have been lost totally because they were beyond repair. One statue was moved to a petting zoo in the Park in 1953. Some of the more recent restorations involve modern techniques, for instance the snout of Megalosaurus was replaced with a temporary 3D printed plastic model. There is a contemporary non-profit organization "Friends of the Crystal Palace Dinosaurs" (cpdinosaurs.org) that coordinates the fundraising and reconstruction efforts.

It is common knowledge that Richard Owen was the paleontological consultant for the project, but I'd never heard before that he was actually second choice. The first choice was Gideon Mantell (62 years old in 1852 when the project was started). Mantell was the discoverer of Iguanodon (the second known dinosaur), was widely recognized as an authority on prehistoric life, was an experience communicator, and had created some displays for the Great Exhibition. Mantell turned down the offer because he felt the exhibit needed more explanatory panels and actual fossil specimens in addition to the sculptures. Also, he was partially disabled from a carriage accident that happened ten years before. Richard Owens (48 at the time) was the preeminent comparative anatomist in England, was a member of the aristocracy, and had worked with Waterhouse Hawkins before. Owen's modern reputation is negative because, because he (incorrectly, from our point of view) opposed any idea of evolution. However, even at the time he was known as a very prickly character who was cruel to his peers and took credit where it was not due. As it turns out, he contributed very little to the project, and criticized it later.

The authors are lukewarm on the idea that the Crystal Palace Dinosaurs caused "dinomania," since dinosaur-themed books and magazines were popular before the 1850s. On the other hand, it might be the first time that some iconic restorations were widely copied, since one sees the influence of the Crystal Palace sculptures on paleoart for decades to come, even when they are known to be inaccurate. (Much like the work of Charles R. Knight is copied in our time.) Also, this may have been the first time paleontological "merch" was available, specifically 1:12 size bronze statues of the animals, although it is not clear whether these were cast from the original clay models from the project or are knock-offs.

This is one of the best paleoart/science history books I have read in a long time. A lot of first-class historical scholarship went into it, and I learned a lot of things I had no idea about. Highest recommendation from me.

Sources:

Witton, M.P.; Michel, E.

"The Art and Science of the Crystal Palace Dinosaurs."

Crowood Press, Ramsbury, UK 2002 192 pages $65 (hardcover).

The Princeton Field Guide to Mesozoic Sea Reptiles—A Review

Bob Sheridan October 29, 2022

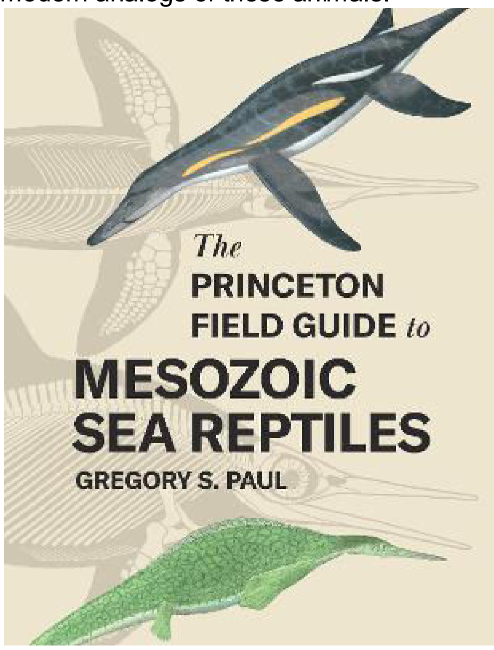
"The Princeton Field Guide" series is aimed at serious hobbyists or professionals in paleontology. "The Princeton Field Guide to Dinosaurs" by Gregory S. Paul first came out in 2010 and had a second edition in 2016. "The Princeton Field Guide to Prehistoric Mammals" by Donald Prothero came out in 2017. "The Princeton Field Guide to Pterosaurs" by Gregory S. Paul came out in 2022. I reviewed all these for the Paleontograph. Now we have "The Princeton Field Guide to Marine Sea Reptiles" by Gregory S. Paul. This is very similar to "Pterosaurs" in organization, and I will repeat some of that review.

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

We usually hear much about ichthyosaurs, mosasaurs, and pliosaurs/plesiosaurs because these are the most unlike creatures today, and those groups are totally extinct now. However, Paul goes extends the discussion to groups like marine turtles, sea snakes, and marine crocodiles, all of which left Mesozoic fossils, but which survive today. There also many miscellaneous, and relatively poorly understood, groups of Triassic reptiles like thalattosaurs, placodonts, tanystropheids, etc.

Presumably the ancestors of the marine reptiles started on land (as egg-laying reptiles), went through an amphibious phase, and eventually became totally aquatic. We have fossils including embryos (mostly for ichthyosaurs), so we can confirm many of them gave live birth and never need to move onto land. However, we have very little idea of the early evolution of most groups.

The lifestyle of many of these extinct marine reptiles can be guessed because they anatomically converged on the same shapes and habitats that marine mammals converged on. The most famous example is the similar shapes of ichthyosaurs and dolphins. This is supposedly due to the fact that the problem of being an air-breathing animal that has to move rapidly through water and eat smaller animals has only a few anatomical solutions. On the other hand, some marine forms ended up with extremely long necks, plesiosaurs by increasing the number of cervical vertebrae, and tanystropheids by increasing the length of individual vertebrae. There are no modern analogs of these animals.



The first half of TPFGTMSR contains 16 chapters, some of which contain up to 9 subchapters. These cover topics such as swimming, senses, energetics, etc., in a few pages. The chapter on "swimming, " for example was interesting, in that it is not fully understood whether flippers in pliosaurs/plesiosaurs were used as "oars" (as in turtles) or "wings" (as in penguins). An interesting contrast between marine reptiles and modern cetaceans in the "senses" department is that the latter have echolocation, while there is no evidence for associated structures in the reptiles. Therefore, the probably depended more on sight in deep water, and we know ichthyosaurs had especially big eyes. As is common with Paul's books, some of these chapters are purely speculative, e.g., that chapter "If Ancient Sea Reptiles" survived.

Cont'd

The second half of the book is a 135 page overview of the known species of marine reptile with some very good "skeleton in silhouette" reconstructions. Each species has data about length, estimated mass, anatomical characteristics, extent of remains, probable habitat, etc. For those of you who love to read the encyclopedia, this is perfect.

This book is very well illustrated as well, the main text having an average of one illustration per page. A caveat, though: As would be expected, Paul illustrates his own books. He does four types of illustrations:

1. Ink renderings of the "skeleton in a silhouette". These are the most common.
2. Ink diagrams comparing extinct sea reptiles, to extant fish, whales, etc.
3. Pencil restorations of animals in standard poses.
4. Painted or color pencil life restorations of the animal in its environment.

There is one useful diagram of the various sub-groups of reptiles and when they flourished in the Mesozoic. However, readers looking for photographs of fossils will not find them here.

Among all the Princeton Field Guides, I found myself a little disappointed with this one. It was a little abrupt starting with general discussions about sea reptiles in the first half of the book (although these were good summaries) to being immediately dumped "into the weeds" with listing of individual species. I was hoping for an extensive discussion of each group, their characteristics, origins, and history of discovery. The "Biology" chapter does this in a summary form within six pages but only for anatomical characteristics.

Sources:

Paul, G.S.
"The Princeton Field Guide to Mesozoic Reptiles". Princeton University Press 2022, 208 pages, $30 (hardcover).

Dinosaurs. New Visions of a Lost World—A Review

Bob Sheridan November 2, 2022

Today's book is "Dinosaurs: New Visions of a Lost World" by Michael Benton. Benton is a professor of vertebrate paleontology at the University of Bristol. He has written a number of popular works. I reviewed "Dinosaurs Rediscovered (2019) and "When Life Nearly Died" (2015) for the Paleontograph. He also wrote an important textbook "Vertebrate Paleontology" that has gone through several editions.

From the title you might expect DNVOALW to be an updated overview of dinosaurs, much like "Dinosaurs Rediscovered". However, a more accurate title would be "Fifteen Mesozoic Animals for Which We Can Make a Good Guess as to Its Appearance." We can make that guess because integument and/or other soft tissue was preserved for some specimens. This book is a "deep dive" into those particular animals.

The first six animals (Sinosauropteryx, Anchiornis, Caudipteryx, Microraptor, Archaeopteryx, and Confusiusornis) are birds or bird-like dinosaurs that have feathers of various types. In cases where where melanosomes (microscopic pigment-containing bodies) are present in the feathers, we can tell what color the feathers were, and how the color was arranged (stripes, etc.) based on the presence and shape of the melanosomes.

At one time (1990's) it was thought that only bird-like dinosaurs had feathers. A little later a large number of non-flying theropods, some very large, were discovered to have feathers. It now appears that all types dinosaurus might have had feathers, and not only saurischians. Psittacosaurus (a stem ceratopsian—an ornithischian) has long bristles on its tail, that appear feather-like. (The author compares the bristles to the fibrous "beard" feathers poking out of the chest of turkeys.) A dinosaur called Kulindadromeus, a small Jurassic ornithopod (another ornithischian) is apparently covered with feathers of various types.

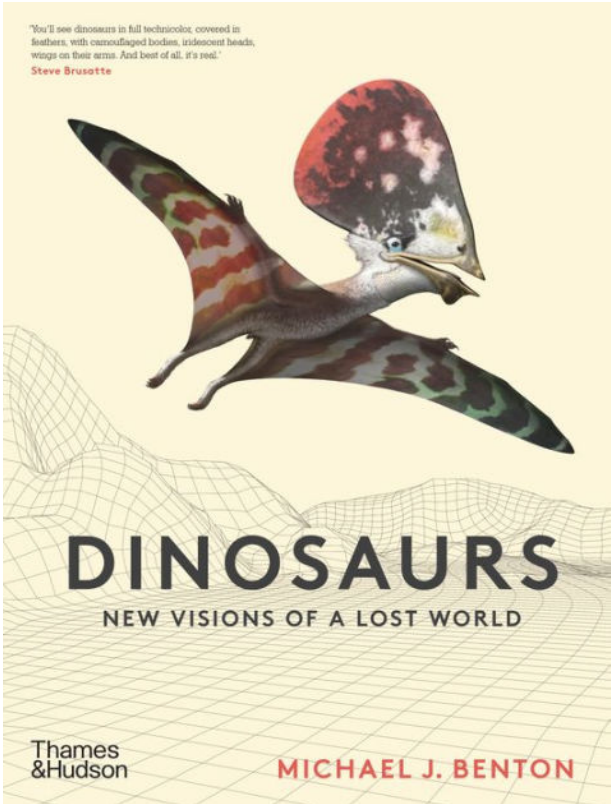
There are three non-feathered dinosaurs discussed: Edmontosaurus, Saltasaurus, and Borealopelta. Edmontosaurus (a hadrosaur) is often found as a "dinosaur mummy," so we know what the scales looked like on various parts of its body.

Cont'd

Saltasaurus is unusual for a sauropod in that it seems to have had a layer of hand-sized disks of bony armor in its skin. Borealopelta is a nodosaur that was preserved (at least the front half of its body), with all the armor plates and spines attached. Melanosomes are present on its back but not chest, which might indicate Borealopelta was countershaded. (Although it is not clear how countershading would help such a low-slung, well-protected animal.)

Stenopterygius is a middle-sized Jurassic ichthyosaur. It has been preserved such that the outline of the body (including the dorsal fin, and upper part of the tail) is visible. There are also examples of Stenopterygius with gut contents and/or embryos inside. It was suspected in the 1950s that at least some ichthyosaurs were black in color. Now that we know how to examine melanosomes in preserved ichthyosaur skin, it is confirmed that most of the skin of Stenopterygius was likely black, with only a slightly less dark coloring on its belly. The explanation probably has to do with staying hidden in the darkness of deep water.

There are two pterosaurs discussed here: Anurognathus (Jurassic China) and Tupandactylus (Early Cretaceous South America). Anurognathus is pigeon-size, with a short, wide skull and forward facing eyes—obviously an insect eater. (The analogy would be to the modern bird, the frog-mouth.) The entire body is covered with “fur," which appears to resemble modern down feathers. The restoration of this animal is more “flying fuzzball” than dragon. Many pterosaurs have unusual crests, but Tupandactylus is somewhat extreme. There is a spar from both the top and bottom of the cranium stretching out. A “sail” of skin is stretched out between these spars. There are at least two types of melanosomes in the sail, meaning it was probably multicolored. Tupandactylus also has fibers (probably feathers) on its head and crest.



There is one mammal: Eomaia. This is a rat-size Early Cretaceous mammal from China. It has long fur on its body, except for the tail. The melanosome shapes suggest a brown or grey color for the fur. Eomaia has some skeletal characteristics of placental mammals, but it is not clear whether it gave live birth to large young (like placental mammals), had a pouch (like marsupials) or laid eggs (like monotremes).

This book is densely illustrated. There are plenty of photos of fossils, photos of contemporary animals, and life restorations of extinct animals. Restorations are by Bob Nicholls, a British paleoartist. The restorations are very detailed and realistic.

Sources:

Benton, M. J.
“Dinosaurs. New Visions of a Lost World”.
Thames & Hudson, 239 pages, $40 (hardcover).

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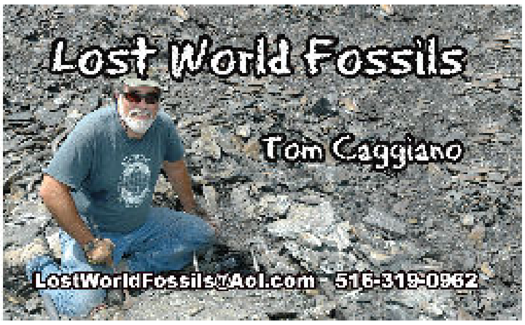
https://www.aaps-journal.org/



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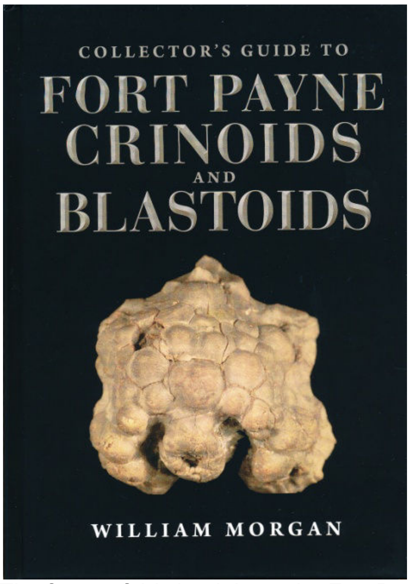

The focus of this book is on the Fort Payne Formation and the fossil crinoids and blastoids, which are found there. Although, it is not widely known outside of academic programs in geology and/or paleontology, the Fort Payne is one the largest Mississippian-age formations in the middle and southeastern 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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