The Paleontograph

A newsletter for those interested in all aspects of Paleontology
Volume 10 Issue 1 March, 2021

From Your Editor

Welcome to our March edition. I hope this issue finds you healthy and safe. Well, it looks like we made it to the other side; at least I hope you all did. My wife and I have been vaccinated and except for feeling lousy for a day after the second shot, we feel great. We are excited for life to return to something close to what was normal. I'm waiting for a big snow storm to hit and it just started coming down as I started to write this.

I have some paleo and non paleo trips planned. First being the Tucson show which starts April 9th. I will be at the Mineral and Fossil Alley Show at the Days Inn (formerly Ramada) on the Highway. Room 140, stop in and say hi if you are in town.

Bob has written a nice variation of articles for you and I hope you enjoy the issue. I would love to expand our readership. If you someone that might be interested please forward this along. Remember it is free for the asking with an email to me.

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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Pterosaur Flight Efficiency Over Time

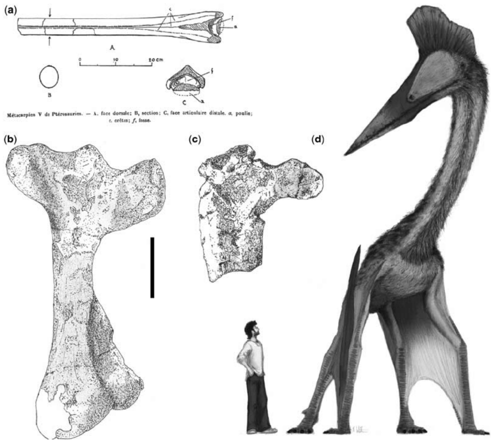
Bob Sheridan November 10, 2020

Pterosaurs are a very long-lived group of Mesozoic flying reptiles that existed from the Late Triassic to the Latest Cretaceous. The earliest were very small, about the size of sparrows, while some of the latest were the size of small airplanes. There was also a shift in the body plan also. The earliest pterosaurs were mostly “rhamphorynchoids” (toothed, short neck, long tail) and later ones mostly “pterodactyloids” (toothless, long neck, no tail). Today’s story mentions a specific group of pterodactyloid pterosaurs called the “Azhdarchoidea” (named for the Eastern European genus Azhdarcho), which includes some of the largest and latest pterosaurs, e.g. Quetzalcoatlus. These originated in the Early Cretaceous.

Venditti et al. (2020) attempt to determine whether the flight ability of pterosaurs has increased with time. This is, of course, very tricky because we have to determine this given only skeletal information, from which one can estimate body mass, wingspan, cross-sectional area as seen from the front, etc. The authors consider two metrics. “Flight efficiency” is taken as the inverse of “cost of transport” (COT), where COT is the metabolic energy required to move a unit mass per unit distance. Generally we would expect this to vary with body mass, i.e. larger animals can move more mass more easily. For the calculation of COT, it is assumed that the metabolic rate of pterosaurs is similar to that of birds. The other metric is “sinking rate”, i.e. how fast the animal would lose altitude during a glide. This also has some dependence on body mass, so the sinking rate was normalized for mass. These authors looked at 75 genera of pterosaurs and made use of their own phylogeny of pterosaurs based on published data.

As expected, the data shows an increase of wingspan with time. The authors point out that non-azhdarchoids show a continuous increase on the average from the Triassic to the Cretaceous, but the average azhdarchoid starts at a moderate wingspan (~1 meter) and stays the same after their origin in the Early Cretaceous. (It should be noted this is the average. Some azhdarchoids reach extremely large sizes; most of the lineage stays moderate in size.) Flight efficiency of non-azhdarchoids seems to go up with time, while that of azhdarchoids starts at a moderate level and seems to fall. Sink rate goes down in non-azhdardchoids with time, while it stays the same with azhdarchoids. There does not seem to be any effect on these trends due to the origin of birds (in the Late Jurassic). Generally speaking, pterosaurs seem on the average to have a lower flight efficiency and a higher sink rate than birds.

The general trend here is that non-azhdarchoid pterosaurs get to be better flyers over time while azhdarchoids do not. To the authors this implies the azhdarchoids might not have depended so much on flight to make their living, and were more like large ground predators. However, no one is suggesting azhdarchoids were totally flightless.



I feel a great deal of skepticism about the trends noted here, although I accept that some of them might be statistically significant. First, the metrics are sensitive to estimates of body mass and/or cross-sectional area, which is at least moderately uncertain in fossil organisms. Second, while the averages may be different among groups of pterosaurs, there is a large variation among the genera in each group. Third, this might be a case of “p-hacking”, i.e. trying a large number of different groupings of pterosaurs until one finds one where differences are statistically significant. This is especially a danger given the small number of genera. The authors did not discuss whether they tried groupings other than azhdarchoids and non-azhdarchoids.

Sources:

Venditti, C.; Baker, J.; Benton, M.J., Meade, A.; Humphries, S.
“150 million years of sustained increase in pterosaur flight efficiency.”
Nature 2020, 587, 83-88.

Kylinxia: a Bridge Cambrian Arthropod

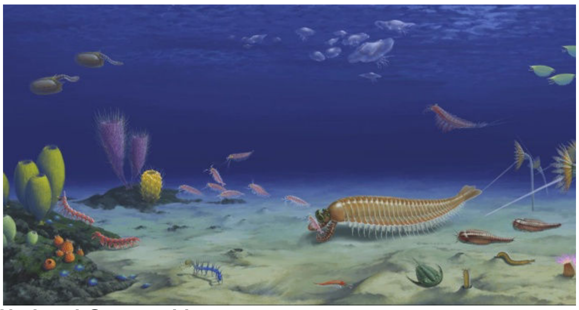
Bob Sheridan December 7, 2020

There are a number of lagerstattens where Cambrian life is preserved. The most diverse fauna are from: the Burgess Shale (Canada) and Qingjiang (China), and Chengjiang (China). Interpretation of Cambrian animals is sometimes difficult. Part of this is because many do not resemble anything alive today. Part of this is because the fossils are almost always just flat stains on rocks, and one must have many specimens to infer a three-dimensional shape.

Most modern animal phyla are thought to have arisen in the Cambrian. Twenty years ago, it was a matter of controversy about whether most Cambrian animals represented phyla that no longer exist, but today the consensus seem to be that most Cambrian animals can be assigned to modern phyla. The story today concerns Cambrian animals that are undisputed arthropods.

We need to mention some specific animals for this discussion. Anomalocarids (named after the genus Anamalocaris) are unusually large (up to 1 meter long) arthropods. They had elongated bodies with a large head and a tail fan. To each side they project long lobes that interlock to produce an undulating swimming surface. Two large compound eyes project on stalks from the sides of their head. Underneath their heads, on either side and in front of the circular mouth, are two “great appendages,” which superficially resemble shrimp tails. These appendages had many segments, presumably very flexible, and could be extended straight or curled tightly downward, making them something like a grasping arm. One interesting story about the anomalocarids is that the appendages and mouth parts were discovered separately and given separate names. It was only later that the two were discovered to be parts of a larger animal. Anomalocarids are within a larger informal group called “radiodonts” because of the circular arrangement of teeth in the mouth.

Another arthropod genus from the Cambrian is Opabinia. The body and tail fins resemble those of Anamalocaris, but it is a much smaller animal, only several centimeters long. It is very unusual in that it has five compound eyes on stalks. In the front is a single flexible “trunk” that ends in a claw. Presumably this was used to bring food to the mouth.



National Geographic

Yet another arthropod group is megacheirans (named after the genus Megacheira). Again, these have bodies like Anomalocaris with two eyes on stalks. In front are two upward-pointing limbs with few jointed segments. These have been variously interpreted as antennae or claws like the chelicerae of spiders and scorpions, depending on the genus. The first few segments of the body form a “head shield”.

National Geographic

Zeng et al. (2020) describe a new unexpected arthropod from the Chengjiang formation. This animal is named *Kylinxia zhang* (named after a chimeric creature in Chinese mythology “Kylin”, “xia” for shrimp-like arthropod, and paleontologist Yehui Zhang). The description is based on six specimens. Kylinxia is several centimeters long. It has a head shield like Megacheira, two “great appendages”, much like in anomalocarids, but curling upward instead of downward, and five eyes like Opabinia. Given the existence of Kylinxia, phylogenetic analysis is able to bridge radiodonts with other arthropods like Megacheira which have appendages attached to the second head segment, which are collectively called “deuteropoda”. If this is correct, antennae, and chelicerae are homologous with “great appendages.”

Sources:

Zeng, H.; Fangchen Zhao, F.; Niu, K.; Zhu, M.; Huang, D.
“An early Cambrian euarthropod with radiodont-like raptorial appendages.”
Nature 2020, 588, 101-105.

Two Stories on Ornithodirans

Bob Sheridan December 11, 2020

Dinosaurs and pterosaurs are considered sister groups among the archosaurs (reptiles with a hole in the skull in front of the eye). Orthodira ("bird necks") is the name given to the group containing the common ancestor of dinosaurs and pterosaurs. How these groups originated in the Late Triassic is not clear since even the earliest pterosaurs are very different from dinosaurs, but it is thought that the common ancestor was a small, slender biped. There are a number of "dinosauromorphs" that could fulfill this role, in particular a group called "lagerterpids" (named after Lagerterpeton). Recently there were two papers (which have two authors in common) on this topic. One characteristic of lagerterpids is a hooklike femoral head and a slender mandible.

Kammerer et al. (2020) describe a new lagerterpid from Madagascar which they name *Kongonaphon kely* ("tiny bug slayer"). This incomplete specimen consists of a right maxilla, a right femur, and various limb parts. The most interesting aspect is that the femur is only about 4 centimeters long, even though bone histology indicates this animal has reached its full size. This is smaller than most known lagerterpids, which are already quite small. The maxilla has unserrated conical teeth. The teeth and its small size suggests Kongonaphon preyed on insects (hence the name).

Phylogenetic analysis confirms that Kongonaphon is similar to other lagerterpids and close to the division of early dinosaurs and pterosaurs. The major point of the paper that, according to the phylogeny, lagerterpids were smaller than both their ancestors and descendants. This implies a "minaturization" that allowed flight to evolve. This is analogous to the supposed miniaturization of theropod dinosaurs that allowed the evolution of birds.

The second paper, Ezcurra et al. (2020), does a more detailed phylogenetic examination of the lagerterpids in comparison with early dinosaurs and pterosaurs. This is helped by more cranial remains of Kongonaphon (discussed above) and Ixalerpeton. The authors point out the ventrally curved dentary of lagerterpids and a similarly curved dentary of early pterosaurs. Similarly with the high tooth count in the lower jaw. The fact that the teeth are multi-cusped in both lagerterpids and early pterosaurs, but not most archosaurs, is also noted. Similarly with details of the braincase (rounded cerebral hemispheres) and inner ear (particularly long anterior semicircular canal). Finally, some early pterosaurs had hooked femoral heads, which was noted as characteristic of lagerterpids. The authors place lagerterpids as a sister group to the pterosaurs.

Of course, none of this explains how pterosaurs first learned to fly. Except for being small, lagerterpids do not appear flight-ready by having elongated fingers, etc.

Sources:

Ezcurra, M.D.; Nesbitt, S.J.; Bronzati, M.; Vecchia, F.M.D.; Agnolin, F.L.; Benson, R.B.J.; Egli, F.B.; Cabreira, S.F.; Evers, S.W.; Gentil, A.R.; Irmis,R.B.; Martinelli, A.G.; Novas, F.E.; da Silva, L.R.; Smith, N.D.; Stocker, M.R.; Turner, A.H.; Langer, M.C. "Enigmatic dinosaur precursors bridge the gap to the origin of Pterosauria." Nature 2020, 588, 445-449.

Kammerer, C.F.; Nesbitt, S.J.; Flynn, J.J.; Ranivoharlmanana, L.; Wyss, A.R. "A tiny ornithodiran archosaur from the Triassic of Madgascar and the role of miniaturization in dinosaur and pterosaur ancestry." Proc. Natl. Acad. Sci. USA 2020, 117, 17932-17936.

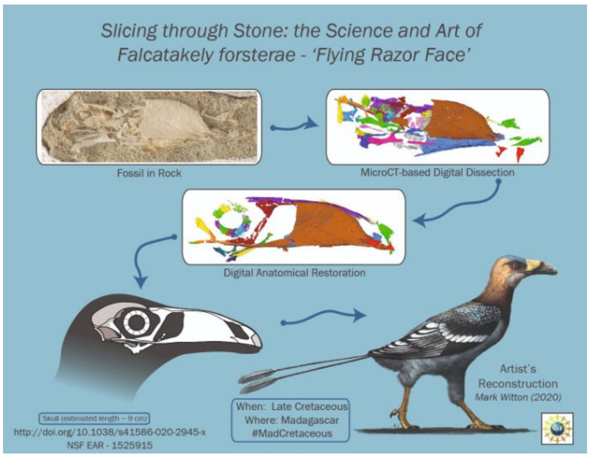
Padian, K. "Close relatives found for pterosaurs, the first flying vertebrates." Nature 2020, 588, 400-401.

Falcatakely: The Enantiornithine "Toucan"

Bob Sheridan December 5, 2020

Today's story concerns a fossil bird excavated from the Late Cretaceous of Madagascar. O'Conner et al. describe the cranium of an animal they name *Falcatakely forsterae* ("armed with a small sythe" and after Catherine Foster, an expert in Madagascar dinobirds). The specimen consists of the scleral ring and bones in front of the orbit. This bird would be about the size of a crow. There is enough anatomy to group Falcatakely among the enantiornithines. Enantiornithines are so-called "opposite birds", with the concave-to-convex articulation of the scapula and coracoid opposite that of all living birds. Almost all enantiornithines have some teeth and retrain finger claws, although they can appear quite modern otherwise. No enantiornithine survived the end of the Cretaceous.

The unusual feature of Falcatakely is that its beak is long and tall, made mostly of an enlarged toothless maxillary bone. In the very front of the beak is a premaxillary bone bearing a single tooth. This is in contrast to most birds, which have a maxillary reaching from the eye to about half of the length of the beak, and a large premaxillary forming the end of the beak. Although the arrangement of bones in Falcatakely is very primitive, much like the dromaeosaur Microraptor, the shape of the beak seems convergent on some modern birds such as the toucan. (Toucans have a very thick keratinous sheath around their rostrum, making the beak much bigger than the bones they contain, whereas Falcatakely probably did not. Thus the convergence is based on shape only.) This type of convergence on a modern type has not been observed previously for enantiornithines. Also, it was not much appreciated how the relative sizes of maxilla and premaxilla could vary among fossil birds.



Sources:

O'Conner, P.M.; Turner, A.H.; Groenka, J.R.; Felice, R.N.; Rogers, R. R.; Krause, D.W.; Rahantarisoa, L.J. "Late Cretaceous bird from Madagascar reveals unique development of beaks." Nature 2020, 588, 272-276.

Magnusantenna

Bob Sheridan January 6, 2021

There are many recent papers on Burmese amber (~98 Myr.), and many unusual small animals have been described. A new example is described in Chen et al. (2021) and given the name *Magnusantenna wuae* ("large antennae" and after the person who discovered the specimen). The specimen is an insect about 1.5 cm in total length. The body is slender, superficially similar to that of modern stick insects. The most unusual aspect, as could be guessed from the name, is that the antennae take up half the total length. The antennae have four segments, the most proximal segment is much like the first segment of most insects (a short cylinder), the second segment is a flat narrow rectangle, and the outer two segments are broad and fan-shaped, at least two-fold wider than the insect's body.

Magnusantenna is a true bug in the family of coreids, which contains modern "leaf-footed bugs" and "squash bugs". They feed on plant juices or other insects. Fossil coreids are known from Lebonese amber. True bugs mature by going through several sub-adult "instar" stages.

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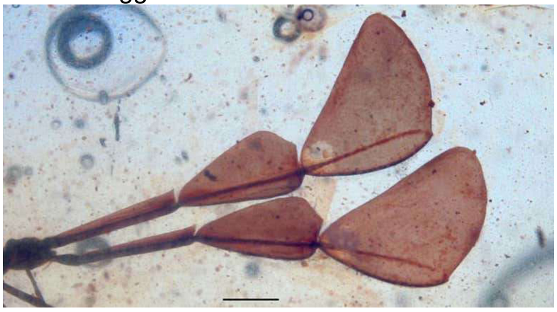
Bug Cont'd

The authors feel the specimen of Magnusantenna is in the fourth instar stage based on the features of modern instars. This might imply the antennae might be even bigger in the full adult.



Long antennae in insects are common, but rarely are as wide as in Magnusantenna. The authors list some possible reasons for such an extreme shape:

1. The wide antennae make the insect look more like a stick with leaves. This is consistent with the stick insect-like body.
2. The antennae need to be big to make them very sensitive. The analogy is the feathered antennae of male moths.
3. The exaggerated size is due to sexual selection, i.e. female Magnusantenna prefer large antennae.

The authors spend some time listing issues with having exaggerated features: they take energy to grow, and possibly make the animal slower and easier to spot. This is in balance with the putative advantages listed above.

Sources:

Du, B.-J.; Chen, R.; Tao, W.-T.; Shi, H.-L.; Bu, W.-J.; Liu, Y.; Ma, S.; Ni, M.-Y.; Kong, F.-L.; Xiao, J.-H.; Huang, D.-W.
"A Cretaceous bug with exaggerated antennae might be a double-edged sword in evolution." iScience, 2021, 24, 101932.

Dinosaur Cloaca

Bob Sheridan January 23, 2021

Except for most mammals, vertebrates have a common chamber, the cloaca, into which empty the urinary, digestive, and reproductive systems. The opening of the cloaca, which can be constricted by sphincter muscles, is called the "vent". The vent varies in appearance. It may be circular, or a vertical, or horizontal slit. The size of scales around the vent can be different from the rest of the skin, and the area may be pigmented. There may be swellings of various types visible from the surface. Inside the cloaca may be complex structures such as a penis (in reptiles and some birds).

Dinosaurs would presumably have vents like other reptiles. While there are many dinosaur fossils with preserved integument, there has never before been an example of a dinosaur vent. Vinther et al. (2021) reanalyze the Frankfurt specimen of Psittacosaurus, a small Early Cretaceous ceratopsian from China. This specimen has a large amount of preserved integument complete with pigmentation. The integument includes tail bristles, which implies that all types of dinosaurs could have feather-like structures.

There is a strip of preserved integument around the end of the ischium bone (the pelvic bone that points backwards in ornithiscians). There is a midline oval bulging of the skin at the end of the bone; this is called the "ischial callosity". This bulge, about 5 cm long, has large rounded scales. The following is the author's interpretation of nearby structures: There are two lateral circular pigmented patches they are calling the "lateral lips" (only the left one is completely preserved). These are tailward of the ischial callosity and presumably are on either side of the vent. Behind the vent on the midline is a slight swelling called the "dorsal lobe."

Cont'd

Cloaca Cont'd
An explicit opening is not visible, so the shape of the vent is not clear (i.e. slit-like as in crocodiles or rounded as in birds). However, there does appear a possible coprolite on the inner surface of the integument, which serves to mark where the opening is likely to be.

The popular press has made a great deal about this discovery hinting that this tells us a great deal about dinosaur sexual behavior. However, the best we can infer from this single sample is that, due to the fact that there is pigmentation around the vent, that this has some sexual signaling function, as is sometimes seen in birds. Since we do not know the sex of this specimen (because no internal parts are preserved), it is not clear what the signal would be.

Sources:

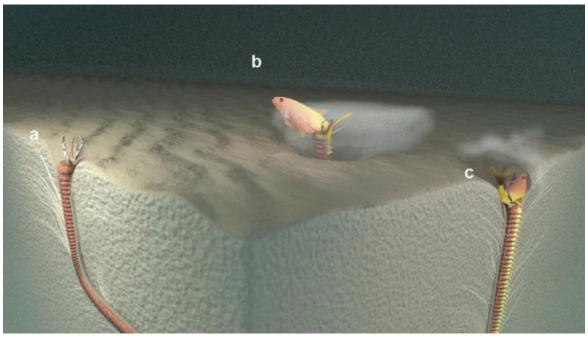
Vinther, J.; Nicholls, R.; Kelly, D.A.
"A cloacal opening in a non-avian dinosaur."
Current Biology 2021, 31, R1-R3

Pennichnus, a New Trace Fossil

Bob Sheridan January 23, 2021

Trace fossils preserve evidence of biological activity but not the actual body of the animal or plant. Examples include footprints, burrows, borings, impressions, coprolites, etc. Trace fossils have their own system of nomenclature, separate from the nomenclature of body fossils, because for the most part it is not clear what creature made which trace.

Pan et al. (2021) describe a new trace fossil *Pennichnus formosae* ("feather trace from Taiwan") which is found in Miocene marine sandstone from Taiwan. The description is based on over 300 specimens. The fossil appears to be an L-shaped cylindrical burrow a few meters in length and a few centimeters in diameter. The upper part would be vertical in its original orientation and the lower part more horizontal. The uppermost parts of the burrow have "feather-like" structures radiating into the matrix; this region is also rich in iron. These burrows are filled with featureless sand for the most part. That is, there is no trace of the original animal.



The analogy the authors make is to the burrows of the modern "Bobbit worm" (sometimes called the "trap-jaw worm" or "sand striker"), which is in the genus Eunice. This animal is a large (a few meters long but a few centimeters wide) polychaete worm covered with an exoskeleton. The Bobbit worm burrows in the sand at the bottom of warm marine environments. Once buried, only the head of the worm appears above the ocean floor. Eunice detects prey with a set of antenna, grabs the prey with wide spiked jaws, and drags it into the burrow.

The explanation of the iron enrichment at the top of the burrow is that the slime from the worm attracts bacteria, which produce reducing conditions that precipitates iron during fossilization. The "feathers" represent sand that has been disturbed by the movement of the worm or by struggling prey.

Other types of marine animals (shrimp and razor clams, for example) are known to form burrows. However, the morphology of those burrows do not resemble Pennichnus as much as do the burrows of Eunice. However, since there is no trace of the animals in the fossil burrow, there is still some uncertainty about what kind of animal Pennichnus contained, although it was probably some kind of worm.

Sources:

Pan, Y.-Y.; Nara, M.; Lowemark, L.; Miguez-Salas, O.; Gunnarson, B.; Iizuka, Y.; Chen, T.-T.; Dashtgard, S.E.
"The 20-million-year old lair of an ambush-predatory worm preserved in northwestern Taiwan."
Scientific Reports 2021, 11, 1174.

Dire Wolves are NOT Wolves

Bob Sheridan January 18, 2021

To the popular press, the most important thing about dire wolves (*Canis dirus*) is that they appeared as characters in "Game of Thrones" (along with mammoths). However, they are a well-known extinct canine known from the Pleistocene in North America. Thousands of specimens are known from the La Brea Tar Pits. These animals are much larger (~50 kg) than the grey wolves that currently occupy North America (~30 kg). The way Dire wolves are restored in paleoart (both in appearance and lifestyle) is closely based on modern grey wolves, and the most parsimonious assumption has been that current wolves and dire wolves may have been more closely related to each other than to other canines (coyotes, foxes, jackals, African wild dogs, etc.). As an aside, the domestic dog is very closely related to (actually the same species as) the grey wolf.

A paper by Perri et al. (2021) studies the relationship of canines using morphometric analysis, partial nuclear DNA sequences and partial mitochondrial DNA sequences. The DNA sequences were isolated from 5 specimens from North American sites between 13,000 and 50,000 years old; unfortunately, no DNA can be isolated from the copious La Brea specimens. However, collagen protein could be isolated and sequenced from one La Brea specimen. These were compared to the DNA and collagen sequences from a number of living canines from a number of continents.

The phylogeny of canines can be expressed as a tree, and we can understand the relationships between canines as branches that join further down on the trunk of the tree. According to the DNA evidence, the grey wolf is most closely related to the coyote. Next joining this group is the African wolf and Ethiopian wolf. Next is the dhole (an Asian canine that resembles a fox). Next is the African wild dog. This might imply the grey wolf may have originated in Africa or Asia. Next to join are two species of jackals. The dire wolf is a sister group to the animals grouped so far. More divergent than the dire wolf are two foxes. All this implies that dire wolves are canines that converged on modern wolves in anatomy and size, but are not more closely related to wolves than to other canines. Therefore the genus "Canis" (which applies to wolves and coyotes) is probably not appropriate for the dire wolf. The genus "Aenocyon" was proposed in 1918 for the dire wolf by American paleontologist John Campbell Merriam.

Canines tend to interbreed when their ranges overlap. We have heard of "coywolves" in North America, and there is genetic evidence of gene flow between dholes and African wild dogs. (Analogous to how some modern Europeans have Neanderthal genes.) Assuming that dire wolves, coyotes, and grey wolves existed in North America at the same time, one might expect some evidence of gene flow between them, but the authors find none. This could imply grey wolves reached North America so recently that there was not time for hybridization.

Sources:

Perri, A.R. et al. (there are 48 authors!)
"Dire wolves were the last of an ancient New World canid lineage."
Nature 2021, 591, 87-91.

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

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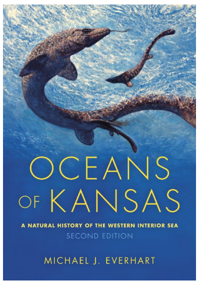
Tom Caggiano personal recommendation.



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

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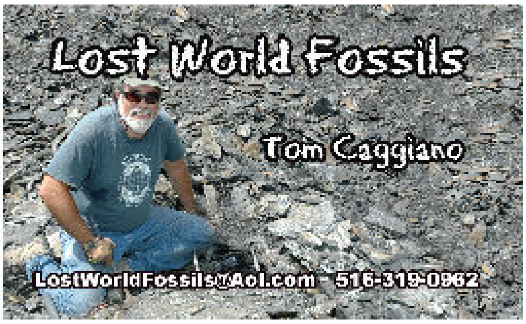
https://www.aaps-journal.org/



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Larson Paleontology Unlimited (LPFOSSILS). Neal and Luke Larson specialize in; invertebrate & dinosaur fossils, restoration & preparation, collection appraisal.

http://ny-nj-gemshow.com/

https://www.coliseumshow.com/

EXPO 2021 has been rescheduled to October 22-24, 2021 due to the ongoing pandemic. We are hoping that the arrival of the vaccines in mid 2021 will allow things to return to some sort of normal by the fall. The show will be moved to the Orr Building on the Illinois State Fairgrounds in Springfield, Illinois. This is a newer facility, with more square footage, restrooms, and easy access for the set up and tear down processes.

Items are posted free of charge but must be paleo related and will be published at my discretion.