The Paleontograph

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

Welcome to our fifth issue. This project has been working out well. In the beginning I did not think I would be able to bang out issues at a monthly rate but that has been the case. With this issue, we add another new writer (Dave) as well as adding a writer (George) from the list of writers from my former work. As usual, Bob is rounding things out.

I hope you all have been enjoying the newsletter. Remember we constantly need additional content. Also remember to pass it along to anyone you know that may be interested. Now that I know this will work, I am going to look into getting someone to archive the issues on a paleo related website or on several websites. That will help spread it around as well as give subscribers a place to refer back to for past issues.

Some of you may know that I am a fossil dealer. I am excited about the new New York Metro Show this month. http://www.nycmetroshow.com/index.html It looks like it may be a great show. Well I am out of room. I'll tell you about it next month.

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

Tomcagg@aol.com

The Guts of Trilobites

Bob Sheridan April 1, 2012

Trilobites are everyone's invertebrate fossil. Trilobites are arthropods that existed from the Early Cambrian to the end of the Permian. One would expect the carapace of trilobites to be preserved as fossils because it is mineralized. However, parts of the digestive system of trilobites (and other arthropods) can often be seen. This is somewhat hard to explain since digestive systems usually contain no hard parts and are the first parts of a dead animal to decay.

Lerosey-Aubri et al. (2012) describe some especially good trilobite fossils from the Weeks Formation in Utah, which is a Cambrian lagerstatten. Nine trilobite specimens with well-preserved digestive systems are from the genera Meniscopsia, Coosella, and Genevievella. These are small trilobites, about an inch long. There are also five specimens of an unidentified ovoid arthropod with well-preserved digestive systems. The preserved part of the digestive system of all these specimens starts in the middle of the glabella (head shield) and extends down to about one half the length of the trilobite. It looks like a segmented cylinder with short "wings" extending out from the places where the segments join. (To me, those digestive systems superficially look like a vertebrate backbone.) In some specimens more of the digestive system is preserved. Starting about in the middle of the trilobite, it tapers to a smooth narrow cylinder, which ends before the pygidium (tail segment). In the x-rays of some specimens, one can see a small J-shaped extension protruding ventrally from the anterior of the digestive system. This probably represents a backwards-facing mouth and esophagus.

The authors point out that a similarly-shaped digestive system is found in modern remipedians, which are blind, elongated, eyeless shrimp that live in caves. However, remipedians have outpocketings all along the digestive system, not just the upper half.

X-ray spectroscopy analysis suggests that the composition of the preserved digestive system is mostly calcium carbonate, calcium phosphate and silicon. The authors suggest that trilobites might be storing calcium in the form of calcium phosphate in the gut as a reservoir for remineralizing its carapace after moulting. The presence of so much phosphate would allow the gut to be preserved as a phosphatized fossil. Another, less likely, possibility they mention is that the gut contents contained a large amount of crushed shell from prey items.

The authors also note that one of their specimens has some kind of phosphatized paired structure in the pygidium. These are observed in some other trilobite specimens. Some modern arthropods have paired structures containing calcium phosphate granules, but these are in a different place anatomically. This does hint that trilobite anatomy might be more complicated than was previously appreciated.

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Size of the Earliest Horse Changing with Temperature

Bob Sheridan February 25, 2012

When I was young, the earliest horse-like animal was known as Eohippus ("dawn horse"). Later Protohippus ("first horse") and Hyracotherium ("hyrax-like beast") were used. Now the name seems to be Sifrhippus ("zero horse"). Changes in nomenclature in paleontology are usually due to finding that two differently named animals were really the same one, so the earlier name takes precedence (e.g. "Apatosaurus" vs. "Brontosaurus"). I learned today from Wikipedia that "Eohippus" was named by O.C. Marsh in 1861, but a fragmentary specimen was found in England in 1841 and named "Hyracotherium" by Richard Owen, who thought it was a hyrax based on the teeth. Maybe someone can tell me where "Sifrhippus" came from. Personally, I feel "dawn horse" is a much more poetic name.

Anyway, Sifrhippus appeared ~55 Myr. ago in North America and is considered the ancestor to all horses. It is usually taken as a paleontological irony that horses went extinct in North America at the end of the Pleistocene and were reintroduced by humans in historical times.

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Horse Cont'd

Henry Fairfield Osborn described this animal as "about the size of a fox terrier" (I am guessing early in the 20th Century), probably to emphasize the differences relative to modern horses, and this comparison seems to have stuck, although as Stephen Jay Gould pointed out in the 1980's, most specimens are bigger than a fox terrier. Interestingly, today's story deals with the size variation in Sifrhippus.

One other topic we need to know about is the Paleocene-Eocene Thermal Maximum, a global rise in temperature (~6 Celsius) that occurred about 55 Myr ago and lasted somewhere between 100,000 and 200,000 years. The transition to the higher temperature took less than 20,000 years, as did the transition back to normal temperatures. One recognizes the PETM in rocks and fossil tooth enamel by isotope shifts in C-13 (carbon isotope excursion, CIE), which presumably measures more CO_2 in the air. Isotope shifts in O-18 in tooth enamel are also taken as a measure of temperature (plus aridity).

Finally, there is a soft "rule" about evolution called Bergmann's Rule, which suggests animals get bigger as the temperature gets colder, and smaller as the temperature gets warmer. It is generally accepted that mammals got smaller during the PETM and larger during Ice Ages, for example. The classical explanation why this rule should hold is that as animals get bigger, the smaller area to volume helps them retain heat. An alternative explanation has to do with "productivity," i.e. if more high quality food is available to an animal, it will be able to grow for a longer time.

Secord et al. (2012) studied 44 specimens of Sifrhippus from the Clarks Fork Basin in Wyoming, spanning the period ~55.5 to ~54.4 Myr. The size of the animals is estimated by the area of the first molar, a common technique. These authored also measured the C-13 and O-18 isotope shifts in the teeth of the Sifrhippus specimens, but also in 150 teeth from other species. One can clearly see the rapid downward sift in the C-13 as a function of time, followed by a rapid upward shift somewhat later, marking the temporary increased CO_2 in the PETM. A corresponding upward shift in O-18 followed by a later downward shift is seen in the same time period, marking the increased temperature. The interesting part is that there is a ~30% downward sift of tooth area for Sifrhippus followed by a ~70% rise, in accordance with Bergmann's Rule. The smallest Sifrhippus would have a weight of about 4 kg (at the peak of the PETM), and the largest about 8 kg (before and after the PETM).

The authors attempt to disentangle whether the size change in Sifrhippus is due to temperature or something else. For example, given that there is more CO_2 in the air, that would allow more lush plant growth, but the plants would be less nutritious and the herbivores would have less energy available for growth. Also, overall "aridity" would lower productivity and smaller animals would result. One of the other specimens from which O-18 was measured is Coryphodon, which is an aquatic animal. Presumably Coryphodon would be less sensitive to aridity that Sifrhippus. The difference in O-18 shift between Sifrhippus and Coryphodon would presumably be a proxy for aridity. There seems to be little correlation between the size of Sifrhippus and aridity. The authors interpret this as an indication that Bergmann's rule depends more directly on temperature than productivity.

The authors hint that dwarfing of animals in the past may reflect what will happen in the near future with CO_2-based global warming, but note that current global warming is occurring much faster now than during the PETM (a few centuries vs. tens of thousands of years).

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Six Ways to Get Kids Interested in Paleontology

David Drizner
David-d@dfdi.com

There is a crisis in our hobby. Participants and enthusiasts are dwindling. When old-timers move on (in more ways than one), who is coming into the ranks to replace them?

Back in the 60s when I was growing up there were a number of Chicago area Rock-&-Mineral clubs. The one I belonged to - ***The Pick and Dop Stick*** -had well attended meetings and shows. Yet today, clubs are folding and museum outreach programs for the public are disappearing. I see fewer young people getting involved. It's the same in other amateur science hobbies. 30 years ago my friends and I were the youngest members attending our astronomy club star party. 30 years later - we're still the youngest members...

The problem is that children today simply have too many options available to entertain themselves, and fossil collecting just can't compete. Who wants to poke around all day in the mud and the sun looking for fossils when you've got an Xbox and 60" TV waiting for you at home? So it is simply this: our hobby is in danger of fading to nonexistence unless we can get a new generation of people interested and involved.

If you want to help reverse this trend and at the same time enrich some child's life with the wonder of science and the natural world, then you should consider starting some outreach programs of your own.

Listed below are six ideas you can use to help start your own public outreach program specifically geared to children. At one time or another I have used them all and sincerely hope that somewhere along the way I've kindled a spark of interest in some child that would one day, grow into a lifelong hobby for them.

1) Donate any unused material, such as books, journals, duplicate fossils, etc. to a local school. In my experience the faculty has always been very enthusiastic about receiving donations of this sort. These items can be used for a "fossil unit" in class, as backup material for a science fair project, and so forth.

2) Contact the Boy or Girl Scouts in your area and offer to give a demonstration on fossils or geology. Scout leaders are always happy to have volunteer help like this. Not only are they always on the lookout for something new to bring to their meetings, but many times the scouts can earn a merit badge in the subject area, just from attending the lecture. When addressing scout groups – make sure your focus is on the LOCAL geology / paleontology. That way you will have a springboard if you want to include a field trip in your program.

3) Offer to do the same at a local school. Grades 5 thru 8 seem to be the most receptive audiences. Coordinate with the teacher regarding the length of your presentation and any extra materials you'll need (computer, projector, etc.). When preparing your demonstration don't forget to take into consideration the age of the children. Remember, you are not mentoring them through their PhDs…

4) Set up an exhibit at your neighborhood library. Most libraries have display cases for people to show off their collections or handicrafts. Make sure your display contains a lot of local material. Go ahead and include that Lebanese Shrimp if you want, but don't forget to also include the lowly brachiopod found just around the corner at a road cut.

5) Keep extra fossils around to hand out to your children's friends, your nieces, nephews etc. Whatever you give them should be something easily admired and identifiable, such as a complete shell or trilobite. No 10-year-old is going to be impressed by an amorphous blob in a rock…even if you are.

6) Remember to highlight the "**WOW!**" factor. Kids will roll their eyes when you tell them the coprolite they're holding is "***mineralized fecal matter***". But tell them that it's "***ancient dino poop***" and believe me – you'll have a fan for life.

I hope these suggestions get you thinking about starting your own educational outreach effort. At the cost of a little time, some basic materials, and a desire to help your community; you'll find that getting involved like this is easy, fun, and personally fulfilling as well. Remember, someone introduced you at some point in your life to amateur paleontology – now it's time for you to carry that torch.

Charles R. Knight. The Artist Who Saw Through Time--A Review

Bob Sheridan February 26, 2012

Charles R. Knight (1874-1953) was not the first artist to paint and sculpt extinct animals, but probably was and still is the most influential. Until middle of the Twentieth Century, he was just about the only artist who specialized in that field. Clearly the dinosaurs in early movies like “King Kong” and “The Lost World” were copied from Knight paintings, and almost all the current paleoartists say that they were inspired by his work. Not many people know that he was an accomplished artist in many fields: an illustrator of children’s books, a builder of stained glass windows, a taxidermist, a sculptor, and a designer of currency.

I can't believe it has been six and a half years since I reviewed Charles R. Knight's partial autobiography “Charles R. Knight: Autobiography of an Artist” for the NJ Paleontograph. The autobiographical material was written by Knight sometime during World War II. However, he lost interest in the project before covering his life after the turn of the 20th Century, when most of his best work was done. I wrote at the time that I wish someone would write Knight's definitive biography. I also hoped for some explanations about the techniques he used to reconstruct extinct animals and make them look so convincing that we still think that’s the way they should look. A new book by Richard Milner "Charles R. Knight. The Artist Who Saw Through Time" is not that biography, but it is a good summary of Knight's artistic work, and does have a short biography as the first chapter. It also has some interesting tidbits about artistic techniques.

Richard Milner is a historian of science and an editor of Natural History magazine. He is probably more famous as a writer and performer of humorous songs about Charles Darwin. For examples, check out http://darwinlive.com

CRKTAWSTT is basically a picture book with explanations. It is divided into about 40 "special topics", in no particular order, for example "It's All Happening at the Zoo", "The Tiger", "Henry Fairfield Osborn", "La Brea Tarpits", "Ice Age", etc. Each topic may take up several pages. Photographs, paintings and sketches take up most of the space, with the remainder being captions and sidebars. There is a foreword by Knight's granddaughter Rhoda Knight Kalt.
Obviously, I cannot cover all topics adequately. I will just mention some things that seemed new to me.

At a basic level, Knight specialized in painting and sculpting animals, and not all the work was on extinct animals. The current book does a good job of covering Knight's non-paleontological work, which is not as well known. You may know the sculpted elephant and rhino heads done by Knight decorating the old Elephant House at the Bronx Zoo, plus the zebra at the Zebra House. The life-size tiger in alert repose in Palmer Square, Princeton is also by Knight. He is responsible for the bison drawings on the 30cent stamp (1923) and the $10 bill (1901).

Cont’d

Book review Cont'd

Knight is mostly associated with the American Museum of Natural History. He first made friends with the taxidermists working there and did his first painting of an extinct animal (Elotherium) at AMNH in 1894. Henry Fairfield Osborn soon took over the senior position in the Department of Paleontology, whereupon he implemented the idea of mounting the skeletons of prehistoric animals in lifelike positions, something rarely done at the time. This, of course, took much artistic talent, which Knight, among others, provided. At the time, restoring lifelike appearance to extinct animals was somewhat frowned upon by the scientific community, since the available information was considered insufficient.

Some of the most interesting early artwork by Knight includes scientific mistakes. Influential is the classic painting of Agathaumus from 1891, which was done under the instructions of Edward Drinker Cope. Agathaumus resembles a cross between Centrosaurus and Triceratops with a very spiky frill. As better specimens of Triceratops became available, it was realized that Agathaumus was a mistake, but one can see Agathaumus decades later in the 1925 version of The Lost World. There is also the sculpture and painting of Naosaurus (1907) which we can recognize as a chimera of two sail-backed Permian reptiles from Texas, Dimetrodon (a carnivore) and Edaphosaurus (a herbivore).

Whatever Knight's association with AMNH, we must remember, though that he did extensive mural work for the Chicago Field Museum and the Los Angeles County Museum. Some of the most iconic paintings (e.g. Triceratops confronting Tyrannosaurus) are at the Field Museum, and most of the Pleistocene-related art is in Los Angeles. Osborn repeatedly offered Knight a permanent position at the AMNH. Apparently, however, Knight preferred being a free-lance artist (he felt it resulted in less interference) and repeatedly turned down these offers, although that resulted in some tough economic circumstances at some periods in his life.

I was aware that Knight was legally blind for most of his life and had to paint with his eyes a few inches from the canvas. This left me wondering how he was able to complete large murals. This book has the answer: assistants transferred his small-scale paintings to the mural and did most of the painting. Knight would later add details.

I normally don't think of Knight as painting humans, and specifically I could not recall any paintings of Neanderthals. However, a number of such paintings are in this book. They are depicted by Knight as a little more stooped and hairy than they usually are today, with somewhat exaggerated facial features. However, Neanderthals are almost always portrayed in a sympathetic way, resourcefully surviving in a very unfriendly world.

One aspect I knew nothing about is Knight as an art critic. Unfortunately for him, he grew up at a time when Modern Art was in ascendancy, and naturalistic painting (especially of animals) was not much in demand in the mainstream. He felt strongly negative about Modern Art, calling it a fad and a commercial scam. One interesting note is that he identified the skull in the Georgia O'Keefe's painting "Ram's Head" as that of a goat, not a ram.

Finally, I did not realize that Knight dreamed of a Dinoland Park, filled with life-size dinosaur sculptures, presumably to be built in Florida. He made plans with Louis Paul Jonas, also a former employee of AMNH, but died before these plans could come to fruition. Jonas later collaborated with scientific advisors Barnum Brown and John Ostrom to create dinosaur sculptures from polyester resin, and these are the sculptures that made it to Sinclair Dinoland at the NY World's Fair 1964-1965 which was one of the high points of my childhood.

This book is a must-have for all you fans of paleoart and historians of science. Even at the nominal price of $40, it would be worth it, and it's cheaper online.

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"Autobiography of an Artist"
G.T. Labs, Ann Arbor, 2005 112 pages, $18 (hardcover).

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Abrams, New York, 180 pages. $40 (hardcover)

Recent Discovery on White Shark Evolution

George F. Klein

There are two schools of thought on the evolution of the Great White Shark (hereafter referred to as the White Shark), *Carcharodon carcharius* [1]:

The White Shark evolved from the giant tooth shark lineage and is a descendant of *Megalodon*.
The White Shark evolved from a mako shark lineage and is most closely related to the extinct mako shark, *Cosmopolitodus (Isurus) hastalis*.

A recent publication in the Journal of Vertebrate Paleontology [2] seems to swing the argument in favor of the second school of thought. The publication is based on a fossil discovered in Peru in 1988, and was acquired by noted shark researcher, Dr. Gordon Hubbell. The fossil consists of the nearly complete jaws of a shark, shown in Figure 1, and 45 vertebra (all not shown below).

Fig. 1: The Peruvian fossil shark jaws- 222 teeth were preserved!

The fossil is from the Pisco Formation of southwestern Peru and is estimated to be approximately 4 million years old, therefore early Pliocene. The Pisco is considered contemporary with the Yorktown Formation of the Eastern US.

In life, the fossil shark was estimated to have a length of about 5 meters (17 feet) and by counting growth rings in its vertebra, the authors of the paper estimated its age at death to be 20.

Although the fossil has been classified in the genus *Carcharodon*, it has not been identified to the species level due to some differences between it and modern White Sharks. The serrations on the teeth of the fossil specimen are weaker than those of the living *C. carcharius*, see Figure 2. This makes more sense if modern White Sharks evolved directly from an ancestor that did not have serrated teeth. Scientists who support scenario #2 above have postulated that living Whites evolved serrations on their teeth gradually from an ancestor with un-serrated teeth, such as *Cosmopolitodus hastalis.*

Because most large toothed sharks such as *Megalodon* have serrated teeth, it seems unlikely that a descendant from this lineage would have weaker serrations than its ancestors.

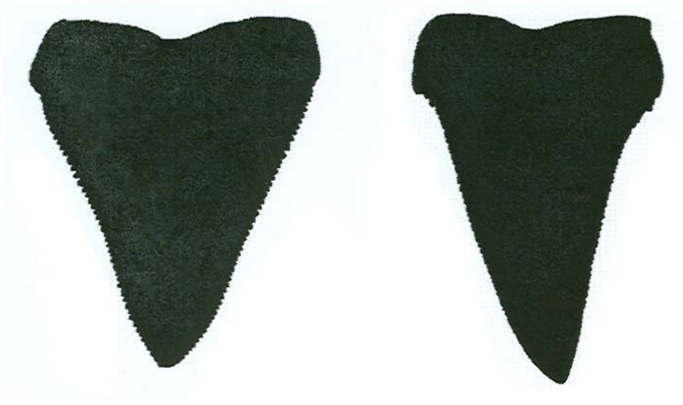

Fig. 2: Typical upper A1 White shark tooth (left), compared to the upper A1 tooth from the Peru fossil. Note the smaller (or weaker) serrations on the Peru tooth.

Like modern Whites, the fossil's largest tooth is the first upper anterior, location A1. The upper A1 tooth has a vertical height of 2.25 inches and the lower A1 tooth has a vertical height of 2.06 inches [5]. The upper A1 tooth is symmetrical in the fossil, again the same as living White Sharks.

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Sharks Cont'd

Unlike modern Whites but similar to *C. hastalis*, the tooth in the intermediate location points toward the tail of the shark (distally). So the fossil shares certain of its features with modern White Sharks and certain features with the extinct mako, *C. hastalis*. Some scientists refer to such fossils as "transitional forms".

Interestingly, the oldest confirmed *Carcharodon carcharius* fossil is a tooth from bed 10 of the Calvert Formation, found near Camp Kaufman [2, 4]. The horizon where the tooth was collected has been dated to approximately 16 million years old, making it much older than the fossil shown above. The tooth is presently in the collection of the Smithsonian Institution and a drawing of it is shown in Figure 3.

Those who support scenario #1 would probably be quick to point out that the age of the earliest known *C. carcharius* tooth predates the fossil shown above by a wide margin. However a "transitional form" and its descendant may co-exist for a long period of time, until the "transitional form" eventually becomes extinct. An example of this is the co-existence of three-toed and one-toed (modern) horses during the Pliocene in North America. Modern horses evolved from their three-toed ancestors.

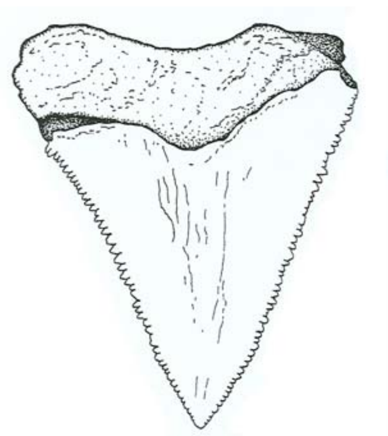

Fig. 3: Drawing of the possibly oldest *C. carcharius* tooth, from the Calvert Formation of Maryland

Also supporting scenario #2 above, is that *C. carcharius* teeth tend to be relatively thinner than those of giant toothed sharks (*Megalodon* and related), *Carcharodon* teeth do not have a bourlette and the serrations of *C. carcharius* tend to be coarser than those of the giant toothed sharks. The Peruvian *Carcharodon* fossil also shows these characteristics.

The discovery of more fossils will help settle the above debate.

References

[1] www.elasmo.com

[2] Ehret, D, G. Hubbell and B. Mac Fadden "Exceptional preservation of the White Shark *Carcharodon* (Lamniformes, Lamnidae) from the early Pliocene of Peru" Journal of Vertebrate Paleontology Vol. 29, No 1, pages 1-13.

[3]www.science20.com/news_releases/which_species_did_modern_great_white_sharks_evolve

[4] Gottfried, M. and R. Fordyce "An associated specimen of *Carcharodon angustidens* (Chondrichthyes, Lamnidae) from the late Oligocene of new Zealand, with comments on *Carcharodon* interrelationships" " Journal of Vertebrate Paleontology Vol. 21, No 4, pages 730-739.

[5] Gordon Hubbell, email communication, January 2012.