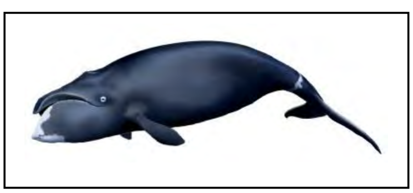
The ECPHORA

The Newsletter of the Calvert Marine Museum Fossil Club — *Volume 31 • Number 1 March 2016*

Woven Baleen Basket from Alaska



***Hall Wiggins** donated this woven baleen basket to the Calvert Marine Museum. The basket was made in Alaska some time before 1953 by the North Alaska Iñupiat people. Mr. Wiggins' father was a driller in Point Barrow at the time and acquired it then. Hands by M. Baughman. Photo by S. Godfrey.*

Detailed view of the seal head that ornaments the lid of the baleen basket. It was carved from a walrus tusk.
Far left: Bowhead whale graphic from: http://www.arcticworld.net/bowhead-whale.htm

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Editor's Note: The following project was completed last year when its author, **Adam Lindholm**, was in 8th grade. For this project, Adam won County Grand Award Junior Division and Regional 2nd Place overall Junior Division. He also won the Discovery Award for Best Use of STEM principals at the regional fair and he earned a Broadcom Masters nomination (national competition for middle school). Adam continued his project this year examining heads and tails of pterosaurs taking first place in Animal Sciences at county and earning a placement at regionals (which will be held on March 19). His 9th grade science teacher nominated him for the Maryland Regional Junior Science and Humanities Symposium. Lightly edited here for inclusion in *The Ecphora*.

Curious Crests

An Examination of the Aerodynamic Tendencies of Cranial Crests in Tapejarid Pterosaurs

By Adam Lindholm

Abstract

Pterosaurs were Mesozoic reptiles that flew using a wing membrane that extended from an elongated fourth finger to their knee. Many sported large and extravagant head crests that might appear to have impeded their flight-ability. My project examined the aerodynamic effects of these crests. I created five 3D-printed models of the heads of four crested species and one hypothetical non-crested species, and tested them in a wind tunnel. I observed them at ten degree intervals from 0 to 90 degrees into the wind, increasing wind speed from 18-50 mph during each test. (Although no small pterosaur could fly that fast, the scaled difference is not large and the higher speeds made turbulence caused by the crest clearer and easier to quantify.) Each crest design generated substantial laminar (smooth) flow at head and quartered winds. At cross winds, turbulent (unstable) winds were observed near the top edges of each model, but otherwise the flow was mainly laminar. Finally, I found trailing edge turbulence in the crested species at head and quartered winds. But this wouldn't affect the animal creating it; rather it would impact pterosaurs flying behind. I concluded that the crests did not have a detrimental effect on flight. In fact, crests actually reduced turbulence experienced by tapejarid pterosaurs. This result fits with the ultimate measure of species success, the fact that as a group, pterosaurs lived for more than 100 million years. The results therefore lend support to the theory that crests were used for display or identification within pterosaur species.

Question:

Pterosaurs are one of the least understood fossil vertebrate groups. They possess several unique adaptations to flight not found in any other group of flying organisms. Their wings were made of a wing membrane that extended from the end of a long fourth finger roughly to the knee cap. Many late Jurassic to mid-Cretaceous pterodactyloids (those with short, as opposed to long tails) sported large cranial crests. It would seem that crests would cause negative aerodynamic effects on the pterosaur during flight. Using five models of four crested, and one hypothetical non-crested species as a control, this idea was put to the test. The models were evaluated in a wind tunnel in which wind speeds were increased over a period of roughly thirty seconds from eighteen to fifty miles per hour. Performance of the benefits of different crest shapes, as well as comparing crested species to non-crested species was tested.

Research:

On July 29th, 2014 in Ekalaka, Montana, research began by interviewing pterosaur paleontologist Nathan Carroll. Very quickly, it was determined that better-preserved species from Brazil would be used, as well as possibly the American species *Pteranodon longiceps*. Further, a measure of success would need to be determined. In August 2014, aerodynamic engineer and Scoutmaster of Boy Scout Troop 303, Gregory Dungan, was interviewed. He likened a pterosaur crest to an upside-down hand-held broom; while a conventional airplane rudder is more like a broom held right-side-up. The airplane rudder is stable, and wants to revert to its original position; whereas the pterosaur crest has to be focused on to retain its vertical and unstable orientation.

Another resource was the book *Pterosaurs* by M. P. Witton. It provided information on pterosaur anatomy, as well as the different families (originally this project was going to use pterosaur species from outside tapejaridae). Several papers put forth different ideas about pterosaur crest use. One, on the aerodynamic tendencies of crests in *Pteranodon* stated the use of the crest as an airbrake or rudder both of which were disproved. Another paper, by Texas Tech University paleontologist Sankar Chatterjee, stated uses as a body-heat regulatory device, an attractive display used during mating season, or a way to differentiate multiple species of the same family.










The species and models used (left to right and top to bottom): *Tupandactylus navigans*, *Caiuajara dobruskii*, *Tupandactylus imperator*, *Tapejara wellnhoferi*, and the non-crested hypothetical species (NoCHyS) Reconstructions are cited in Bibliography

Eventually, it was found that using a variety of beak shapes would result in inconsistencies of aerodynamic testing in a wind tunnel. It was then decided that multiple species from one family – the tapejarids – would be used. The species tested were:

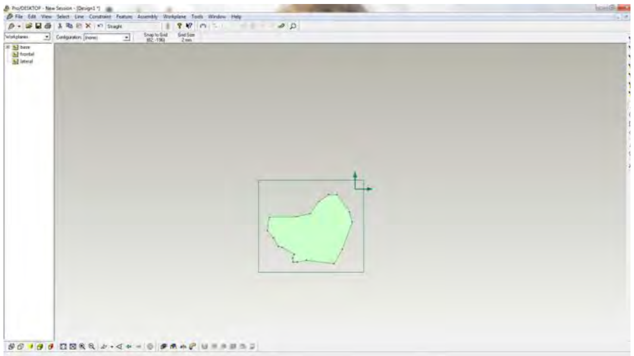
1. *Tupandactylus imperator*, a very large-crested species from Brazil.
2. *Tupandactylus navigans*, a tall-crested species also from Brazil, but smaller in size than *T. imperator*.
3. *Caiuajara dobruskii*, a recently discovered species with a tall, curved crest; but much smaller than either *T. imperator* or *T. navigans*.
4. *Tapejara wellnhoferi*, a species with a rear skull crest, and a larger nasal crest that was roughly the same size as that of *C. dobruskii*.
5. A hypothetical non-crested species serving as a control to see the aerodynamic effects on a pterosaur without a cranial crest.

Hypothesis:

If a pterosaur had a cranial crest, then the crest would not have a large effect on aerodynamics except during transient periods of turning during which it encountered quartered winds and crosswinds. This is supported by the variety of crests found in pterosaurs, and for how long they were present in the fossil record (125 million years for crested specimens).

How the Models Were Created:

First, using photographs taken at an exhibition on pterosaurs at the American Museum of Natural History in New York, as well as photos from the internet, tracings were created on parchment paper. These tracings were entered into Pro-Desktop, a computer-assisted design program. Rough shapes of the skulls were traced digitally. The skulls were divided into three parts: head, crest, and beak.



The model of *Tupandactylus imperator* in early stages of design.

Then, based on the actual size of the skull (imaginosaurs.com) compared to the size of the tracing, a scale factor could be created, allowing for width to be determined. Once the model was extruded (width created), the model's parts could be printed. Once assembled and glued, tell tails – strings that allow airflow to be observed – were applied to the models.

The model of *Tapejara wellnhoferi* being tested in the wind tunnel.

Procedures:

1. Place and secure the model in the wind tunnel, oriented at zero degrees (directly into the wind)
2. Begin filming
3. Slowly increase the wind speed beginning at 0 mph and then raising it at the wind tunnel's set increments of 18 mph, 27, 32, 41, and finally the maximum of 50 mph.
4. Test and film at 50 mph wind speed.
5. Stop wind machine and turn the model 10 degrees.
6. Restart the wind machine, and repeat testing and filming.

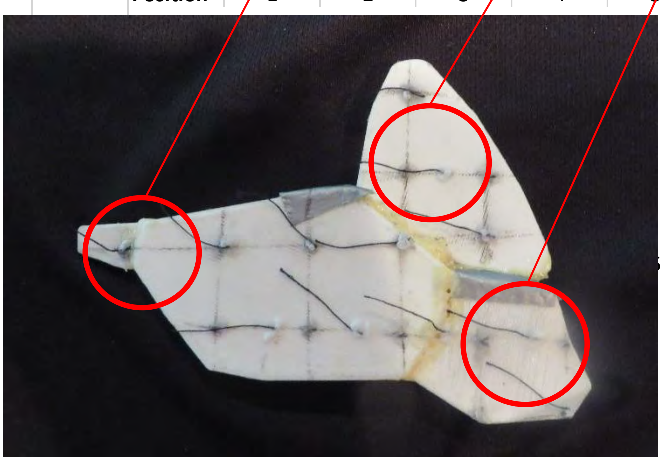
7. Continue the process, turning the model in 10 degree increments each stop, until complete crosswind of 90 degrees is attained and testing is completed.
8. Remove the model from the wind tunnel, and replace with the next model to be tested.
9. Repeat steps for each model.
10. Transfer movie recordings from camera to computer.
11. Closely observe the movements of each tell, and record them in Observation Log, rating movement of the tell tails – strings on a scale of 0-3 as follows:
    - 0 – no movement
    - 1 – small movement
    - 2 – medium movement
    - 3 – large movement
12. Transcribe written observations from logs to computer spreadsheets
13. Analyze and compare readings to determine differential in effects on subject species.

Testing Parameters:

The models would be placed at the nine angles and have air blown at them from eighteen to fifty miles per hour. Although the scaled pterosaurs could not fly that fast, and neither could the full size animals (likely topping at 30-35 mph), the wind was used to stress the tell tails slightly more; and unlike fighter jets, fifty miles per hour is not too far off the scale speed. Laminar flow, or smooth, fluid stream of air would indicate a more aerodynamic design, and turbulence (rough air flow) would indicate a less stable design.

Degrees	Position	1	2	3	4	5	6	7	total	obs	avg
	1					1	0		1	2	0.846154
	2		0	0	0	0			0	4	
	3	3	1	1	1	1			7	5	
0	4				1				1	1	
	5				2				2	1	
	6								0	0	
	7								0	0	
									11	13	

Position	1	2	3	4	5	6	7	total	obs	avg
					1	0		1	2	0.846154
					0					
					1					
								11	13	



Recorded motion chart for *Tapejara* showing correspondence between the model and the area of recorded data. The points on the chart are an inversion of the photo below.

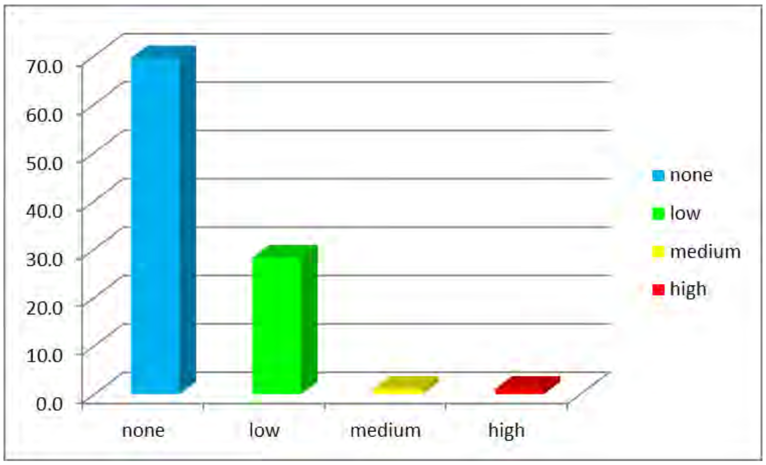
					5	6	7	total	obs	avg
					1	0		1	2	0.923077
					0			1	4	
					0			7	5	
								0	1	
								3	1	
								0	0	
7								0	0	
								12	13	

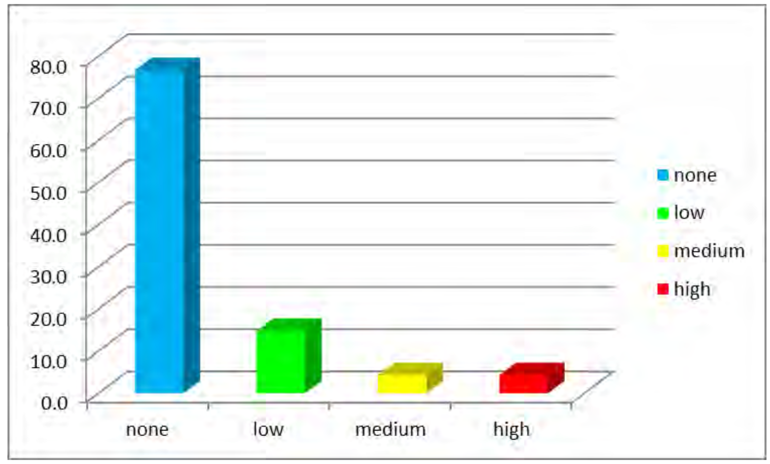
Position	1	2	3	4	5	6	7	total	obs	avg
1					3	0		3	2	1.076923
2		0	1	0	0			1	4	
3	3	3	1	0	0			7	5	
4				0				0	1	
5				3				3	1	
6								0	0	
7								0	0	

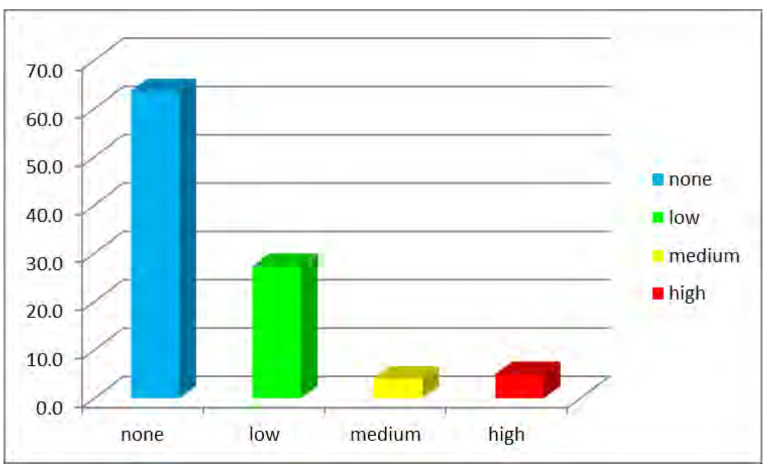
Data Analysis:

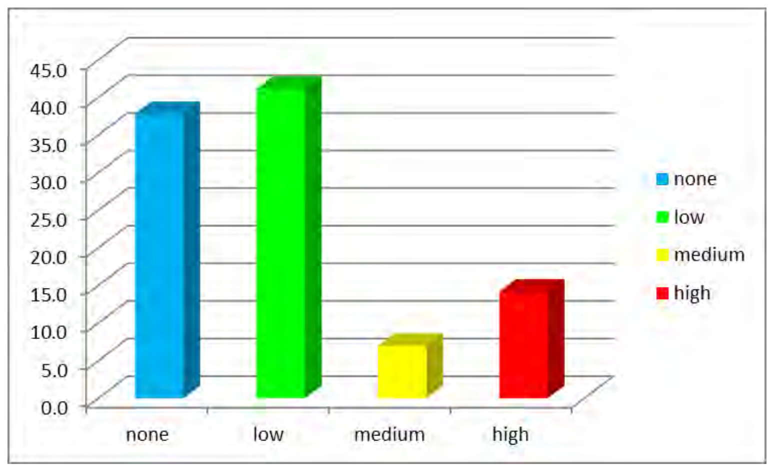
After recording the tell tail movement over the 30 tests per model, the average for each position tested was created. Based on the number of 0-1-2-3 turbulent tells on each model, a bar graph for each species (below) was created. A final line chart was made using the average turbulence at each degree. The line chart, bar graphs, and the overall average turbulence of each species were used to determine the total aerodynamic efficiency.

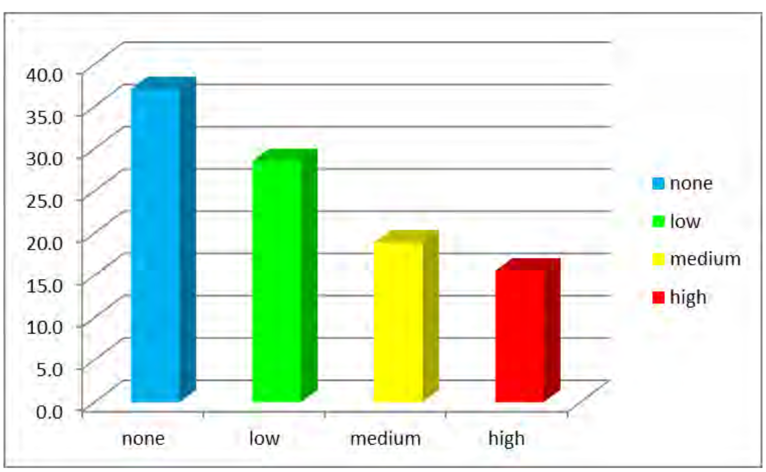
Bar and Line Graphs:





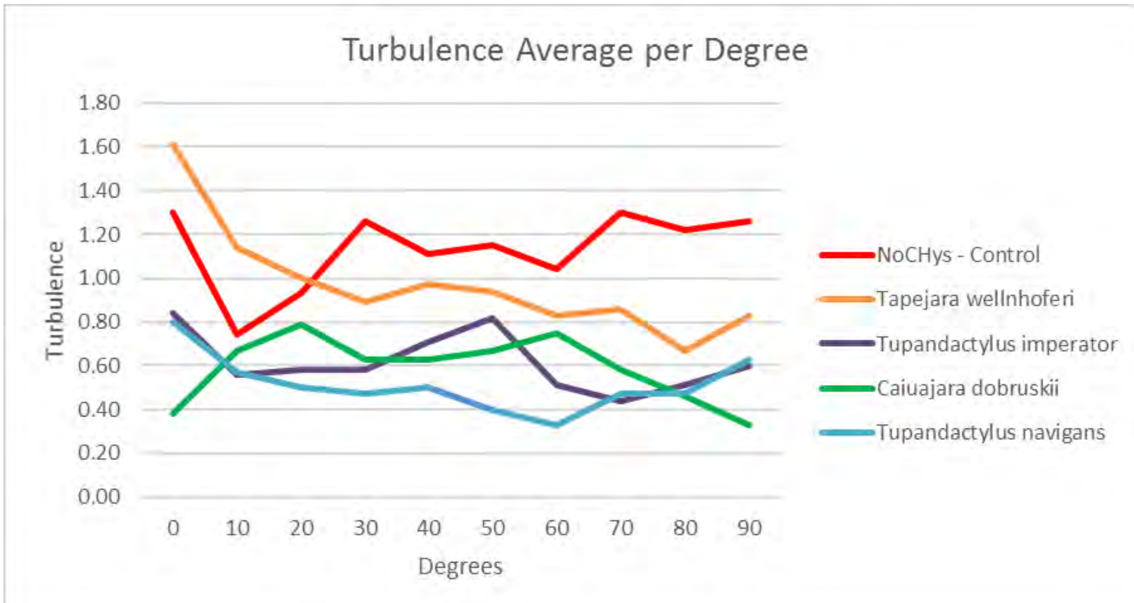






Above (left to right and top to bottom): The bar graphs for *T. navigans*, *C. dobruskii*, *T. imperator*, *T. wellnhoferi*, and the hypothetical species. Turbulence ratings of "none," "low," "medium," and "high" represent ratings of 0, 1, 2, and 3, respectively.
Below: The chart for average turbulence overall and average turbulence per each degree. Also, the line chart of each average per degree of turbulence rating per model.

Species	Degrees										Avg.
	0	10	20	30	40	50	60	70	80	90	
NoCHys - Control	1.30	0.74	0.93	1.26	1.11	1.15	1.04	1.30	1.22	1.26	**1.13**
Tapejara wellnhoferi	1.61	1.14	1.00	0.89	0.97	0.94	0.83	0.86	0.67	0.83	**0.97**
Tupandactylus imperator	0.84	0.56	0.58	0.58	0.71	0.82	0.51	0.44	0.51	0.60	**0.62**
Caiuajara dobruskii	0.38	0.67	0.79	0.63	0.63	0.67	0.75	0.58	0.46	0.33	**0.59**
Tupandactylus navigans	0.80	0.57	0.50	0.47	0.50	0.40	0.33	0.47	0.47	0.63	**0.51**



Conclusions:

The original hypothesis was refuted: If a pterosaur had a cranial crest, then the crest would *not* have a large effect on its aerodynamics, except during transient periods of turning when it encountered quartered winds and crosswinds. Based on the tests, the following order of aerodynamic stability from least to greatest was determined:

- The non-crested hypothetical species
- *Tapejara wellnhoferi*
- *Tupandactylus imperator*
- *Caiuajara dobruskii*
- *Tupandactylus navigans*

The reason for this order was based on the averages in which non-crested hypothetical species averaged 1.0 on the turbulence scale, as did *Tapejara wellnhoferi*, *Tupandactylus imperator* scored 0.5, while *Caiuajara dobruskii* and *Tupandactylus navigans* were 0.3. While the highest score belonged to the non-crested hypothetical species, with an average turbulence rating of 1.13, none of the models tested gave an alarming result – anywhere near the maximum of 3.0.

The observed trend was that small or no crests performed worst aerodynamically. The largest crest, presumed before testing to be the worst, actually ranked in the middle. The species with medium sized crests performed best of all. However, with these medium size crests on *Caiuajara dobruskii* and *Tupandactylus navigans* being very tall, some degree of "roll motion" might have occurred when the top of the crest caught crosswinds when the head turned. This rules out the likelihood of the crest being used as a rudder.

During the testing process, some tells were removed because of trailing edge turbulence. Trailing edge turbulence occurs whenever a body is in the air. Even if that body were a flat disc travelling vertically, there would still be large areas of disturbance below and behind the tell tail, simply as the result of an object moving through the air. What, then, would the crest have been used for? Some possibilities include: as a device to attract a mate; as a way to differentiate between similar-looking species; as a thermal regulator to heat up or cool down the animal.

While pterosaurs with head crests would not want to be turned 90 degrees to the wind because of roll motion, they may have travelled long distances in migratory patterns. The fossils of some pterosaur species – for example the non-tapejaridae *Tropeognathus mesembrinus* (*Ornithocheirus*) – have been found in South America, North America and other parts of the world, which would have required the crossing of oceans. Like sailboats, those pterosaurs may have "tacked" into the wind when attempting to cross a large body of water, using their "sweet spot" of 45 degrees in order to avoid direct headwinds (10-30 degrees) or crosswinds (70-90 degrees) in order to minimize turbulence. In total, having a crest on a pterosaur was more beneficial than not having a crest. And medium-size crests performed better than particularly small or particularly large crests.

Further Scientific Application:

This project helps shed light on one of the least-understood group of fossil vertebrates. It further advances knowledge in that field, and may well inspire more people to become interested in paleontology/functional morphology. Also, the idea of pterosaurs tacking, as mentioned in the conclusion, might foster further research into pterosaur migration strategies when crossing an ocean or a continent. Another idea is that of synapses attached from the crest to the brain indicating possible rudder function. By studying the pterosaur braincase, this could be possible. A pterosaur-inspired aircraft with a sliding rudder was proposed in 2007. The mainly laminar flow observed on the crests means that they are quite stable; and perhaps aerodynamic engineers could use their shape to improve aircraft flight.

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"*Carchocolodon*"

Erin Baker *and* ***Jeri Cuffley*** *cast this chocolate meg tooth. Death by chocolate! Hands by M. Baughman. Photo by S. Godfrey.* ☼

Bowhead Baleen

*The woven baleen basket figured on page 1 was made from bowhead whale baleen (*Balaena mysticetus*). They have baleen that is up to 11 feet long. Native peoples of North America, specifically Alaska, are entitled to continue to subsistence hunt the Bowhead whale. Image from:* http://www.adn.com/sites/default/files/styles/full_width_850/public/images/topic/rural-alaska/bowhead-whale-hunt.jpg?itok=9_ORBML- ☼

Oh Deer…

Wet, furless, and compliant skin partially drawn over the reaching skeleton of a whitetail deer on the beach along the St. Mary's River, St. Mary's County, MD. Photo by S. Godfrey. ☼

Upcoming Lectures at CMM

1. Dr. Thomas R. Holtz, Jr.; ***Realm of the Tyrant King: Last Days of the Dinosaurs in the American West*** on **Saturday, March 5th** at 2:30 p.m. at the Calvert Marine Museum. The lecture is free and open to the public.

Holtz is a dinosaur paleontologist specializing in the origin, evolution, adaptations, and paleobiology of carnivorous dinosaurs (especially *Tyrannosaurus* and its kin).

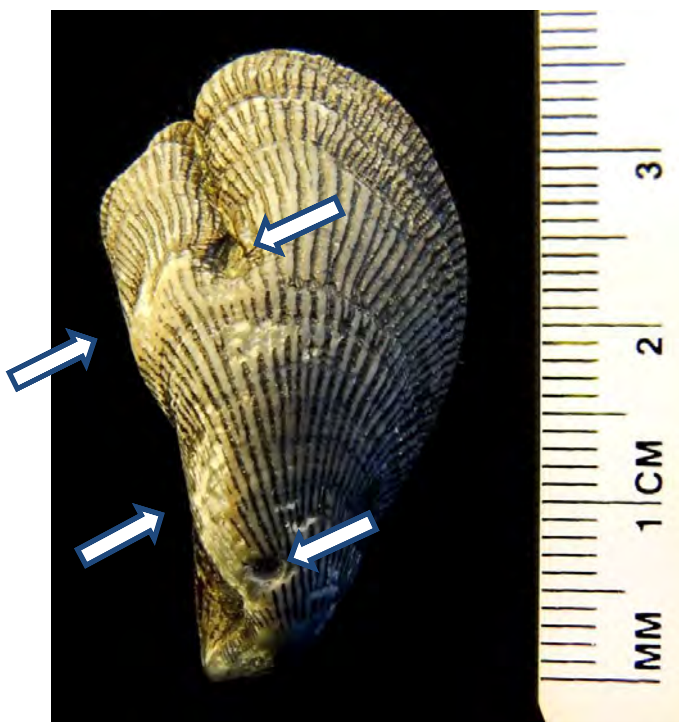
2. Dr. Robert M. Hazen; ***Chance, Necessity, and the Origins of Life*** on **Saturday, April 9th** at 3:00 p.m. at the Calvert Marine Museum. The lecture is free and open to the public.

Dr. Robert M. Hazen is a Senior Staff Scientist at the Carnegie Institution of Washington's Geophysical Laboratory and the Clarence Robinson Professor of Earth Science at George Mason University.

3. Dr. Hans-Dieter Sues; ***The Turtle Story: The Origin and Evolution of an Unusual Body Plan*** on **Saturday, May 21st** at 2:30 p.m. in the Harms Gallery at the Calvert Marine Museum. The lecture is free and open to the public.

Dr. Hans-Dieter Sues is Senior Research Geologist, Curator of Vertebrate Paleontology, and Chair Department of Paleobiology at the National Museum of Natural History, The Smithsonian Institution. ☼

Blue Mussel Shows Staying Power



The white arrows point to places where this blue mussel was either bitten or pecked at; at least one of which broke the shell. Nevertheless it survived to which the damaged shell attests. Photo by S. Godfrey. ☼

Moss on the Cliff

Framed by winter ice, these vibrant green moss-balls grace the cliff. Photo by S. Godfrey. ☼

Ice-Cream Cone Worms

These sand-grain tubes were made by marine "trumpet" or "ice-cream-cone" worms Pectinaria gouldii. *They were found after a recent winter storm along Calvert Cliffs. Photo submitted by John Nance.*
Hi-Res image posted to Flickr:
https://www.flickr.com/photos/vims_photos/24150407374/in/album-72157644926456435/ ☼

Freeze-Thaw Slumping

Freeze-thaw Miocene sediments ooze onto the beach south of Cove Point, MD. Photo by S. Godfrey. ☼

Brown Pelican Down

*A dead brown pelican (*Pelecanus occidentalis*) partially buried in the sand on the beach below the cliffs south of Cove Point, MD. Photo by S. Godfrey.* ☼

Vertebrate-Bitten Coprolite from South Carolina

By Stephen J. Godfrey and George Frandsen

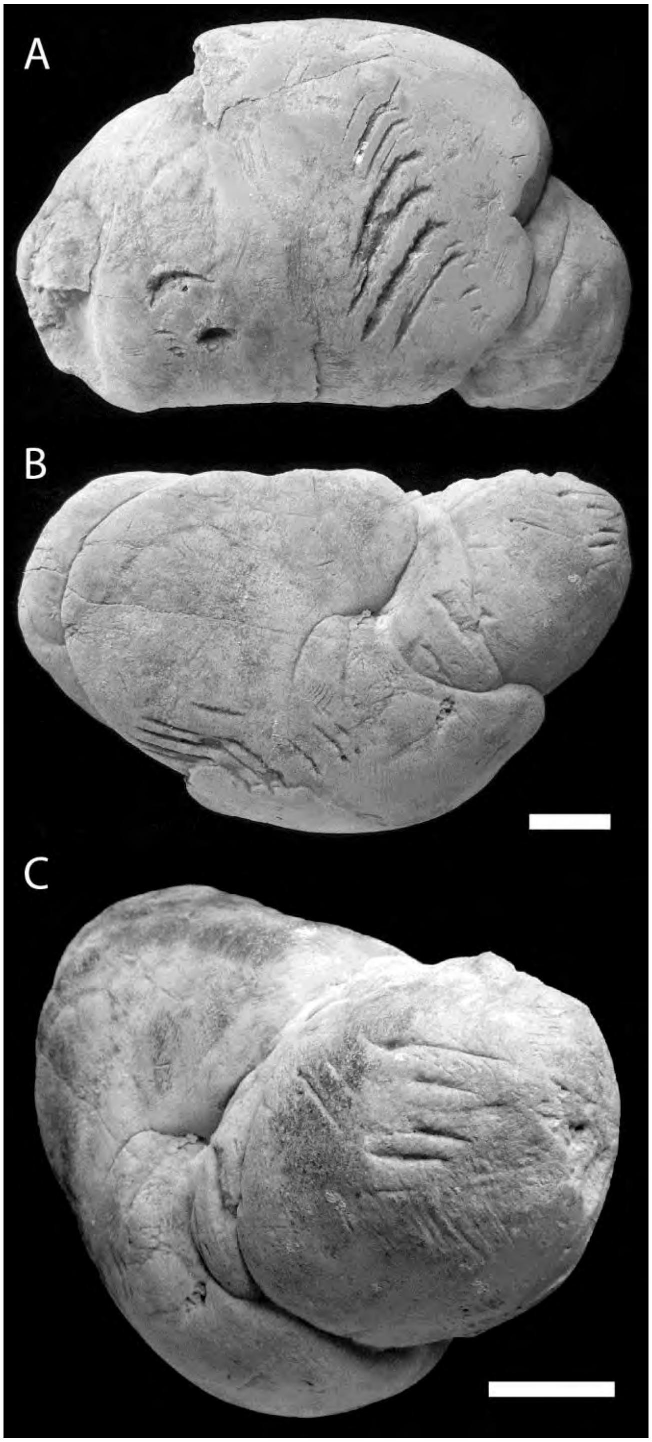


Figure 1. CMM-V-6615, *a vertebrate-bitten coprolite collected from a sand pit near Summerville, South Carolina. A-C. This vertebrate coprolite preserves three prominent series of tooth scorings over its surface. B. Coprolite turned about its long axis 180 degrees to show additional tooth markings on its reverse side. C. Coprolite turned approximately 60 degrees from its position in B. to illustrate the bite-marks on its small hemispherical end. Specimen whitened with sublimed ammonium chloride to improve contrast and highlight detail. White scale bars equal 10 mm.*

Figure 2. CMM-V-6615, *a vertebrate-bitten coprolite, natural color. The large black arrow points to a primary striation (tooth gouge), whereas the small white arrows point to secondary tooth gouges. Hand by M. Baughman. Photos by S. Godfrey.*

Introduction

Of all the coprolites known from the fossil record, only three have been formally recognized as preserving vertebrate tooth impressions or bite marks (Godfrey and Smith, 2010; Godfrey and Palmer, 2015). Here we describe another unique coprolite, *CMM-V*-6615 (Calvert Marine Museum Vertebrate collection), (Figs. 1 & 2), that preserves tooth bite and raking marks over its surface. We presume that the interaction between the toothy vertebrate and coprolite was exploratory: Was the coprolite edible? Evidently, it turned out not to be.

Geological Setting

The coprolite was found near Summerville, South Carolina. Summerville is situated mostly in Dorchester County with small portions in Berkeley and Charleston counties. The coprolite was acquired from an online vendor by G. F. and donated to the Calvert Marine Museum. Unfortunately, the vendor was unwilling to provide exact collecting locality information (other than to say that it was removed from a local sand pit), substantially diminishing the scientific value of this otherwise important specimen!

Sand pits in the Summerville area remove sand down to the top of the early Oligocene Givhans Ferry Member of the Ashley Formation (R. Weems pers com.). In so doing, Oligocene, Miocene, Pliocene, and Pleistocene fossils are also unearthed. Based on this information, the coprolite is no older than early Oligocene.

From the natural color of this coprolite, its origin from within the Ashley Formation has been suggested (J. Geisler pers com.). The Ashley Formation is now considered to be Rupelian (Early Oligocene) in age (Geisler and Sanders, 2006; Weems and Sanders, 2014; Weems et al., 2004).

The Oligocene paleoenvironment in the Summerville area was a nearshore coastal environment (Weems and Sanders, 2014).

Description

CMM-V-6615 approximates the shape of an oblate spheroid – 98 mm long and 60 mm in diameter at its maximum girth. It weighs 219.4 g. It is beige to dark brown in color (Fig. 2) and exhibits deep folds that wrap its circumference. Prominent tooth-raking marks occur on both sides of the coprolite (Fig. 1A and B and Fig. 2) as well as on its smallest hemispherical end (Fig. 1C). The tooth marks in the two series of primary bite marks (Fig. 1A & B and Fig. 2) are linear. However, the long axes of these two linear series of tooth marks on opposite sides of the coprolite are offset by about 45 degrees from each other (making it seem less likely that both series were made during one bite by upper and lower teeth respectively). Within these two linear series, tooth spacing is very nearly 5 mm throughout. In both of the linear series of bite marks, following the initial contact of teeth to coprolite, the teeth moved perpendicular to the tooth row, then they were raked away over the surface of the feces at an angle of about 45 degrees. The teeth penetrated into the coprolite to a maximum depth of about 1 mm.

The markings on the hemispherical end of the coprolite are approximately 2 mm apart but could represent tooth marks from successive passes (i.e., bites) over the surface.

Additionally, much of the surface of CMM-V-6615 is marked by many hundreds of finer parallel-sided striations of unknown origin.

Discussion

Although the identity of the animal that produced the coprolite remains unknown, it is consistent in its size and shape to those previously attributed to crocodilians (Hantzschel et al., 1968; Sawyer, 1981; Sawyer, 1998; Hunt and Lucas, 2010; Milàn, 2012).

The alignment of the bite marks indicates that the biter had nearly straight jaws; at least throughout the section represented by these bite marks. In this regard, they resemble the bite marks described in another coprolite from South Carolina (CMM-V-4480, Fig. 3) as having been made by a gar (Fig. 4, *Lepisosteus* sp; Lepisosteidae) (Godfrey and Palmer, 2015).

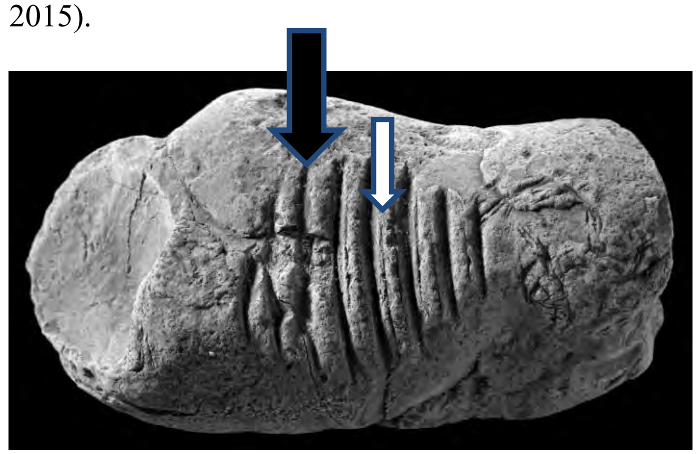


Figure 3. Gar tooth-marked coprolite (CMM-V-4480) showing the primary (large black arrow) and secondary (small white arrow) tooth striations. Specimen whitened with sublimed ammonium chloride to improve contrast. Modified from Godfrey and Palmer, 2015).

In Figure 2, the two white arrows mark several shallower tooth gouges that occur adjacent to and between the deeper primary ones, suggesting a jaw with teeth like that of a gar; it possesses large medial fangs and smaller peripheral teeth (Fig. 4). However, because the finer gouges in CMM-V-6615 are not as uniform as are those described in CMM-V-4480 (Godfrey and Palmer, 2015; Fig. 3), we do not identify these bite marks as having been made by a gar. Furthermore, there do not appear to be any diagnostic features associated with these tooth marks that conclusively identify the taxon that bit CMM-V-6615!

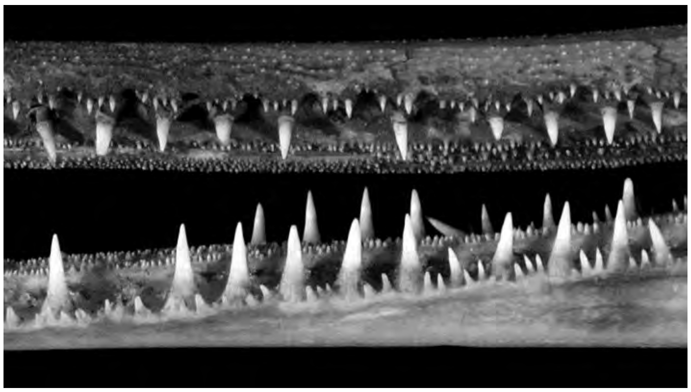


*Figure 4. Left lateral view of the mid-section of the rostrum of an extant gar (*Lepisosteus osseus*, CMM-O-33) showing the presence of many small peripheral teeth adjacent to the fewer larger fangs in both the upper and lower jaws. Modified from Godfrey and Palmer, 2015).*

The bold tooth gouges on CMM-V-6615 are also interesting because the edges of some of the markings (Figs 1A and 2) are "ragged", suggesting that the surface of the coprolite did not yield compliantly as the teeth raked its surface. The markings give the impression that the coprolite was firm enough at the time it was bitten to preclude tooth penetration to the full height of the tooth.

We don't know why the coprolite was originally bitten, other than to suggest that perhaps it was done to assess its palatability; some creatures engage in coprophagy. If that was why, evidently it was deemed unpalatable, whereby increasing the odds of it becoming fossilized.

Acknowledgments

Many thanks to R. Weems and J. Geisler for their appraisals of where this coprolite might have originated.

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☼

Raja; Stingray Teeth

Here are two Raja sp. from the Miocene Choptank-St Marys contact in Virginia. Both are only 1 mm so collectors don't normally see these unless they search fine matrix. They are a male (the high crowned specimen) and either a female or non-breeding male (the low crowned specimen). Test and photos submitted by M. Gulotta. ☼

Gyrolithes Burrow

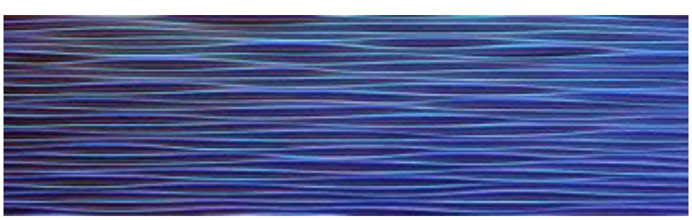
Dr. Robert Hazen *collected and donated this lengthy* Gyrolithes*; a helical burrow/trace fossil found in the clayey sediments of the Little Cove Point Member of the St. Marys Formation. Photo submitted by R. Hazen.* ☼

Sculpey Trilobite

Jeri Cuffley *sculpted this lovely* Phacops rana *trilobite using only Sculpey; a low-heat-hardened polymer clay. Car keys for scale. Photo submitted by J. Cuffley.* ☼

Toothy Meg

Kelly Carpenter *created this megalodon silhouette using small fossil shark teeth. Photo submitted by K. Carpenter.* ☼



Gummy Trilobite

Erin Baker *and* ***Jeri Cuffley*** *created this gummy trilobite…filled I'm sure with all kinds of essential vitamins and minerals. Hand by M. Baughman. Photo by S. Godfrey.* ☼

Great Blue Heron

Articulated partial neck of a great blue heron on the beach north of Parkers Creek, Calvert Cliffs, MD. Photo by S. Godfrey. ☼

The Húsavík Whale Museum In Iceland

This whale museum is a non-profit organization founded in 1997. Its goal is to provide interesting information about whales and their ecology. CMMFC field trip??? Learn more at: http://www.whalemuseum.is/

Gallery photo of the Húsavík Whale Museum from: https://img.washingtonpost.com/rf/image_1484w/2010-2019/WashingtonPost/2015/10/21/Travel/Images/whales_of_iceland_71445440393.jpg?uuid=TiVMWHgGEeWl4kDWsq0Y3Q ☼

Pathological Dolphin Vertebrae Added to CMM Comparative Osteology Collection

These extant dolphin lumbar vertebrae were recently added to our collection. The lower right specimen is normal, although it is missing its capping disc (i.e., its epiphysis). The upper left specimen from the same individual shows osteomyelitis of the base of the neural arch (the bone appears swollen), marginal osteophytes around the perimeter of its epiphysis, and degeneration of its bony vertebral plate (i.e., its epiphysis). Hands by M. Baughman. Photo by S. Godfrey. ☼

Meg; the Movie…

They're making the MEG movie.
http://www.theguardian.com/film/2015/jun/17/eli-roth-horror-movie-meg-shark-prehistoric
A new expanded version of MEG also just debuted!
Submitted by S. Alten ☼

Modified Meg?

This partial megalodon tooth was found as float along Calvert Cliffs by **Landon** *and* **Anthony Williams***. The symmetrical way in which it is "broken" suggests that it might have been rendered thusly by Amerindians for use as a tool. However, someone needs to study how fossil shark teeth break once on the beach; perhaps this "projectile-point" shape is one of the natural ways in which meg teeth erode. Photo submitted by A. Williams.* ☼

Tooled Mako Tooth?

*This mako tooth (*Carcharodon [aka Cosmopolitodus/Isurus*]* hastalis*) was found by* ***Jason Osborne*** *as float in Southern Virginia. This notched tooth was possibly used as a projectile point or cutting implement. It appears as though the root was struck to notch it for hafting to a wooden shaft. Jason also donated this specimen to our permanent collection; many thanks! Hand by M. Baughman. Photo by S. Godfrey.* ☼

Axe Head Found During Fossil Hunt

Matt Boland *found this nice example of a grooved axe along the Potomac River while collecting fossils! M. Boland's hands for scale, photo by A. Alford.*

The following comments courtesy of **Dr. Ed Chaney** - Southern Regional Archaeologist, Jefferson Patterson Park & Museum: *This is a full-grooved axe (so called because the groove for hafting the axe to a handle goes all the way around the artifact). At more than 8 inches long, it is definitely on the large side of the size range, but not extraordinarily so. Stone axes were uses for any number of chopping activities, but the primary one was woodworking. The damage to the blade of your axe may have been caused by one of those activities. Grooved axes were produced over a period of thousands of years, and it is hard to date an individual axe if it was not found in association with other artifacts. However, the peak in the use of grooved axes seems to have occurred around 3,000 to 6,000 years ago. This is a nice example!* ☼

Ancient Squash Seeds Found

http://www.cfweradio.ca/on-air/blogs/dustin-mcgladrey-351668/entry/471/

Submitted by V. Kricun. ☼

Tiny Burrow Trace Fossils

The action of waves pounding on the base of the clayey cliffs exposed thousands of tiny Miocene burrows in Shattuck zone 11, north of Parkers Creek, Calvert Cliffs. Photo by S. Godfrey. ☼

Tiny Fecal Pellets

John Nance *found this bivalve shell internal mold (?* Mercenaria, *St. Marys Formation) filled with tiny coprolites. The producer of these fossilized fecal pellets is as yet unknown. Hand by M. Baughman. Photo by S. Godfrey.* ☼

All in a Day's Work

Russell Morin *found this handsome meg tooth recently along Calvert Cliffs. Hands by R. Morin. Photo by S. Godfrey.* ☼

Looking for Shark Teeth

Dr. Kenshu Shimada (kshimada@depaul.edu) is looking for "*Brachycarcharias* sp.?" shark teeth (image taken from Fossil Fish Volume III, page 49, published by the North Carolina Fossil Club). He is currently leading a study to describe this taxon that also appears to occur in Japan, California, and Peru. If you think that you have teeth like this in your collection and are interested in helping him, please contact him directly using his above-listed email. ☼

First Fossil Bed from the Dinosaur Extinction Event

http://www.iflscience.com/plants-and-animals/first-fossil-bed-discovered-dinosaur-extinction

Submitted by J. Cuffley. ☼

One Mutation Away from Multicellularity

http://wpo.st/xh631

Submitted by D. Alves. ☼

Sperm Whale Teeth Donated

***Pam Platt** found and donated these two associated Miocene sperm whale teeth to the Calvert Marine Museum. They were found along Calvert Cliffs. Notice the eroded/worn area below their crowns showing the multiple layers of dentine that characterized many sperm whale teeth. Hands by M. Baughman. Photo by S. Godfrey.* ☼

Drum Fish Partial Skull

***Luther Lohr** found this partially concreted fish skull some years ago along the low cliffs at Langley Bluff, St. Mary's County. (Very unfortunately, that site no longer exists) Seen here in right lateral view, it shows some similarities to that of the modern red drum,* Sciaenops ocellatus *(figured below). Disarticulated bones and otoliths of the Miocene* Sciaenops *are among the most commonly encountered bony fishes found along Calvert Cliffs. Hands by M. Baughman.*

*Neurocrania of a fossil (left) and modern red drum (*Sciaenops ocellatus*) neurocranium shown here in ventral view. Photos by S. Godfrey.* ☼

Red Drum
http://www.huntstats.com/images/RED-DRUM.jpg

MakerBot in Motion

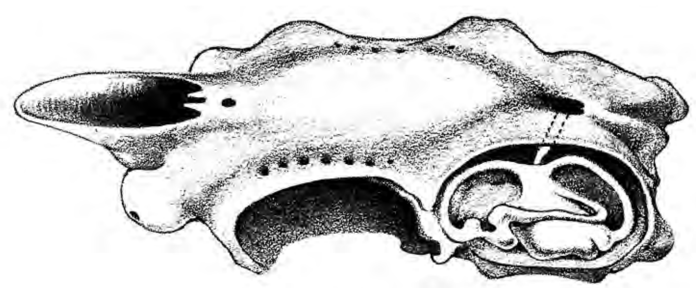
The Paleontology Department at the Calvert Marine Museum was recently awarded a "Museums for America" grant from the Institute of Museum and Library Services. Funding for the project, "*Breathing New Life Into Old Bones*" has allowed the Calvert Marine Museum to purchase Avizo 3D software and a MakerBot Replicator Z-18 3D printer to create models of specimens from their paleontology collection. It provides the museum the opportunity to print images and create visuals and hands-on models for use in educational programming, public exhibits, conferences, and peer-reviewed journals. CMM Paleontologists may now visualize, analyze, and understand the scientific data in the collection in ways that would be unattainable by other means.

"This software and printer will enhance our ability to share discoveries with the public, teach about life millions of years ago and promote understanding of why things are the way they are today," says John Nance, Paleontology Collections Manager at the Calvert Marine Museum.

The Institute of Museum and Library Services is the primary source of federal support for the nation's 123,000 libraries and 35,000 museums. Their mission is to inspire libraries and museums to advance innovation, lifelong learning, and cultural and civic engagement. To learn more, visit www.imls.gov. ☼

Fossilized Shark Cartilage

Miocene shark cartilage is only rarely preserved. This remarkable specimen, CMM-V-1726, preserves the otic capsules of a shark. "Otic" refers to the ear region, that included among other features the semicircular canals figured in the lower right quadrant of the following image. Hand by M. Baughman. Photo by S. Godfrey.



Shark chrondrocranium in left dorsolateral view. The otic region has been cut open to show the semicircular canals and basal sacculus within. Illustration from:

Wischnitzer, S. 1972. Atlas and dissection guide for comparative anatomy. W.H. Freeman and Co., San Francisco. 203 pp. ☼

Organ-Pipe Ironstone

This very large section of ferricrete (i.e., sediments naturally cemented by iron oxide) recently slumped onto the beach along the southern end of Calvert Cliffs. The massive structure retains the horizontal orientation that it had when positioned high in the cliffs. It originated in the post-St. Marys Formation sandy sediments (either Eastover Formation, Pliocene, or Pleistocene) that characterize the upper half of this section of the cliffs.

End view of the anastomosing pipes of ferricrete. The unconsolidated sands between the "pipes" were removed during the last nor'easter. Photos by S. Godfrey. ☼

Bright Red Iron Stain

***Ralph Eshelman** spotted this bright red iron oxide staining in the cliffs at Calvert Cliffs State Park. Photo submitted by R. Eshelman.* ☼

Plant Impressions Preserved in Ironstone

This small piece of ironstone was found as float along the southern end of Calvert Cliffs and appears to preserve impressions of stems and other woody plant parts. Hands by M. Baughman. Photo by S. Godfrey. ☼

Whale Skull X-Rayed

***Nichole Doub** - Head Conservator at the Mac Lab (Jefferson Patterson Park & Museum) positions a jacketed Miocene fossil whale skull beneath the X-ray tube. The skull was collected along Calvert Cliffs by **Mike Ellwood**, with help from the Scientists Cliffs maintenance crew; many thanks to all!*

***Erin Wingfield** - Collections Assistant (left) and **Nichole Doub** with sensors in hand pause outside the x-ray facility during exposure of the x-ray film. Photos by S. Godfrey.* ☼

On Your Way to the Beach…

*Lion's Mane Mushroom or Bearded Tooth Mushroom (*Hericium erinaceus*) belongs to the tooth-fungus group. Native to North America, Europe, and Asia it can be identified by its long spines, its appearance on hardwoods and its tendency to grow a single clump of dangling spines. In the wild, these mushrooms are common during late summer and fall on hardwoods, particularly American Beech.*
https://en.wikipedia.org/wiki/Hericium_erinaceus
Photo taken in St. Mary's County, MD by S. Godfrey. ☼

The American Fossil Federation

The American Fossil Federation (AFF) will be holding its fifth annual fossil auction on Sunday March 13, 2016 at the North Bowie Community Center (3209 Stonybrook Dr., Bowie, MD). **The public is invited to attend.**

- Doors open at 11 AM.
- Business meeting begins at noon.
- Auction begins between 12:45 and 1:00.
- All sales are **Cash Only**.

AFF club members bring in an assortment of fossils from various localities and times periods along with other fossil related materials (posters, fossil replicas, display cases, books, and other items related to fossil collecting) to be included in the auction.

Admission is free.

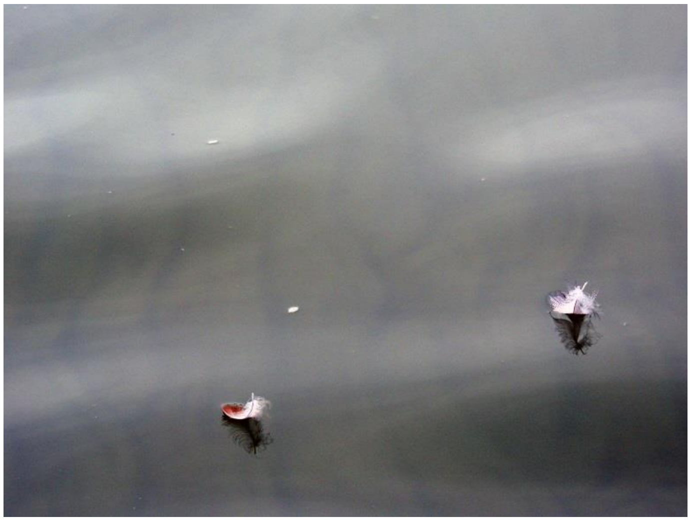
Your participation is highly desired J.

Just a reminder: Daylight Savings Time begins Sunday March 13 at 2 AM. Be sure to set your clocks accordingly.

The AFF meets six times a year on the second Sunday in January, March, July, September, and November and the third Sunday in May (to allow for the celebration of Mother's Day).

Submitted by J. Patzer
President of the AFF ☼

Floating Feathers



I couldn't help but photograph a few of the many feathers that were drifting ashore from all the bay ducks rafting on the Chesapeake Bay.

A single Greater Scaup feather floats below the reflection of Calvert Cliffs. Photos by S. Godfrey. ☼

CALVERT MARINE MUSEUM FOSSIL CLUB EVENTS

FOR ALL TRIPS CONTACT **Bob Ertman** at robertertman@msn.com. As soon as possible, but NO LATER than Thursday before a trip. His cell phone number is: 410 533-4203

Saturday, March 5th, 2016. Fossil Club meeting at 1:00 pm in the 3rd floor lounge followed by **Dr. Thomas R. Holtz, Jr.**; ***Realm of the Tyrant King: Last Days of the Dinosaurs in the American West*** at 2:30 p.m. in the Harms Gallery at the Calvert Marine Museum.

Saturday, March 19th, 2016. Odessa, DE. Meet up 9:45 - 10:00 am. We'll move on to the farm in Odessa to walk the fields and collect petrified wood (cypress from the Pleistocene, probably 1.5-2 million years old). No special equipment is necessary; in fact, you should leave your tools at home so that we will not do anything to cause erosion on this no-till farm. Here's a link to a nice write up about one of our trips to a nearby site: http://viewsofthemahantango.blogspot.com/2011/08/petrified-wood-from-delaware.html.

This is a **John Wolf** Memorial Trip.

Saturday, April 9th, 2016. Dr. Robert M. Hazen; ***Chance, Necessity, and the Origins of Life*** at 3:00 p.m. in the Harms Gallery at the Calvert Marine Museum.

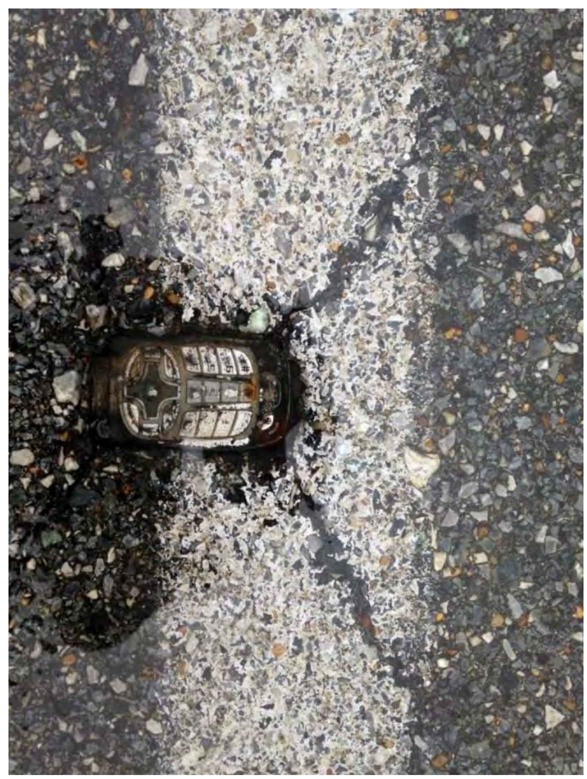
Saturday, May 21st, 2016. Fossil Club meeting at 1:00 pm in the 3rd floor lounge followed by **Dr. Hans-Dieter Sues**. ***The Turtle Story: The Origin and Evolution of an Unusual Body Plan*** at 2:30 p.m. in the Harms Gallery at the Calvert Marine Museum.

Sunday, June 5th, 2016. Purse State Park, (low tide a little after noon) meet at 11:30 AM. Aquia Formation (late Paleocene, about 60 million years ago). This site is on the Potomac River in Charles County, MD. Best known for internal molds of the gastropod *Turritella* sp. (more than you can carry out); occasional crocodile, ray, shark teeth (*Otodus* sp., and *Striatolamia* sp.), and petrified wood (also some nice specimens of jasper and other minerals). Access to the site requires a moderate hike through the woods, and sometimes rather strenuous hiking and climbing over trees along the water's edge. Collecting is mostly by beachcombing along the riverbank; screening may be productive. Take a look at what you can find: http://www.fossilguy.com/sites/potomac/index.htm. And some examples of the petrified wood can be found here: http://dlynx.rhodes.edu/jspui/handle/10267/1814

Saturday, September 17th, 2016. Fossil Club meeting at 1:00 pm in the 3rd floor lounge followed by a public lecture TBD at 2:30 p.m. in the Harms Gallery at the Calvert Marine Museum.

Saturday, November 19th, 2016. 12:00 PM – Chestnut Cabin @ Scientists Cliffs – beach walk/collecting, potluck lunch, meeting, and presentation. ☼

Cell Phone…Fossil in the Making?



This cell phone is deeply imbedded in asphalt. I wonder how many will make their way into the Anthropocene fossil record. Photo by S. Godfrey. ☼

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The Ecphora is published four times a year and is the official newsletter of the Calvert Marine Museum Fossil Club. **The Editor welcomes contributions for possible inclusion in the newsletter from any source. Submit articles, news reports of interest to club members, field trip reports, and/or noteworthy discoveries.** All opinions expressed in the newsletter are strictly those of the authors and do not reflect the views of the club or the museum as a whole.

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Many thanks to **John Nance** for proofreading this edition.

Newsletter website: http://calvertmarinemuseum.com/204/The-Ecphora-Newsletter