MARYLAND GEOLOGICAL SOCIETY Est. 1991 BALTIMORE, MARYLAND

The Rostrum

The Newsletter of the Maryland Geological Society
Baltimore, Maryland
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President's Message

"Are we there yet?"

While acting as chauffer to my two young granddaughters for a trip to the playground, within minutes I heard a forgotten but familiar cry emanating from the backseat – "Are we there yet?". It was a question I had not heard since the days when my own kids were young. Proper instructions on how to use the phrase must be outlined in the kid's handbook "How to Annoy Parents (and Grandparents, Too!)". But it did make me think about the current state of where we stand in the fight against the viral pandemic. While much of daily life has reverted to a degree of normalcy, we are not all the way there yet. And now the Delta variant of the virus threatens to force a step backwards. What has been the primary impact on our organization? - we have not held an in-person meeting since November, 2019, but have held several meetings on-line via Zoom. The Bowie Community Center is scheduled to finally reopen on August 1st. It is my hope that we can hold a meeting at the Center for our regularly scheduled weekend in September. Additionally, I would like to hold a scaled down version of our annual auction at that meeting. Guidelines provided by the Center indicate that masks might be required inside the building and no food will be allowed inside. More details will be emailed out in early September. If we are not all the way there yet, I hope we are far enough along to finally be able to see one another again, to share some fossil finds and associated stories, and finally feel like things are almost like they used to be.

Cheers, Rick

Dates to Remember

Sunday, September 19, 2021 – General Meeting (hopefully!) & Mini-Auction
Please note: No meeting in July

Meeting Time
11:00 AM to 3:00 PM

Featured Mineral – Adamite

What we know is a drop,
what we don't know is an ocean.

Isaac Newton

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Maryland Geological Society

Founded in 1991, MGS is comprised of both amateur and professional mineral and fossil collectors. The organization emphasizes collecting, identification, study and display aspects of the geological sciences. MGS is a nonprofit organization affiliated with the American Federation of Mineralogical Societies (AFMS) and the Eastern Federation of Mineralogical and Lapidary Societies (EFMLS).

Dues

Annual dues are $15.00 per individual adult member. Applications for membership may be obtained from the MGS website or by contacting the Membership Chairman, Mike Folmer, at 417 West Maple Road, Linthicum, MD 21090, (410) 850-0193. Dues are payable by January 1st of each year.

Meetings

Meetings are held bimonthly, beginning in January at the Bowie Community Center, located at 3209 Stonybrook Drive, Bowie, MD - (301) 464-1737. The doors open at 11:00 AM and the meetings are completed by 3:00 PM. Club meetings will be held as scheduled so long as the Bowie Community Center is open.

Tentative Meeting Dates & Programs for 2021

January 17: Zoom Meeting

March 21: Zoom Meeting

May 16: Zoom Meeting

July 18: No Meeting

September 19: Annual Auction

November 21: General Meeting

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The Rostrum

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Website

www.mdgeosociety.org

Material for the website should be sent to Jim Stedman at stedmanjim@gmail.com.

Featured Mineral: Adamite
Bob Farrar

The Featured Mineral for May will be Adamite. Named for French mineralogist G. J. Adam, adamite is not of much importance economically, but is an interesting species for collectors.

Adamite consists of basic zinc arsenate, $Zn_2(OH)AsO_4$. It crystalizes in the orthorhombic system. Adamite is typically yellow or greenish yellow, but trace elements may impart other colors, including bright green (copper), pink (manganese), blue (aluminum), and purple (cobalt). Crystals may be elongate or short and blocky, and often form rounded radial aggregates. Other physical properties include a hardness of 3.5, specific gravity of 4.3 to 4.4, and translucence or transparency. Adamite can generally be distinguished by a chemical test for zinc, and the lack of bubbling in acid, which distinguishes it from smithsonite.

Adamite typically forms through the oxidation of sphalerite in the presence of arsenic. By far the best-known locality is the Ojuela Mine in Mapimí, Durango, Mexico. This locality has produced great numbers of yellow specimens, but also has produced green, purple, and blue material. Crystals from the Ojuela Mine may be up to 12 cm long, though this is exceptional. There are a number of other well-known localities around the world. The type locality is Chañarcillo, Chile. Tsumeb, Namibia is famous for green crystals. Other localities include Lavrion, Greece; Constantine, Algeria; Dalnegorsk, Russia; and several localities in Australia. US localities are not as well-known, but include Franklin, NJ; Juab Co., UT; Mineral Co., NV; and Coconino Co., AZ.

Adamite is of no use as a gemstone or industrial mineral, but it is popular with mineral collectors. Thanks largely to the abundance of specimens from the Ojuela Mine, adamite can be seen at almost any good rock show and be had for a reasonable price.

Adamite *specimen from Durango, Mexico. Image by Rob Lavinsky and reproduced under Creative Commons Attribution-Share Alike 3.0 Unported license. Image is available at [Wikimedia Commons.]*

Bonus Mineral: Creedite
Bob Farrar

For this issue of *The Rostrum*, we have a bonus mineral: creedite. Named for its type locality, the Creede Quadrangle of Colorado, creedite is not a particularly common mineral, but it is an interesting one for mineral collectors.

Creedite is a fluoride of calcium and aluminum, with additional components of water, sulfate and hydroxyl, $Ca_3Al_2(SO_4)(OH)_2F_8{\cdot}2H_2O$. It crystallizes in the monoclinic system with crystals ranging from short and blocky to needle-like, often in sprays or radiating aggregates. Creedite ranges from colorless or white to violet, though inclusions of other minerals may impart other apparent colors. Other physical properties include a hardness of 4.0 and specific gravity of 2.7. Creedite is not something that the average collector will need to identify; trust your sources.

Creedite typically occurs in the oxidized zones of fluoride ore deposits. Among the most prolific sources in recent years is the Navidad Mine in Durango, Mexico. There it forms radiating spheres of crystals that are often colored orange by the inclusion of iron oxides. These spheres may be several centimeters across, and several spheres may fuse together to form larger aggregates. Among the most colorful specimens are violet crystals from Kazakhstan. Other notable world localities include Oruro, Bolivia; Qinglong, China; and Santa Eulalia, Mexico. US localities include Cripple Creek, Colorado; Nye Co., Nevada; and Inyo Co., California.

Creedite is of no importance as a gemstone or industrial mineral, but it is popular with collectors. Specimens from the Navidad Mine are sufficiently abundant as to be available on the mineral market for reasonable prices. Specimens from other localities are harder to come by, but are usually not terribly expensive, so most collectors can afford to add creedite to their collections.

Field Trips

Field Trip Coordinators – Marci Robinson & David Shore

The Maryland Geological Society is an advocate of responsible collecting. The society has permission to collect in all of the sites listed that require such permission. Most trips are weather dependent and some require at least an average level of physical fitness. Field trips are restricted to MGS members only.

No field trips currently scheduled.

John Bell Hatcher – Paleontological Royalty

Jim Stedman

Late on the overcast, windy afternoon of November 5, 1896, paleontologist John Bell Hatcher, alone and on horseback, worked his way through a desolate plain on his way to the port of Punta Arenas, Chile. During the afternoon, to allow his horse to drink and graze, he dismounted and looped the reins over the horse's back. When he went to mount again, he found that the reins had become tangled in the horse's legs. Attempting to release the reins, he bent down but the horse startled and a broken shank on the bridle bit tore into Hatcher's scalp. Unsuccessful at stopping the profuse bleeding, he saw no alternative than to continue his journey. Soon, faint from the loss of blood, he halted and, in a final attempt to stanch the blood flow, wrapped handkerchiefs around the large gash and forced his Stetson hat down onto his head. With night coming on, he covered himself in blankets and a rain slicker, and lay down on the ground, dazed, alone, and cold. The bleeding finally ended before daybreak. Hatcher resumed his journey and, five days later, weary and sick, he rode into Punta Arenas, his head wound seriously infected (Hatcher 1903).

I suspect Hatcher (1861-1904) considered this journey to Punta Arenas a success because he arrived in time to safeguard crates holding four tons of fossils that his expedition had collected and previously sent to the port for transfer to a New York-bound ship. This is perhaps an extreme example, but really only to a slight degree, of Hatcher's courage, strength, and singular focus. He is one of my paleontological heroes, a complicated individual who made seminal contributions to the science and who was, without question, one of the greatest fossil collectors ever. A recent biographer, paleontologist Lowell Dingus, crowned Hatcher the "King of the Dinosaur Hunters" (Dingus 2018). Some of his adventures are worthy of a fictional character such as Indiana Jones, though I must stress that Jones was *merely* an archaeologist. (The photograph of Hatcher at left is reproduced with the kind permission of the Yale Peabody Museum of Natural History.)

The fossils Hatcher collected during the last third of the 19th century into the early 20th century, mostly in the American West but also elsewhere, including South America, constitute important parts of the vertebrate fossil holdings of the Peabody Museum of Natural History (Yale University), the Carnegie Museum of Natural History, and the National Museum of Natural History (Smithsonian Institution). Hatcher was also a consummate geologist whose fossil collecting was deeply informed by his understanding of stratigraphy.

Life of a Paleontologist

His interest in fossils began in his youth in Iowa (see Scott 1904 for a brief overview of Hatcher's life). While working in a coal mine to earn money for college, Hatcher found fossils and built a small collection of Carboniferous specimens. He spent a few months at Grinnell College in Iowa, and then transferred to Yale University where he studied the natural sciences, including geology. He earned a bachelor's degree from Yale's Sheffield Scientific School in 1884. Upon graduation and eager for employment, Hatcher approached Yale professor of paleontology Othniel Charles Marsh (1831-1899), who was also a curator at Yale's Peabody Museum. Both the academic position and the museum itself were created with financial donations from Marsh's wealthy uncle, George Peabody. From 1884 until 1893, Hatcher was a principal collector in the field for Marsh. Though he scoured formations primarily in the West, from Wyoming to Texas, he also spent time gathering fossils for Marsh on the East Coast, including Maryland.

Hatcher's time with Marsh was toward the end of the so-called "Bone Wars" in which Marsh and paleontologist Edward Drinker Cope (1840-1897) engaged in an incredibly productive, sometimes counterproductive, and decidedly cutthroat competition to collect dinosaur fossils in the Western states.

After parting ways with Marsh in 1893, Hatcher became a curator of vertebrate paleontology and assistant in geology at Princeton University, leading fossil collecting expeditions with students in the western U.S. during the summers of 1893 to 1895. In 1896 through 1899, he went further afield, mounting missions to Patagonia (the Argentinian and Chilean regions at the southern end of South America). In 1900, Hatcher became curator of paleontology and osteology at the Carnegie Museum of Natural History. He died of typhoid fever in 1904 at the age of 42.

Triceratops* and *Brontotherium

In his biography of Hatcher, Dingus presented a list by genus of the specimens collected by Hatcher over the course of his career and which are housed in museums (Dingus 2018). Overall, it documents a singularly impressive accomplishment, listing thousands of specimens. It also delineates how successful Hatcher was in finding fossils of ceratopsian dinosaurs, *Triceratops* among them. Paleontologist Charles Schuchert saw the amassing of these particular fossils as the pinnacle of Hatcher's collecting career. He wrote, "In the field seasons from 1889 to 1892, Hatcher sent in remains of 50 ceratopsians, 33 being represented by more or less perfect skulls – the most striking results of his many years of collecting" (Schuchert 1940, p. 215). It was not just the discovery of these fossils that marked this as a great accomplishment. Consider the challenge of extracting and shipping such specimens. As Schuchert marveled, "The largest skull sent to New Haven (No. 24), weighing 6,850 pounds, had to be lifted out of a 50 foot ravine and then hauled more than forty miles to the railroad over trackless country and through streams . . ." (Schuchert 1940, p. 215).

I associate Hatcher with *Triceratops* partly because, as a volunteer with the National Museum of Natural History, I quickly fell into the museum-wide habit of calling the Museum's *Triceratops* skeleton cast "Hatcher." The original skeleton the Museum displayed was composed of many fossil bones collected by the paleontologist. "Hatcher" is shown here in a picture taken in 2014, standing proudly just before the opening of the interim exhibit *America's Last Dinosaurs*. Sadly, with the recent opening of the new *Hall of Fossils – Deep Time*, "Hatcher" has been condemned to go on display lying prone, serving as a meal for a hungry *Tyrannosaurus rex*.

Among other fossils that I connect with Hatcher are those of the Late Eocene Epoch's *Brontotherium*, a rhinoceros-like mammal that is a relative of horses. He found many fossils of this animal which are now housed in museum collections. That these fossils may still be in various states of preparation became evident to me while I was volunteering in the Natural History Museum's FossiLab. A slab of matrix holding a *Brontotherium* jaw is shown in this picture from 2011 as it was being prepped in the lab. Hatcher himself had discovered and recovered this specific fossil in the Nebraska Badlands, probably in 1887.

At Work In Maryland

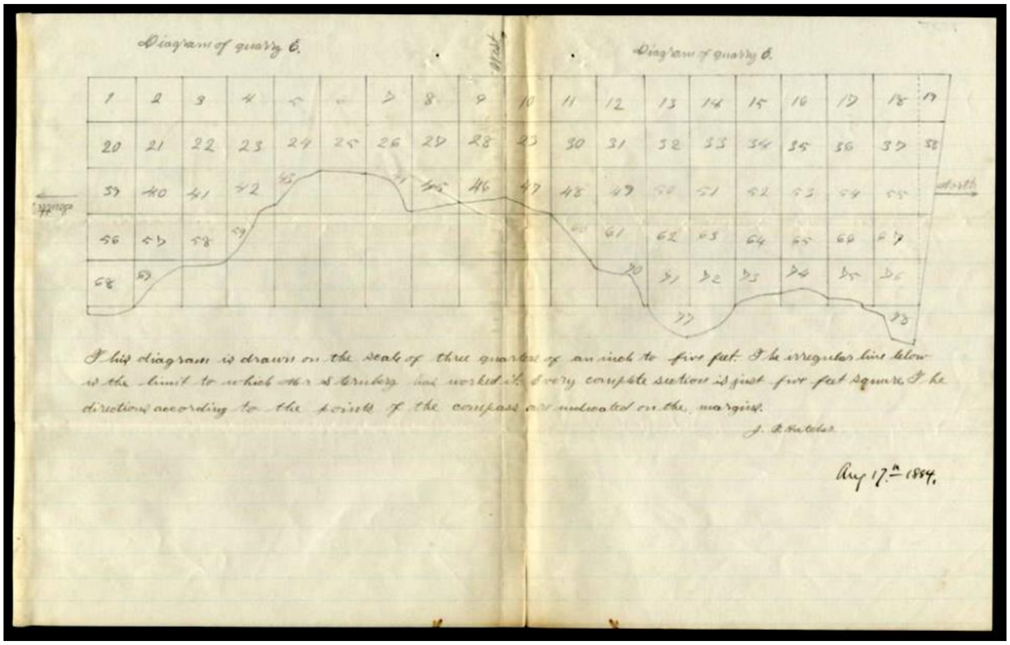
As noted earlier, Hatcher had a connection to Maryland. At Marsh's direction, he went in search of Cretaceous fossils in Maryland in the late 1880s, sometimes in the area in Prince George's County that now holds *Dinosaur Park*. Frankly, I think Hatcher found collecting in Maryland to be somewhat frustrating. He was at odds with the U.S. Geological Survey's "expert" when it came to the area's geologic formations and their ages. He collected in the iron ore pits outside of Washington, D.C., but was frequently prevented from doing so because water had to be pumped out first. Rain turned the local clay into mud. The fossils that were to be found were typically worn and difficult to extract without breaking. And Hatcher's work ethic and devotion to the task were not matched by those aiding him in the enterprise.

A wonderful example of this last disconnect occurred in late December, 1887. He had brokered a deal between Marsh and Charles E. Coffin who owned the iron ore pit at Muirkirk where Hatcher was finding bones. Coffin had shut down the pit a couple of years earlier but agreed to provide equipment and men to work it again in search of ore and bones. On Friday, December 23rd, Hatcher wrote Marsh to complain: "We have only been able to work two days this week & it took us until this afternoon to get the mud cleared away, so as to get the engine & cars at work. The men will not work tomorrow nor Monday so that I can do no more until next Tuesday." Hatcher's impatience with the men is clearly evident, though, in all fairness, the delay was prompted by Christmas. But, when Tuesday, December 27th , rolled around, Hatcher had to have been livid. He complained to Marsh that day: "I went out to resume work today but not a single man showed up although they said they would be on hand today. I can not do anything as they do not work under me directly. Of course we pay them only for the time they work, but I do not like to be disappointed so much." (See Note at end of this article regarding the source of Hatcher's correspondence with Marsh.)

Despite such challenges, Hatcher's work in Maryland proved to be significant. Lowell Dingus listed, among the fossils Hatcher collected during these Maryland trips, over 100 fossil specimens of the dinosaur *Astrodon*. Further, paleontologist Peter M. Kranz has written that the fossils Hatcher and Marsh found in this part of Maryland "form the basis of the main collection of Potomac Group dinosaurs (Early Cretaceous age) housed at the National Museum of Natural History, the Smithsonian Institution in Washington, D.C." (Kranz no date). He added, "From the bones they found, Marsh named several new species of dinosaurs, including *Priconodon crassus*, which is an armored dinosaur, large meat-eating dinosaurs and a number of sauropods."

Impact on the Profession

Hatcher had a long lasting impact on paleontology. Yes, he collected myriad important fossils, but, in the process, he also elevated paleontology's field practice. He was academically trained and his collecting expeditions into the field were guided by science and an understanding of the scientific value of the specimens he was uncovering. He brought this attitude into the field even on his first collecting foray to Kansas for Marsh in 1884. Chaffing at having to work in a quarry with the veteran fossil hunter Charles H. Sternberg (1850-1943), whose collecting practices seemed haphazard, Hatcher received Marsh's permission to collect in the quarry on his own. Hatcher immediately imposed a rigor on the process. Marsh had previously directed his collectors to draw maps of the areas in which they were collecting, noting the location of fossils, so some semblance of order could be imposed on the specimens when they reached Yale. Hatcher went a significant step further, dividing the floor of the quarry into a grid of five-foot squares, and drawing a map of the grid work in order to record the position of each individual fossil collected. Corresponding labels were applied to the fossils themselves as they were collected. Dingus wrote that, it was at the time a "novel fossil collecting technique," but one "that is still used today" (Dingus 2018, p. 35). Shown here is the initial map that Hatcher drew, dated August 17, 1884. (This image is reproduced with the kind permission of the Yale Peabody Museum of Natural History.)



Among other innovations linked to Hatcher is the now common practice of jacketing fossils in the field to protect them in transit back to laboratories for prepping. Historian Lukas Rieppel posited that it was Hatcher who first started to "bandage" fossils on site, encasing them in with cloth strips soaked in water and flour (Rieppel 2019). As the practice spread among collectors, plaster replaced the flour and water mixture.

A clever technique which Hatcher apparently pioneered was the recruitment of ant colonies in support of his collecting. He resorted to this innovative method under pressure from Marsh who wanted mammal fossils. In the Mesozoic formations where Hatcher often collected, mammal fossils were relatively scarce and invariably tiny. In sites with such fossils, Hatcher discovered that ant colonies living there often deposited mammal fossils in the sandy mounds they built up around their nests. Scooping up and sifting the ant hill material would separate out the minute fossils. If there weren't any ant hills in a spot likely to have mammal fossils, Hatcher would shovel up an ant nest from elsewhere and transfer it there. Returning in later years, he would find new nests with hills bearing mammal fossils (Hatcher 1896). (The ants in question are likely to have been harvester ants.)

A Difficult Character

It must be admitted that there are aspects of Hatcher's personality that challenge even his most loyal fans. He was often irascible, and prone to strike out at colleagues and employers. People fell into and out of favor frequently. He neglected certain aspects of his life, including his family, preferring to spend time in the field. In a February 1, 1892, letter to Marsh, he wrote, "I like being at home well enough. But [my wife and child] are all getting along well now & I believe the field is the place for me. The time passes quicker there than anywhere else in the world." This last is a sentiment I suspect many fossil hunters have felt, for better or worse.

His behavior may have arisen partly in response to a couple of factors. For much of his life, he suffered from an undiagnosed chronic illness he called "rheumatism" and which manifested itself in painful joints, among other issues. For Hatcher, when he was in the grip of this malady, field work must have been quite hard.

But perhaps the most trying aspect of his life was the very structure of vertebrate paleontology as it was practiced in this period. Unlike other specialized scientific fields at the end of the 19th and beginning of the 20th centuries, vertebrate paleontology grew up around collections of fossils often housed at museums. According to historian Ronald Rainger, the leading scientists at these museums were generally men of substantial wealth who acted as "entrepreneurs" in their drive to build prominent fossil collections (Rainger 1990). The entrepreneurs exercised nearly complete control over a large group of low paid, typically uneducated workers who collected fossils, people who were valued largely only for what they found. Hatcher apparently resented this repressive hierarchical structure, feeling he was denied the credit he deserved for his finds. Though hampered by modest financial means, he was academically trained and harbored greater aspirations than simply fossil collecting. Perhaps it is not surprising that his relationships with his fellow collectors and his employers were often fractious.

More Than A Collector

Hatcher was more than a supremely gifted collector. As Rainger appropriately summed up Hatcher's status: "In terms of fieldwork and *research*, Hatcher was at the forefront of early twentieth-century American vertebrate paleontology" (Rainger 1990, p. 15, emphasis added). Once freed of Marsh's constraints, a steady stream of often important scientific articles and studies flowed from his pen. One list of his publications reveals that, though the first of these was only printed in 1893, the year he broke away from Marsh, by the time of his tragic death 11 years later, he had published a total of 48 articles and studies (Schuchert 1905). Sadly, we cannot know how much more there might have been to come.

John Bell Hatcher was, without doubt, paleontological royalty.

Note: Hatcher's correspondence with Marsh has been digitized and is available at the Yale Peabody Museum of Natural History's website. The letters cited above in this article as well as the quarry map are included in the Hatcher material at the Peabody Museum's website:

https://peabody.yale.edu/collections/vertebrate-paleontology/correspondence-o-c-marsh.

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The Murchison Meteorite: A Most Amazing Rock

Eric J. Seifter, MD

On Sunday February 28, 2021 at 21:54 GMT, UK citizens reported a fireball and 600 grams of a rare meteorite were recovered in Winchcombe, Gloucestershire. One of the largest fragments landed on a driveway. The black silky crust, white speckled gray interior, and oily aromatic odor suggested that this was one of the rarest and most interesting meteorites: a carbonaceous chondrite.

Carbonaceous chondrites are a type of stony meteorite, which is the most common type of meteorite (80% of all specimens), which surprises most collectors since the larger, more durable iron meteorites dominate museum collections. Stony meteorites are composed of 75 to 90% silicon-based minerals and 10 to 25% nickel-iron alloy, with only trace amounts of iron sulfide. Chondrites are named for chondrules, the spherical light-colored particles composed of calcium-aluminum inclusions (CAIs). The minerals in chondrites show no evidence of melting or any interaction with other materials since their formation.

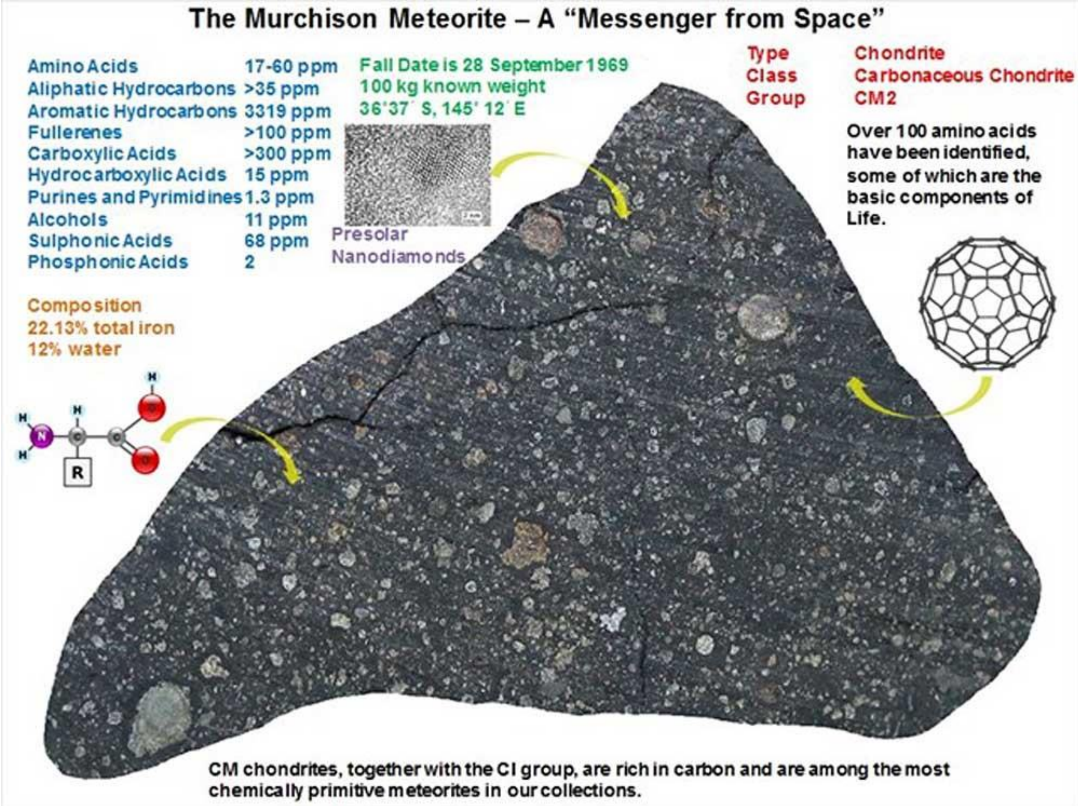


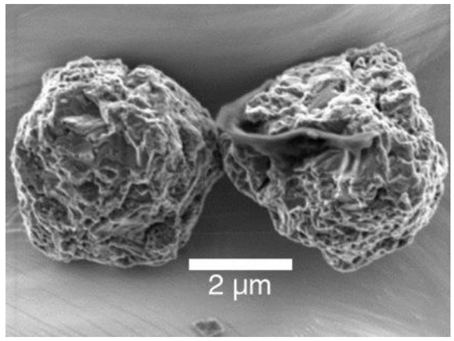
Figure 1: Summary of Organic and Inorganic compounds detected in the Murchison Meteorite. https://www.geocaching.com/geocache/GC6EK8H_murchison-meteorite-the-building-blocks-of-life?guid=994f64f6-12c5-4449-a1b8-4cc2653c3559

The French Orgueil meteorite (14 kg total) was one of the first carbonaceous chondrites, having been discovered after a fireball in southwestern France in 1864. Surprising amounts of water and carbon found in the late 1800s suggested that these meteorites derived from a comet. But many more surprises would come after the 1969 windfall of material from Allende and Murchison.

Of approximately 65,000 known meteorites recovered, only about 1200 have been witnessed on entry and of these, only 51 are carbonaceous chondrites. Only scant amounts have been found, with two exceptions: the 2 metric tons (2000 kg) of the Allende carbonaceous chondrite, which fell as thousands of fragments in the Mexican state of Chihuahua on February 8, 1969 and the 100kg of the Murchison meteorite, which fell 160 km north of Melbourne in the Australian state of Victoria on September 28, 1969 at 10:58AM local time. Fragments were strewn over 13 square miles around the town of Murchison and 12 kg of material is in private hands. The large amounts of the Allende and Murchison meteorites has allowed extensive scientific study of these amazing rocks.

PRESOLAR STARDUST GRAINS

Meteors and comets date from the time of the formation of the solar system 4.5 billion years ago and carbonaceous chondrites are dated to 4.56 – 4.57 billion years old, 20 million years earlier than the formation of the Earth. But within carbonaceous chondrites, scientists have discovered presolar grains which originated long before the formation of our sun. These presolar grains were previously described as "stardust," but this term has been replaced by "presolar stardust grains." It turns out that different quantities of xenon and neon isotopes are formed from condensed material emanating during mass loss from stars of different types. For example, stardust grains from dying red giant stars have a different isotopic xenon signature than those from a supernova or a dying nebula. These isotopic xenon signatures cannot be found from our type of sun or otherwise within our solar system. These presolar stardust grains were first discovered in acid-insoluble residues from the Murchison meteorite in 1987 by Edward Anders in Chicago. Silicon carbide grains and separate diamond grains contain large amounts of xenon of unusual isotopic signatures (some grains with one signature, suggesting one stellar source and other grains with multiple signatures, suggesting multiple stars, nebulae, or supernovae contributions).



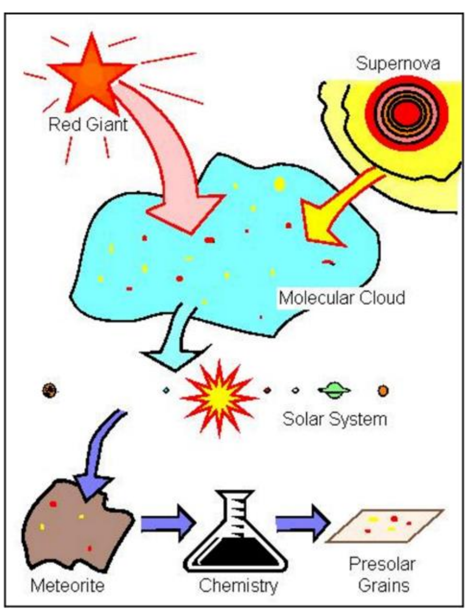
Pre-solar grains found within the Murchison CM2   Image Source: geosci.uchicago.edu

How can we date the age of these presolar dust grains? We cannot use usual isotopic decay rates (analogous to the well-known carbon dating) because we do not know the original quantity of isotopes in each unique xenon signature. The uranium-lead isotopic decay rates have been most helpful for dating meteorites from the birth of our solar system. Also, some of the grains contain mixtures of these unique signatures suggesting multiple sites of origin, which would lead to multiple ages.

The answer to dating these particles comes from cosmic ray exposure dating. While in a star, the material is shielded from cosmic rays and when the material is ultimately incorporated into a comet (or subsequent fragment of that comet known as a meteor), the material is also shielded from cosmic rays. Cosmic ray damage would only occur while the material is floating in interstellar space, and this damage is manifested by the creation of Helium-3 and Neon-21 isotopes. The accumulation of these isotopes with cosmic ray exposure will date these particles' interstellar sojourn before incorporation into a comet in our solar system.

In 2020, Phillipp Heck at UChicago published this dating on silicon carbide particles from the Murchison meteorite. Most of the silicon carbide particles dated to 300 million years of cosmic ray exposure before the formation of the solar system (4.9 billion years ago). These grains condensed from outflows from giant branch stars which possibly formed during a period of enhanced star formation 7 billion years ago, 2.5 billion years before our solar system and sun was formed. This article appears in the *Proceedings of the National Academy of Sciences* 117: 1884-1889, 2020.

Only carbonaceous chondrites (up to this point) have provided us with these particles that antedate our solar system. The Rosetta Space Probe launched in 2004 by the European Space Agency landed on the comet Churyumov-Gerasimenko. Before equipment failure, the probe identified large amounts of carbon in polyaromatic organic solids and an oxygen atmosphere surrounding the comet. The Japanese Hyabusa2 probe returned samples from the asteroid Ryugu in December 2020 and investigations are underway on the charcoal-colored pebbles and dust looking for organic compounds and presolar stardust grains. NASA's OSIRIS-REx probe successfully collected samples from the asteroid Bennu and will return those samples to Earth in September 2023.



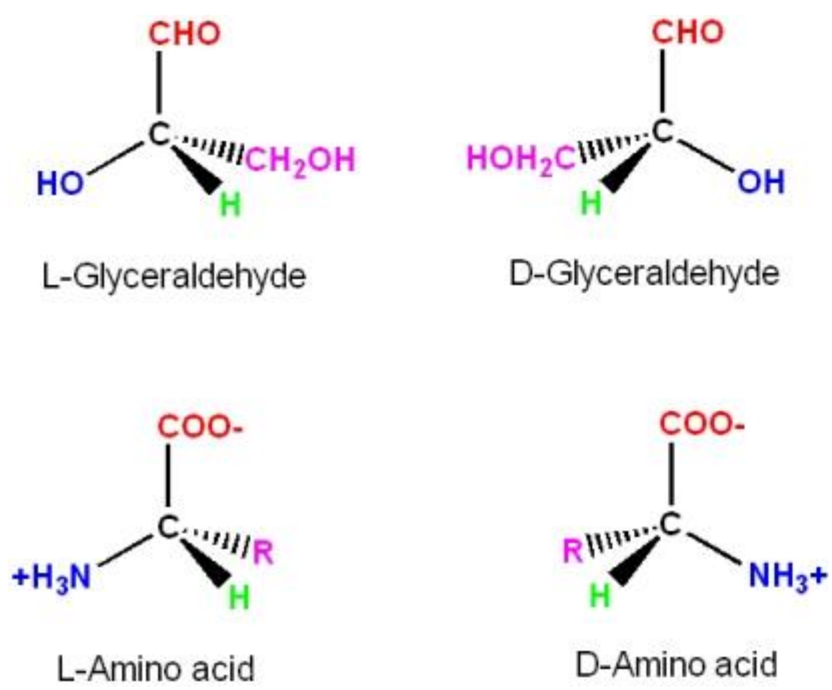
AMINO ACIDS AND NUCLEIC ACIDS: THE BUILDING BLOCKS OF LIFE

The Murchison meteorite is a CM2 group carbonaceous chondrite containing 12% water and 22% iron. The abundant light-colored calcium aluminum inclusions are embedded into a gray matrix which contains the afore mentioned presolar stardust grains, but more abundantly filled with organic carbon-based compounds which are the building blocks of life. Studies beginning in the 1970s and extending until today have identified thousands of such carbon-based compounds. These include almost 100 amino acids, 19 found on earth, such as glycine, glutamic acid, isovaline, serine, threonine, diamino acids, and extraterrestrial beta and gamma amino acids (where the carboxyl group and amino groups are not attached to the same alpha carbon atom as is true in proteins found in living organisms).

These findings hearken back to the famous Miller-Urey experiments from the 1950s at UChicago. Stanley Miller and Harold Urey mixed methane, nitrogen, water, and ammonia, then sparked this mixture with an electric discharge. All of the alpha amino acids found in the Murchison meteorite can be created by this Strecker reaction (aldehyde or ketone reacts with cyanide and ammonia followed by hydrolysis). Other mechanisms such as the addition of ammonia to cyanoacetylene have been proposed for the formation of the more exotic extraterrestrial amino acids.

The Miller-Urey experiments yield equal amounts of the “L” (left-sided) and “D” (dextra right- sided) enantiomers of the amino acids. Translation: Amino acids, being asymmetric, come in 2 versions, a left-sided and right-sided versions. Think of your two hands. They are almost identical but their configuration is a mirror image of each other. In amino acids, the carbon atom has 4 attachments: (1) a hydrogen atom, (2) a carboxyl group (double bond oxygen plus hydroxyl OH-, (3) an R group of one to multiple carbons with various side groups, and (4) an amino group NH2. If you position the tetrahedral amino acid with the hydrogen as far from your face as possible, if you see the carboxyl group on your left, the R group in the center, and the NH2 amino group on the right, this is called an L-enantiomer (the acronym to remember this is CORN). An amino group on the left, then R group, then carboxyl on the right is the D-enantiomer. All living things on Earth use the L-enantiomer exclusively.

Amino acid enantiomers as being either the "L" or "D" form



What about Murchison’s composition? The Miller-Urey experiment would suggest equal numbers of L and R amino acids, and indeed many amino acids in Murchison show this distribution. But there are several amino acids like valine and glutamic acid with markedly elevated amounts of the L-version, the one utilized by life on Earth. And we have no idea why; only theories involving synthesis skewed by inorganic molecules.

Murchison also contains purines and pyrimidines, the components of DNA and RNA coding. Mass spectrometry identified 50,000 unique organic compounds and over a million may ultimately be identified. Over 3000 aromatic compounds cause the petroleum odor noted when baked samples of this meteorite were discovered after streaking through our atmosphere.

ORIGIN OF LIFE ON EARTH?

The Murchison meteorite and other carbonaceous chondrites offer a window into the composition of comets, which are composed of material within massive quantities of ice and carrying an atmosphere of oxygen as discovered in one example. One could imagine comets bombarding a newly forming Earth to fill oceans, provide gases for an atmosphere, and most importantly, critical building blocks for the formation of life such as the amino acids and the nucleic acids. These constituents aggregated together with the condensing of the solar system and it is simple to imagine that these processes must occur in the formation of most solar systems. This suggests that the potential for life in the universe is much greater and more ubiquitous than previously imagined.

MY MURCHISON METEORITE FRAGMENT

My specimen measures 3.2 x 2.9 x 1.6 cm. It comes from the collection of Dr. Elbert Aubrey King, Jr. (1935-1998), the first Lunar Sample Curator at the NASA Manned Spacecraft Center. He was the first U.S. researcher to reach the Puelito de Allende strewn site and collected a prodigious amount of the Allende meteorite. He used some of these samples to trade for samples of the Murchison meteorite from Australian authorities. This occurred when he joined the University of Houston after the completion of the Apollo 11 Mission and involved specimens in his private collection. Specimens of the greatest scientific value were retained by NASA and other universities. The largest collection of Murchison material is owned by the Field Museum and UChicago.

In January 2018, my house burned to the ground while my family was on vacation. While more than 70% of the fossil collection was recovered mostly unscathed on subsequent excavation (nothing like re-discovering your treasures covered by debris, dirt, and groundwater!), I never found my Allende meteorite. Using restitution funds from my insurance, I re-invested for an upgrade to get this Murchison specimen from Anne Black, who owns Impactika. She had multiple meteorites which came from the Elbert King collection.

I was about to enter 10th grade in high school in 1969 when Apollo XI touched down on the Moon and returned lunar samples to Earth. I believed at the time, as I squinted to understand the grainy TV images of Neil Armstrong's descent, that I was witnessing the seminal moment in our quest to understand the formation of the Solar System. Little could I imagine that the two witnessed meteorite falls of the Allende and Murchison meteorites that same year would provide much more information in this regard.

Others may appreciate fragments from stony meteorites which emanate from the Moon or Mars. These are identifiable by their mineral content and most importantly by their age. All meteorites from the asteroid belt were formed 4.54 billion years ago. Meteorites from Mars and the Moon date much younger, between 1.5 and 3 billion years ago (based on uranium-lead isotope dating). The Murchison meteorite pre-dates the Earth at 4.56 billion years and contains particles dated back to 7 billion years, along with an amazing array of molecules for the building blocks of life. I see no comparison!

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Shows & Events

Due to restrictions in place for social gathering in many states resulting from the current pandemic, the majority of previously scheduled shows and events have been canceled or postponed. Consequently, no events are being listed here. Check with organizers for their latest guidance before planning on attending any event.

Dates to Remember

Sunday, September 19, 2021 – General Meeting (hopefully!) & Mini-Auction
Please note: No meeting in July

Meeting Time & Location

11:00 AM to 3:00 PM
Bowie Community Center
3209 Stonybrook Drive, Bowie, MD 20715
301-464-1737

Location/Directions: The Center is located off of Route 450 in Bowie. Detailed directions and a map can be found on the MGS website (**www.ecphora.net/mgs/**).

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