

# Cedar Valley Gems

Cedar Valley Rocks & Minerals Society

Cedar Rapids, Iowa

[cedarvalleyrockclub.org](http://cedarvalleyrockclub.org)

CEDAR VALLEY GEMS

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**Next CVRMS Meeting**  
**Tues. April 20**  
**7:15 pm**

**<<VIRTUAL MEETING>>**

**Join the Zoom Meeting**

[https://us02web.zoom.us/  
j/87289747880](https://us02web.zoom.us/j/87289747880)

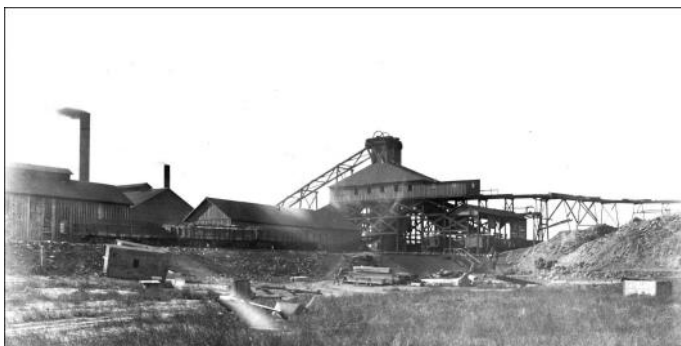
*featured speaker*

**Ray Anderson**

**Cedar Valley Rocks & Minerals Society**

## **“Iowa’s Industrial Minerals”**

The CVRMS Board is considering suggesting the topic **“Industrial Rocks and Minerals of Iowa”** for the **2022** Rocks, Fossils, and Minerals Show to the membership. To provide a little information on the topic Ray Anderson will present a talk that was originally prepared for the 2013 annual meeting of the Iowa Concrete Pavers Association. He will discuss the rocks and minerals that have been mined in Iowa, their geologic origins and production histories. This includes common products such as limestone, gypsum, coal, and sand and gravel, but also some lesser-known materials such as iron ore, peat, and lead.



Wapello Coal Mine, Monroe Co.

## **Fossils Reveal Cephalopods May Be 30 Million Years Older Than We Thought**

The class of marine animals known as cephalopoda – which today includes squids, octopuses, and cuttlefishes – could have been around on Earth **30 million years** earlier than previously thought, according to new research. What's more, if we do need to reset the timings on the appearance of cephalopods, then the whole evolutionary history of invertebrate organisms might need re-examining, given the importance of these creatures in the overall picture of life on the planet. Key to the new research is the discovery of several **522-million-year-old** cone-shaped fossils on the Avalon Peninsula in Newfoundland, Canada, featuring certain tell-tale features that mean they could arguably be classed as cephalopods. *"If they should actually be cephalopods, we would have to backdate the origin of cephalopods into the early Cambrian period,"* says geoscientist Anne Hildenbrand. *"That would mean that cephalopods emerged at the very beginning of the evolution of multicellular organisms during the Cambrian explosion."* Up until now, the earliest cephalopods were thought to be *Plectonoceras cambria* - tiny mollusks with cone-like shells that lived in the late Cambrian period, roughly 490 million years ago. While our knowledge of *P. cambria's* anatomy is based on incomplete fossils, these new finds are similar enough to suggest a connection



Sections of the newly found fossils.

could separate them. *"This find is extraordinary,"* says geoscientist Gregor Austermann. *"In scientific circles it was long suspected that the evolution of these highly developed organisms had begun much earlier than hitherto assumed. But there was a lack of fossil evidence to back up this theory."* <https://www.sciencealert.com/cephalopods-may-be-30-million-years-older-than-previously-thought>

## CVRMS Mar. 16 **Virtual** Meeting

7:24 p.m. **THE MEETING CALLED TO ORDER** by Marv Houg via Zoom. 25 participants.

**MINUTES:** -Motion to approve as published by Dale, 2<sup>nd</sup> by Jay. Approved as published.

**TREASURE'S REPORT:** Dale reported little change from last month; \$227.80 expenditures. Motion to approve by Glen, 2<sup>nd</sup> by Bill. Motion passed.

**PROGRAM:** by Jim Preslika, "*Report on the Fauna from the Brooks Hardground Bed of Independence, Iowa.*" Great presentation on the Buchanan County Fossil Project followed by 45 minute discussion!

**AUCTION:** Still set for September 18 and 19. So far we have booked 1000 to 1200 lots

**ROCK SHOW:** Still set for November 6-7.

**TAKO:** Take A Kid Outdoors program at Cline Quarry will be restricted to employees and quarry neighbors. We will probably participate. Marv will talk to Deb.

**CLUB PICNICS:** Possibilities looking better but we will play it by ear.

**CLUB FIELD TRIPS:** Probably when weather improves.

**MOTION TO ADJURN:** by AJ; 2<sup>nd</sup> by Dale. Meeting adjourned—9:16 pm.

Respectfully Submitted,  
*Ray Anderson*, Acting Secretary



Iron Oxide Concretion from Cedar River Gravels  
polished by Ray Anderson

## CVRMS Board Minutes Mar. 23

7:14 p.m. **THE MEETING CALLED TO ORDER** by Marv Houg via Zoom, *Members Present:* Sharon Sonnleitner, Marv Houg, Kim Kleckner, Dale Stout, Bill Desmarais, Toby Jordan, Jay Vavra, and Ray Anderson. Also present: Alan Johnson, .

**MINUTES:** -Motion to approve as published by Sharon, 2<sup>nd</sup> by Dale. Approved as published.

**TREASURE'S REPORT:** No change for Mar 16 report. Motion to approve by Ray, 2<sup>nd</sup> by Jay. Motion passed.

**AUCTION:** Marv reports 1010—1086 lots committed so far. Dale left message with "Country Cookin" food truck (Wellman) but has not received a reply. Discussed advertisement; MWF newsletter, free boards, contact past bidders.

**SHOW:** Our annual show is set for November 6-7, 2021. Ray and Tiffany will contact museums about loan of Iowa meteorite specimens. Show flyers must be to VAST by August. Bill suggested "*Industrial Rocks and Minerals of Iowa*" for 2022 show theme. Ray will contact Fort Dodge about possible loan of Cardiff Giant replica for display at 2022 show.

**CVRMS MEETINGS:** Dale will reserve the Hiawatha Community Center when it is available. Zoom meeting for the near future.

**CVRMS PICNICS:** The possibility of summer picnics is improving. We will play it by ear.

**FIELD TRIPS:** Dale wondered about Independence quarry. Marv will check. Marv will also check to see if Wendling Quarries might allow field trip. Kim suggested that the club purchase a gravel pit that is for sale. Ray will check with Shirley Sixt about a visit to her quarry north of IC. Palo quarry is another possibility.

**BUS TRIP:** Bill suggested postponing it until April 2022. Board members agreed. Will be presented to club.

**501(c)(3) NON-PROFIT STATUS:** Dale will see if he can complete the form for CVRMS using MAPS application as template.

**SQUARE ACCOUNT:** Jay says Square account for credit card purchases at auction is set up and ready to go.

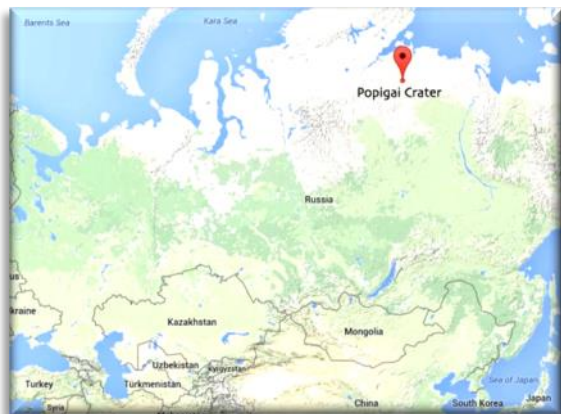
**STATE FOSSIL BILL:** No information on status of bill to designate the crinoid as Iowa's State Fossil.

**MOTION TO ADJOURN:** made by Dale, second by Ray. 7:55 meeting adjourned

Respectfully Submitted,  
*Ray Anderson*, Acting Secretary

## Popigai: Russia's vast, untouched diamond crater

In the far north of Siberia, Russian scientists have stepped up research on a once-secret deposit of diamonds whose scale dwarfs anything ever discovered and could turn world markets "upside down." Soviet scientists had in the 1970s uncovered the 60-mile diameter Popigai Crater left by a huge asteroid in Siberia 35 million years ago. A closer inspection of the dramatic impact zone, lying thousands of kilometers from any city, revealed a fine material that was actually super-compressed diamonds caking the permafrost. For a long time, the discovery of the diamond deposit was a state secret. It was little publicized after the fall of the Soviet Union when its sheer remoteness (1200 miles from the main Trans-Siberian railway line) made exploitation impossible. But interest is now picking up thanks to work by the Novosibirsk-based Sobolev Institute of Geology and Mineralogy, which recently gave rare information about the deposit to the media. The deposit contains not the clear, precious diamonds so adored by brides and monarchs but the black industrial strength "impact diamonds" that could be used for deep-sea drilling or forging finely delicate machine parts. Russian media reports said that Soviet experts had known at the time that the so-called "abrasive" powers of highly-compressed diamonds found in the open were much stronger than those made by synthetic firms. But the Communist era's logic dictated the promotion of the chemical industry and five-year plans that outlined specific



production quotas for everything from synthetic diamonds to bars of soap. The field was left almost entirely unexplored for the subsequent 30 years. It was finally declassified in the 1990s at a time of deep economic crisis that prevented any serious production or investment work. The find was then essentially forgotten before his institute picked up its study again three years ago. Examining only 0.3 percent of the entire territory of the crater scientists established 147 billion carats worth of (industrial) diamonds. So the entire crater must contain many trillion carats of diamonds. That creates the possibility of Russia undercutting the price of the synthetic material now produced in China and delivering a cheap new technology for making machine and airplane parts as well as jewelry work. But there are still problems linked to accessibility and the site's extreme remoteness from any railways or roads or population centers. <https://phys.org/news/2012-09-popigai-russia-vast-untouched-diamond.html#:>

## Spotlight Gemstone: Diamond



On almost all modern birthstone lists, diamond is recognized as the birthstone for April. Diamond is also the gem that marks the 60th and 75th wedding anniversaries. Diamonds are thought to have been first recognized and mined in India, where significant alluvial (river) deposits of the stone could be found many centuries ago along the rivers Penner, Krishna and Godavari. Diamonds have been known in India for at least 3,000 years, and probably 6,000 years. Diamond is the only gem composed of one single element: carbon. Each carbon atom shares electrons with 4 other carbon atoms in a face-centered cubic crystal structure called a diamond lattice. Because of the extreme rigidity of this lattice, diamonds can be contaminated by only a very few types of impurities, such as boron and nitrogen. Small amounts of defects or impurities (about one per million of lattice atoms) color diamond blue (boron), yellow (nitrogen), brown (lattice defects), green (radiation exposure), purple, pink, orange or red. Diamond also has relatively high optical dispersion (ability to disperse light of different colors). Diamonds are the hardest material on earth (9 on the Mohs hardness scale): 58 times harder than anything else in nature. Most diamonds formed more than a billion years ago, at high temperature and pressure found only at depths deep in the Earth's mantle, about 90 to 120 miles beneath the surface. Diamonds are brought close to the Earth's surface through deep volcanic eruptions of magma, which cools into igneous rocks known as kimberlites and lamprolites. The diamonds are recovered by mining deep into these "pipes" or from rivers and near-shore deposits that include diamonds that nature eroded from the rocks. Diamonds are graded in quality based on the "4Cs", *clarity*, *color*, *cut*, and *carat weight*. **Clarity** grades assess the number, size, relief, and position of inclusions and blemishes. The less **color**, the higher the grade. Even the slightest hint can make a dramatic difference in value. **Cut** (proportions, symmetry, and polish) is a measure of how a diamond's facets interact with light. **Carat Weight**, larger diamonds of the same quality are much rarer than smaller ones and are worth more per carat. Although diamonds are made synthetically, their cost of production averages \$2500 per carat, as compared to a cost of \$40 to \$60 per carat to mine the stones.

## What in the World?



**What in the World?** Is this idyllic waterfall, and where can it be found??

## March's Photo



Last month's "What in the World" photo showed the **Painted Dunes** of Lassen Volcanic National Park. The Painted Dunes are

multicolored pumice fields formed by oxidation of volcanic ash as it fell out of volcanic eruptions that have sculpted the area inside Lassen National Park in Northern California. The ash on Painted Dunes is brightly oxidized because it fell on lava flows when they were still hot. The Painted Dunes and other eccentric geological features lie near Cinder Cone, a 700-foot tall cinder cone volcano that's believed to have last erupted in 1650s.

## ROCK CALENDAR CVRMS EVENTS OF INTEREST

### 2021

**Apr. 2 — Central Iowa Mineral Society  
MONTHLY VIRTUAL MEETING - 7:30 pm**

speaker John Hill

"Amber, the Organic Gemstone"

**Apr. 13 — Blackhawk Gem & Min. Soc.  
MONTHLY VIRTUAL MEETING - 7:15pm**

<https://us02web.zoom.us/j/87084911650>

speaker Ray Anderson

"Iowa's Attempt to Develop an Underground Compressed Air Storage Facility"

**Apr. 20 — CVRMS Monthly Meeting  
MONTHLY VIRTUAL MEETING - 7:15 pm**

<https://us02web.zoom.us/j/87289747880>

speaker Ray Anderson

"Iowa's Industrial Minerals"

**Apr.26 — 3 Rock Clubs Monthly Program  
MONTHLY VIRTUAL PROGRAM - 7:15 pm**

<https://us02web.zoom.us/j/89524404665>

speaker James Kraal

"Rodckhounding the Texas Panhandle"

**Sept 18-19— CVRMS Auction**

Amana RV Park and Event Center

Amana, Iowa

[more details to follow](#)

**Sept. 24-26 — Geode Fest**

Chaney Creek Boat Access

Illinois Highway 96 N

Hamilton, Illinois

**Oct. 22-24 — MAPS 2021 Fossil Expo**

Illinois State Fair Grounds

Springfield, Illinois

[more details to follow](#)

**Nov. 6-7 — CVRMS Rks, Fos, & Min Show**

Hawkeye Downs

Cedar Rapids, Iowa

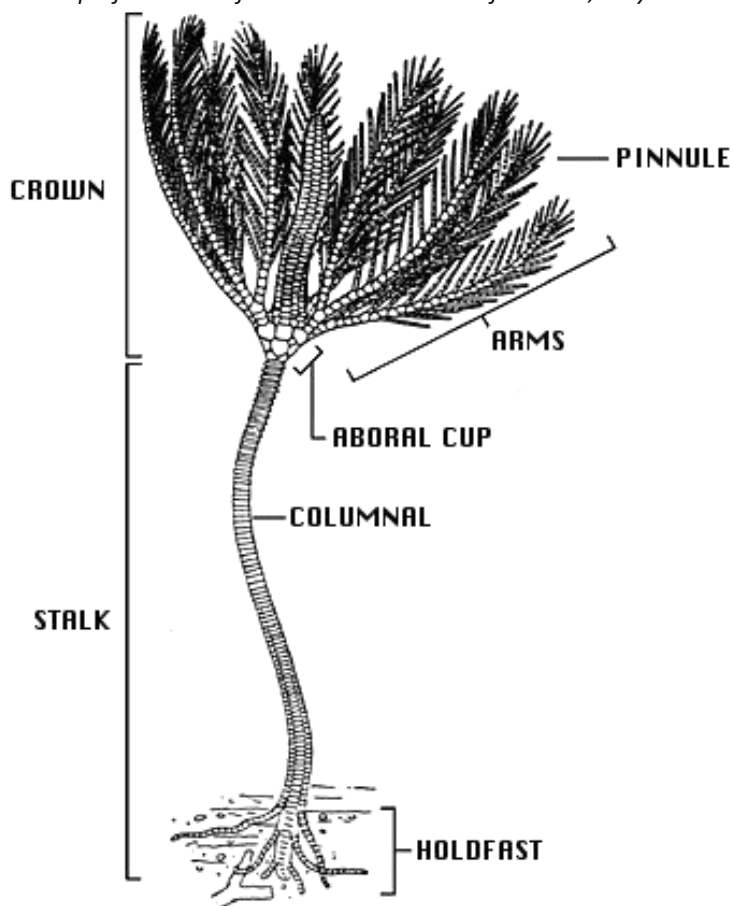
[more details to follow](#)

## Ask a Geologist by Ray Anderson aka "Rock Doc", CVRMS Vice President

Ask a Geologist is a monthly column that gives CVRMS members an opportunity to learn more about a geologic topic. If you have a question that you would like addressed, please send it to [rockdoc.anderson@gmail.com](mailto:rockdoc.anderson@gmail.com), and every month I will answer one in this column. Please let me know if you would like me to identify you with the question. I will also try to respond to all email requests with answers to your questions.

During the 45 minute discussion that followed the excellent presentation on Cephalopods at the Independence quarry by Jim Preslicka at the March CVRMS Zoom meeting, the topic wandered to crinoids, and someone asked "if crinoids are animals, do they have brains??" No one in the meeting had an answer to that question; there is never a geologist around when you need one. So I called a geologist with that question.

**Dr. Brad Cramer**, University of Iowa Department of Earth and Environmental Studies, explained that some animals don't have a single location with cells that perform the duties of a brain (like humans) but may have clusters of cells in various parts of their bodies that perform those functions. In the case of crinoids, they have what is called a "central nerve ring" around their mouth. Wikipedia says "The crinoid nervous system is divided into three parts, with numerous connections between them. The oral or uppermost portion is the only one homologous with the nervous systems of other echinoderms. It consists of a central nerve ring surrounding the mouth, and radial nerves branching into the arms and is sensory in function. Below this lies an intermediate nerve ring, giving off radial nerves supplying the arms and pinnules. These nerves are motor in nature, and control the musculature of the tube feet. The third portion of the nervous system lies aborally (opposite the mouth), and is responsible for the flexing and movement actions of the arms, pinnules and cirri. This is centered on a mass of neural tissue near the base of the calyx, and provides a single nerve to each arm and a number of nerves to the stalk."



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### Crinoid Body Parts

Crinoids, like all Echinodermata, have 5 sections and are radially symmetrical (picture a starfish). The sea lilies are "permanently" fastened to the sea floor by a holdfast (a root-like structure). The stalk is made up of small calcareous sections called columnals which are held together by ligaments. The columnals are stacked up like tires at the dump. They have a hollow center that contains coelomic and neural tissue (basically these are the vital organs for movement, digestion, respiration, and reproduction). The Stalks can reach lengths of several meters. On top of the stalk is the aboral cup. It is made up of several plates which form a ring. There are usually 2 or 3 of these rings. This contains both the mouth and anus which are on the upper side of the cup.

There can be additional rings which extend the size of the calyx (aboral cup). The arms extend from the cup. They are also made up of plates. They can have many branches. In modern crinoids the branches have feather-like growths called pinnules. The pinnules have rows of tube feet on each side of a groove running down the center. This groove is connected through the arms to the mouth. It is an extension of the coelomic and neural tissue.

### Feet On Their Arms!

All crinoids are or were filter feeders. The arms gather food that floats past. This animal is able to move its crown to face the flow of water. This helps it gather more food. The arms are covered with tiny tube feet that can capture the food particles. The feet pass these particles on to the center of the arm where there is a groove that transports it to the mouth. Their food consists of algae, invertebrate larva, small crustaceans, and other bits of organic matter. <https://www.fossils-facts-and-finds.com/crinoid.html>

## A Cephalopod Has Passed a Cognitive Test Designed For Human Children

A new test of cephalopod smarts has reinforced how important it is for us humans to not underestimate animal intelligence. Cuttlefish have been put to a new version of the marshmallow test, and the results appear to demonstrate that there's more going on in their strange little brains than we knew. Their ability to learn and adapt, the researchers said, could have evolved to give cuttlefish an edge in the cutthroat eat-or-be-eaten marine world they live in.



Cuttlefish

The marshmallow test, or [Stanford marshmallow experiment](#), is pretty straightforward. A child is placed in a room with a marshmallow. They are told if they can manage not to eat the marshmallow for 15 minutes, they'll get a second marshmallow, and be allowed to eat both. This ability to delay gratification demonstrates cognitive abilities such as future planning, and it was originally conducted to study how human cognition develops; specifically, at what age a human is smart enough to delay gratification if it means a better outcome later. Because it's so simple, it can be adjusted for animals. Obviously you can't tell an animal they'll get a better reward if they wait, but you can train them to understand that *better* food is coming if they don't eat the food in front of them straight away. Some primates can delay gratification, along with dogs, albeit inconsistently. Corvids, too, have passed the marshmallow test. Last year, cuttlefish also passed a version of the marshmallow test. Scientists showed that common cuttlefish (*Sepia officinalis*) can refrain from eating a meal of crab meat in the morning once they have learned that dinner will be something they like much better - shrimp. However, in this case it's difficult to determine whether this change in foraging behavior in response to prey availability was also being governed by an ability to exert self-control. So a new test was designed, for six common cuttlefish. The cuttlefish were placed in a special tank with two enclosed chambers that had transparent doors so the animals could see inside. In the chambers were snacks - a less-preferred piece of raw king prawn in one, and a much more enticing live grass shrimp in the other. The researchers found that all of the cuttlefish in the test condition decided to wait for their preferred food (the live shrimp), but didn't bother to do so in the control group, where they couldn't access it. The cuttlefish in the present study were all able to wait for the better reward and tolerated delays for up to 50-130 seconds, which is comparable to what we see in large-brained vertebrates such as chimpanzees, crows and parrots. Future research should, the team noted, try to determine if indeed cuttlefish are capable of planning for the future.

<https://www.sciencealert.com/cuttlefish-can-pass-a-cognitive-test-designed-for-children>

## Illinois State Fossil - Tully Monster (*Tullimonstrum gregarium*)

In 1955, a fossil hunter by the name of Francis Tully was exploring the spoil piles of a coal mine near Braidwood, Illinois. He was searching for fossils inside of 300-million-year-old ironstone nodules found in the Francis Creek Shale. Mr. Tully split one open to reveal a very strange animal that no one had seen before. It had a long proboscis or snout on its head sporting a claw, spade-shaped fins on its rear and a horizontal bar underneath its head with an eye on each end. This prehistoric oddity would eventually be named *Tullimonstrum gregarium* (commonly referred to as a **Tully Monster**) and it would go on to confound scientists for



decades. In the decades since its original discovery hundreds of additional specimens have been found in Illinois, some up to 14 inches long. In 1989 this enigmatic animal was declared the Illinois state fossil which is quite fitting as **Illinois is the only location in the world similar animals have been found**. Since its discovery the Tully Monster has been described as a nematode, polychaete worm, mollusk, a stem arthropod and a chordate. Paleontologists couldn't even decide if it was an early vertebrate or an invertebrate. In the past decade, two papers have sought to investigate the additional specimens using new analytical methods. These studies discovered several previously unknown anatomical features pointing towards a chordate or early vertebrate identity. Most notably of these was a flexible rod-like structure called a notochord that was previously interpreted as a gut trace. Notochords are a defining characteristic of chordates, the phylum which includes vertebrates. In vertebrates, the notochord is what develops into the spinal column. The paleontologists also noted similarities between the teeth of the Tully Monster and those of lampreys and hagfish. Then focusing in on what was believed to be eyes, they also found the presence of both spherical and cylindrical melanosomes, another defining characteristic of chordates. Based on this research we finally have an understanding of how the Tully monster fits into the tree of life. Or do we... Another more recent study has again put its identity back into doubt. Focusing in on the melanosomes in its eyes, it came to the conclusion the structures more closely match those of invertebrates. <https://www.fossilera.com/pages/illinois-state-fossil-tully-monster-tullimonstrum-gregarium>

# Unusual Violet Maxixe Beryl

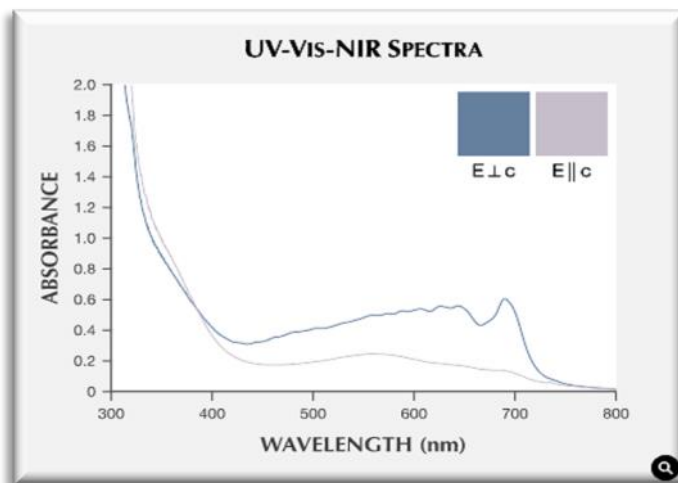


**Figure 1.** This 26.72 ct Maxixe beryl has an unusual violet color. Photo by Diego Sanchez.

Recently examined in the GIA's Carlsbad laboratory was a 26.72 ct transparent violet modified cushion mixed-cut stone (figure 1). Standard gemological testing revealed a refractive index of 1.583–1.592 and a specific gravity of 2.78, both consistent with beryl. Using plane-polarized light, pale purple and saturated blue pleochroic colors were observed. An uniaxial optic figure was seen at the girdle, and the optical orientation of the stone showed the stronger blue pleochroic color down the optic axis direction. The stone was inert to long-wave UV light and fluoresced weak greenish yellow to short-wave UV. Viewed with fiber-optic light during microscopic examination, it displayed a few scattered blocky crystals, platelets, and needles, confirming natural growth origin. No coatings were seen on the surface under reflective light. Other than the unusual violet color, these properties were consistent with Maxixe beryl. Advanced testing by LA-ICP-MS revealed that the stone lacked iron. This result was consistent with Maxixe beryl, in which iron is too low to be measured (I. Adamo et al., "Aquamarine, Maxixe-type beryl, and hydrothermal synthetic blue beryl: Analysis and identification," *Fall 2008 G&G*, pp. 214–226). Maxixe beryl normally has a blue to violet-blue body color, but this stone showed an unusual violet color. The UV-Vis-NIR spectrum (figure 2) showed absorption bands between 500 and 700 nm and a broad band near ~690 nm. This spectrum was consistent with Maxixe

beryl (again, see Adamo et al., 2008). While Maxixe beryl has been found to be colored by natural irradiation, it can also be produced by artificial irradiation. Some of these "Maxixe-type" beryls produced by artificial irradiation are known to fade when exposed to "mild heat or strong light" (see Winter 1997 Lab Notes, p. 293). However, there is no conclusive test to determine whether

Maxixe color results from natural or artificial irradiation, and as such, beryl in the blue to violet color range that shows the type of visible spectrum previously mentioned is designated simply as the Maxixe variety of beryl by the GIA laboratory. A small sample cut from the same rough as the 26.72 ct violet beryl was provided by lapidary Nolan Sponsler for destructive testing in order to evaluate the color stability of this material. An optically oriented wafer, 4.45 mm thick and normalized to a 25 mm path length in order to better observe the change in color, was fabricated from this sample with parallel polished windows that are parallel to the optic axis to allow measurement of the o- and e-rays. UV-Vis-NIR spectra were collected on the sample prior to fade testing and at four-hour intervals of exposure to a 150-watt halogen bulb at a distance of approximately four inches from the bulb to avoid any significant heating. The results showed fading of the sample until its color was very pale, confirming that this material may fade. One should avoid prolonged exposure to light and store it in a dark environment to preserve the color. This violet Maxixe beryl was purported to be from Santa Maria de Itabira, Minas Gerais, Brazil. It is notable for its unusual color and its fantasy cut design. In addition to this



**Figure 2.** The violet beryl showed a typical UV-Vis-NIR spectrum for Maxixe beryl. Pleochroic colors were calculated from the spectra and revealed a blue (o-ray, dark blue trace and color swatch) and light violet (e-ray, pale purple trace and color swatch) pleochroism.

violet Maxixe beryl, another violet beryl group mineral named "johnkoivulaite" was documented in 2019 (see *Fall 2019 GNI*, pp. 454–455); that new beryl is from the Mogok mining area in Myanmar. However, standard gemological properties clearly separate the two violet beryl minerals. Even though this beryl owes its appealing violet hue to what would be considered an unstable color center, the color should remain intact if prolonged exposure to intense light sources is minimized.

<https://www.gia.edu/gems-gemology/fall-2020-gemnews-unusual-violet-maxixe-beryl>

## Ancient Earth Really Was a Serene Water World, New Evidence Confirms

It's tricky to figure out what Earth might have looked like in the early years before life emerged. Geological detectives have now obtained more evidence that it was rather different to the planet we live on today. According to a new analysis of the features of Earth's mantle over its long history, our whole world was once engulfed by a vast ocean, with very few or no land masses at all. It was an extremely soggy space rock. So where the heck did all the water go? According to a team of researchers led by planetary scientist Junjie Dong of Harvard University, minerals deep inside the mantle slowly drank up ancient Earth's oceans to leave what we have today. "We calculated the water storage capacity in Earth's solid mantle as a function of mantle temperature," the researchers wrote in their paper. "We find that water storage capacity in a hot, early mantle may have been smaller than the amount of water Earth's mantle currently holds, so the additional water in the mantle today would have resided on the surface of the early Earth and formed bigger oceans. Our results suggest that the long-held assumption that the surface oceans' volume remained nearly constant through geologic time may need to be reassessed." Deep underground, a great deal of water is thought to be stored in the form of hydroxy group compounds - made up of oxygen and hydrogen atoms. In particular, the water is stored in two high-pressure forms of the volcanic mineral olivine, hydrous wadsleyite and ringwoodite. Samples of wadsleyite deep underground could contain around 3 percent H<sub>2</sub>O by weight; ringwoodite around 1 percent. Previous research on the two minerals subjected them to the high pressures and temperatures of the mantle of modern day Earth to figure out these storage capacities. Dong and his team saw another opportunity. They compiled all the available mineral physics data, and quantified the water storage capacity of wadsleyite and ringwoodite across a wider range of temperatures. The results showed that the two minerals have lower storage capacities at higher temperatures. Because baby Earth, which formed 4.54 billion years ago, was much warmer internally than it is today (and its internal heat is still decreasing, which is very slow and also has absolutely nothing to do with its external climate), it means the water storage capacity of the mantle now is higher than it once was. Moreover, as more olivine minerals are crystallizing out of Earth's magma over time, the water storage capacity of the mantle would increase that way, too. In all, the difference in water storage capacity would be significant, even though the team was conservative with its calculations. The researchers wrote, "The mantle's water storage capacity today is 1.86 to 4.41 times the modern surface ocean mass." If the water stored in the mantle today is greater than its storage capacity in the Archean Eon, between 2.5 and 4 billion years ago, it's possible that the world was flooded and the continents swamped, the researchers found. This finding is in agreement with a previous study that found, based on an abundance of certain isotopes of oxygen preserved in a geological record of the early ocean, that Earth 3.2 billion years ago had way less land than it does today. These findings help us better understand the delicate evolution of our planet, and the strange, often seemingly inhospitable turns along the way that eventually led to the emergence of humanity. <https://www.sciencealert.com/we-just-got-even-more-evidence-that-ancient-earth-was-a-water-world>

## Jaw-Dropping Fossil Find Contains a Dinosaur Sitting on an Entire Clutch of Eggs

An international team of scientists has announced the discovery of an extraordinary fossilized nest in China, preserving at least eight separate dinosaurs from 70 million years ago. The clutch of ancient eggs belongs to a medium-sized adult oviraptor, and we know that because the parent is actually part of the fossil. The skeleton of this ostrich-like theropod is positioned in a crouch over two dozen eggs, at least seven of which were on the brink of hatching and still contain embryos inside. The ancient scene is unprecedented, and provides the first hard evidence that dinosaurs were brooding parents, laying their eggs and incubating



Restoration (white indicates bones preserved in the adult skeleton). (Bi et al., 2020)

them for quite a long time. Since the 1980s, paleontologists have unearthed numerous dinosaur nests containing fossilized eggs. Some rare ones have even been found with the parent's skeleton sitting on top. Other oviraptor eggs suggest they might have been a blue-green color. Inferring behavior from these fossils, however, has proved problematic. While it seems the oviraptor parents are brooding on their nests, it's also possible these dinosaurs perished while laying or guarding their eggs, not necessarily incubating them. This is more similar to how crocodiles deal with their nests, not modern birds. The new specimen was recovered from the Nanxiong Formation of Ganzhou in South China - a region renowned for the world's largest collection of fossilized dinosaur eggs - but it's unlike anything scientists have found before. The relationship between dinosaur parent and embryo has never been closer than this. The body of the adult oviraptor is preserved in "extremely close proximity to the eggs", with little to no sediment in between. In at least seven of the eggs, embryonic material was found exposed, including ossified bones in identifiable shapes. One of the eggs may actually contain a complete skeleton, with its vertebrae, dorsal ribs, a humerus, both ilia and femora, and a tibia laid out in a curled position. Interestingly enough, however, not all the embryos were at the same stages of development. This suggests the clutch may ultimately have hatched at different times - a feature that was thought to show up much later, in only some types of birds. While oviraptors are often considered an intermediate stage in this evolutionary process, it looks as though they might have independently moved away from simultaneous hatching, and this suggests the evolution of bird reproduction was not a simple linear process. The sex of the adult oviraptor is still under debate (it could be a male or a female based on available data), but the idea matches other analyses of theropod nests, which suggest some level of paternal care. <https://www.sciencealert.com/fossilized-dinosaur-found-brooding-on-a-nest-of-preserved-eggs-with-actual-embryos-inside>



# Turning Diamond Into Metal

Long known as the hardest of all natural materials, diamonds are also exceptional thermal conductors and electrical insulators. Now, researchers have discovered a way to tweak tiny needles of diamond in a controlled way to transform their electronic properties, dialing them from insulating, through semiconducting, all the way to highly conductive, or metallic. This can be induced dynamically and reversed at will, with no degradation of the diamond material. The research, though still at an early proof-of-concept stage, may open up a wide array of potential applications, including new kinds of broadband solar cells, highly efficient LEDs and power electronics, and new optical devices or quantum sensors, the researchers say. Their findings, which are based on simulations, calculations, and previous experimental results, are reported this week in the *Proceedings of the National Academy of Sciences*. The paper is by researchers from MIT, the Nanyang Technological University in Singapore, and the Institute of Science and Technology in Moscow. The team used a combination of quantum mechanical calculations, analyses of mechanical deformation, and machine learning



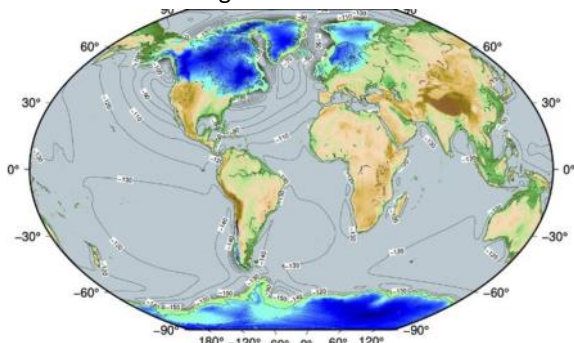
to demonstrate that the phenomenon, long theorized as a possibility, really can occur in nanosized diamond. The concept of straining a semiconductor material such as silicon to improve its performance found applications in the microelectronics industry more than two decades ago. However, that approach entailed small strains on the order of about 1 percent. The scientists have spent years developing the concept of elastic strain engineering. This is based on the ability to cause significant changes in the electrical, optical, thermal, and other properties of materials simply by deforming them -- putting them under moderate to large mechanical strain, enough to alter the geometric arrangement of atoms in the material's crystal lattice, but without disrupting that lattice. In a major advance in 2018, researchers showed that tiny needles of diamond, just a few hundred nanometers

across, could be bent without fracture at room temperature to large strains. They were able to repeatedly bend these nanoneedles to tensile strain as much as 10 percent; the needles can then return intact to their original shape. Key to this work is a property known as bandgap, which essentially determines how readily electrons can move through a material. This property is thus key to the material's electrical conductivity. Diamond normally has a very wide bandgap of 5.6 electron volts, meaning that it is a strong electrical insulator that electrons do not move through readily. In their latest simulations, the researchers show that diamond's bandgap can be gradually, continuously, and reversibly changed, providing a wide range of electrical properties, from insulator through semiconductor to metal. Researchers found that it's possible to reduce the bandgap from 5.6 electron volts all the way to zero, and if you can change continuously from 5.6 to 0 electron volts, then you cover all the range of bandgaps. Through strain engineering, you can make diamond have the bandgap of silicon, which is most widely used as a semiconductor, or gallium nitride, which is used for LEDs. You can even have it become an infrared detector or detect a whole range of light all the way from the infrared to the ultraviolet part of the spectrum. Researchers say that the ability to engineer and design electrical conductivity in diamond without changing its chemical composition and stability offers unprecedented flexibility to custom-design its functions. The methods demonstrated in their work could be applied to a broad range of other semiconductor materials of technological interest in mechanical, microelectronics, biomedical, energy and photonics applications, through strain engineering. So, for example, a single tiny piece of diamond, bent so that it has a gradient of strain across it, could become a solar cell capable of capturing all frequencies of light on a single device, something that currently can only be achieved through tandem devices that couple different kinds of solar cell materials together in layers to combine their different absorption bands. These might someday be used as broad-spectrum photodetectors for industrial or scientific applications. The process can also make diamond into two types of semiconductors, either "direct" or "indirect" bandgap semiconductors, depending on the intended application. For solar cells, for example, direct bandgaps provide a much more efficient collection of energy from light, allowing them to be much thinner than materials such as silicon, whose indirect bandgap requires a much longer pathway to collect a photon's energy. The process could be relevant for a wide variety of potential applications, such as for highly sensitive quantum-based detectors that use defects and dopant atoms in a diamond. But given the great variety of conditions made possible by the different dimensions of strain variations, with a particular application in mind, the diamond could optimize toward that application target. And what is nice about the elastic straining approach is that it is dynamic, so that it can be continuously varied in real time as needed. This early-stage proof-of-concept work is not yet at the point where they can begin to design practical devices, the researchers say, but with the ongoing research they expect that practical applications could be possible, partly because of promising work being done around the world on the growth of homogeneous diamond materials.

<http://www.geologyin.com/2020/10/turning-diamond-into-metal.html>

## Scientists May Have Just Solved The Old Mystery of Earth's 'Missing Ice'

It should be simple. When temperatures on Earth get hotter, huge amounts of water ice trapped in giant glaciers begin to thaw, releasing water into the oceans, and causing sea levels to rise. It's the story of our lives. By contrast, when global temperatures plummet, which happens during ice ages, sea levels proceed to drop, as water content retreats from the ocean, freezing once more in huge inland ice sheets. This epic, ongoing cycle of ice ebb and flow – the transitions from glacials to interglacials – has been occurring since time immemorial. But there's a problem. For years now, scientists tracking these cycles have suggested there's a "missing ice" problem: a mysterious discrepancy between very low sea levels roughly 20,000 years ago, and the volume of ice stored in glaciers at the same time.



Ice surface elevation, 20,000 years ago. (Evan Gowan)

At its heart, the problem is this. During the peak of Earth's last ice age – the Last Glacial Maximum (LGM), which ended approximately 20,000 years ago – sea level is thought to have been about 427 ft lower than it is today, based on ancient coral sediment evidence. But modelling suggests ice volume in glaciers at this point in time wasn't great enough to explain such a low sea level. So how can we explain this 'missing' ice? With a new ice volume reconstruction called PaleoMIST 1.0, the researchers were able to model the evolution of global ice sheets way into the past, much farther back than even the LGM. The results of the model suggest the anomaly in our data isn't a case of missing ice, but rather mistaken inferences about how low the sea level actually fell during the LGM. According to PaleoMIST 1.0's ice physics model, the sea level dropped no more than 380 ft below where the waves lap today, with ice volume (being fully accounted for) clocking in somewhere around  $16.2 \times 10^6 \text{ mi}^3$ . According to the team, the misdirection of the missing ice argument stems from a couple of factors – firstly, over-reliance on far-field indicators (coral sediment evidence from locations elsewhere in the world), which may not accurately represent global average sea levels as we once thought they did. While the missing ice mystery appears to be solved, the researchers don't expect theirs will be the last word on this topic. <https://www.sciencealert.com/scientists-just-solved-the-mystery-of-where-earth-s-missing-ice-disappeared-to>

## New Perfection Found in Diamonds Created by an Asteroid

A new perfection was found in diamonds created by an asteroid in a Siberian crater 35 million years ago. The Popigai Impact Structure reserves are enough to keep the planet in diamonds for 3,000 years. New research indicates special qualities which makes these diamonds unique in the world, according to a new announcement by scientists in Novosibirsk. Scientists from the Sobolev Geology and Mineralogy Institute of the Siberian Branch of the Russian Academy of Sciences and Japanese colleagues determined that the diamonds displayed a 'high abrasiveness'



that is 50% to 60% superior to natural or synthetic diamonds. The impact diamonds from the crater also have *exclusive polishing characteristics* making it possible to produce ideally smooth surfaces. "Even nano-size crystals of a regular diamond scratch surfaces, but these diamonds polish so well that you won't see any scratches even with an electronic microscope," they said. This bodes well for potential applications in high-precision optical systems in satellites, jewelry and other industries, new composite materials, borers and cutting tools. Further studies of the impact diamonds from the vast crater, with reserves 10 times bigger than the world's known diamonds, will continue in cooperation with the Kyiv Institute of Super-Solid Materials, Alrosa's subsidiary Almazy Anabara and De Beers' synthetic diamond subsidiary Element Six, and Baker Hughes. The output of synthetic diamonds has reached 14 billion carats, and the new impact diamonds will have their own niche potentially forcing out synthetic diamonds which are less efficient to produce. The diamonds were created by the impact of an asteroid that crashed into the Earth 35 million years ago, leaving the 62 mile-wide crater. The crater is located above the Arctic Circle northeast of the most northern Russian city of Norilsk. Graphite in the ground was instantly transformed into diamonds over a vast territory. <http://www.geologyin.com/2016/07/a-new-perfection-found-in-diamonds.html>

# These Huge 'Demon Ducks' With Squished Brains Were an Extreme Evolutionary Experiment

Back when mega wombats, sheep-sized echidnas, and marsupial lions roamed the ancient lands of Australia, there also lived a gigantic flightless bird. Known by some as the “**demon duck of doom**,” *Dromornis stirtoni* is described by paleontologist Trevor



Artist's impression of the largest mihirung, *D. stirtoni*

Warren Handley could discern previously unresolvable details from four mihirung skull fossils: 24-million-year-old *Dromornis murrayi*; 12-million-year-old *Dromornis planei* and *Ibandornis woodburnei*; and 7-million-year-old *D. stirtoni*. This allowed the



Reconstruction of a *Dromornis planei* skeleton, Museum of the Northern Territory

Worthy as an “*extreme evolutionary experiment*.” “*It would appear these giant birds were probably what evolution produced when it gave chickens free reign [sic] in Australian environmental conditions*,” explained Worthy, a researcher from Flinders University in Australia. While discoveries of their skulls are rare, fossil records suggest “*mihirung*” (an Aboriginal word for “*giant bird*”) existed for an incredible 25-million-year stretch of time. Some species were about the size of cassowaries, but others eventually evolved into the whopping half-ton weight of *D. stirtoni*, with massive beaks to help them devour all the vegetable foods they required to maintain their exaggerated size. However, to make room for their enormous beak, these absurdly inflated chickens developed rather distorted skulls. “*To accommodate the muscles to wield this massive bill, the cranium had become taller and wider than it was long, and so the brain within was squeezed and flattened to fit*,” said Worthy. Using modern imaging techniques, Worthy and Flinders University paleontologist

the researchers to identify traits that reveal how these animals probably lived. “*Together with their large, forward-facing eyes and very large bills, the shape of their brains and nerves suggested these birds likely had well-developed stereoscopic vision, or depth perception, and fed on a diet of soft leaves and fruit*,” Handley explained. The researchers built brain models from CT scans of the fossilized skulls from Queensland and the Northern Territory and compared them to modern birds to further clarify their relationships. “*The unlikely truth is these birds were related to fowl – chickens and ducks*,” said Worthy. The team thinks periods of lush forested states in Australia during the mihirung's early evolution provided adaptation pressure for the birds to form their advanced vision, allowing them to navigate these complex forested environments. The flightless giants then appear to have used these abilities to adapt to the steadily drying Australian climate through to the late Pleistocene – eventuating in their likely restriction to shrinking woodlands around waterways, potentially placing them directly in the path of new human arrivals. These forces, amongst others, may have led to the demise of these unique bird beasts, somewhere between 50,000 to 20,000 years ago. Their cranial and endocranial morphology is “*unlike any attained in the evolution of birds*” and represents distinct adaptations to the progressively changing Australian environments, Handley and Worthy concluded in their paper.

<https://www.sciencealert.com/giant-demon-ducks-of-doom-had-to-squish-in-their-brains-despite-their-massive-heads>

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Club meetings are held the 3rd Tuesday of each month from September through November and from January through May at 7:15 p.m., at the Hiawatha Community Center in the Hiawatha City Hall, [101 Emmons St., Hiawatha IA](http://www.hiawathacity.org). The December meeting is a potluck dinner held on the 1st Tuesday at 6:30. June, July, and August meetings are pot-lucks held at 6:30 p.m. at area parks on the 3rd Tuesday of each month

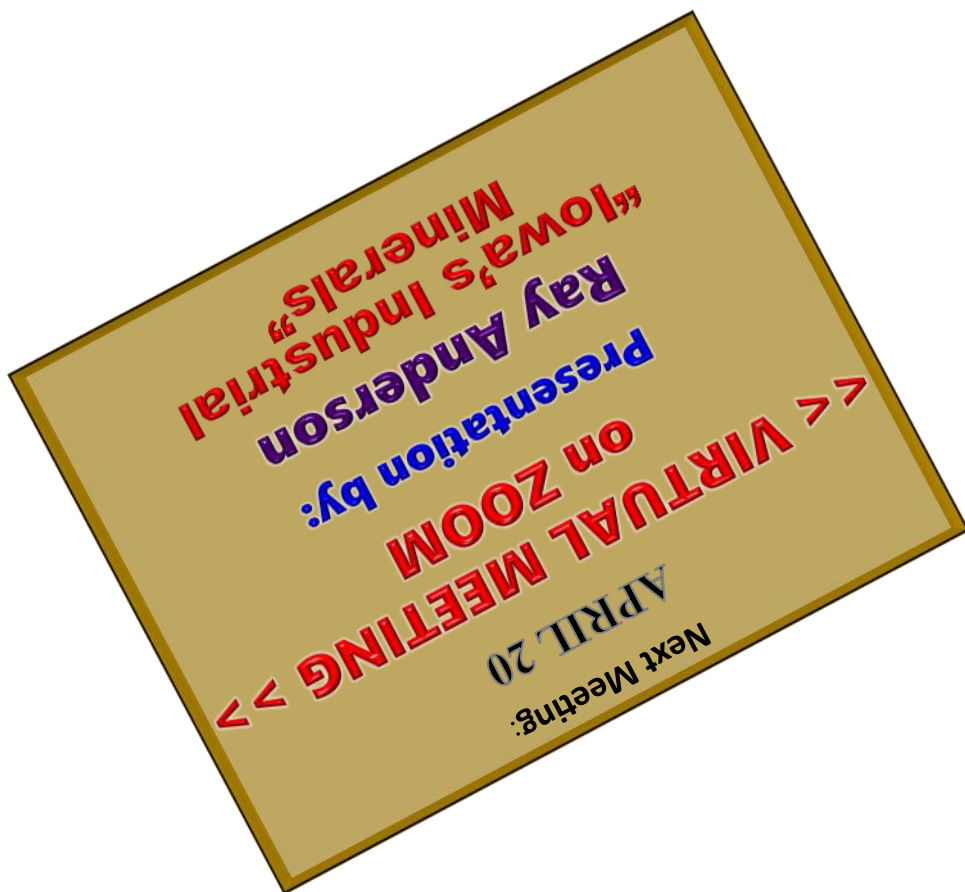
### CEDAR VALLEY ROCKS & MINERAL SOCIETY

CVRMS was organized for the purpose of studying the sciences of mineralogy, geology, and paleontology and the arts of lapidary and gemology. We are members of the Midwest (MWF) and American (AFMS) Federations. Membership is open to anyone who professes an interest in rocks and minerals.

**Annual dues are \$15.00 per family per calendar year. Dues can be sent to:**

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