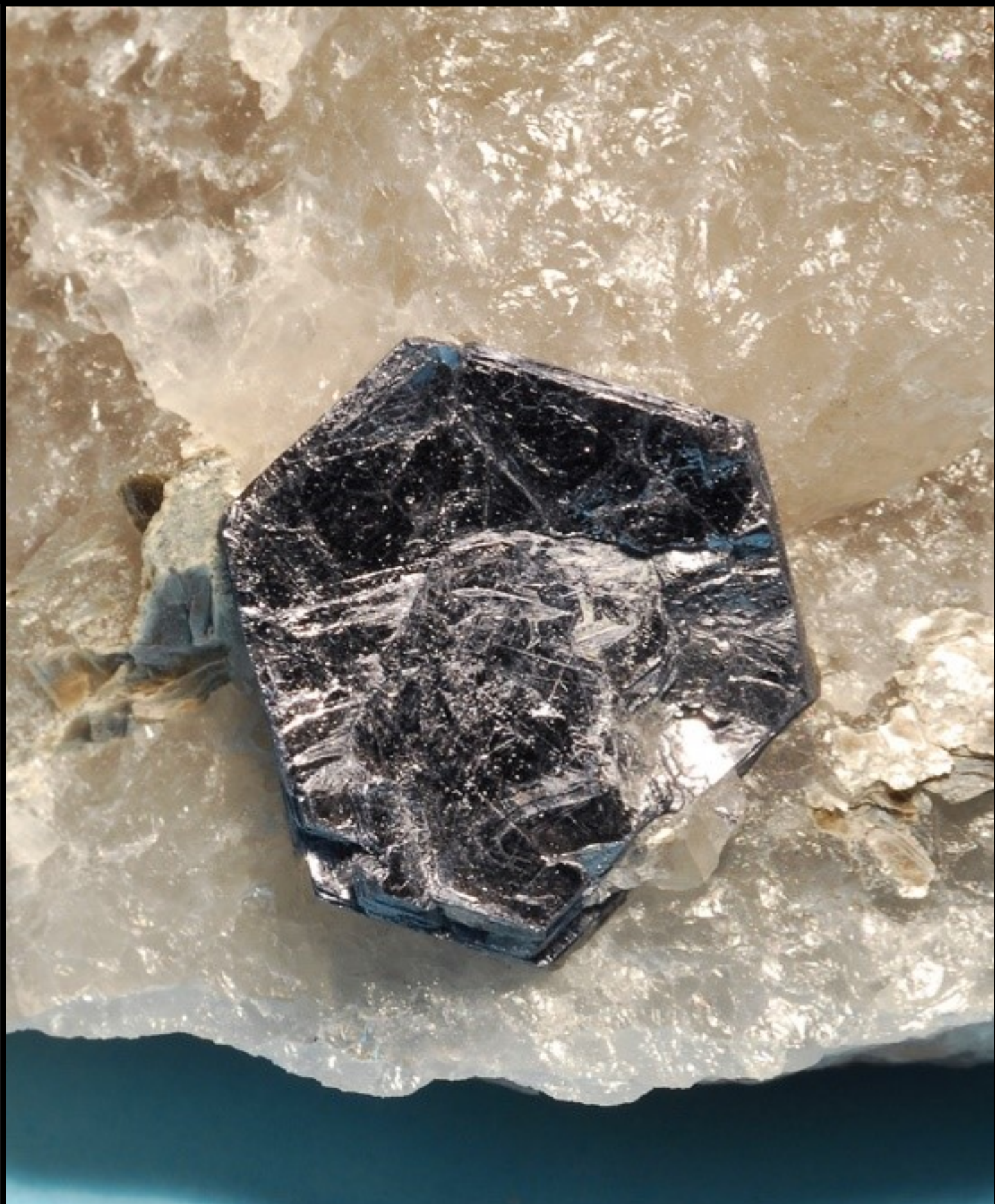


# DAISY MOUNTAIN ROCKCHIPS

The purpose of Daisy Mountain Rock & Mineral Club is to promote and further an interest in geology, mineralogy, and lapidary arts, through education, field experiences, public service, and friendship.

**VOLUME 5, ISSUE 8**

**AUGUST 2020**



Molybdenite in Quartz from Cleator, Yavapai County, Arizona. *Photo by Stan Celestian*

## FOSSILS: PART X

Kingdom: Animalia

Phylum: Mollusca Class: Cephalopoda

By Susan Celestian

The name 'cephalopoda' derives from the Greek for "head foot". The class is characterized by a head/foot surrounded by at least 8 suckered grooved, or hooked arms; and it includes the extant octopi, squid, *Nautilus* (member of only remaining nautiloids), and cuttlefish, plus now-extinct fossil ammonoids and belemnites.

The class Cephalopoda is further subdivided, and below are the subdivisions of main interest to us:

- Subclass - Nautiloidea: Late C-Rec
- Subclass - Ammonoidea (3 orders): D-K
  - Order Goniatitida
  - Order Ceratitida
  - Order Ammonitida
- Subclass - Coleoidea (3 orders)
  - Cohort Belemnoida (Belemnites): M-K
  - Cohort Neocoleoidea
    - ⇒ Order Spirulida (Ram's Horn Squid)
    - ⇒ Order Sepiida (Cuttlefish): K-Rec
    - ⇒ Order Teuthida (Squid): K-Rec
    - ⇒ Order Octopoda (Octopus): IP-Rec

General cephalopod characteristics are as follows:

- ▶ The geologic record of the class extends from the Upper Cambrian to Recent.
- ▶ The body plan is bilaterally symmetrical -- again, with the head/foot surrounded by tentacles.
  - They have a large lobed brain made up of condensed ganglia, and relatively complex nervous system, in general. In fact, some are considered quite clever -- octopi leaving their home aquarium, slithering to another to feed on some delicacy, and then slithering back to their home aquarium; octopi quickly learning to open the childproof cap on a bottle of herring.<sup>1</sup> Further, octopi can use tools, appear to play, and may exhibit personalities -- heavy stuff for an invertebrate! [\*Discover\*](#)

<sup>1</sup><https://animals.howstuffworks.com/marine-life/cant-open-that-childproof-bottle-ask-an-amazing-octopus.htm>

*Gastropoda continued on page 3...*



## MOLYBDENITE

By Susan Celestian

In the past molybdenite was lumped together with graphite or lead ore -- the Greek word *molybdos* means 'lead'. The element, molybdenite, was discovered by Carl Wilhelm Scheele in 1778, and a few years after that molybdenite was identified as a mineral, distinct from graphite and others.

Molybdenum is processed by froth flotation, much like copper. The Bagdad Mine in Arizona produces a lot of molybdenum (*moly*) by flotation, in conjunction to the processing of copper ores.

Additionally, rhenium is known to substitute for some molybdenum, and sometimes in percentages to make it economically recoverable. Bagdad Mine moly contains a significant amount of rhenium.

### Chemical Formula - MoS<sub>2</sub>

**Crystal System** - Hexagonal (3 axes of equal length and at 60° from each other in one plane, and a 4th at 90° to the other 3). Go to [Mindat](#) or [Mineral.net](#), and scroll down to interactive graphic of crystalline molybdenite.

**Growth Forms/Habits** - hexagonal tabular crystals, micaceous, scaly, massive-grainy

**Hardness** - 1-1.5

**Color** - Silver, lead-gray, bluish lead-gray

**Luster** - metallic

**Streak** - Bluish gray to grayish-black

**Specific Gravity** - 4.62-4.73

**Cleavage** - perfect in one plane

**Fracture** - uneven

**Other** - Sectile & flexible; greasy feel; melting point of 4,730°F

See Molybdenite in Figures A and B.

*Linarite continued on page 11....*

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...Cephalopoda continued from page 2

- They have a tube (*hyponome*), through which they expel water at high velocity, in order to propel through the water. (More on this under the topic of mobility). You will see this in action in some of the linked videos within this article.
- Most have sharp eyesight -- as sharp as that of a shark. They can distinguish the size, shape, and orientation (horizontal vs vertical) of objects of interest. Except for *Nautilus*, their eyes have iris, retina, lenses, and often cornea.
- As mentioned earlier, they have at least 8 -- 10 arms for squids -- and up to 90, in *Nautilus* -- surrounding the mouth. Some (squids and cuttlefish) also have two tentacles, used for grabbing prey and in mating.
- There are chemical olfactory sensors that aid in locating food and mates.
- They have a closed circulatory system, with copper-based blood (that turns blue in the presence of oxygen) -- and 3 hearts.
- Cephalopods respire via gills.
- Modern Octopi, squid, cuttlefish, and fossil ammonites and belemnites can/could release "ink" into the water when provoked. The cloud of ink confuses predators.
- Shells predominate the cephalopod fossil record, as might be expected. Both nautiloids and ammonoids possessed a chambered shell, as does the modern *Nautilus*. Fossil belemnites possessed an internal solid rostrum, into which was set an internal chambered shell. Other cephalopods either have no shell, or some reduced shell structure, like the cuttlebone of the cuttlefish, often used in bird cages, as calcium source, entertainment and beak abrasion.

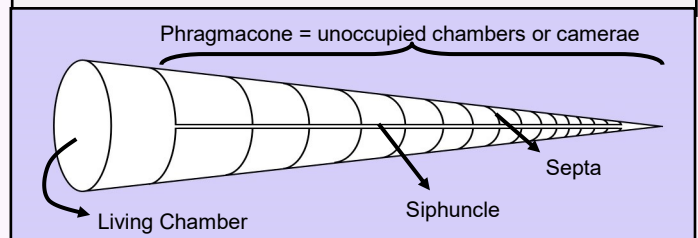
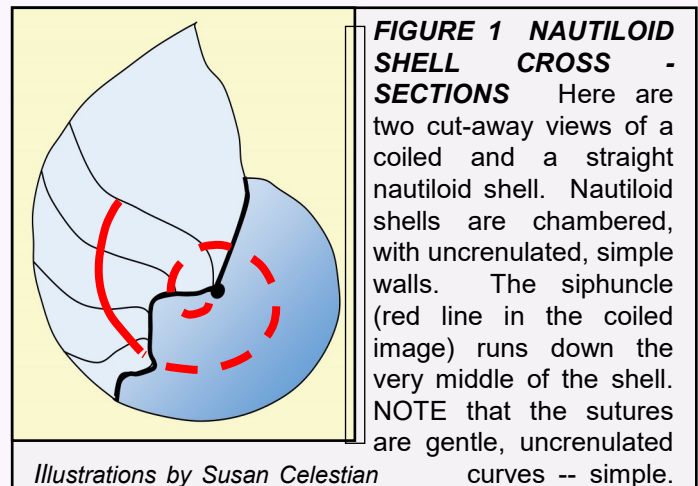
Additionally, the shells' chambers are interconnected by a tube, called a *siphuncle*. It is through the siphuncle that gas is pumped into and out of the empty chambers, for buoyancy control.

The living organism occupies only the outermost chamber, abandoning previously created chambers.

- ◇ Shells: As already mentioned, cephalopod shells -- when there is a shell -- are chambered, and sometimes distinctively so. The coiling is generally *planispiral* -- each addition of shell wraps over previous coils (all in one plane), so that there is no spire.

The chamber walls are called *septa*, and the juncture of septa with the exterior shell wall is called the *suture*.

- ◇ NAUTILOIDS: Nautiloids appeared in the Late Cambrian, and of the 2500 known fossil species, only two genera (6 species) survived the Cretaceous. Fossil nautiloid shells were primarily straight and conical, although partially to fully coiled fossils are known. And of course, the modern Pearly *Nautilus* is coiled. The primary characteristic, is that the walls between chambers (or *camerae*) is simple, smooth, and un-crenulated. Additionally, the siphuncle runs medially (right through the middle of the shell). See Figure 1.



Cephalopoda continued on page 4....

...Cephalopoda continued from page 3

- ◇ AMMONOIDS: Ammonoids appear in the fossil record during the Devonian, and evolved rapidly. They are excellent index fossils, especially for the Mesozoic (Triassic, Jurassic, Cretaceous).

Unlike the nautiloids, ammonoid sutures were lobed, saddled and crenulated -- becoming more complex, as you move up the geologic time scale. A number of explanations have been expounded to explain this:

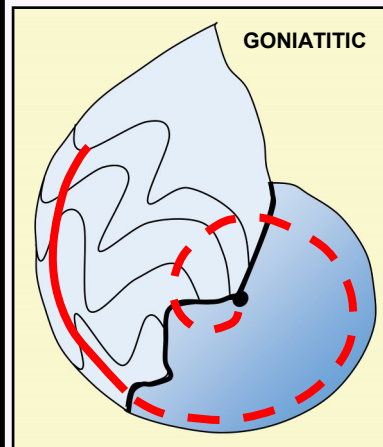
- \* Increase attachment for tissues.
- \* Increase shell strength to allow for deeper dives -- or
- \* Contrary to the above notion, one study indicates that the resistance to pressure is reduced, but buoyancy increases, indicating a return to shallow water.<sup>2</sup>

There are 3 styles of ammonoid suture patterns -- *goniatitic*, *ceratitic*, and *ammonitic*. Variations on these patterns are numerous, and the basis for the identification of species. In general, the suture patterns became more complex as one rises in the geologic column; however, there is much overlap. Goniatic patterns predominate during the Paleozoic, ceratitic during the Triassic, and ammonitic during the Jurassic and Cretaceous (although present back to the Permian). See Figure 2.

Again, ammonoids make excellent index fossils. There are over 10,000 identified fossil species, as they have the following characteristics. Many species existed for very short periods of geologic time. Being free-swimmers, and due to the fact empty shells would probably float quite easily, they are geographically widespread. The suture marks (and

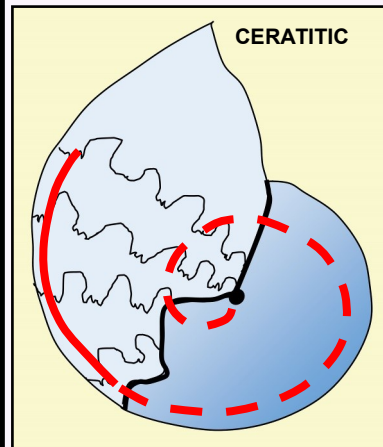
even exterior characteristics) are quite distinctive. And they were very abundant, swarming the Mesozoic seas.

Shell terminology is the same as that for nautiloids, identified in Figure 1.

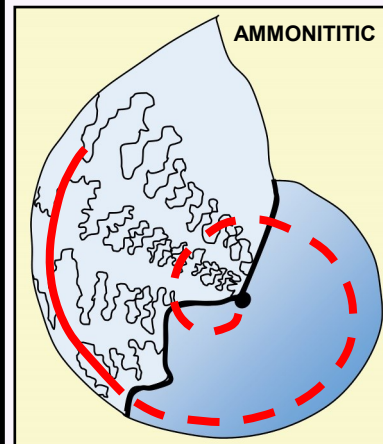


**FIGURE 2  
AMMONOID SUTURE  
PATTERNS**

**Goniatic** sutures are characterized by smooth lobes and saddles, or broad zig zags.



**Ceratitic** sutures are characterized by smooth lobes and crenulated saddles.



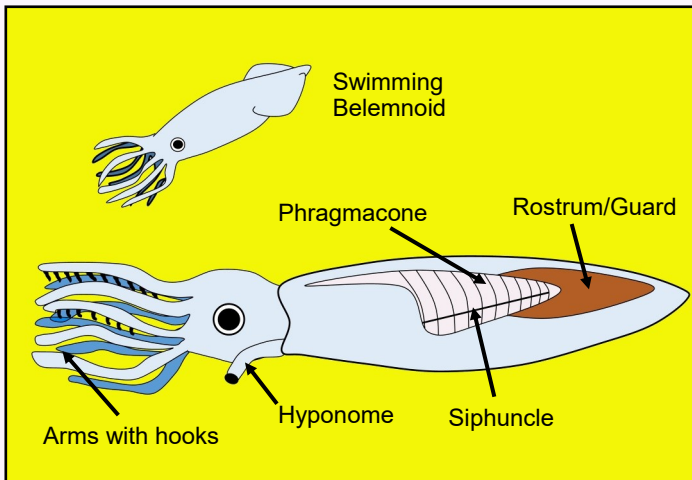
**Ammonitic** sutures are characterized by crenulated lobes AND saddles.

Illustrations by Susan Celestian

<sup>2</sup>Daniel, T.L., B.S. Helmuth, W.B. Saunders, and P.D. Ward. 1997. Septal complexity in ammonoid cephalopods increased mechanical risk and limited depth. *Paleobiology* 23(4): 470-481.

...Cephalopoda continued from page 4

- ◇ BELEMNOIDS: Existing from the Devonian to the Cretaceous, but truly best defined and abundant during the Jurassic and Cretaceous, belemnoids resemble modern squids. However, they possessed 10 arms -- bearing hooks -- and no tentacles (while squid have 8 arms and 2 tentacles). And they possessed a cone-shaped, internal, chambered shell set into a solid, cigar-shaped structure, called a *rostrum or guard*. It is the latter that is most commonly fossilized. See Figure 3.



**FIGURE 3 BELEMNOID BODY FEATURES** The shell of belemnoids was totally internal. The phragmacone, being relatively fragile, is seldom preserved; however, the rostrum (a feature quite unique to belemnites) is a solid calcite structure, and is fairly readily preserved in the fossil record. It may have acted as some sort of counterbalance to the head/arms, making the animal neutrally buoyant.

Fleshed out, the creatures had flexible flaps toward their posterior, that could be used to swim, like a squid or cuttlefish. *Illustration by Susan Celestian*

- ◇ SQUIDS: A group that survived the Cretaceous extinction event, squids do have the vestige of an internal shell -- a chitinous *pen or gladius*. Squids have 8 arms and 2 tentacles.
- ◇ CUTTLEFISH: As already mentioned, cuttlefish have an internal, chambered buoyancy-compensating shell, called a *cuttlebone* (Figure 5).

...Cephalopoda continued from page 4

- ▶ Cephalopoda habitat:
  - Cephalopods are exclusively marine.
  - They occupy nearly every environment: polar to tropical; surface to very deep (up to about 5 miles); although most live in water less than 1000 feet deep.
    - ◇ Cuttlebones will implode at depths of 660-1970 feet.<sup>3</sup>
- ▶ Cephalopoda habit: .
  - Feeding habits: All extant cephalopods are beaked -- a beak not unlike that of a parrot. Most have a radula, or toothed structure. They hold their prey with their arms, cover them with digestive juices (sometimes poisonous), and bite flesh off bone.
 

Cephalopods are active predators and eat worms, fish, crustaceans, and mollusks,
  - Nearly all spend a great deal of time swimming (some never rest on the ocean floor).
  - Mobility:
    - ◆ As mentioned earlier, cephalopods possess a hypostome, by which they achieve jet propulsion, for bursts of high speed movement. They generally move backwards, although some limited 'steering' is possible. They can even propel themselves through the air for up to 160' or so.
    - ◆ Some octopi can walk, using their tentacles.
    - ◆ Squid and cuttlefish (and probably fossil belemnites) can swim a bit, using a rippling flap of body tissue. Squids can swim up to 20 mph, using their hyponome. They dart about like bats.
    - ◆ Most cephalopods can float, being less dense than seawater (due to ammonia incorporated into their tissues, or nitrogen and other gases

<sup>3</sup> kids.kiddle.co

...Cephalopoda continued from page 5

in unoccupied chambers). Shelled cephalopods (*Nautilus*, cuttlefish, fossil nautiloids, ammonoids and belemnoids) can/could pump gas into and out of vacant areas of the shell, creating a buoyancy that allows vertical movement.

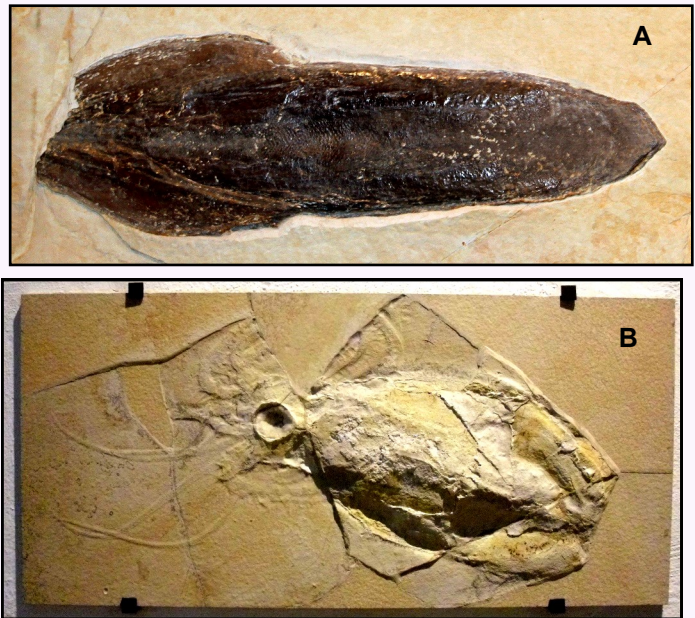
- Reproduction:
  - ◊ Cephalopods are male or female.
  - ◊ Both male and female octopi, squid, cuttlefish, and Spirulida die after mating -- sometimes right away, often later (especially for females who may tend to the developing eggs). *Nautilus* may mate multiple times.
  - ◊ Eggs are laid in dens, in sand, on rocks, among coral, or in seaweed. Hatching may occur in a few days, or as long as more than a year.
  - ◊ Life expectancy: under 3 years, except *Nautilus*, who may live over 20 years.

► Interesting facts:

- The largest fossil nautiloid measured 11 feet long. A *Cameroceras* was estimated to be an unconfirmed 36 feet long. The largest ammonoid fossil (*Parapuzosia seppenradensis*) was incomplete and still almost 6 feet in diameter. Imagine those armed predators!!
- Octopi have 3 hearts and 9 brains (one central, and a "brain" in each arm.
- Octopi arms can regrow if partially cut off.
- The giant squid (*Architeuthis*), measuring up to 60 feet long, has been caught by fisherman and found washed ashore. (Sperm whales like to snack on this huge creature.) It is thought they may live up to 5 years.
- The female Blanket Octopus -- up to 6 feet long -- is 10,000-40,000 times heavier than the walnut-sized male!<sup>4</sup>

- The name 'ammonoid' comes from their resemblance to the ram's horns worn by the Egyptian god Ammon. And the common genus suffix 'ceras' of many species names is Greek for horn.
- Folklore has it that belemnites formed where lightning struck the ground; or they were candles of gnomes and pixies (in Scandinavia). Homeopathically, they were soaked in water and served to horses to cure distemper (Scotland), rheumatism (England), or crushed and blown into sore eyes.
- Wanna make cephalopod cookies? <https://www.things4thinkers.com/3d-printed-ammonite-fossil-cookie-cutter-2-1-2-x-2.html>
- Or... How about a tattoo? <https://nextluxury.com/mens-style-and-fashion/ammonite-tattoo-designs-for-men/>

Images of cephalopod fossils follow, in Figures 4-23.



**FIGURE 4** *Trachyteuthis hastiformis*, a relative of the soft-bodied cephalopods, out of the Upper Jurassic Solnhofen Formation. Image A is of a cuttlebone-like structure. Note the preservation of arms and fins in image B. Image A is by H. Zell of a specimen at the Museum für Naturkunde Berlin and available by [GNU Free Documentation License](https://www.gnu.org/licenses/fdl.html). Image B is by FerdiBf at de.wikipedia of a specimen at the Jura-Museum Eichstatt, Public Domain.

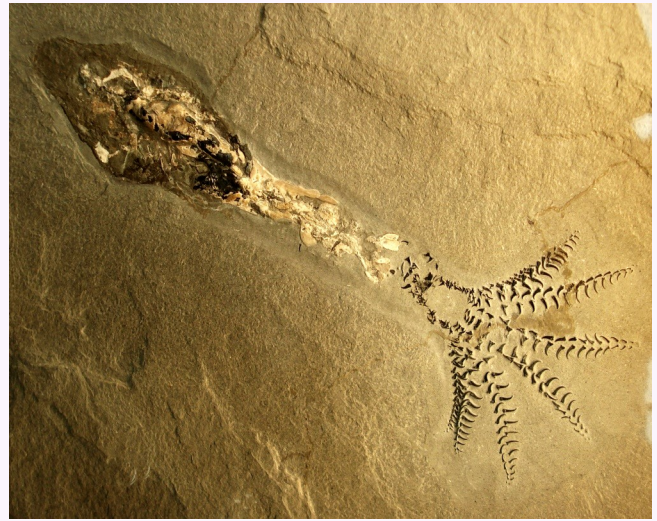
<sup>4</sup>[nationalgeographic.com](http://nationalgeographic.com)

...Cephalopoda continued from page 6



**FIGURE 5 CUTTLEBONES** During our trip to Australia in their 2018 winter, the beaches were littered with cuttlefish shells.

Photo by Susan Celestian



**FIGURE 7 A BELEMNOID** This is *Phragmoteuthis conocauda*, a Lower Jurassic belemnoid, displayed at the Paläontologisches Museum München, in Munich, Germany . This fantastically preserved fossil is lacking the solid rostrum, but the hooks of the arms are beautifully displayed! Image by Ghedoghedo used under the conditions of the Attribution Share-Alike 3.0 Unported (CC BY-SA 3.0)



**FIGURE 6 BELEMNOID ROSTRUMS**

Here are two examples of the solid rostrum, internal to belemnoids. "A" is *Pachyteuthis* sp. from the Sundance Fm., Greybull, Big Horn Co, WY. It is nearly 4" long. "B" we collected off Pryor Mt. Road, in Montana. It is 3" long. Note in B that there is a gray V-shaped area in the center. That is the area that once housed the phragmacone -- the relatively fragile internal shell. Photos by Stan Celestian



**FIGURE 8 "BELEMNITE BATTLEFIELD"** This rock is out of the Badlands of South Dakota. The accumulation of broadly parallel rostrums suggests action by currents. What might account for so many rostrums? Mass death after spawning event? Ichthyosaur vomit? Selective sorting? Mudslide? ?????

Photos by Stan Celestian



...Cephalopoda continued from page 7



**FIGURE 9 NAUTILOID** This is an internal mold, exposing a cross section of a straight nautiloid, out of the Upper Ordovician of northern Kentucky. Note the smooth chamber walls, and the medial siphuncle. *Image courtesy of Mark A. Wilson (Department of Geology, The College of Wooster) \_Public Domain*



**FIGURE 10 NAUTILOID** This straight nautiloid fossil also clearly exposes the smooth, uncrenulated sutures. Looking at the end, you can see the central dot, that is the siphuncle (see arrow). *Images by Stan Celestian*



**FIGURE 11 COILED NAUTILOID** This coiled nautiloid (*Eutrephoceras* sp) is from the Pierre Shale, Glendive, Dawson County, Montana. Collected by Stan & Sue Celestian. *Image by Stan Celestian*



**FIGURE 12** *Hoploscaphites* sp., out of the Cretaceous Pierre Shale, Glendive, Dawson County, Montana. 1.87 inches across. *Photo by Stan Celestian*



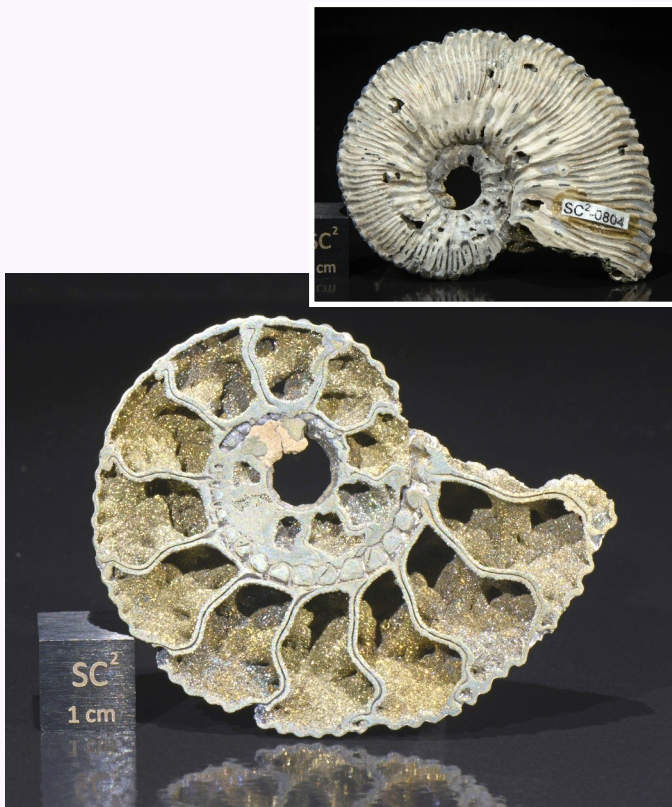
**FIGURE 13** A selection of ammonoids collected by Stan and Sue Celestian, out of the Pierre Shale near Glendive, Dawson County, Montana, on a Federation field trip during the summer of 2015. Did someone say Field Trip!? *Image by Stan Celestian*



...Cephalopoda continued from page 8



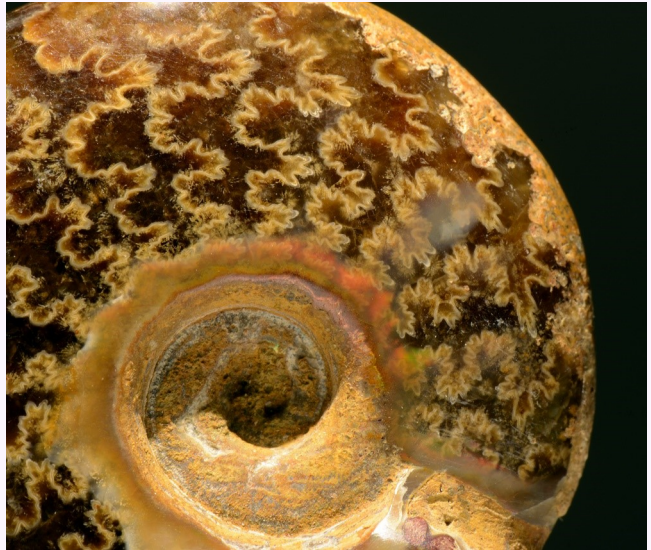
**FIGURE 14** *Perisphinctes* sp. from the Late Jurassic of Sakaraha, Madagascar. A closer look will reveal the ammonitic sutures. 4.5 inches diameter.  
Photos by Stan Celestian



**FIGURE 15** An ammonoid from Madagascar, whose chambers have been beautifully lined with pyrite. This species appears to be goniatitic, with some subtle lobes/saddles. 2.25 inches across.  
Photos by Stan Celestian

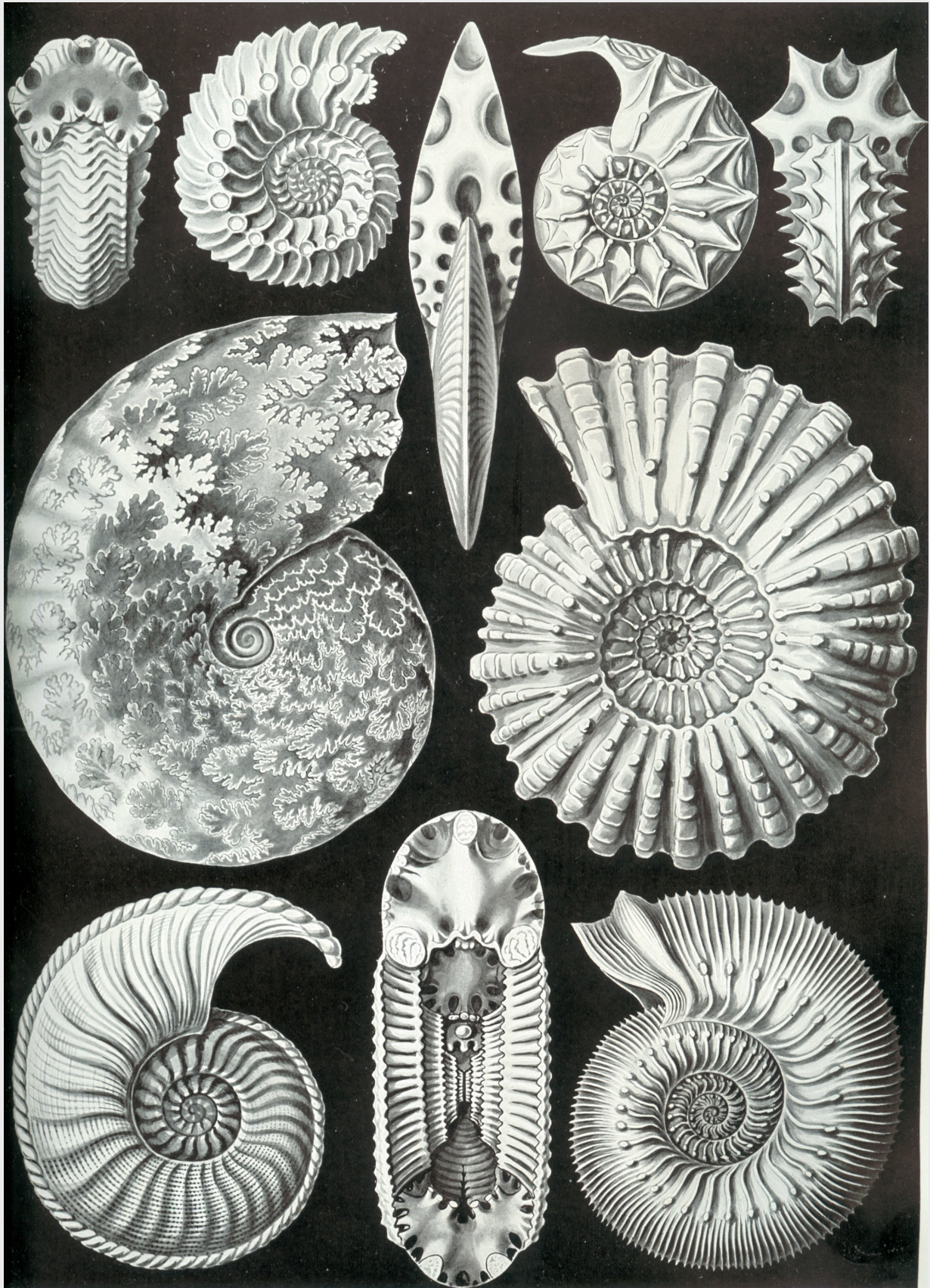


**FIGURE 16** Ammonitic sutures of a Madagascar ammonoid. This specimen is polished, and you can see the iridescence of the original shell. 2.3 inches across. Photos by Stan Celestian



**FIGURE 17 ARIZONA AMMONOID** This specimen is small -- about 1 inch across. It was collected in 1974, out of the Cretaceous Mancos Shale, north of Tuba City, Coconino County, Arizona. Image by Stan Celestian

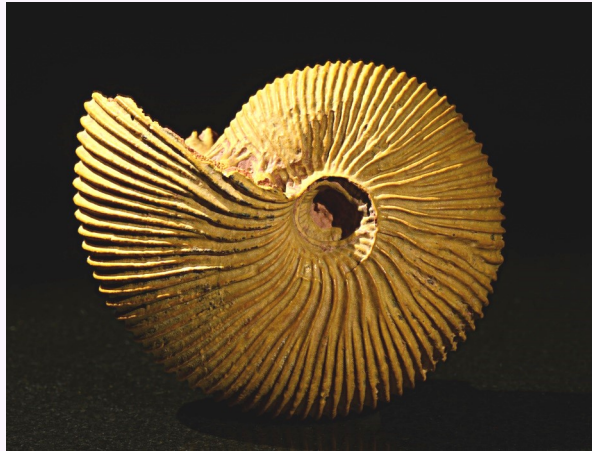
...Cephalopoda continued from page 9



**FIGURE 18 VARIOUS AMMONOIDS** Scientific illustrations of ammonoids by Ernst Haeckel, 1904, *Kunstformen der Natur* (Art Forms of Nature); Public Domain

Cephalopoda continued on page 11....

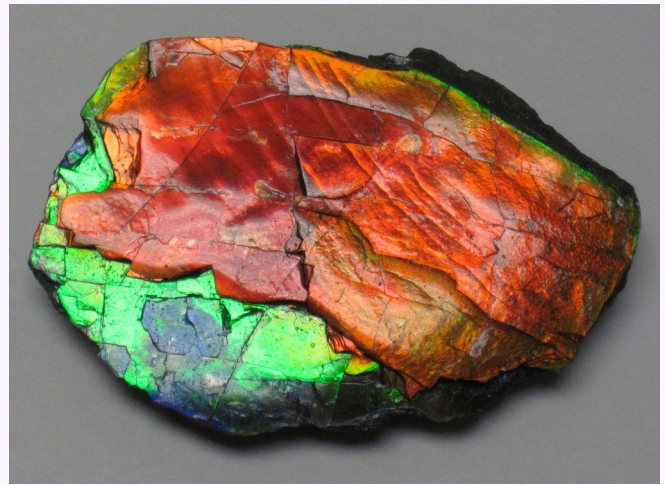
...Cephalopoda continued from page 10



**FIGURE 19**

*Macrocephalites lamellosus* from the Middle Jurassic of Anwil, Switzerland. The view up the aperture shows how the ammonitic suturing increases the surface area to which the cephalopod might attach. 3 inches across.

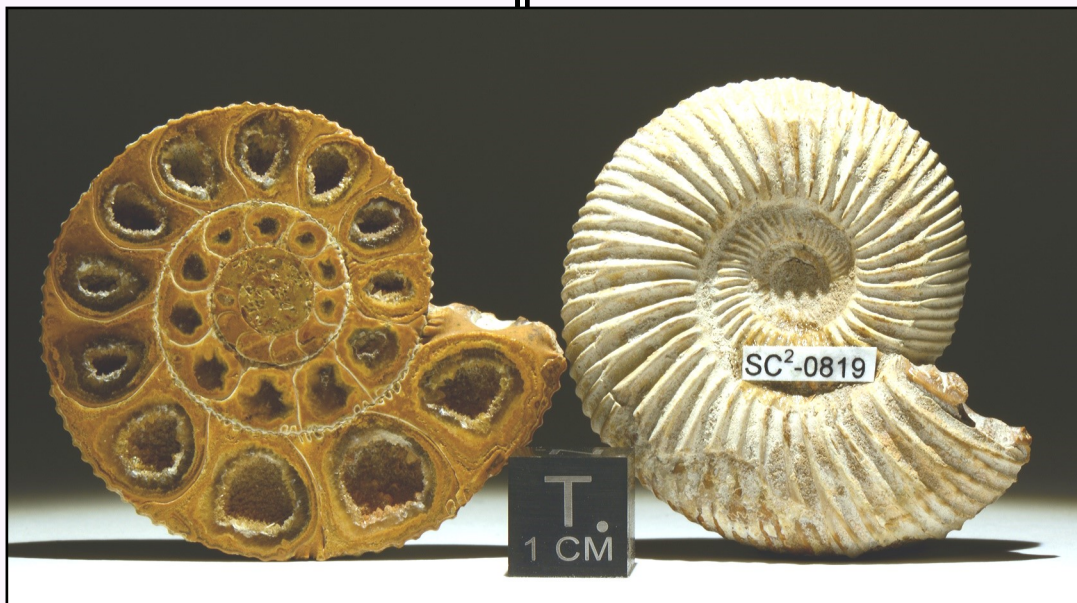
Photos by Stan Celestian



**FIGURE 20 AMMOLITE**

The fossilized iridescent layer of an ammonoid shell is classified as a gemstone, called ammolite. This material is from *Placentoceras* sp., and exclusively from the Upper Cretaceous Bearpaw Formation of St Mary River Valley, Alberta, Canada. The nacreous (usually shiny and pearly) layer is originally aragonite. Diagenetic changes during fossilization has altered and brightened the layer. Interference of light rebounding from the plate-like aragonite layers causes the play of colors.

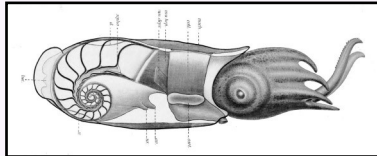
Photo by James St. John and made available through [Creative Commons Attribution 2.0 Generic license](https://creativecommons.org/licenses/by/2.0/).



**FIGURE 21** This ammonite has sutures that appear to make it a nautiloid, however the 3-D aspect is more convoluted that would appear at first glance.

Photo by Stan Celestian

...Cephalopoda continued from page 11



**FIGURE 22 RAM'S HORN SQUID**

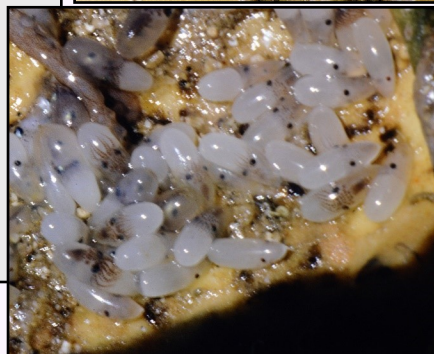
The shell on the left (about 1" across) was found on a beach in Western Australia. Many of these shells had been washed ashore all along the coast. They are the internal shell of a deep-water-dwelling cephalopod, *Spirula spirula*. The shell is very buoyant, and can travel long distances before it is deposited. It lives at depths over 3000 feet, and ascends to shallower depths (300-900 feet) to feed. The species prefers temperatures of around 50°F, which is pretty cool for an invertebrate. Additionally, *Spirula* has an organ that emits light, inspiring the other common name -- Tail-Light Squid. The drawing shows how the shell lies internally within the squid-like body. Photo by Stan Celestian. Illustration by Ewald Rübsamen in *Die Cephalopoden* published in 1910. Public Domain due to age.

**FIGURE 23**

Rocky Point, Mexico: In the upper photo, an octopus is holding two bivalve shells together, in guard of its nursery. In



the middle photo, the shells have been opened (by us) to expose the octopus eggs. And in the lower photo you can see the eggs up close. They look a bit like alien heads or ghost -- white blebs with two black eyes.



Photos by Stan Celestian

## GENERAL RESOURCES FOR CEPHALOPODS

### General:

- <https://en.wikipedia.org/wiki/Cephalopod#Taxonomy>
- <http://tolweb.org/Cephalopoda>
- <https://ucmp.berkeley.edu/taxa/inverts/mollusca/cephalopoda.php>
- <https://animaldiversity.org/accounts/Cephalopoda/>
- <https://www.japantimes.co.jp/news/2017/09/23/national/science-health/cephalopods-show-signs-intelligence/#:~:text=His%20team%20found%20that%20cuttlefish,when%20small%20fish%20were%20present.&text=Just%20in%20case%20there%20were,of%20this%20group%20of%20animals.>
- <https://ocean.si.edu/ocean-life/invertebrates/cephalopods#:~:text=During%20NOAA's%202016%20Okeanos%20mission,living%20on%20the%20ocean%20floor.>
- <https://www.fieldmuseum.org/blog/cephalopods-here-there-and-everywhere>
- <http://www.waterencyclopedia.com/Ce-Cr/Cephalopods.html>
- <https://aquarium.ucsd.edu/blog/get-to-know-the-four-types-of-cephalopods/>
- <https://ocean.si.edu/ocean-life/invertebrates/cephalopods#:~:text=During%20NOAA's%202016%20Okeanos%20mission,living%20on%20the%20ocean%20floor.>

### Octopi:

- <https://animals.howstuffworks.com/marine-life/cant-open-that-childproof-bottle-ask-an-amazing-octopus.htm>
- <https://www.nationalgeographic.com/animals/invertebrates/b/blanket-octopus/#:~:text=Blanket%20octopus%20pairs%20are%20some,40%2C000%20times%20more%20than%20males.>

### Belemnoids:

- <https://www.bgs.ac.uk/discoveringGeology/time/Fossilfocus/belemnite.html>
- <https://www.bgs.ac.uk/discoveringGeology/time/Fossilfocus/belemnite.html>
- <https://tonmo.com/articles/belemnites-a-quick-look.35/>

### Nautiloids/Ammonoids:

- [https://en.wikipedia.org/wiki/Nautiloid#:~:text=Nautiloids%20are%20often%20found%20as,coil%20\(as%20in%20Lorieroceras\).](https://en.wikipedia.org/wiki/Nautiloid#:~:text=Nautiloids%20are%20often%20found%20as,coil%20(as%20in%20Lorieroceras).)
- <https://www.luckysci.com/2014/05/the-quick-difference-between-nautiloids-and-ammonoids/>

### Cuttlefish:

- <https://en.wikipedia.org/wiki/Cuttlebone>
- [https://kids.kiddle.co/Cuttlebone#:~:text=The%20microscopic%20structure%20of%20cuttlebone,\(660%20to%201%2C970%20ft\).](https://kids.kiddle.co/Cuttlebone#:~:text=The%20microscopic%20structure%20of%20cuttlebone,(660%20to%201%2C970%20ft).)

### Squid:

- <https://en.wikipedia.org/wiki/Squid>
- <https://www.britannica.com/animal/squid>
- <https://www.wbur.org/hereandnow/2019/05/13/smart-squids>
- <https://en.wikipedia.org/wiki/Spirula>

### Ammolite

- <https://en.wikipedia.org/wiki/Ammolite>
- <https://geology.com/stories/13/ammolite/>

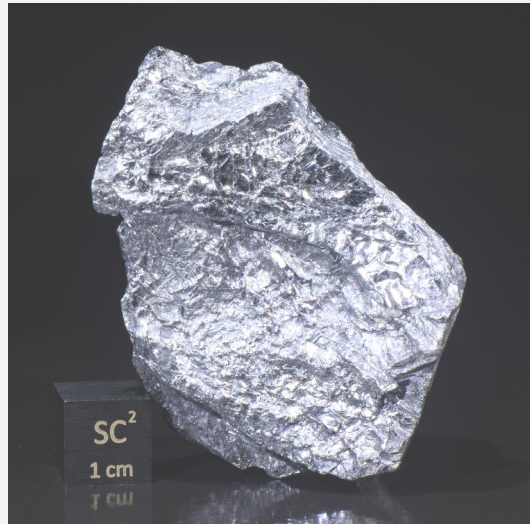
...Molybdenite continued from page 2

#### Uses of Molybdenum:

- ◆ Alloyed in steel (strength, hardness, corrosion resistance, wear resistance, electrical conductivity)
  - \* Allows steel to withstand pressures of 300,000 pounds per square inch<sup>1</sup>
- ◆ High-temperature lubricant additive (as molybdenum disulfide) -- engines, bike brakes, bullets, ski wax, grease for bearings
- ◆ Catalyst in the petroleum industry, for removal of sulfur
- ◆ Paint additive: corrosion resistance, fade-resistant oranges
- ◆ Fertilizer: sodium molybdate provides essential molybdenum to nitrogen-fixing bacteria.



**FIGURE A MOLYBDENITE CRYSTALS** A very small outcrop of milky quartz, near Crown King, Arizona, yields nicely-formed hexagonal crystals of molybdenite. *Photos by Stan Celestian*



**FIGURE B MOLYBDENITE** Here are two views of the same specimen of molybdenite. In the lower photo, note the lamellar or layered aspect. It even looks like it feels greasy! *Photos by Stan Celestian*

#### GENERAL RESOURCES FOR MOLYBDENITE:

<https://www.livescience.com/34687-molybdenum.html>

<https://www.minerals.net/mineral/molybdenite.aspx>

<http://webmineral.com/data/Molybdenite.shtml#.XzqT-uhKq2w>

<https://www.mindat.org/min-2746.html>

<https://en.wikipedia.org/wiki/Molybdenite>

<sup>1</sup>Investing News.com

# COMET NEOWISE

## C/2020 F3 (NEOWISE)

by Stan Celestian



*Photo by Stan Celestian*

Comet NEOWISE as it appeared in the northwest sky shortly after sunset on Saturday, July 18, 2020. (Exposure time 25 seconds with a 24 mm lens at f 3.5). The picture was taken from Amethyst Hill just east of Wickenburg.

It is not very often that we get a chance to see a comet, in our skies, with the unaided eye. **Enter comet NEOWISE.** It was discovered on March 27, 2020, by the **W**ide-field **I**nfrared **S**urvey **E**xplorer (**WISE**) that was recommissioned in 2013, hence the “**NEO**” part of the name. At the time it was very dim, and at a distance of 160 million miles from Earth. But, it was heading toward the Sun for a rendezvous on July 3rd. At closest approach it was a mere 27 million miles from the Sun (inside the orbit of Mercury, which averages 30 million miles from the Sun). Many comets don't survive such a close approach, as they are often ripped apart by enormous gravitational stresses. But comet NEOWISE's 3-mile in diameter icy nucleus remained intact and continued in its orbit back out to deep space.

Fortunately, for Earth observers its brush with the Sun heated it up significantly and allowed much of its icy nucleus to vaporize. Methane ice, carbon dioxide ice, but predominately water ice were vaporized and driven away from the Sun (and comet) by the solar wind (a stream of particles emitted by the Sun outward in all directions). The solar wind pushes these vapors (actually a plasma) out away from it to form a stream of luminous material called the comet's tail. This tail, called the gas tail (also the ion, or plasma tail) fluoresces bluish from the UV rays in sunlight. This is due to ionized carbon monoxide (CO+) absorbing electrons and emitting a bluish light.

*Neowise continued on page 15....*

...Neowise continued from page 14

Additionally, a dust tail was also produced by the sublimation (ice to vapor) of the comet's nucleus. The nucleus is not pure, clean ice, but contains a bit of dust as well. This dust is also released as the nucleus vaporizes. In fact, this dust is of interest to planetary astronomers and planetary geologists, as it is

primordial material - remnants of the early history of the solar system. But we do not see the comet's nucleus, as it is hidden by the coma. The coma is a region of gas and dust that is driven off the nucleus by the Sun's radiation. But orbiting spacecraft can penetrate the coma to see NEOWISE's 3-mile diameter chunk of ice nucleus. The dust tail appears yellowish, as it simply reflects sunlight. These tails can stretch for millions of miles beyond the head of the comet. (The head consists of the nucleus surrounded by the coma.)



*Photo by Stan Celestian*

Comet NEOWISE on Tuesday, July 21 2020. (Exposure time 60 seconds, with a 200 mm lens at f 2.8). The picture was also taken from Amethyst Hill just east of Wickenburg, Arizona.

This photo shows both the gas and dust tail. Note the bluish-green fluorescence on the sunward side (bottom of photo) of the coma. This is thought to be from diatomic carbon ( $C_2^+$ ) which is not abundant in comets, however it fluoresces brightly.

On July 22, 2020 NEOWISE was at its closest approach to Earth -- some 64 million miles away.

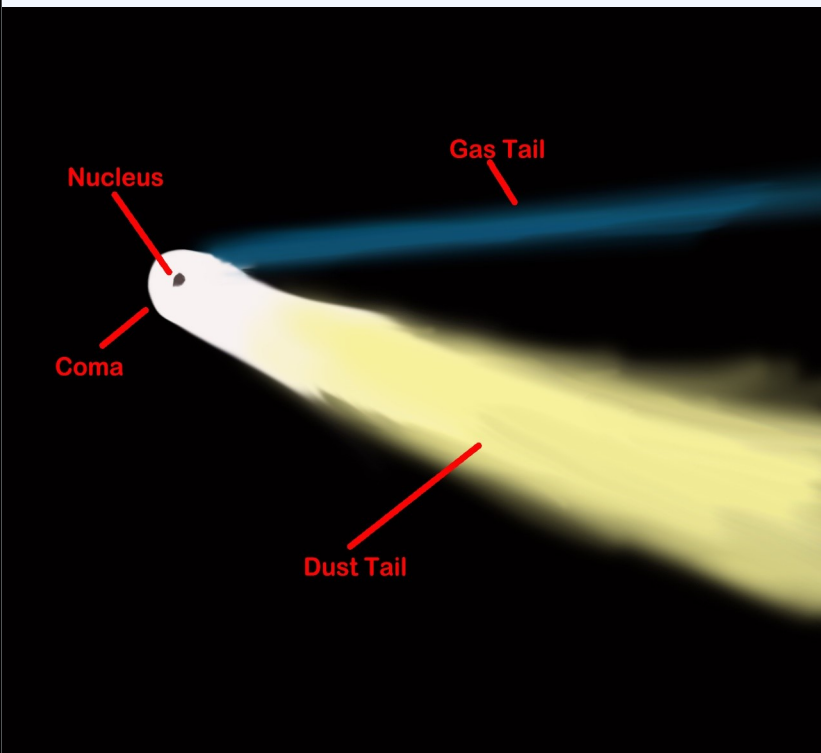


*Photo by Stan Celestian*

25, 2020. (Exposure time 62 seconds with a 70 mm lens at f 2.8). The picture was taken from Date Creek Road. This is the last shot of the comet. The comet was getting dimmer and the Moon was getting brighter, both factors that make imaging the comet more difficult.

Comet NEOWISE in the northwest shortly after sunset on Saturday, July

...Neowise continued from page 15



## PARTS OF A COMET

This diagram shows the main parts of a comet.

**NUCLEUS:** This is the main part of a comet. It generates (through sublimation) the other, highly visible parts of the comet. It consists of various types of ices and dust. It may also contain a rocky body. The nucleus can also spin.

**COMA:** As the nucleus approaches the Sun, radiation heats the surface of the nucleus, causing the ices to vaporize (a process called sublimation - solid to gas, with no liquid phase). These escaping gases produce the coma which surrounds the nucleus, and makes it impossible to visually see it. However, various techniques including radar and infrared observations have been able to image some nearby comets. (See picture below.)

**GAS TAIL:** Heating of the nucleus releases gases that become ionized (atoms somewhat stripped of electrons). These gas ions are carried directly away from the Sun by the solar wind, which consists primarily of particles of hydrogen and helium nuclei, as well as electrons, and trace amounts of other atomic nuclei. The gas tail is also called an ion tail or plasma tail, because the particles are charged and travelling at high speeds.

**DUST TAIL:** The vaporization of the nucleus also releases dust particles. For the most part these particles are small, about 1 micron (smoke particle size), but other particles may be sand-sized. The dust tail is yellowish, because it reflects the Sun's light. The dust tail spreads out much more than the gas tail, as each particle of dust is different in size. This difference causes each particle to be deflected a different amount by the solar wind. In many cases, a stream of dust and sand-sized particles is produced in the comet's orbit around the Sun. If the Earth passes through this dusty region of the comet's orbit a meteor shower is created. As examples, the orbit of Halley's comet is laden with dust and other small particles, and when Earth passes through this region, we see these meteor showers: the Eta Aquarids, active from mid-April through most of May, and the Orionids in October, are both the result of Earth passing through the orbital path of Halley's comet. Many other meteor showers are connected to comet orbits.



This is an image of the nucleus of Halley's comet taken from the Giotto mission. Note the jets of sublimating gas coming from the nucleus on its left side.

*Image courtesy of NASA*



*Photo by Stan Celestian*

Telescope and Camera Equipment: Getting ready for an evening shoot, at the Rowley Mine. Celestron 11" S-C with the camera mounted on top.

Neowise continued on page 17....



...Neowise continued from page 16

## A FEW OTHER NOTABLE COMETS



*Photo by Stan Celestian*

The **Great Comet of 1997 -- Hale-Bopp**. The term "Great Comet" is reserved for those that are especially bright -- bright enough to be seen at night by a casual observer. They are also referred to by the year in which they were observed. Hale-Bopp was named after two astronomers who recorded their observation at nearly the same time. By tradition, the comet is named after the discoverers. But it is also referred to as the Great Comet of 1997. (Note the detail in the comet's blue gas tail.)

I was able to capture this image of the comet in April, 1997. For more information about the comet and its co-discoverers, follow this link: [https://en.wikipedia.org/wiki/Comet\\_Hale%E2%80%93Bopp](https://en.wikipedia.org/wiki/Comet_Hale%E2%80%93Bopp)



*Photo by Stan Celestian*

Ikeya-Zhang photographed in September 9, 2002

**Its official designation is 153P/Ikeya-Zhang.** It was independently discovered in 2002, by two astronomers, one in Japan and one in China.

Neowise continued on page 18....

...Neowise continued from page 17



*Photo by Stan Celestian*

Comet Halley (Comet 1P/Halley ) March 11, 1986

Perhaps one of the most famous comets is Halley's Comet. Even though it is named after Sir Edmund Halley, he did not discover the comet. Instead, he determined it was a comet that returns to our skies in about 75- to 76-year intervals. During that time, it was seen as a test of the newly developed Newtonian physics. In fact, in 1680, Newton and Halley worked jointly (mostly Newton) to determine the orbit and periodicity of the comet. Seventy-six years later, when the comet's predicted return was realized, Newtonian physics was not only vindicated, but held as the science of understanding the motions of all heavenly bodies, and his theories of universal gravitation. Unfortunately neither Newton or Halley lived to see the return of the comet that now bears Halley's name.

For an interesting article on Sir Edmund Halley and Sir Isaac Newton's collaboration dealing with comets and celestial body motions, visit this advertisement-rich article: <https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/edmond-halley-successfully-predicts-return-great-comet-1682>

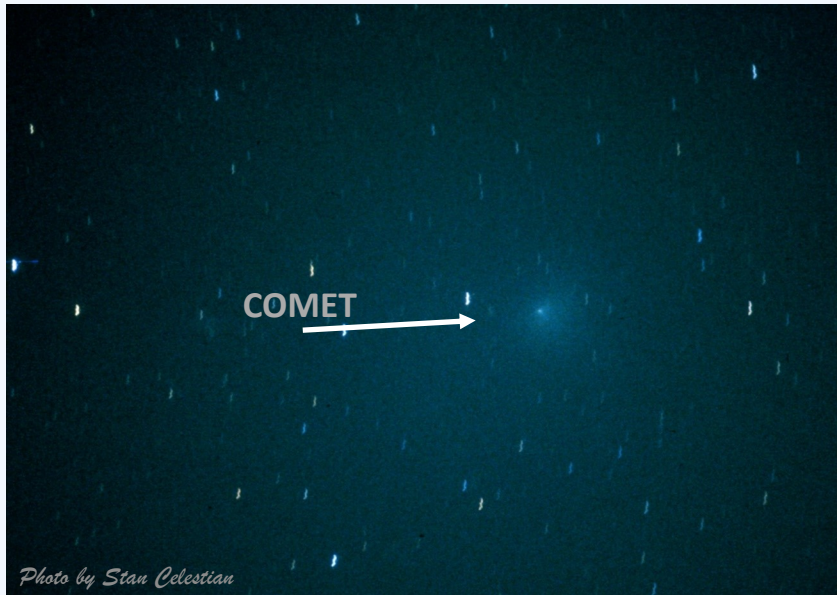


*Photo by Stan Celestian*

Comet Panstarrs (Comet C/2011 L4 ) March 11, 2013. Evening view looking west from Waddell, AZ. (1.6 second exposure with a 200 mm lens)

Neowise continued on page 19...

...Neowise continued from page 18



### Comet IRAS–Araki–Alcock (C/1983 H1)

In 1983 it made the closest known approach to Earth of any comet in 200 years, at a distance of about 2,900,000 miles. Granted, it was not a spectacular comet with long flowing tails; it was just a little fuzz ball (coma around the nucleus). It was still very memorable, due to its closeness to Earth. As I was taking this 1 minute exposure (Ektachrome 400) the comet was visually moving, with respect to the background stars. So, I had to keep moving the telescope to keep the camera on target. As a result of the manual adjustments, the stars in the image are not pinpoints of light, but are squiggly lines, due to my faulty technique -- but the comet is not deformed.



**Hyakutake C/1996 B2 taken on March 26, 1996** At closest approach (15 million miles from Earth) the coma of this comet was about 4X the Moon's diameter. But it was only bright for a few days. On May 1st, it was estimated by satellite data that the comet's tail stretched to a distance of an amazing 360 million miles, nearly twice the length of the previous record holder. By the end of May, it was no longer visible without telescopic aid. It is still heading out of the inner solar system but will return in 70,000 years.

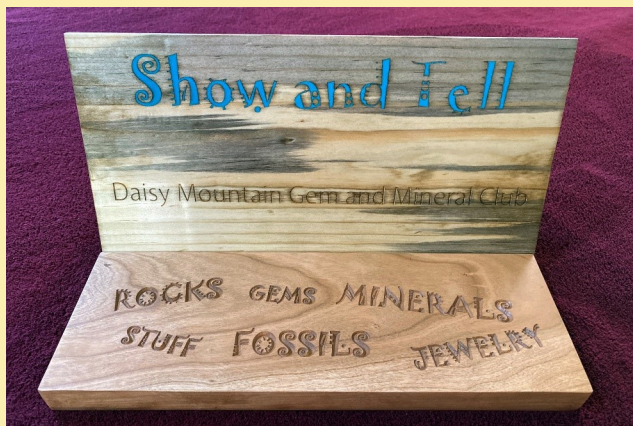
The radio telescope at Arecibo in Puerto Rico indicated that the icy nucleus was about 3 miles across, and surrounded by a plethora of pebble-sized particles. This is a fairly small-sized nucleus, Hale-Bopp's nucleus was about 37 miles in diameter, and Halley's was just over 9 miles.

UPCOMING FIELD TRIPS & MEETINGS

Nothing planned for sure at press time, but watch your email for announcements.

DATES SUBJECT TO CHANGE

Bill and the field trip committee will be actively looking for productive spots for field trips. If you have any suggestions, you are encouraged to contact him at bfreese77@cox.net



Share!

Part of the fun of being in a rock club is sharing with members. Have you found a cool rock -- recently or in the past? Have you made something out of a rock or mineral?

Bring an item in to the monthly and tell its story.

Everyone who brings in something for Show & Tell will get an extra ticket for the attendance/nametag raffle.

Words of Wisdom

passed along by our own

Bob Evans



Never say, 'oops'. Always say, 'Ah, interesting'.

FACEBOOK



Visit and join the club page periodically. See what is happening, and boost our visibility on the web. Go to: The Daisy Mountain Rock and Mineral Club. It is set up so you can post photos of outings or related items. Share with friends!

AWARD-WINNING WEBSITE

http://www.dmrmc.com/

If you have comments, contact Nancy Gallagher.

INSTAGRAM



Follow the club on Instagram. Go to https://www.instagram.com/daisymountainrockclub/ and follow today. Share with friends!

Officers, Chairpersons, & Trustees

- President: Ed Winbourne... ewinbourne@gmail.com
Vice President: Bill Freese... bfreese77@cox.net
Secretary: Rebecca Slosarik .. rslosarik1@gmail.com
Treasurer: Cynthia Buckner... Cbuckrun1@q.com
Publicity: Jessie Redmond...
Membership: Tiffany Poetsch tnpoetsch@gmail.com
Editors: Susan & Stan Celestian... azrocklady@gmail.com
Field Trip: Bill Freese ... bfreese77@cox.net
Show Chair: Ed Winbourne
Trustees:

- Cynthia V Claudia M
Susan C Tiffany P
Bob E Jim R
Jennifer G Witt R
Don R Howard R
Jessica C. Rebecca S
Johnaton M Joe G
Clark L

Meetings are held the 1st Tuesday of the month at the Anthem Civic Building, 3701 W Anthem Way, Anthem, AZ 85086. General meeting at 6:30 pm. We do not meet in July or August.

DMRMCLUB@GMAIL.COM

Membership Dues: First year \$30, then \$20.00 Adults per Person First year \$45, then \$25.00 Family (2 people)

Meeting Dates for 2020

Jan 7, Feb 4, Mar 3, Apr 7, May 5, June 2, Sept 1, Oct 6, Nov 3, Dec 1

MEETINGS CANCELLED UNTIL FURTHER NOTICE DUE TO COVID-19 RESTRICTIONS

## WIRE-WRAPPING CLASS

4:30-6:30 pm

Prior to the meeting

**Bring:** cab or stone, about quarter-sized or larger; 26 and 18 or 20 gauge copper-based wire; round nose pliers and flush wire cutter, beads (optional), little clamps, masking tape, E6000 jewelry glue.

Free, but donations are appreciated.

Questions? Contact Jennifer at

Jennifer@eliteshuttersandblinds.com

MEETINGS ARE ON HIATUS FOR THE SUMMER NOW. HOPEFULLY, WE WILL BE ABLE TO RESUME IN THE FALL

BRING PAPER & A PEN TOO!

Looking for something to practice while you hunker down at home? Browse YouTube and Pinterest for tutorials. They are great resources -- no substitute for the personal attention of Jennifer, of course.

**NEEDED:** QUALITY MINERAL (or OTHER) DONATIONS WITH LABELS -- for monthly raffle prizes; and for raffle, door prizes, and sales tables at the annual show. If you have specimens to donate, please see Robin Shannon. The Daisy Mountain Rock and Mineral Club is a 501(c)(3) non-profit organization, and will gratefully acknowledge your donation with a Tax Deduction Letter. Thank You!

### NOTE FROM THE EDITORS

Have a geological interest? Been somewhere interesting? Have pictures from a club trip? Collected some great material? Send us pictures -- or write a short story (pictures would be great).

Deadline for the newsletter is the 22nd of the month.

Mail or Email submissions to:

Susan Celestian

6415 N 183rd Av

Waddell, AZ 85355

azrocklady@gmail.com



Visit <http://rmfms.org/> for news about conventions, events, and associated clubs. If you are travelling, you might want to contact a club local to your destination. Maybe they have a field trip you could join, while in town.



**A Monsoon Storm Cloud - or should I say a *nonsoon* storm cloud?** This thunderstorm (cumulonimbus clouds) was strong enough that it pushed clouds up to the troposphere. At that level the clouds spread laterally to produce the anvil. The view is looking northeast from Waddell, Arizona. To view the entire cloud formation see the panoramic shot at: [www.flickr.com/photos/usageology/50181122162/in/photostream/](http://www.flickr.com/photos/usageology/50181122162/in/photostream/) Photo by Stan Celestian

## UPCOMING AZ MINERAL SHOWS

**September 25-27 - Clarkdale, AZ**  
Mingus Gem & Mineral Club; Clark Memorial Clubhouse Auditorium, 19 North St; Fri-Sat 9-5, Sun 10-5; Admission: free.

**October 9-11 - Buckeye, AZ** West Valley Rock & Mineral Club; Buckeye Arena, 802 N 1st St; Fri-Sat 9-5, Sun 9-2; Admission: adults \$3, children under 13 free. See Poster on page 16.

**October 10-11 - Sierra Vista, AZ** Huachuca Mineral & Gem Club; Cochise College, 901 N Colombo Av; Sat 9-5, Sun 10-4; Admission: free.

**November 28-29 - Wickenburg, AZ**  
Wickenburg Gem & Mineral Society; Has-sayampa Elementary School, 251 S Tegner St; Sat 9-5, Sun 10-4; Admission: Free.

If you are travelling, a good source of shows AND clubs is <http://the-vug.com/educate-and-inform/mineral-shows/> or <http://www.rockngem.com/ShowDatesFiles/ShowDatesDisplayAll.php?ShowState=AZ> For out-of-the-country shows: <http://www.mindat.org/shows.php?current=1>

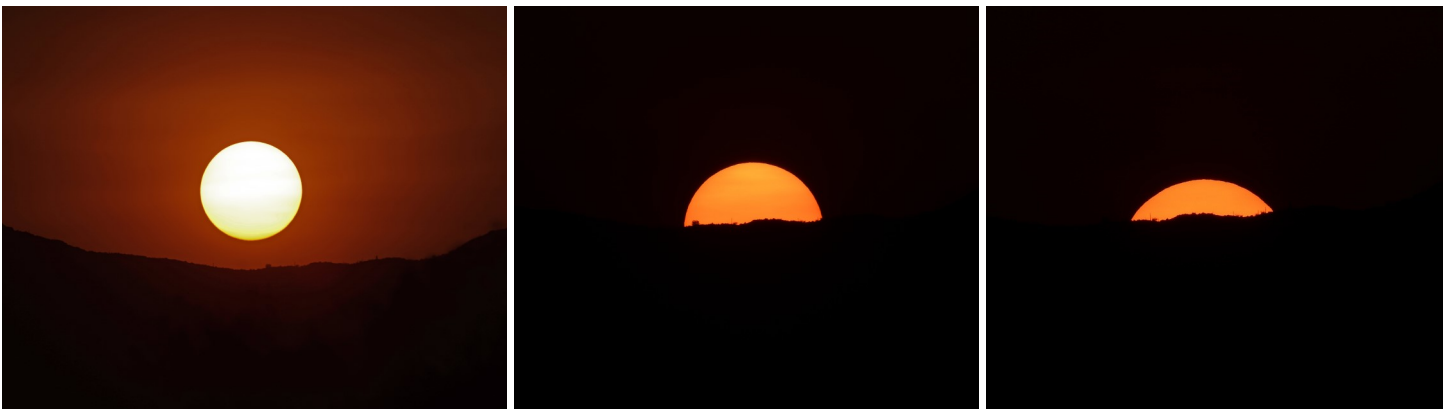
*This schedule could change due to pandemic-driven policies. Check The Vug (URL above) for announcements, phone numbers, or club websites to confirm that a show will go on.*

Zoom Board Member Meeting Minutes  
May 27, 2020

In attendance: Bob E., Claudia M., Deanne G., Ed W., Howard R., Jessie C., Rebecca S., Stan C., Sue C., and Tiffany P. (through Zoom video chat)

- June general meeting cancelled
  - ◊ Voting was unanimous
  - ◊ Hopefully, we will be able to resume this year
  - ◊ Field trips will not be suspended
    - \* Updated on groupworks and emails sent out
- Claudia M. updated us on the scholarship progress
  - ◊ Recipient has not responded to the scholarship award
  - ◊ Has until June 10<sup>th</sup>
    - \* If no response, scholarship will go to the other candidate
  - ◊ The scholarship subcommittee will investigate giving award to a community college student instead of a having to go through the high schools next year
- Ed W. discussed our upcoming rock and gem show
  - ◊ Will talk to the principal
  - ◊ If we have a show this year, we will not have one in March
  - ◊ Will have another meeting to discuss and see how this pandemic is progressing

Respectfully submitted, Rebecca Slosarik



**Sunset over the White Tank Mountains, AZ** Sunset through the smoke of California's Apple Fire, from Waddell, AZ. The view is over the White Tank Mountains. No filter was used on the camera.

[Here](#) is a link to a NASA satellite view of the smoke that covered the Phoenix area (and a lot more).

# Helzarockin' Gem & Mineral Show



**Oct 9-11 2020**  
**Buckeye Arena 802 N 1st Street**

**9 a.m. - 5 p.m. Friday & Saturday**  
**9 a.m. - 2 p.m. Sunday**

**Arizona Early Days Gas Engine & Tractor Association**  
**Saturday Only**

**Adults \$3 kids under 13 Free**  
**Free Scavenger Hunt for the kids!**