THE NORTHERN VIRGINIA MINERAL CLUB INC

The Mineral Newsletter

Meeting: January 22 Time: 7:45 p.m.

Long Branch Nature Center, 625 S. Carlin Springs Rd., Arlington, VA 22204

Pyrrhotite

Nicolai Mine

Primorskiy Kray, Russia

Smithsonian Mineral Gallery. *Photo: Chip Clark.*

Volume 59, No. 1
January 2018
Explore our website!

January Meeting Program:

Club Member Show and Tell

Deadline for Submissions

January 20

Please make your submission by the 20th of the month! Submissions received later might go into a later newsletter.

In this issue …

Mineral of the Month
Pyrrhotite

by Sue Marcus

We begin 2018 with a Mineral of the Month that is interesting for many reasons.

Pyrrhotite has an interesting name. It is useful. It can glitter! And I have a special fondness for it, which I will explain later.

Pyrrhotite is an iron sulfide, with a basic formula of Fe_7S_8. "Polytype" is a word I learned in my research on this mineral: it means that chemically identical materials may be structured slightly differently. In the case of pyrrhotite, crystals classified as monoclinic may appear to be hexagonal. These polytypes are called pseudohexagonal crystals.

Temperatures of formation above 254 °C result in pseudohexagonal crystals; below that, monoclinic crystals form. The amounts of iron and sulfur in the mineral chemistry can also vary by units of one each, increasing from Fe_7S_8 to $Fe_{11}S_{12}$. Therefore, the more technical version of the chemical formula is $Fe_{(1-x)}S$ (x = 0 to 0.2). Pyrrhotite is common but not simple!

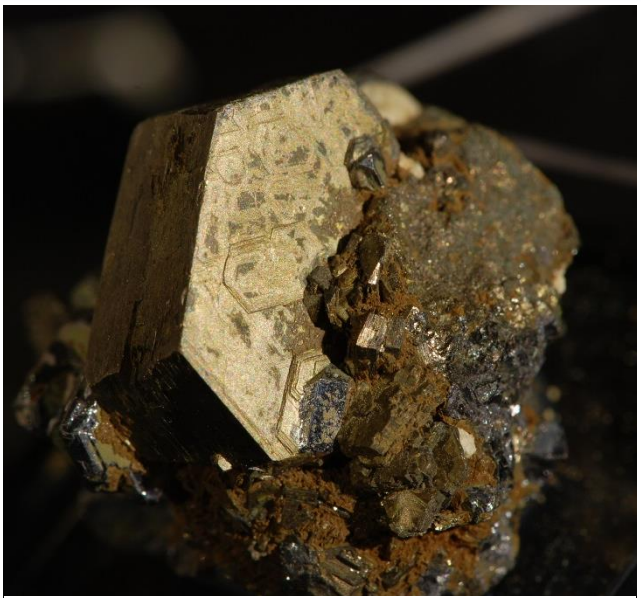
In 1847, French mineralogist Ours-Pierre-Armand Petit-Dufrénoy named pyrrhotite based on the Greek word *pyrrhos* (flame-colored), perhaps due to glints of red in slightly tarnished, brassy specimens.

The terms "splitters" and "joiners" refer to different kinds of scientists. Splitters like to *split* groups such as fossil brachiopods into ever smaller groups based on taxonomy or other factors. Joiners prefer to *join* groups like those same brachiopods into larger categories.

Many mineralogists have become splitters. Mindat reported a polytype of pyrrhotite called pyrrhotite-4M. This is a split (or distinction) that most mineral collectors will never notice—or find relevant. Mindat also notes two varieties of pyrrhotite: cobaltian pyrrhotite and nickeloan pyrrhotite. Most collectors and mineral dealers know all these simply as pyrrhotite.

Pyrrhotite is weakly magnetic. It is usually found in dark, iron-rich igneous and metamorphic rocks, occurring less frequently in pegmatites. Common minerals like quartz or calcite form collectible crystals in many settings; by contrast, the geologic conditions for forming pyrrhotite crystals are much more limited.

Pyrrhotite is typically intergrown with other sulfide minerals in deposits known as massive sulfides that are mined for nickel, copper, zinc, gold, silver, and other metals. Pentlandite is the primary nickel ore, and it is usually intergrown with pyrrhotite. These deposits of literally heavy minerals leave few spaces



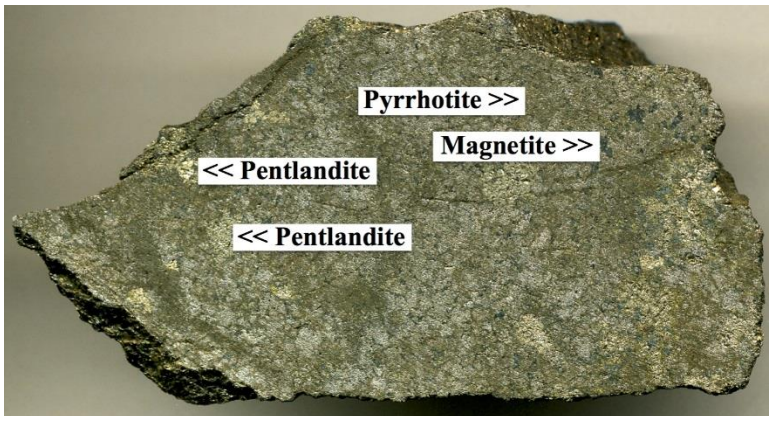
Pyrrhotite from Santa Eulalia, Chihuahua, Mexico. Photo: Bob Cooke.

Northern Virginia Mineral Club members,

Please join your club officers for dinner at the Olive Garden on January 22 at 6 p.m.

Olive Garden, Baileys Cross Roads (across from Skyline Towers), 3548 South Jefferson St. (intersecting Leesburg Pike), Falls Church, VA
Phone: 703-671-7507

Reservations are under Ti Meredith, Vice-President, NVMC. Please RSVP to me at ti.meredith@aol.com.



Pentlandite intergrown with other minerals, including pyrrhotite. This specimen is from the a nickel mine, the South Mine in the Sudbury Impact Structure, Ontario, Canada. Source: Wikipedia; photo: James St. John.

for crystals to grow. Their weight crushes potential voids.

I'm most familiar with pyrrhotite associated with pentlandite in nickel deposits. In this geologic environment, it is relatively common in Manitoba, Canada, though not in euhedral crystals.

The most notable localities for collectible crystals are Dal'negorsk, Primorskiy Kray, Russia, and the Potosí Mine, Santa Eulalia District, Chihuahua, Mexico. More recently, the Yaogangxian Mine, Hunan Province, China, has produced esthetic specimens of pyrrhotite, along with many other fine specimens like arsenopyrite, fluorite, and scheelite. Pyrrhotite rosettes are reported from Trepča, Kosovo.

The Dal'negorsk region includes lead, zinc, tungsten, and associated minerals like nickel-bearing pyrrhotite as well as boron and fluorite mineralization. To me, the Dal'negorsk specimens (see the example on the cover) are the classics and the finest—large and perfectly formed, and the best ones are lustrous, too.

The Yaogangxian Mine is part of a region of tin–tungsten deposits that also hosts beryllium-, fluorine-, and molybdenum-rich minerals as well as lovely pyrrhotite rosettes.

The Santa Eulalia District was most important for silver production, although the ores also contained lead and zinc (probably with silver bound into the chemistry of the galena), with occasional nice pyrrhotite crystals. Santa Eulalia pyrrhotite may occur as lustrous elongated crystals, although the crystals are more commonly tarnished and stubby.

Like the Mexican deposits, the Trepča deposits were mined for silver as part of the silver–lead–zinc deposits found there. Fewer pyrrhotite specimens are known from Trepča, although some of those shown on Mindat are euhedral and lustrous.

The United States and Canada are not known for pyrrhotite crystals, although minor amounts of pyrrhotite may be found in many places. Pyrrhotite is even reported in Virginia; Mindat lists four localities where it is "reported valid," which is not a stellar recommendation for collectors, unless you want to find everything you can from our own particular state!

Pyrrhotite has special memories for me. My husband, Roger, and I worked for the Manitoba (Canada) Mines Branch. Over our second anniversary, Roger was due to be sent to Thompson, Manitoba, a major nickel mining town. I'm a geologist, too, and I didn't want to spend my second anniversary alone in a new city (Winnipeg), so I asked to go along.

Yes, I got an all-expenses-paid trip to Thompson, Manitoba, for my second anniversary! We did go to one of the active mines and brought back some pyrrhotite–pentlandite ore while we were socked in by the weather. But that's another story.

Technical details (source mostly Mindat):

Chemical formula	Fe_7S_8
Crystal form	Monoclinic
Hardness	3.5 to 4
Density	4.58–4.65 g/cm^3 (measured); 4.69 g/cm^3 (calculated)
Color	Dark bronze, metallic tan
Streak	Dark gray-black
Cleavage	None
Fracture	Uneven
Luster	Metallic, micaceous
Tenacity	Brittle

Sources

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Miscellaneous Business and Show and Tell

January 22 Program

by Ti Meredith, Vice-President

For our first meeting in 2018, we will have a short business meeting to take stock of our club's status and plans for the year. Then we will have a show-and-tell for club members.

Club Officers

At our December meeting, we elected club officers for 2018:

President ..... Bob Cooke
Vice-President ..... Ti Meredith
Secretary ..... David MacLean
Treasurer ..... Roger Haskins

Our club officers will introduce themselves and take questions.

Upcoming Events/Budget Status

We will go over the 2018 calendar of events to prepare for the coming year and make sure the right events go into the club newsletter. Part of the discussion will focus on purchasing name tags for new club members.

We will also report on the status of our club budget. The budget is prepared and approved by the club's executive board, then submitted for approval to the club membership. The treasurer is preparing a summary of 2017 expenses and receipts, including from the NVMC show at GMU last November.

2017 Club Show

We will go over the 2017 club show. We will present awards for volunteers; report on show results, including proceeds for the Schaefermeyer Scholarship Fund; and discuss show-related successes and areas with room for improvement, giving everyone a chance to make comments and suggestions.

Show and Tell

Club members will have the opportunity to show off acquisition(s) related to our hobby, whether rock, mineral, gem, fossil, or lapidary. Do you have a favorite acquisition from 2017? Self-collected or self-created items go first!

The Prez Sez

by Bob Cooke, President

The January edition of the Prez Sez is supposed to be written by the newly elected president. However, as of early December, we still didn't have a candidate for president. So I drafted this Prez Sez with the full expectation that Editor Hutch Brown would use it merely as a placeholder in the draft newsletter until a real president could rise to the occasion.

As it happens, no new candidate for club president stepped forward. So I guess I am serving for one more year!

As you read this, Carolyn and I are still in jolly ole England, doing our best to house-sit, dog-sit, and snail-sit until the newlyweds return from their honeymoon. Time will tell whether we achieved anything of note in regard to museums, minerals, or culture during our sojourn.

One of the deficiencies that I would like to address next year is my understanding of what aspect of minerals appeals to each of you. For example, my main interest is collecting "thumbnail" crystals (those that can fit in a 1-inch cubical box) and secondarily understanding the science behind their formation.

But what about you? Crystals of a bigger or smaller size? Lapidary? Faceting? Jewelry? Fossils? Field geology? Can you give a short presentation describing some aspect of your interest to the rest of us?

If we can appreciate what each of us does, then we can pick each other's brain on challenges we are facing within our own niches. In other words, we can function like a club, not just like a bunch of individuals who show up for monthly meetings.

Bob

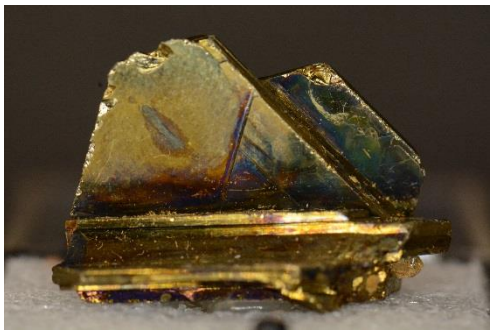
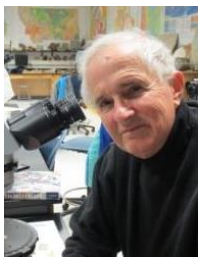


Photo of a pyrrhotite micromineral by Bob Cooke.

What's your interest in our hobby?



Club Meeting and Holiday Party

December 18, 2017

by David MacLean, Secretary

Vice-President Ti Meredith called a short business meeting to order at 6:45 p.m. at the Long Branch Nature Center in Arlington, VA. Approval of the minutes for the November 2017 club meeting was deferred until the January 2018 meeting.

Recognitions

The vice-president recognized past presidents in attendance, including Sue Marcus, Rick Reiber, and Barry Remer.

Ti also recognized guests David Nanney, president of the Mineralogical Society of the District of Colombia; Celia and Lyra Zeibel; Scott Perlick; Tara Hodges; and Conrad Smith.

Club Officer Elections

The Club Officer Nominating Committee presented the following nominations for 2018:

President .....Bob Cooke
Vice-President .....Ti Meredith
Secretary .....David MacLean
Treasurer.....Roger Haskins

By motion duly made and seconded, the candidates were elected by acclimation.

Announcements

Ti asked for suggestions for 2018 programs, including names and contact information for speakers.

Ti said that attractive rocks and minerals are needed for the Kids' Mini-mines at the 2018 show. Sizes ranging from half an inch to 2 inches are preferable.

Ti thanked Holiday Party Planning Committee Co-chairs Holly Perlick and Marie Johnston for organizing the party, the main event for the night. By motion duly made and seconded, the members adjourned the business meeting. The Christmas party followed.

Holiday Party

Ti Meredith and Sue Marcus conducted a drawing for a variety of prizes, such as work gloves and table decorations.

Some people brought wrapped gifts for the party. The gifts were distributed in various ways.

As always, there were pulled chicken and pulled pork, vegetable trays, fruit, and lots of sweets.

Letter from Lois McDowell

by Bob Cooke, President

Before our Holiday Party in December, I sent letters to both Lois Dowell and Karen Lewis notifying them that they had been awarded honorary membership in the NVMC and that the official announcement would be made at the party. I invited them to join us.

I have not heard back from Karen but did receive the following letter from Lois:

Greetings, Bob and all club members!

I am still overwhelmed to have received the invitation to the Christmas party and honors recognition. After long consideration, I believe it best not to attend.

I am now 102 years and 5 months of age and get around the house with my cane or walker.

I keep up with all the local and world news, read books, watch nature from my large windows, and keep up with five grandchildren. They are all in good law jobs or in prestigious medical schools.

Kirsten, the oldest, is employed in Annapolis, Maryland, and comes weekends to learn lapidary and work in my workshop.

How lucky I am for her to carry on! I count my many blessings when talking to many friends made through the club and looking at photos taken on field trips.

You are all in a challenging hobby that takes you near nature and creation. So while you can, never turn down an opportunity.

Fondly,

Lois H. Dowell

Save the dates!

Field Trip Opportunities

Northern Virginia Community College *Geology Field Trips*

NOVA's Annandale campus offers 1-day weekend courses—essentially, field trips—related to our hobby. You can get more information at the Field Studies in Geology—GOL 135 Website.

Paleozoic Geology of Virginia/West Virginia

April 7, 2018, 7 a.m.–9 p.m. This field trip will let you explore the late Silurian and Devonian geology of western Virginia and West Virginia, considering ancient depositional settings (tropical marine reefs, lagoons, shelves, deep basins, and terrestrial flood plains) and fossils, as well as later deformation (faulting and folding) associated with the Valley and Ridge Province.

Cretaceous Geology of Maryland/Fossil Hunt

April 15, 2018, 10 a.m.–6 p.m. Well-known dinosaur expert and paleontologist Dr. Peter M. Kranz will lead this fun outdoor expedition to nearby fossil sites, where you can discover many exciting fossils to take home. Must have own transportation.

Bench Tip: Mandrels

Brad Smith

Straight rod mandrels have a multitude of uses in helping to bend sheet and wire, and frequently we need a round rod for winding jump rings. Common sources for different-sized rods are knitting needles, wooden dowels, and clothes hangers. Metal rods can also be found in hardware stores and hobby shops.

But to get the right "look" in chainmaile designs, you need exactly the right size mandrel, not so easy to find. Jewelry catalogs sell selections of straight rod mandrels for $50 or more.

My choice is a set of transfer punches used in woodworking. The set has 28 sizes, from 3/32 inch to 1/2 inch, and costs only about $12. It is available from Harbor Freight as item number 3577; it's also available from MZS in Holland as item number 250575.

See Brad's jewelry books at amazon.com/author/bradfordsmith

Mystery Find in Virginia

by Hutch Brown, Editor

I recently received an email from Holly Gardner of Norfolk, VA, who made a curious find along Contrary Creek, which feeds the Lake Anna reservoir in north-central Virginia. She attached photos and asked for help in identifying her find.

Some of our club members have already offered opinions. If you have any other insights, please contact Holly Gardner at rain7@me.com.

I came across a Northern Virginia Mineral Club newsletter while trying to research a mineral I found while rock hunting with some friends by Contrary Creek near Mineral, VA. I cannot find anything about this mineral. It looks like dark green obsidian but when I shine white light through it, the light coming out has a red hue to it, and there are "bubbles" in it similar to moldavite, along with gold-colored streaks. If you or any member of your club can offer any classification, I would much appreciate it.

In response, Bob Cooke wrote:

From the conchoidal fracture, I'd guess it's a quartz or glass of some kind. I also see what appear to be bubbles that are elongated in a preferred direction. I'm not aware of bubbles like that in quartz, flint, obsidian, or moldavite. My guess is manmade glass slag.

Tom Tucker essentially concurred:

That's a piece of brown glass slag from the old iron furnace that was located there on Contrary Creek—in the pre-pyrite-mining days. I'd have to check, but maybe it was called Victoria Furnace. Anyhow, it's common slag, not unusual, no value. Just a piece of history.

I checked online for the name of an iron furnace along Contrary Creek and found the Rough and Ready Furnace, in operation from the 1830s to the 1850s. More checking revealed the Victoria Furnace in the same vicinity, in operation until the 1870s.

Minerals Come From Mines

Profile of the Kennecott Mine in Alaska

by Mike Kaas

The famous Kennecott Mine is actually a group of mines: the Bonanza, Jumbo, Erie, Glacier, and Mother Lode Mines. They are located in the Wrangel Mountains about 7 miles north of the village of McCarthy, AK (N 61.485°, W 142.889°).

Discovery and Early Production

The Bonanza Mine copper orebody was discovered in 1900. The outcrop of its ore was exposed high on a ridgetop (fig. 1). The Kennecott Copper Corporation consolidated many of the claims in the area in 1905; however, it would take construction of the 196-mile Copper River and Northwestern Railway to permit routine production to start.

The railroad provided access to the port of Cordova. From there, the Alaska Steamship Company transported the ore to a smelter in Tacoma, WA.

First production at the Bonanza Mine began in 1911. The Jumbo Mine started in 1913 and the Erie Mine in 1916. The Mother Lode Mine was located on the other side of the ridge and operated by the Mother Lode Coalition Mines Company. It became part of the Kennecott operations in 1919.

Top: *Copper minerals exposed in an outcrop on the Bonanza Mine Trail.* **Bottom:** *Copper ore exposed in the concrete structure of the Kennecott mill. Sources: Kyll (2017); Johnsson and Johnsson (2017).*

Figure 1—Left: *The Kennecott, AK, townsite in 1964. The large mill building is at the center; debris from the Kennecott Glacier is in the foreground. The famous mines were located 4 miles away on the high ridge behind the town.* **Top:** *An outcrop of the Bonanza Mine orebody was found near Bonanza Peak at an elevation of about 6,900 feet. Source: USGS Photographic Library.*

The company built the Kennecott Mill at the edge of the Kennecott Glacier (figs. 1, 2), at an elevation of about 2,000 feet. Figure 2 shows the routes used to bring ore from the mines to the mill. Two major tramways connected the Bonanza and Jumbo Mines directly with the mill (fig. 2). A tramway from the Mother Lode Mine to the McCarthy Creek valley was eliminated when the mine was connected by a tunnel from the Bonanza Mine. A smaller tramway was used to lower ore from the Erie Mine to a road along the glacier, from where it could be carted to the mill.

Living facilities for miners at the Bonanza and Jumbo Mines made year-round operations possible (fig. 3). The facilities included a boarding house, a tramway station, ore bins, a shop, and a warehouse.

Copper Occurrence

In the Kennecott mines, the copper ore occurred as a replacement in the Chitistone limestone formation, which lies above the Nikolai greenstone, a thick succession of altered basaltic lava flows. These formations dip to the northeast and have a N 60° W strike. Faults occurred along the bedding plane and transverse to it.

Mineralization occurred in a dolomitic limestone layer in wide, steeply dipping fissures that strike normal to the bedding. These fissure veins ranged from a few feet to over 100 feet in width and from 200 to 500 feet above their base. They could extend up to 4,000 feet down dip (fig. 3).

"Flat" orebodies occurred where the fissures intersected a fault plane running parallel to the dip of the formations. On the surface, fragments of ore that had broken off the outcrop of the Bonanza vein were also recovered from talus slopes and glacial ice.

It is an understatement to say that the Kennecott ore was fabulously rich. The principal ore mineral was chalcocite, along with malachite, azurite, and covellite. Smaller amounts of enargite, bornite, chalcopyrite, and native copper were also found. The ore contained an important silver byproduct.

In some parts of the orebodies, large masses of pure chalcocite were mined. This high-grade ore, shipped directly to the smelter without processing, averaged 50–55 percent copper. Lower grade ore was sent to the mill for processing. The overall ore grade was over 12 percent copper.

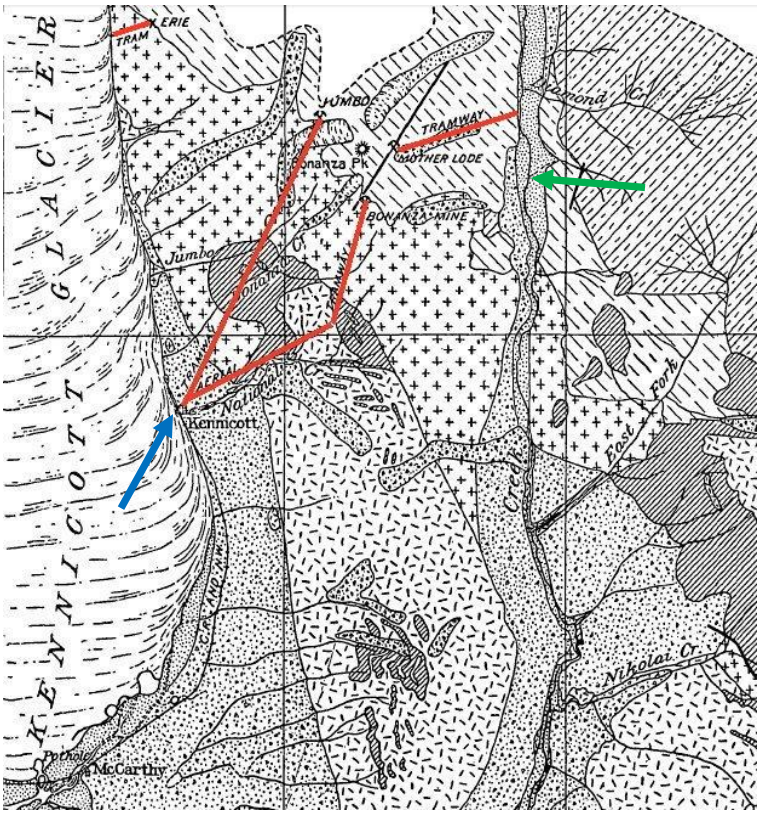


Figure 2—*The Kennecott Mill (blue arrow) is located at the edge of the Kennecott Glacier. Tramways (red lines) connected the Bonanza and Jumbo Mines with the mill and the Mother Lode Mine to a road in the McCarthy Creek valley (green arrow). Later, a tunnel connected the Mother Lode to the Bonanza Mine. Another tramway carried ore from the Erie Mine to a road along the glacier, from where it could be carted to the mill. Source: Birch (1924).*

Figure 3—*Facilities for miners at the Bonanza Mine, designed to make year-round operations possible. Photo: National Park Service.*

Operations

Mining the outcrop ore at the Bonanza Mine was done by open pit. Underground mining was done in two stages using shrinkage stoping (fig. 4). When possible, the high-grade ore was extracted first, then the lower grade mill ore was mined.

In both stages, the broken ore was drawn out of chutes and loaded into mine cars (fig. 5), which carried the ore to the inclined shaft for hoisting to the surface. The ore was then loaded into tramway buckets for the trip downhill to the mill.

In the mill, crushers and screens were used to reduce the ore to fine particles. Then a variety of jigs and shaking tables used gravity to separate the valuable minerals from the waste rock. Mill tailings were disposed of in an area below the mill.

Finally, the concentrated ore and the direct-shipping high-grade ore were loaded into bags for shipment by rail. In 1916, an innovative ammonia leaching plant was constructed to further recover copper from the tailings.

From 1911 to 1938, the Kennecott mines produced 1.2 billion pounds of copper valued at $3.5 billion at prices in October 2017. The mines directly employed 200–300 workers, with an additional 300 employed in the mill and other townsite operations.

The wealth generated by the mines was used to develop several other important mines in the Lower 48 and overseas. These included the Utah Copper Mine (Bingham Canyon), the Ray Mine in Arizona, the Chino Mine in New Mexico, the Nevada Consolidated Mine near McGill, and the Braden Mine (El Teniente) in Chile.

Extensive diamond drilling efforts at Kennecott failed to identify any additional orebodies, and the mines were closed for good in 1938.

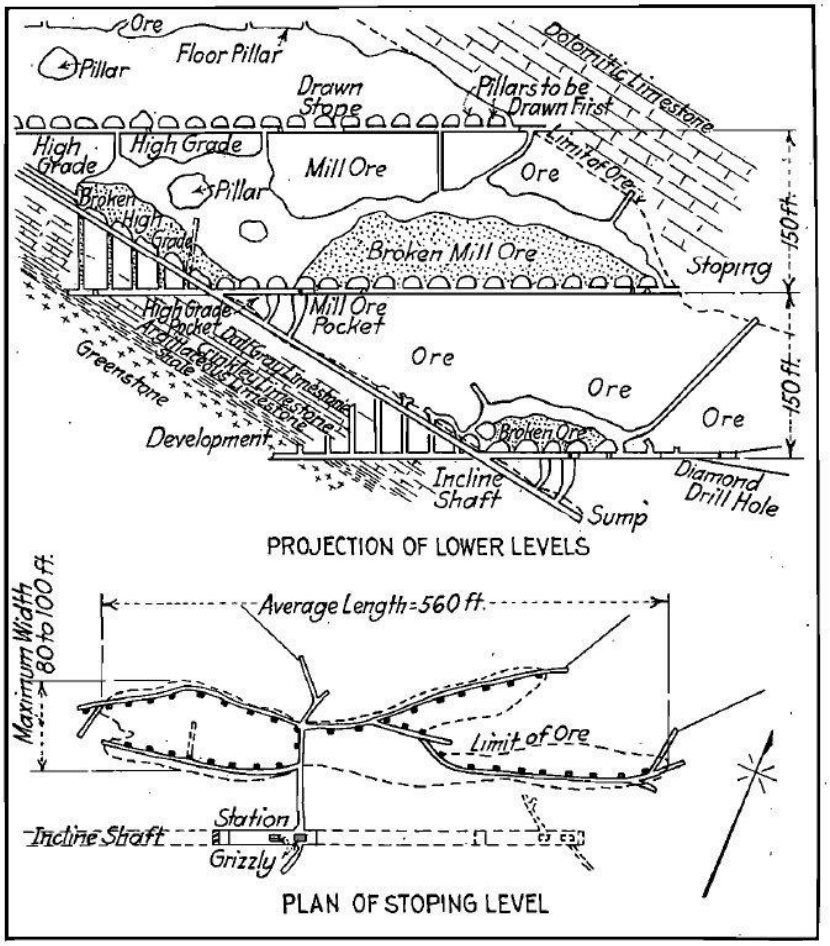


Figure 4—*Cross-section and plan views of the mining of the fissure veins with the shrinkage stoping method. Source: Birch (1924).*

Figure 5—*Miner pulling ore from a stope through a chute and loading a mine car. Photo: National Park Service.*

Minerals from Kennecott. **Top left:** *Kennecott chalcocite with azurite (Mindat 2017b, photo: Rob Lavinsky).* **Top right:** *Chalcocite float material, Jumbo Mine (photo: Joe Kurtak).* **Bottom left:** *Malachite, Bonanza Mine (Lehigh Minerals n.d.).* **Bottom right:** *Native copper from the Kennecott mines (Polartrec 2016).*

Historical Legacy

Although the harsh Alaskan winters have taken a toll on the buildings high up at the mines, the mill town of Kennecott has survived for 6 decades with much less degradation. In 1980, the Kennecott area was included in the newly created Wrangel–St. Elias National Park and Preserve.

In 1986, the Kennecott complex was declared a national historic landmark. Since that time, the historic buildings and their contents have been carefully documented as part of the Historic American Buildings Survey/Historic American Engineering Record (or HABS/HAER).

Since 1998, the National Park Service has been stabilizing and restoring the historic structures as funding permits. Visitors get a glimpse of this famous industrial outpost and of a natural environment that is truly unique to Alaska.

For those unable to visit Kennecott, the Mining History Association website has a "virtual walking tour" of the town and the huge Kennecott Mill. You can find it by clicking here.

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Federation News

Kids' Booth Spinning Wheels

by Jim Brace-Thompson, AFMS Jrs. Program Chair

Editor's note: *The article is adapted from the* A.F.M.S. Newsletter *(October 2017), p. 2.*

Go to many local gem and mineral shows that have a Kids' Booth, and one thing you'll likely see (in addition to grab bags) is an activity that goes by a variety of names: a Spinning Wheel, a Wheel-of-Fortune, a Prize Wheel, and so on.

Basically, we're talking a roulette wheel like you see in Las Vegas. But rather than taking your money, the wheels in our Kids' Booths guarantee a rocky prize with every spin!

Many clubs have such a wheel, and most such wheels have been in the club for decades. Most are "clunkers." They are heavy, are awkward to move and store, and have seen better days. Many are so off-balance that they stop at the same two or three numbers on each spin.

If you have such a wheel—or if you're one of the few clubs that has never had such a wheel at an annual show—I've learned of a source that offers beautiful wheels that are lightweight, compact, and easily assembled and disassembled for convenient storage and transport.

The source is Spinning Designs (910 First Avenue, Asbury Park, NJ 07712, phone 732-775-7050, website SpinningDesigns.com).

They offer a basic off-the-shelf model that starts at just $99. It comes in various sizes, with colorful premade designs and a dry-erase surface so that you can easily customize your wheel from show to show or for other club events.

Or, if your club treasury is flush with money, you can get fancier models and designs in the $300 to $350 range—as well as a supersize model, with "price available on request."

If you have an old "clunker" wheel that has seen better days—or if you would like to incorporate a wheel into your show for a great Kids' Activity—I encourage you to check out SpinningDesigns.com. I know from decades of personal experience in running Kids' Booths that wheels like these are a guaranteed source of fun!

GeoWord of the Day

(from the American Geoscience Institute)

rattlesnake ore

A gray, black, and yellow mottled uranium ore of carnotite and vanoxite, its spotted appearance resembling that of a rattlesnake.

(from the *Glossary of Geology*, 5th edition, revised)

Wildacres Registration Now Open!

by Steve Weinberger, Wildacres Committee Chair

Editor's note: *The article is abridged from* EFMLS News *(December 2017), pp. 1, 8.*

Wildacres is a fantastic retreat located on Pompeys Knob just off the Blue Ridge Parkway about an hour north of Asheville, NC. Signing up for the May 21–27 session will give you the opportunity to take one or two classes; hear excellent talks from our guest speaker, Helen Serras-Herman; and participate in a variety of other activities.

Registration is open! You can find a registration form in the EFMLS newsletter, December 2017 issue, or go to the Wildacres Website. Some classes fill quickly, so register early! You can choose from the courses listed below.

Coming to Wildacres in May 2017 …

Beaded Bezel (*Mia Schulman*): Instead of using metal to set your cabochons, we will use rows of small beads. The end result is a striking piece of jewelry suitable for any occasion. No experience needed. 2-day class, 1st semester.

Knitted Wire & Bead Bracelet (*Mia Schulman*): Don't worry; you don't have to know how to knit. These bracelets are stunning and people are always surprised when told they are knitted. No experience needed. 2-day class, 2nd semester.

Cabochons—Basic (*Bernie Emery*): Transform rock into a cabochon. Learn trim saw, grinding, sanding, and polishing. Slabs are provided or use your own. Bring apron and safety glasses. No experience needed. 2-day class, 1st semester.

Cabochons—Intermediate (*Bernie Emery*): Learn techniques for cutting different shapes. Slabs are provided or use your own. Bring apron and safety glasses. Prior experience with cabbing and trim saw. 2-day class, 2nd semester.

Electro-etching—Beginner *(Micah Kirby):* Description forthcoming on Wildacres website.

Electro-etching—Intermediate *(Micah Kirby):* Description forthcoming on Wildacres website.

Faceting (*Steve Weinberger*): Learn to cut and polish a 57-facet round brilliant gemstone, to identify well-cut stones, and to select rough material. Bring an optivisor (#7 or #9) and an apron. No experience needed. 4-day class.

Silversmithing—Basic (*Richard Meszler*): Learn how to work silver sheet and wire to fabricate jewelry. You get a kit with metals and supplies as well as a step-by-step description of each project. No experience needed. 2-day class, 1st semester.

Silversmithing—Intermediate (*Richard Meszler*): Learn to make a bezel setting and bail for setting a cabochon to make a pendant. You get a kit with all you need. Basic silversmithing experience, including soldering. 2-day class, 2nd semester.

Cold Connections I (*Morning Sherrod*): Learn basic metalworking skills. Make connections using rivets, jump rings, and wire. Also learn about patinas and etching. Materials and tools furnished. No experience needed. 2-day class, 1st semester.

Cold Connections II (*Morning Sherrod*): Learn advanced metalworking skills, including etching, texturizing, setting cabs, and using prongs, tabs, and sandwiching techniques. Also learn how to sweat solder metals together. Beginners welcome. 2-day class, 2nd semester

Loop and Loop Chains—Beginner (*Chuck Bruce*): Learn to fuse fine silver jump rings and link them together into a chain. Use different patterns—Roman Fold-over and Single Fold-over (Foxtail)—to finish a bracelet and pair of earrings. No experience needed. 2-day class, 1st semester.

Loop and Loop Chains—Advanced (*Chuck Bruce*): Learn to fuse fine silver jump rings and link them together into a chain. Use different patterns—Double Fold-over (Foxtail) and Sailor's Knot—to finish a bracelet and pair of earrings. No experience needed. 2-day class, 2nd semester.

Viking Knit (*Val Johnson*): Learn an ancient technique of weaving a silver rope. Using a few tools and supplies, you can create stunning chains. Student will complete a bracelet in single stitch. 2-day class, 1st semester.

Fascinating Facts About Silver

Editor's note: *The piece, which has no given author, is adapted from* Crack 'n Cab *(newsletter of the Gem & Mineral Society of Syracuse, NY), January 2013, p. 7. It appeared earlier in* RockCollector *(January 2013) and* Golden Spike News *(December 1999).*

Although silver was discovered later than gold and copper, it has been known and used by humankind since prehistoric times. Herodotus, the Greek historian, wrote of silver used to make coins and beads, exploited from the river sands of the Pactolus in Lydia (western Turkey today).

The Chinese wrote of silver metals in 2500 BC. In the earliest excavations at the site of Troy, considerable deposits of silver and gold treasure have been extracted. Among the artifacts, silver bracelets and gold earrings were buried in the ancient city 2,000 years before Christ.

The oldest silver mines of importance were in Asia Minor (Turkey today) and on islands in the Aegean Sea. The Romans and later civilizations in Europe obtained most of their silver from Spain until supplies became scarce during the Middle Ages.

After the discovery of the Americas in 1492, Mexico became the largest silver-producing country in the world. Canada and the United States also produce significant amounts of silver.

Silver is a lustrous white metal widely distributed in nature. In ores, it is commonly associated with gold, lead, and copper. Much of the world's silver comes from smelting the associated metals.

Hornsilver (AgCl) is found in the oxidized portions of ore near the Earth's surface. Small amounts of silver in the oxidation zone form as the more complex compounds erode and weather.

Deeper in the Earth, silver occurs in sulfides, arsenides, and antimonides (compounds of silver with sulfur, arsenic, and antimony) deposited from primary hydrothermal solutions.

Argentite occurs in low-temperature hydrothermal veins in association with other silver minerals or sometimes in the cementation of lead and zinc deposits. Found in a metallic state, it is called native silver.

Native silver. Source: Wikipedia.

Native silver usually occurs in dentritic and wirelike forms (aggregates of minute crystals).

Silver can also occur in thin sheets or in large masses. In Kongsberg, Norway, magnificent crystalline wire specimens occur in association with sulfides, calcite, barite, fluorite, and quartz.

The world's largest specimen of massive silver was mined in Aspen, CO; it weighed 844 pounds. On the Keweenaw Peninsula of Michigan, small amounts of silver can be found in association with native copper.

In Mexico, the Guanajuato Mine has been in operation since 1500. In the last 5 centuries, the mine has produced more than 5 trillion kilograms of silver.

About three-fourths of the world's silver production is used for monetary purposes, either as coins or as bullion that governments hold to redeem paper currency.

The leading industrial use of silver is for tableware and jewelry. The second largest consumer is the photographic industry. When compounded with bromide or chlorine, silver forms salts that register light and shade on photographs.

Silver has the highest thermal and electrical conductivity of any substance, making it ideal for use in electronic equipment.

Silver is second only to gold in malleability. One ounce of silver can be drawn into wire 30 miles long. A silver leaf can be beaten to a thickness of 1/100,000 of an inch.

The Rocks Beneath Our Feet

Mountain Lake: A Geologic Puzzle

Part 1

by Hutch Brown

Editor's note: *The article is adapted from the April 2015 issue of* The Mineral Newsletter. *It follows up on a series of articles on Virginia's only other natural lake, Lake Drummond on the Coastal Plain. (The Lake Drummond series was in five issues of the newsletter in 2017.)*

I once thought that Virginia had no natural lakes. I knew that most U.S. lakes were formed by glaciers and that glaciers never reached Virginia.

Yet Virginia does have two natural, nonglacial lakes. One, Lake Drummond, lies in the Great Dismal Swamp on the Coastal Plain. The other, Mountain Lake, is in the Appalachian Mountains near Blacksburg, VA. The lakes have very different origins.

Rock Slide

Mountain Lake formed when rocks, boulders, and debris dammed a small creek called Pond Drain. Most lakes formed in this way are really large ponds: Mountain Lake has a surface area of no more than 50 acres. (By comparison, the Burke Lake reservoir in northern Virginia has a surface area of 218 acres.)

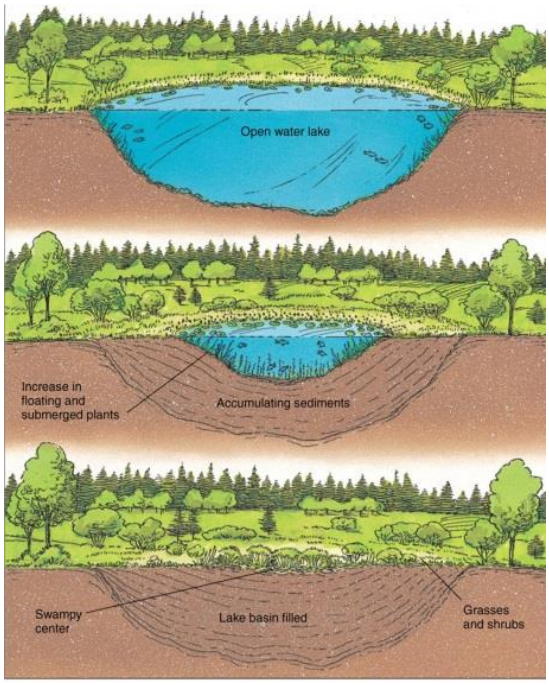

Figure 1—*Succession of a pond from open water to a boggy meadow. Mountain Lake in Virginia seems to be immune to the process. Source: Allen (2013).*

Mountain Lake in southwestern Virginia. The lake was full (top) when the resort was featured in the 1987 movie Dirty Dancing. *In 2017, the lake was down to a shallow remnant of its former self (bottom, arrow), but it will almost certainly refill. Top: N.a. (2011); bottom: Hutch Brown.*

Small natural lakes tend to disappear within a few hundred years (fig. 1). The outflow stream gradually cuts through the dam, or else sediments fill the lake, turning it into a boggy meadow. The area finally returns to a forested valley drained by a stream.

Mountain Lake is a remarkable exception. It is estimated to be more than 6,000 years old; and, although its water levels fluctuate—since 2008, for example, it has been nearly dry—the lake has always refilled.

What caused the dam that formed Mountain Lake? And what keeps the lake in existence? The answers lie in the geology underlying Giles County, VA, where Mountain Lake is located.

Mountain Lake Bedrock

Most landforms in our area have only one kind of bedrock. For example, the nature center where our club meets in Arlington, VA, sits over a metamorphic bedrock called Indian Run sedimentary melange. You can find the gray or brown bedrock exposed for miles along Four Mile Run and its tributaries. And nearby Sugarloaf Mountain in Maryland is made up almost entirely of a compact white quartzite named for the mountain itself.

Mountain Lake is an exception (fig. 2). Located between ridges at 3,875 feet in elevation, the lake sits in a saddle draining from south to north, and it is about half a mile long. If you take the trail around the lake (flat but rugged and about 2 miles long), you cross over three different kinds of sedimentary bedrock, unusual for an area so small.

Near the resort at the foot of the lake, you can see exposures of the Martinsburg Formation. At Mountain Lake, it is a reddish-brown shale (fig. 3, top), and in it you can easily find marine fossils. The sediments were laid down about 445 million years ago in an ancient marine basin at the foot of the rising Taconic Mountains during a mountain-building event called the Taconic Orogeny—more on that below.

As you hike north along the lake, you soon reach a very different kind of bedrock, the Juniata Formation. It is also sedimentary but much coarser in texture. The exposures I saw near Mountain Lake were a silvery gray sandstone or graywacke (fig. 3, middle).

The deepest part of Mountain Lake is in the north. As you cross around the top of the lake, you pass into an area of sandstone boulders, what geologists call the Tuscarora sandstone. The bedrock is white and very compact, almost like quartzite (fig. 3, bottom).

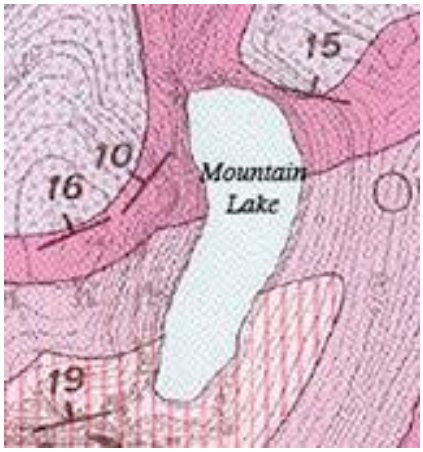

Figure 2—*Geologic map of the Mountain Lake vicinity, showing the shape of the lake and its three kinds of bedrock. Pink stripes = Martinsburg Formation; lavender = Juniata Formation; dark pink = Tuscarora sandstone. Source: Radford University (2014).*

Figure 3—*Changing bedrock around Mountain Lake. As you go from south to north, you pass over three very different types of bedrock. Top—fossil-bearing shale in the youngest member of the Martinsburg Formation; middle—sandstone or coarse graywacke in the Juniata Formation; bottom—the Tuscarora sandstone, so well consolidated that it resembles quartzite or even white quartz. Photos: Hutch Brown.*

Tectonic Processes

All three rock types originated in the same way: as sediments from the same mountain chain filling the same marine basin. All three resulted from the Taconic Orogeny, a mountain-building event that lasted from about 450 million to 435 million years ago.

The Taconic Orogeny began when a land mass known as the Taconic Terrane collided with proto-North America (fig. 4). In plate tectonics, a terrane is a land mass from a tectonic plate that grafts onto another plate after colliding with it. The Taconic Terrane was at the edge of an advancing oceanic plate. The heavier continental plate dove under the oceanic plate, forming an ocean trench in the subduction zone, along with an arc of volcanic islands (fig. 5).

Before the collision, vast shallow seas covered most of what is now the United States (fig. 4), including most of Virginia. As the Taconic Terrane struck proto-North America, it formed mountains along much of the continental margin (fig. 5). The continental subduction zone was like a ramp: the volcanic island arc rode up over the continental margin, pushing it down and forming broad shallow marine basins ahead of the rising mountains.

As the mountains eroded, the shallow foreland basins gradually filled with clastic sediments—eroded bits of preexisting rock. The sediments covered earlier carbonate sediments laid down in ancient seas from decomposing sea life and precipitated calcite. Over time, a sequence of sedimentary rock layers formed: carbonate rocks (limestones and dolomites) covered by layers of clastic rocks (conglomerates, sandstones, siltstones, mudstones, and other rocks from terrestrial sediments), all from the eroding Taconic Mountains.

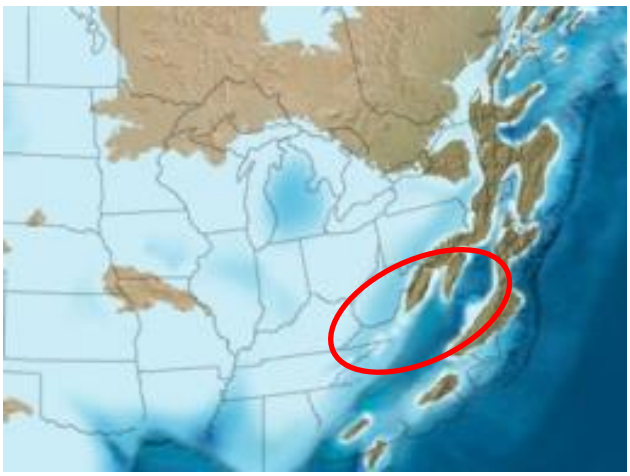

Figure 4—*Taconic Terrane colliding with proto-North America about 450 million years ago. Before the collision, most of what is now Virginia (circled) was covered by shallow seas. Source: Harwood (2014).*

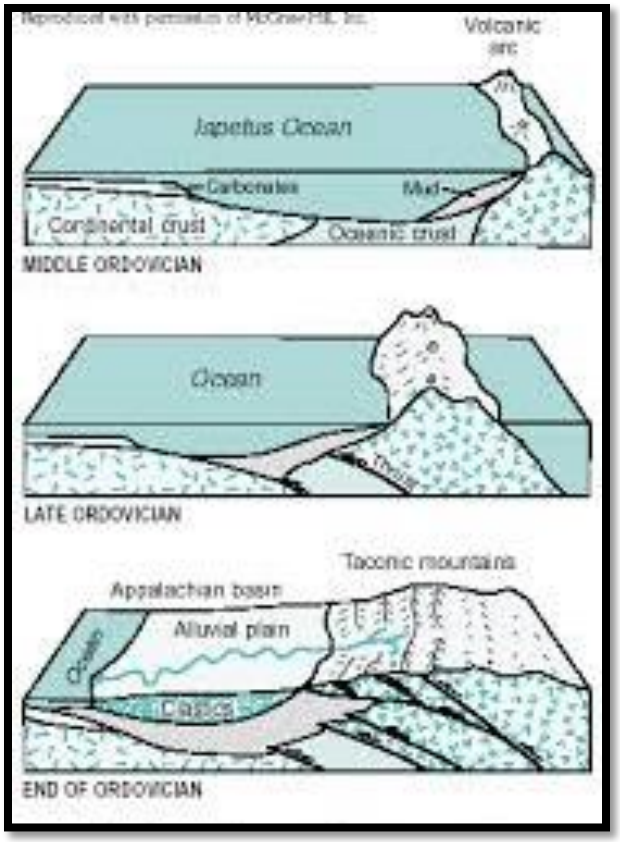

Figure 5—*The Taconic Orogeny. The island arc approaches proto-North America (top) about 480 million years ago. As the collision begins (middle), the oceanic plate rides up over the continental margin, and clastic sediments form at the base of rising mountains, beginning to fill the foreland basin. After uplift ends (bottom), the Taconic Mountains erode away, filling the foreland basin and draining into the inland seas beyond. Source: Dott and Batten (1988).*

The sequence of clastic rocks began with sediments from materials that eroded relatively easily, such as shales and basalts. The sequence ended with one of the most erosion-resistant minerals: quartz. Pure quartz sandstones capped the rock sequence, interspersed with softer sediments laid down in lagoons when sea levels temporarily rose (table 1).

What is now southwestern Virginia was finally eroded down to an alluvial plain drained by meandering rivers flowing west into the great interior seas beyond (fig. 5). When sea levels rose again about 410 million

years ago, carbonate sediments covered the newly formed clastic rocks across the entire area.

The Taconic Orogeny thus laid the foundations for two of our area's five physiographic provinces: the Piedmont and the Valley and Ridge. The eroded roots of the Taconic Terrane itself, grafted onto the continental margin, became the Piedmont. The sediments from the Taconic Mountains filled the foreland basins to the west, resulting in the sedimentary rock formations exposed today in the Valley and Ridge.

By about the end of the Silurian Period (408 million years ago), the rock formations near Mountain Lake today were all in place. Table 1 shows the entire sequence, from the middle Ordovician carbonate rocks through the late Silurian Tonolaway limestone, which together bracket the Taconic Orogeny and its aftermath. All of the rocks shown in table 1 are exposed in Giles County, and three of them—the Martinsburg, Juniata, and Tuscarora rocks—underlie different parts of Mountain Lake (fig. 2).

Alleghanian Orogeny

How can that be? If the rock layers formed on top of each other, from oldest (Martinsburg) to youngest (Tuscarora), how can they be lying side by side at the bottom of Mountain Lake?

The answer has to do with the folding and faulting caused by an even greater mountain-building event known as the Alleghanian Orogeny, which began about 320 million years ago.

Next: How the Alleghanian Orogeny restructured the bedrock in the area of Mountain Lake.

Acknowledgment

The author thanks NVMC member Sue Marcus for reviewing and improving the article. Any errors are the author's alone.

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Table 1—*Rock layer sequence in Giles County, VA, middle Ordovician to late Silurian Periods.*

Formation name	~Age (million years)	~Thickness (feet)	Component(s) (most to least)
Tonolaway	405–410	<100	Limestone
Keefer	410–420	100–230	Sandstone,[a] graywacke[b]
Rose Hill	420–430	100–270	Shale, siltstone, sandstone
Tuscarora	430–435	50–210	Sandstone,[a] graywacke[b]
Juniata	435–440	150–375	Shale, siltstone, graywacke,[b] sandstone
Martinsburg	440–455	1,000–1,800	Shale, siltstone, mudstone, limestone
Middle Ordovician carbonates	455–490	600–1,200	Limestone, dolomite

a. Pure and hard, sometimes compared to quartzite.
b. Sandy shale (intermediate between shale and sandstone).
Sources: Folk (1960); McDowell and Schultz (1990).

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January 2018—Upcoming Events in Our Area/Region (see details below)

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1 New Year's Day	2	3 MSDC mtg, Washington, DC	4	5	6
7	8 GLMSMC mtg, Rockville, MD	9	10	11	12	13
14	15 Martin Luther King Day	16	17	18	19	20
21	22 NVMC mtg, Arlington, VA	23	24 MNCA mtg, Arlington, VA	25	26	27
28	29	30	31			

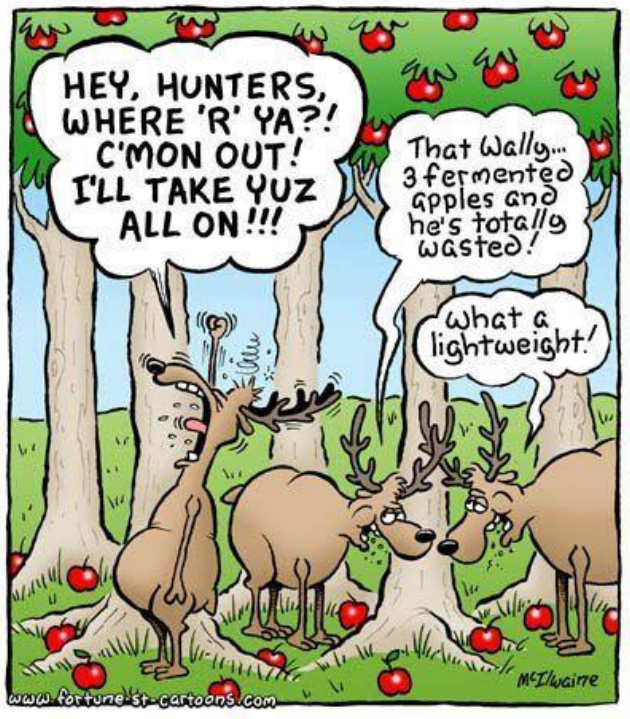
Event Details

3: Washington, DC—Monthly meeting; Mineralogical Society of the District of Columbia; 7:45–10; Smithsonian Natural History Museum, Constitution Avenue lobby.

8: Rockville, MD—Monthly meeting; Gem, Lapidary, and Mineral Society of Montgomery County; 7:30–10; Rockville Senior Center, 1150 Carnation Drive.

22: Arlington, VA—Monthly meeting; Northern Virginia Mineral Club; 7:45–10; Long Branch Nature Center, 625 S Carlin Springs Rd.

25: Arlington, VA—Monthly meeting; Microminералogists of the National Capital Area; 7:45–10; Long Branch Nature Center, 625 S Carlin Springs Rd.



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THE NORTHERN VIRGINIA MINERAL CLUB INC
Crystals are the flowers of the Mineral Kingdom

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http://www.novamineralclub.org

The Northern Virginia Mineral Club

Visitors are always welcome at our club meetings!

Please send your newsletter articles to:
hutchbrown41@gmail.com

RENEW YOUR MEMBERSHIP!

SEND YOUR DUES TO:
Roger Haskins, Treasurer, NVMC
4411 Marsala Glen Way, Fairfax, VA 22033-3136

OR

Bring your dues to the next meeting.

Dues: Due by January 1 of each year; $15 individual, $20 family, $6 junior (under 16, sponsored by an adult member).

Purpose: To encourage interest in and learning about geology, mineralogy, lapidary arts, and related sciences. The club is a member of the Eastern Federation of Mineralogical and Lapidary Societies (EFMLS—at http://www.amfed.org/efmls) and the American Federation of Mineralogical Societies (AFMS—at http://www.amfed.org).

Meetings: At 7:45 p.m. on the fourth Monday of each month (except May and December)* at **Long Branch Nature Center**, 625 Carlin Springs Road, Arlington, VA. (No meeting in July or August.)

**Changes are announced in the newsletter; we follow the snow schedule of Arlington County schools.*