Nittany Mineralogical Society Bulletin

Nittany Mineralogical Society, Inc., meeting in State College, Pennsylvania
Contact information on back page

Editor (see back page):
David C. Glick

May, 2018

Visit our web site: **www.nittanymineral.org**

May 16th meeting:

Space Debris, Part 2:
Asteroids and Comets: Dark Threats

by
Dr D.P. "Duff" Gold
Professor Emeritus of Geology
Penn State

Our May meeting will be held Wednesday the 16th in room 114 (the large auditorium) Earth & Engineering Sciences Building on the west side of the Penn State campus in State College, PA. Maps are available on our web site.

6:45 to 7:40 p.m.: Social hour, special refreshments and Reception in the lobby - ***PLEASE ARRIVE BY 7:20***

7:40 to 8:00 p.m.: ***Honoring Dr. Duff Gold as a Life Member of NMS***

about 8:00 p.m.: featured program

The event has free admission, free parking, and free refreshments, and is open to all; ***parents/guardians must provide supervision of minors.*** *Bring your friends and share an interesting evening!*

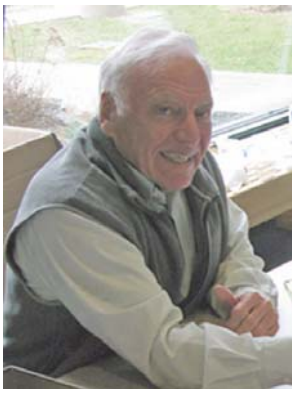
The emphasis of this talk is on recognition of astroblemes (impact scars), and development of a scale involving size and associated magnitude of energy transfer. The objective is to gain some idea of frequency through deep time, and speculate on "risk." The reality of "large events" was demonstrated in real-time on July 16, 1994, with the impact of Shoemaker-Levy 9 cometary fragments on Jupiter.

Very few of us would consider "space debris" as a hazardous agent when discussing large natural disasters such as hurricanes, tropical storms, earthquakes, tsunamis and volcanic eruptions. The closest we come is the Volcanic Energy Index (VEI), adapted to units of "energy transfer" expressed in megatons of TNT in a highly brissant explosion. Appreciate that the volcanic explosive eruptions of Krakatoa (August 27, 1883), estimated to have ejected 46 km^3 (11 cubic miles) of debris into the atmosphere is rated a 6 on the VEI (~220 megatons), and the Tambora eruption (April 10, 1815), which ejected 150 cubic kms (36 cubic miles) of ash and pumice, has a VEI rating of 7. Both greater than the Tunguska air-blast explosion (estimated >60 megatons) of an ~100 ft diameter comet head, over a remote part of Siberia on June 30, 1908, are amongst the greatest explosions recorded by man. The Tunguska explosion that leveled 200 km^2 (770 square miles) of taiga forest, is attributed to an approximately ~100 ft diameter comet head exploding in the atmosphere. This scale is open-ended; with known asteroid packing sufficient kinetic energy to match the rotational energy of the earth, and initiate "ocean boiling" events. We will touch on the co-lateral damage such as nuclear winter, climate change and mass extinctions and briefly compare hazardous event risks.

We plan to have samples of unique shock metamorphism (shatter-cones, suivite, pseudo-tachylite breccias, and melts, tektite, desert glass and KT boundary ash) on display. ❄

AND

Honoring Dr. Duff Gold as a Life Member of Nittany Mineralogical Society.



Before the main program at the May 16th meeting, please join us for a short reception and presentation to honor Duff Gold, a founding member and Board member through the Society's 24-year history. **See page 3.**

In the Coming Months:

Check the web site and upcoming Bulletin issues for any changes or updates.

No meetings in June or July.
Monthly third-Wednesday meetings resume in August.

August 15, Wednesday: Show and Tell Meeting

August 26, Sunday: NMS Picnic, Penna. Furnace, PA

❄

Geo-Sudoku

by David Glick

This puzzle contains the letters AEFLONTUZ. One row or column spells a two-word term for a geological feature in the Falu Gruve Mine. Each block of 9 squares, each row, and each column must contain each of the nine letters exactly once. The solution is on page 8.

N								
		O		N	A	T		
F					Z			E
U	O		Z	L			E	
	F	A	E	U				
E				F	T		O	U
O					U			F
T	Z		O	E		A		
A			N		L		T	

Do you have a mineral word with 9 letters, none repeated, that hasn't been used recently in our Geo-Sudoku? Please submit it the Editor (see page 8).

FEDERATION NEWS

Nittany Mineralogical Society, Inc., is a member of EFMLS, the Eastern Federation of Mineralogical and Lapidary Societies, and therefore an affiliate of AFMS, the American Federation of Mineralogical Societies. We present brief summaries here in order to encourage readers to see the entire newsletters.

The **EFMLS Newsletter** is now being distributed electronically; a link is available on our web site **www.nittanymineral.org**. The May issue is not yet available., however, it has been announced that the 2019 convention will be June 1-2 in Monroe, New York.

The **AFMS Newsletter** is available by the same methods. The May issue starts with a junior activities article on basic lapidary arts; hand-polishing softer stones and wire-wrapping don't require any power tools. President Sandy Fuller writes about how volunteering can be rewarding. Results of the Bulletin Editor's Contest and the Web Site Contest are announced, as are other awards from the recent convention. Results of the Endowment Fund Drawing for 18 prizes are shown; it raised $1155. The safety article, "You are Being Watched," urges us all to set a good example for kids and others with safety and courtesy.

The Federations encourage everyone to see the web sites for the complete Newsletters. There's a lot there!

-Editor

Relax in the Blue Ridge Mountains during your free time at Wildacres

Eastern Federation Wildacres Workshops

May 21-27 and Sept. 3-9, 2018

from http://efmls-wildacres.org/

Indulge your passion for minerals, gems, jewelry, and craft. Join entry and intermediate level short classes. Enjoy programs from our great Speakers-in-Residence. Form new friendships and deepen old ones. Do it all at Wildacres, a beautiful retreat center atop the Blue Ridge Mountains of North Carolina. What could be better?!

Speakers-in-Residence are: for Spring 2018, Helen Serras-Herman (Gem Artist & Author), and for Fall 2018, Alfredo Petrov (Explorer, Raconteur, Mineral Dealer).

See the class list, registration materials, information on the speakers-in-residence, photos, video, and more at <http://efmls-wildacres.org/>.

DR. DUFF GOLD
Nittany Mineralogical Society Life Member 2018

by David Glick,
NMS President

At our May 16th meeting we will honor Dr. David P. "Duff" Gold for his many contributions to Nittany Mineralogical Society by conferring our highest honor, Life Membership.

NMS was founded in January 1994, and Duff was there to start serving as the Society's Treasurer, a Board of Directors office which he held until stepping down in 2007. At the Society's first meeting, in February 1994, he presented the program, "How Do Diamonds Form?" With this month's presentation, his total will be 14 programs over NMS's 24-year history of monthly meetings. He also gave four presentations during our series of seven symposia for mineral collectors, and provided his expertise on several of the symposium field trips and other NMS field trips.

Duff with John Passaneau at NMS's 2002 Symposium at Sterling Hill, NJ. *A. Sicree photo.*

Duff took over as Program Chair in December 2007, and has sought out speakers of interest for our varied audience, cajoled them into coming to speak to us,

Duff in the field at Skytop with Andrew Sicree.

A Board meeting around 2005. *J. Passaneau photo.*

dealt with last minute changes, filled in, and provided guidance throughout. Between his Treasurer and Program Chair positions, he has served on the Board of Directors for our entire 24-year history. As an Emeritus Professor, he's also been our means of gaining permission to hold our meetings on the Penn State campus, even as restrictions have increased in recent years.

Duff is always enthusiastic to participate in our annual event for children and their parents, Minerals Junior Education Day.

Duff with Bob Altamura at the lapidary station, 2017 Minerals Junior Education Day. *D. Glick photo.*

We honor Dr. Duff Gold for his unfailing support and participation in Nittany Mineralogical Society, and for his efforts in furthering our goals of educating and fostering interest in the earth sciences. He has set a great example for all of us, encouraging the interest of children and adults in science, and enlightening hobbyists and professionals. Duff, congratulations on another well-deserved honor, and many thanks.

There Once Was a Goat Named Kåre — Over a Millennium of Mining at Falu Gruve, Sweden

by Dr. Nathalie Brandes,
Professor of Geology at Lone Star College

3rd Place, 2018 Bulletin Editor's Contest
Adult Articles- Advanced
Houston Gem & Mineral Society
The Backbender's Gazette, February 2017
Phyllis George, Editor (SCFMS)

Long ago, in what would one day be known as Bergslagen, Sweden, a young goatherd tended his animals. It was a lush, green land of forests, meadows, and some bogs. The animals grazed contentedly, all except a billygoat named Kåre. He wandered away from the rest of the herd. When he returned, his horns were bright red with some strange sort of mud.

"What did you get yourself into now, Kåre?" the goatherd asked as he cleaned the animal before heading home.

The following day, the same thing occurred. After disappearing for a few hours, Kåre returned to the herd with bright red horns.

"I am growing tired of your mischief, Kåre," the goatherd chided as he cleaned the billygoat once again before returning home.

On the third day, when Kåre wandered away, the young goatherd followed him and found where he had been rubbing his horns in an unusual red mud. Curious about the brilliant color, the goatherd dug into the mud and discovered a piece of chalcopyrite. Thus begins the story of Kopparberget, Sweden's Great Copper Mountain, known today as Falun Mine.

Falun is located 250km northwest of Stockholm in the traditional but informal region of Bergslagen. The exact borders of Bergslagen are poorly defined and can include parts of up to nine counties in south-central Sweden where mining has been an important industry (Lasskogen, 2010; Angelstam et al., 2013; Angelstam and Axelsson, 2014). The climate of the region is humid continental with cold winters, warm summers, and no dry season. The mean annual temperature is 4°C with an average 700 mm precipitation annually (Raab, 1995). The landscape around Falun includes numerous streams and lakes amid rolling hills. The area was severely deforested during the height of mining, but vegetation typical of the boreal forest has returned (Olsson, 2010). Common trees in the area include Scots pine and Norway spruce with lesser silver birch, grey alder, rowan, and aspen (Hammarlund et al., 2008). The forest floor is dominated by heather, bilberry, blueberry, lingonberry, and crowberry (Classen, 2012).

Bergslagen is located in the southwest part of the Svecokarelian orogeny in the Fennoscandian Shield (Stephens et al., 2009; Stephens and Anderson, 2015). Rocks of this region are dominated by 1.8 to 1.9 Ga Palaeoproterozoic metavolcanics known as leptites. These are interpreted as felsic pyroclastics and rhyolitic ash deposited in a submarine environment (Allen et al., 1996; Lundström, 1987). There are also some mafic and intermediate metavolcanics as well as metasediments interpreted as mudstone, turbidite, and greywacke (Ripa and Kübler, 2003; Stephens et al., 2009) in addition to some carbonate units (Allen et al., 1996). Plutonic rocks of various compositions intrude these rocks (Lasskogen, 2010). There has been debate concerning the tectonic setting of these rocks. Löfgren (1979) and Loberg (1980) suggested a volcanic arc over a subduction zone. Other researchers (Oen et al., 1982; van der Welden et al., 1982; Oen, 1987) concluded it was a continental rift. Most recent research concludes that this was an extensional back-arc environment in which there was early intense volcanism, thermal doming, and extension followed by a cessation of extension, thermal subsidence, finally concluding with compression, deformation, and metamorphism (Allen et al., 1996; Stephens et al., 2009). Deformation and amphibolite facies metamorphism affected the Bergslagen region during the 1.8-1.9 Ga Svecokarelian Orogeny (Lasskogen, 2010). Some parts of western Bergslagen were also affected by the Sveconorwegian Orogeny around 1.0 Ga (Stephens et al., 2009).

The ore deposit at Falun is hosted in the Leptite Formation, which is interpreted to be metamorphosed felsic volcanics and some sediments (Grip, 1974; Lasskogen, 2010). Most of these rocks are quartz-and mica-rich and traditionally called "ore quartzites" and "mica schist" (Geijer, 1917). Both calcite and dolomite marble as well as skarn are also found at Falun Mine. All these rocks have been folded into a large, steeply plunging isoclinal syncline (Koark, 1986; Kresten, 1986; Kampmann et al., 2016).

Falun is best known as a copper mine with the main sulfide ores concentrated at the hinge of the syncline. This is, however, an oversimplification of the complex nature of

The open pit at Falun Mine. This pit was mined for copper, gold, and other minerals for over 1,000 years. *Photo by Paul Brandes*

The underground workings of the Falun Mine. The walls are stained yellow due to sulfide mineralization of the area.

the ore deposit (Lasskogen, 2010). Törnebohm (1893) established four basic ore types. Further studies have expanded this classification to include seven ore types. Hard ore includes both veins and disseminated chalcopyrite, pyrite, and sphalerite with lesser amounts of pyrrhotite, cosalite, and galenobismuthite. This ore is hosted in quartzite. There is also compact pyrite ore, also known as soft ore, which includes massive chalcopyrite, sphalerite, and galena with minor pyrrhotite, magnetite, tennantite, tetrahedrite, and quartz and carbonate gangue minerals (Törnebohm, 1893; Weijemars, 1987). Sköl is altered rock related to fault zones that can be 5–25 m wide. Occasionally, these zones contain chalcopyrite and galena (Törnebohm, 1893; Gavelin, 1989). Gold is found in the native state in quartz veins and lenses that were emplaced after the massive sulfides were deposited and deformed (Åberg and Fallick, 1993). Veins of galena with up to 47.7 ppm gold occur along a fault in the mine (Gavelin, 1989; Lasskogen, 2010). Compact ball ore, which is massive sulfide ore containing spherical inclusions of quartzite host rock is found near sköl ore zones (Gavelin, 1989). Lastly, skarns host ore rich in zinc and lead but poor in copper (Gavelin, 1989; Lasskogen, 2010).

Several different hypotheses concerning the formation of the sulfide ores have been proposed. Early researchers suggested the ore was produced by metasomatism in the Leptite Formation (Törnebohm, 1893; Högbohm, 1910; Sjörgren, 1910). Others proposed that ore fluids from granite intrusions replaced limestones (Geijer, 1917; 1964; Hjelmqvist, 1948). Koark (1962) was the first to suggest volcanic exhalation as the source of ore-bearing fluids. The currently accepted description of Falun is that the main deposit is a pyritic Zn-Pb-Cu-(Au-Ag) sulfide emplaced as a stratabound volcanic associated limestone-skarn (SVALS) deposit. The ore was formed in a submarine environment as volcanism waned but before deformation and metamorphism affected the area (Allen et al., 1986; Kampmann et al., 2016). Ore grades varied during the long life of the mine, but estimated averages are 5% Zn, 2% Pb, 0.6–4% Cu, 13–35 g/tonne Ag, and 0.5-4 g/tonne Au (Tegengrem, 1924; Grip, 1978; Allen et al., 1996).

There is much debate over the early history of Falun. Although the legend of its discovery by Kåre the billygoat is deeply lodged in the folklore of the region, the earliest known written account of this tale dates to 1651. Similar stories of animals discovering rich mineral deposits are associated with

numerous older mining areas, including Sala, Røros, and Rammelsberg. Some scholars believe these legends exist to explain events that date back so far in time the true origins are lost (Olsson, 2010).

Archaeological evidence is equivocal concerning the origins of mining at Falun. An early radiocarbon and pollen study (Lundqvist, 1963) concluded the date for the onset of mining was AD 1080±60. Sediment cores analyzed in a later study indicated mining began circa AD 700 (Qvarfort, 1984). Following improvements in radiocarbon dating, new analyses pushed back the earliest mining in the area to AD 589±97 (Eriksson and Qvarfort, 1996). Metal artefacts found on the islands of Björkö in Lake Mälaren and Gotland in the Baltic Sea are dated to the 10thto 11thCenturies and are believed to be made from Falun Mine material (Lindeström, 2002). All these dates, however, are contradicted by a recent study that reevaluated sampling methods and dating techniques and concluded that mining at Falun only began circa AD 1245 (Bindler and Rydberg, 2015).

The earliest written record of mining operations at Falun is a document from 1288. It outlines that Bishop Petrus Elofsson exchanged an estate with forests, fishing rights, and flour mills for a 1/8thshare of the mine. In addition to being signed by Bishop Petrus, the document was signed by King Magnus, three other bishops, and an archbishop. This document shows that Falun was already operating as a shareholding company, one of the earliest known in history (Lindeström, 2002; Olsson, 2010). In addition to the king himself owning shares, by the early 1300s, the company grew internationally, with wealthy residents of Lübeck, Germany owning mining rights at Falun (Olsson, 2010).

Prior to the mid-1700s, mine workers were employed by "Master Miners," who were shareholders in the venture. Ownership of a share in the mine was based on ownership of a share of a smelter (Blomkvist, 2013). The Master Miners needed to arrange their own labor force and the processing of extracted ore (Sundberg, 1991; Ridder, 2013). The actual miners were peasants who were granted special rights according to the Charter of 1347, including asylum right to criminals, exemption from military service, and tax reduction. By the 1600s, a minimum wage and official working hours were also guaranteed (Olsson, 2010; Angelstam et al., 2013; Blomqvist, 2013). At this time, workers were also ensured paid funeral expenses for victims of mining accidents, a retirement, and free healthcare (Olsson, 2010). In the mid-1700s, employment shifted to the model of a more modern company, with miners employed by the mine, not a Master Miner (Lindroth, 1955; Olsson, 2010; Blomqvist, 2013).

The mine at Falun was originally an open cast mine. In pursuit of the richest ore, however, miners soon worked underground (Classen, 2012). Firesetting—using very hot fires to soften hard rock—was originally employed to aid the mining process (Sundberg, 1991). The use of black powder was demonstrated in the 1670s by two German brothers. It was first adopted for surface use, but by 1710 black powder was used in both surface and underground applications (Olsson, 2010). As the extraction of ore pressed deeper underground, dewatering became a concern. Construction of dams and ponds began in the 1300s in an attempt to restrict water from entering the mine (Isacson, 2013). Dewatering of the mine was accomplished by hand or horsepower until the 1550s, when the first waterwheel was installed for this purpose (Lindroth, 1955; Sundberg, 1991). Waterwheels along dams and canals eventually provided the power for pumps, hoisting engines, and bellows (Isacson, 2013).

Following the extraction of ore, it was crushed, then roasted in open fires around Falun. The roasted ore was then smelted. After smelting, the copper was refined (Sundberg, 1991; Lindeström, 2002). Originally, crude copper was sent via the Hanseatic League for refining in Germany and Holland. After 1619, refining was completed in Säter, Sweden (Olsson, 2010; Hamrin and Olsson, 2011). In the 1800s, processing of ore moved from open roasting to other techniques, and by the early 1900s, new plants were constructed for various wet separation methods. (Lindeström, 2002).

Sweden became a major European power in the mid 1500s and enjoyed this status until the early 1700s (Sundberg, 1991; Hutchinson, 2001). This was in part due to the rich ore of Falun Mine providing wealth to the kingdom. The Council of the Realm even stated, "The kingdom stands and falls with Kopparberget" (qtd. in Olsson, 2010). Peak production occurred in the mid-1600s, when it is estimated the mine produced half the world's supply of copper (Sundberg, 1991). At this time, Falun was the second largest city in Sweden (Liljas, 2013).

As a result of the large amount of ore being processed around Falun Mine, massive amounts of SO2were released into the atmosphere during ore roasting. It is estimated that in the mid-1600s, about 35,000 tonnes of SO2per year were released (Ek et al., 2001). This had a profound impact on the environment around Falun. The pungent scent of sulfur could be smelled up to 80 km away (Lindeström, 2002). Visitors often complained of thick smoke in the city that caused twilight conditions at midday and the overpowering fumes making breathing difficult as well as causing problematic coughs and nosebleeds (Olsson, 2010). By 1633, a statute banned ore roasting outside the immediate mining area during summer to prevent damage to crops. The sulfurous air,

however, did have some benefits. There were no mosquitoes, fewer reports of contagious diseases, and when plague spread throughout Sweden in 1710, the disease did not strike Falun (Lindeström, 2002).

By the late 1600s, the Great Copper Mountain was a warren of hollowed out passages and galleries. A number of rock falls and collapses in the mine prompted an inspection by the Board of Mines in 1686 that concluded measures were necessary to secure the mine. Thus, it came as no surprise when the Great Collapse occurred in 1687 (Olsson, 2010). A massive amount of rock separating two galleries fell and produced a pit 100 m deep with rubble filling the collapse up to 350 m below the surface (Lindeström, 2002). This large area became known as Stora Stöten, the Great Pit (Olsson, 2010). Fortunately, the collapse occurred on Midsummer Day (25 June)—an important celebration when no one was working in the mine, thus there were no casualties (Olsson, 2010). In the immediate years following the Great Collapse, production of copper remained high since the rich ore that had been in walls and pillars supporting and separating galleries was now available to mine. Soon, however, copper production began to decline, but the production of other metals, including zinc, gold, and silver, increased (Lindeström, 2002; Classen, 2012).

In 1888, the old shareholding system that had existed at the mine since the Middle Ages was modernized into a joint-stock company known as Stora Kopparberg Bergslags AB (Olsson, 2010; Wagner, 2012). This company expanded well beyond the mine at Falun, acquiring ironworks, steel mills, sawmills, and paper mills as well as expanding operations at the mine to include such things as a sulfuric acid factory and an iron sulfate factory (Hamrin and Olsson, 2010). Falun Mine continued to operate until 8December 1992. After over a millennium of mining, the economic ore had finally run out (Olsson, 2010). The joint-stock company, known as STORA, is still in business, now specializing in forestry and paper products (Olsson, 2010; Wagner, 2012).

Over the life of the mine, it is estimated that 30 million tonnes of ore were extracted (Lindeström, 2002; Haglund and Hanæus, 2010), producing around 400,000 tonnes of copper (Sundberg, 1991). In addition to the metal riches that shaped Sweden's history, the ore at Falun also had an impact on the countryside and culture of the nation. Pyrite-rich waste rock is used to create a unique paint known as Falun red (Sahlström, 2012). The earliest reference to this paint dates to 1570, when King Johan III ordered the paint for the roof of a castle. This red paint soon became very popular throughout Sweden. Artists, authors, and poets have used the Falun red painted farmstead as a symbol of Swedish heritage (Olsson, 2010). Paint is still produced today with the proceeds of its sale used to help support the upkeep of the historic mine (Isacson, 2013).

Falun Mine was declared a World Heritage Site in 2001 (Wagner, 2012; Isacson, 2013). Guided tours are offered to underground workings. Visitors can also walk around the mining complex, stopping at old wooden shaft houses and structures painted the famous Falun red. There is also a museum onsite offering exhibits concerning the long history of the mine. Perhaps the most interesting thing to do is stand at the edge of the Great Pit viewing the work of over a thousand years, wondering if the legend is true, if it all started with a mischievous goat named Kåre.

House in Falun, Sweden painted in typical colors; Falun Red with white trim.
Photo by Paul Brandes

Editor's Note: Dr. Nathalie Brandes originally submitted this document with over five pages of references. However, due to the space that would have taken up in this newsletter, she elected not to print any references, allotting that space to the work of additional authors instead.

For more information:
https://en.wikipedia.org/wiki/Falun_Mine
https://www.eyeflare.com/article/falun-copper-mine/
https://www.mindat.org/loc-3154.html

Some Upcoming Shows and Meetings

Our web site http://www.nittanymineral.org has links to more complete lists and details on mineral shows and meetings around the country. See www.mineralevents.com for more/

May 12, 2018: South Penn Rock & Min'l Swap & Sale, by CPRMC & Franklin Cty RMC. South Mtn Fair-grounds, 1.5 mi NW of Arendtsville off PA 234 (for GPS: 615 Narrows Rd., Biglerville PA 17307). Sat. only, 8-3.

May 12, 2018 -Earth Science Show & Sale, The Rock & Mineral Club of Lower Bucks County, PA. Christ United Methodist Church, 501 Wistar Road, Fairless Hills, PA; 9:00 AM to 3:00 PM.

May 12, 2018: Spring Outdoor Rock Swap & Sale, by North Jersey Mineralogical Soc. Sterling Hill Mining Museum, 30 Plant St, Ogdensburg NJ. Sat only 9-5 http://nojms.webs.com/north-jersey-swap-n-sell

June 2, 2018: Spring Mineralfest, by PA Earth Sci. Ass'n. Macungie Mem. Park, Poplar St., Macungie, PA. One hundred tables overloaded with minerals, fossils, gems, jewelry, crystals and geodes from six continents - and possibly from outer space. Sat. only, 8:30-3. www.mineralfest.com/

Sept. 15-16, 2018: Annual Gem, Mineral & Jewelry Show by: Central Pennsylvania Rock and Mineral Club. New location: Harrisburg Consistory (2701 North 3rd Street) Harrisburg PA 17110 Sat 10-6, Sun 10-5 http://www.rockandmineral.org/annual%20show.htm

Sept. 29-30: Franklin-Sterling Gem & Mineral Show. Littell Center, 10 Munsonhurst Road #12, Franklin NJ 07416 Sat.9-5,Sun. 10-4. http://spmom3.wixsite.com/franklin-gem-mineral

October 6, 2018: Autumn Mineralfest, by PA Earth Sci. Ass'n. Macungie Mem. Park, Poplar St., Macungie, PA. One hundred tables overloaded with minerals, fossils, gems, jewelry, crystals and geodes from six continents - and possibly from outer space. Sat. only, 8:30-3. www.mineralfest.com

Geo-Sudoku Solution

N	T	Z	F	O	E	U	A	L
L	E	O	U	N	A	T	F	Z
F	**A**	**U**	**L**	**T**	**Z**	**O**	**N**	**E**
U	O	T	Z	L	N	F	E	A
Z	F	A	E	U	O	N	L	T
E	L	N	A	F	T	Z	O	U
O	N	E	T	A	U	L	Z	F
T	Z	L	O	E	F	A	U	N
A	U	F	N	Z	L	E	T	O

Visit us at www.nittanymineral.org

INVITE A FRIEND TO JOIN THE SOCIETY

The Nittany Mineralogical Society prides itself on having among the finest line-up of speakers of any earth sciences club in the nation. Everyone is welcome at our meetings. If you'd like to be part of our Society, dues are $20 (regular member), $7 (student rate), $15 (seniors), $30 (family of two or more members, names listed). Those joining in March or later may request pro-rated dues. Your dues are used for programs and speakers, refreshments, educational activities, Bulletins, and mailing expenses. Please fill out a membership form (available at www.nittanymineral.org), make checks payable to "Nittany Mineralogical Society, Inc." and send them in as directed, or bring your dues to the next meeting.

We want to welcome you!

CONTACT INFORMATION

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The **Bulletin Editor** will welcome your submissions of articles, photos, drawings, cartoons, etc., on minerals, fossils, collecting, lapidary, and club activity topics of interest to the members. Please contact:

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Newsletter submissions are appreciated by the first Wednesday of the month. Photographs or graphics are encouraged, but please do not embed them in word processor files; send them as separate graphics files (TIF, or good to highest quality JPEG files, about 1050 pixels wide, are preferred). Please provide captions and name of photographer or artist.