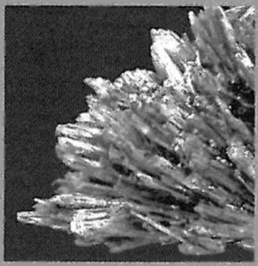
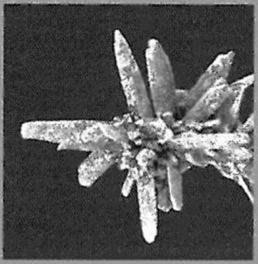
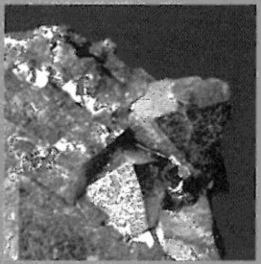
ANNUAL NEW MEXICO MINERAL SYMPOSIUM

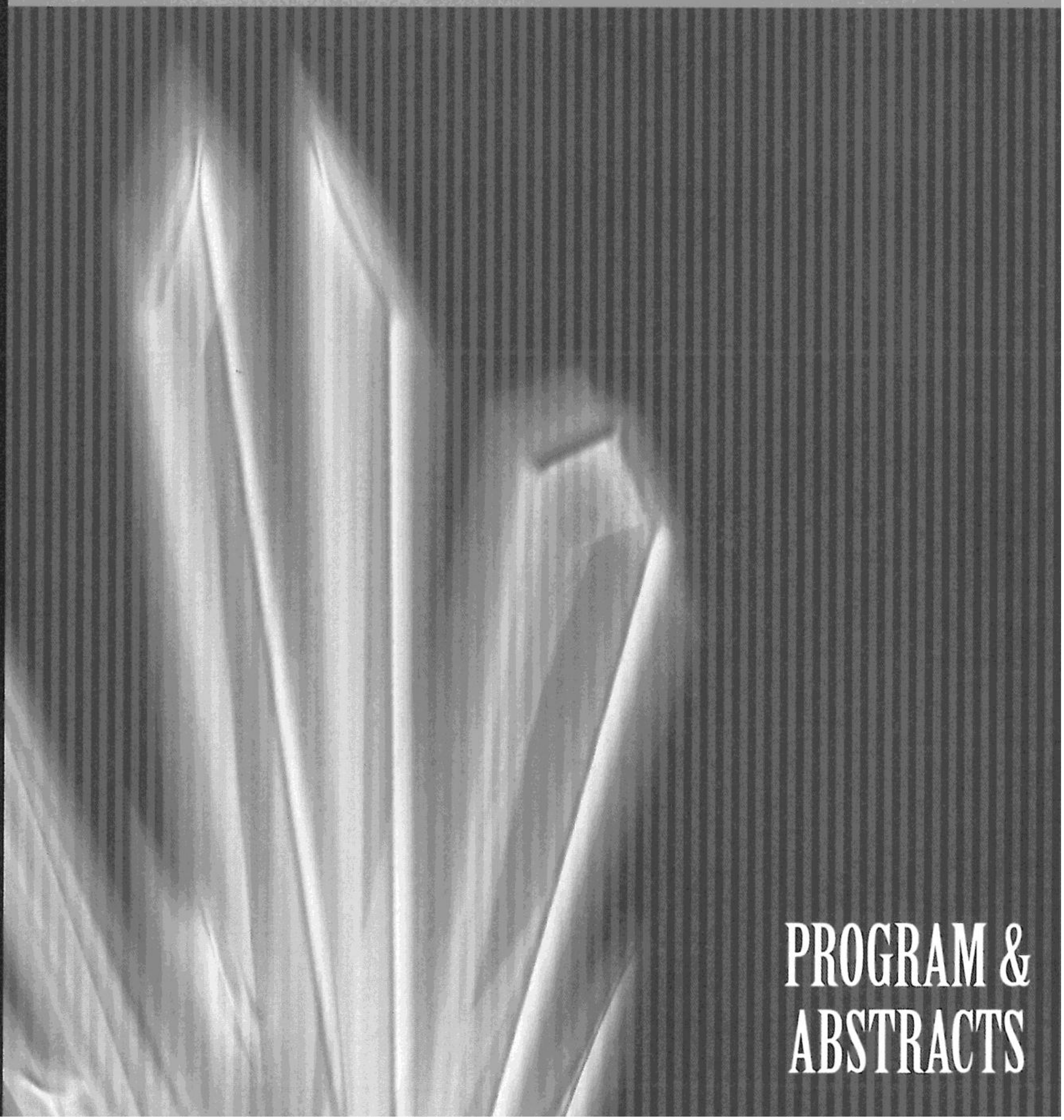
30th Annual
New Mexico
Mineral Symposium

November 14 & 15, 2009









PROGRAM & ABSTRACTS

30th Annual
New Mexico
Mineral Symposium

November 14 & 15, 2009

New Mexico Bureau of Geology and Mineral Resources
A Division of New Mexico Institute of Mining and Technology

Socorro 2009

Welcome to

The Thirtieth Annual

New Mexico Mineral Symposium
and
First Mining Artifact Collectors Association Symposium

November 14 and 15, 2009

Macey Center Auditorium
New Mexico Institute of Mining and Technology
Socorro, New Mexico

The Mineral Symposium is organized each year by the Mineral Museum
at the New Mexico Bureau of Geology and Mineral Resources.

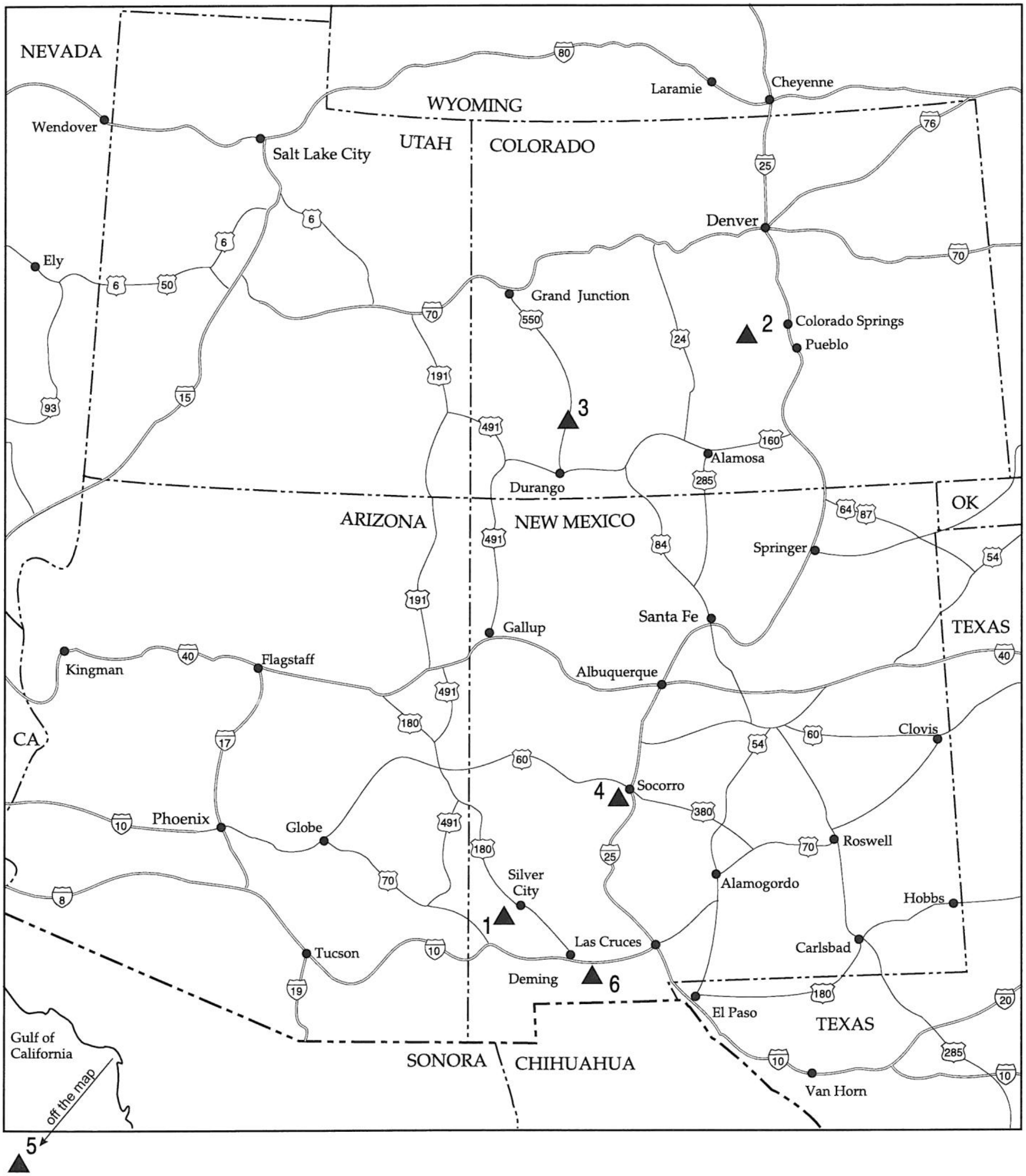
Sponsors this year include:

Albuquerque Gem and Mineral Club
Chaparral Rockhounds
Los Alamos Geological Society
New Mexico Geological Society Foundation
Friends of Mineralogy
City of Socorro

CITY OF SOCORRO

The New Mexico Mineral Symposium provides a forum for both professionals and amateurs interested in mineralogy. The meeting allows all to share their cumulative knowledge of mineral occurrences and provides stimulus for mineralogical studies and new mineral discoveries. In addition, the informal atmosphere allows for intimate discussions among all interested in mineralogy and associated fields.

New Mexico minerals on the cover: top left — pyrolusite, top right — halite, bottom left — malachite pseudomorph of linarite, and bottom right — magnetite.



Geographic Index Map

30th New Mexico Mineral Symposium

30th Annual New Mexico Mineral Symposium 2009

SCHEDULE

Friday, November 13

6:00 pm	Informal tailgating and social hour, individual rooms, Comfort Inn & Suites (# 1 on map—FREE

Saturday, November 14

8:30 am	Registration, Macey Center; continental breakfast
9:15	*Opening remarks,* main auditorium
9:30	*Specimen cleaning, trimming, and preparation 101—Les* Presmyk
10:00	*Mining activity and new finds, southwestern New Mexico—Robert* W. Walstrom (1)
10:30	Coffee break
11:00	*Victor—Colorado's city of mines: its history, geology, mines, and minerals—* Steve Veatch (2)
11:30	*Hubnerite mineralization in the San Juan Mountains, southwestern New Mexico—* Tom Rosemeyer (3)
12:00 pm	Lunch and Museum tours
1:00*	*Mine lighting—a hall off(l)ame—Hal* Post
1:30*	*L. E. Polhemus: engineer, merchant, doctor, and scam artist—David* Thorpe
2:00	*Pseudomorphs: they aren't what they used to* be—Ray Berry and Jack Thompson
2:00*	*Heavy metal miners: not a modern rock group—Bob* Schroth
2:30	*The trials and tribulations of mining rust—Alan* Perryman and Richard Overley (4)
2:30*	*Miners' candlesticks of Colorado—Tony* Moon
3:00	Coffee break
3:30	*Basalt to wulfenite—Ray* Grant
4:00	*Thirty years of Symposium presentations: a retrospective—Ray* DeMark, featured speaker
5:30	Sarsaparilla and suds: cocktail hour, cash bar
6:30	Dinner followed by an auction to benefit the New Mexico Mineral Symposium

Sunday, November 15

8:15 am	Morning social, coffee and donuts
9:15	*Welcome to the second day of the symposium and follow-up remarks*
9:30	*Tri-state mines, memories, mules, and the Galena, Kansas, Mining and Historical Museum—* Dale Wheeler
10:00	*Geologic settings of wulfenite in Arizona—Jan* Rasmussen
10:30	Coffee break
11:00	*Minerals of the Santa Rosalia district, Mexico—Jack* Crawford (5)
11:30	*The marvelous agates of Luna Co., New Mexico—Fred* Hurd and Chris Cowan (6)
12:00 pm	Lunch
1:15-3:00	Silent auction, upper lobby, Macey Center, sponsored by the Albuquerque Gem and Mineral Club for the benefit of the Mineral Museum (FREE)

*denotes Mining Artifact Collectors Association talk in Galena Room, some concurrent with Mineral Symposium

Mineral preparation and cleaning 101

Les Presmyk, 610 S. Bay Drive, P.O. Box 1273, Gilbert, Arizona 85233

All mineral specimens require cleaning, and most require some trimming or other preparation. The first cleaning takes place sometime after the specimen is collected, and there are periodic cleanings that need to take place after sitting for years in someone's collection. No one has perfected a dust-free case, especially in Arizona. With a few basic tools and supplies and a bit of knowledge and common sense, any collector can keep their specimens looking nice. There are additional techniques that an advanced collector can use or should be left to a professional. It depends on the willingness of someone to handle chemicals and, more importantly, dispose of them properly when finished.

Trimming is a process that is usually best left to someone who has the tools and the experience to do a proper job. Anyone who has field collected has done some trimming, especially to get that one-pound specimen separated from 100 lb of rock or at least light enough to get it back to the truck and take it home. There is way more to trimming than a chisel and a 3 lb. sledge hammer, not just in finesse but in the end result. However, no matter how many years of experience someone has or however many tools they have at their disposal, there is always a risk when trimming any specimen. The years of experience and, the shop full of tools just help to minimize that risk.

Getting started

You need some equipment to get started. Nothing fancy but the following list will give you the ability to clean most of your specimens, especially if they were acquired from someone who already performed a professional cleaning. This list will provide you with the basics.

- Brushes, ranging from toothbrushes to artists and paint brushes.
- Two plastic wash tubs (three is better)
- Several different sizes of "Tupperware" type plastic containers
- Dish strainer and newspaper
- Tap water-nature's most powerful solvent (wash water)
- Distilled or demineralized water (rinse water)
- Liquid dish soap
- One or more books-Sinkankas' *Gem and Mineral Data Book* is my recommendation
- Common sense

When setting up to clean minerals, use two tubs of water, one for the soapy wash water and one for the rinse water. You can even do an intermediate (third) one to save your rinse water by having a post-wash/pre-rinse tub of tap water. The final rinse is done in distilled or demineralized water to keep the dissolved minerals in our water from leaving any scum on your specimens, much like what builds up on your drinking glasses.

Here are some dos and don'ts:

1. Do make sure the mineral(s) is not water (or whatever liquid you are using) soluble. Do not overlook this one. I know of someone who once placed a crystallized chalcanthite in their fish tank.
2. Keep your water clean. The wash water will get dirtier much faster than the rinse water.
3. Do make your specimens and water about the same temperature. Some minerals, like cerussite and sulfur, are very temperature sensitive. Others, like quartz, are sensitive if the quartz is at 50° and the water is 110°.

4. Don't use your spouse's fancy Tupperware, unless, of course, it is an emergency. There are plenty of good, inexpensive plastic containers at your local grocery or department store.
5. Do make sure your minerals are not sunlight sensitive if you are washing and drying specimens outside. Cinnabar and silver minerals will darken, topaz will lighten.
6. Don't try to wash fuzzy minerals in water without knowing how strong the crystals are. Not all acicular crystals are equally strong, and the weight of the water can mash the crystals down. However, if you decide to try it, gently lower the specimen into the water, preferably upside down, don't swish it back and forth, and bring it back out. Continue to hold it upside down until most of the water has drained off.
7. Do understand what dissolves the minerals you are working with. For example, warm water is fine for malachite, but warm to hot water can begin to attack azurite and dull bright crystal faces.
8. Don't use drying chemicals, such as acetone or alcohol, without checking out the effects on a poor specimen. These chemicals can pull water out of some minerals and have detrimental effects on the crystals.

Advanced tools:

- Dental picks. Don't buy these, just ask your dentist for some he or she is ready to throw away.
- Ultrasonic cleaner. For delicate crystals or dirt in crevasses you cannot reach with brushes.
- Crock pots. Heat does accelerate chemical processes.
- Do-it-yourself car wash or high pressure water sprays/guns.
- Acids and bases. Ammonia to Lime Away to vinegar, citric acid, and oxalic acid (poisonous) to hydrochloric, hydrofluoric, nitric, and sulfuric acids. All need to be treated with respect and require personal protective equipment.
- Safety equipment:
  - Respirators
  - Protective gloves. Make sure the gloves are made to protect you from the solution you are working in.
  - Safety glasses/face mask
  - Apron
  - Fan/ventilation

Common sense is truly important when using high pressure water sprays. On one hand, it is amazing the number of minerals one can use high pressure water on. On the other hand, it is equally amazing the number of minerals one should not use high pressure water on. ALL fuzzy minerals are off-limits unless your intent is to try to blast a bunch of the minerals away from another more desirable mineral. Minerals with cleavage, such as calcite and topaz, need to be respected for possibly coming apart.

Only a few of the acids will be dealt with in this presentation. Vinegar and citric acid, as well as Lime Away, are readily available and can be used to dissolve calcite away from other minerals. Oxalic acid is easy to use and very effective for removing iron oxide stains from quartz. However, it is very poisonous so care must be taken to keep animals and children away from the tubs. Also, you do not want to use it on calcite or anything with calcium in it because it will form calcium oxalate, an off-yellow precipitate that is insoluble. Hydrochloric acid is readily available as pool (muriatic) acid, cheap as strong acids go, and very effective in removing rust stains. It requires significant time to neutralize to ensure no yellow iron stains precipitate out and sometimes just is not worth the trouble.

Strong acids and bases need to be respected and used by those who are experienced. Whenever using acids, let the specimen sit in tap water for several hours before putting the specimen into the acid solution. This allows any fractures or cracks to fill with water. Once the specimen is clean, baking soda is a very good neutralizing agent. Ammonia works well, but it can sometimes have interesting side effects on some minerals. Always neutralize the solution before disposing of it.

Trimming

The main purpose of trimming is to remove excess matrix so that the prominent mineral and crystals are not overwhelmed by a large amount of extraneous material. Trimming also gets done so a specimen will fit into a certain size category required by the collector. There are some who object to trimming, either because they are afraid to have it done, or because they believe that somehow a specimen should remain just as it came out of the ground. To preserve a specimen just as it came out of the ground makes no sense, unless there is something significant about the matrix. The amount of matrix that is part of a specimen is just an accident. Specimens need to be trimmed, if for no other reason, than to decrease the amount of space each collector needs to house and display their collection. Successful trimming is a matter of three things.

- First, the willingness to do it. If you are afraid of breaking something or splitting the specimen, certainly valid reasons for not trimming, then don't.
- Second, once you get past your fears (some collectors I know swear that a stiff shot of alcohol helps, but I do not recommend it), then trimming is like the advice on how to get to Carnegie Hall: practice, practice, practice. If you just purchased a flat of minerals to get the one the seller made sure was in there so you would buy the entire flat, you can start with the worst specimen and work your way to the best one. It is all about knowing how the matrix and crystals will react when trimmed. For example, the limestone that surrounds quartz crystals from Diamond Point, Arizona, splits very nicely in a hydraulic trimmer. The New Jersey basalts, while appearing to be just as solid and homogeneous, are actually shot through with fractures and when placed in a trimmer break with very little predictability.
- Third, it is a matter of having the right tools, which can be anything from tile nippers to diamond saws and micro-abrasion units.

Basic tools that will get you started.

- Tile nippers or horseshoe clippers-available at hardware stores or home improvement stores
- Screwdrivers
- Screw-type trimmer
- Safety equipment
  - Gloves
  - Glasses, goggles, or face shield. You will experience flying bits of rock and minerals.

The more advanced trimmer/preparer will require some or all of the following:

- Hydraulic trimmers, preferably the German "Zuber" trimmer
- Micro-abrasion units, these require an air compressor
- Dermal tools
- Air scribes, also require an air compressor
- Diamond saws
- Air compressor

The basic tools are readily available and relatively inexpensive. They are limited in what you can do but very effective. Screw-type trimmers are especially effective for smaller specimens and micromounts. Larger specimens will require hydraulic trimmers and diamond saws. One can easily have $10,000 to $20,000 in trimming equipment in order to minimize risk and ensure success.

The only Zuber that is available on the market is the smallest of the three. Chinese imitations were on the market for a while, and the most successful ones were those modified by Dennis Beals in Denver, Colorado. There are plans and designs for trimmers utilizing automotive hydraulic jacks. Screw trimmers are available commercially or can be home made.

Mining activity and new mineral finds in southwestern New Mexico

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Mining activity has been severely reduced recently in southwestern New Mexico due to a drop in copper values. Most operations have been shut down or greatly curtailed while waiting for a market upturn. However, precious metal prices have remained elevated, sparking recent activity in exploration and mining. Where there is mining, new mineral discoveries can be expected. And that is good news for mineral collectors. New mineral finds have recently been made as a result of mining activity and exploration as well as individual efforts by this author and others in southwestern New Mexico. Those will be addressed below.

Steeple Rock district, Grant County, New Mexico

Last year during the 2008 Mineral Symposium at New Mexico Tech, this author gave a talk on the mineral occurrences of the Steeple Rock district of western Grant County, New Mexico. Several developments concerning mining make this district encouraging for mineral collectors. First, the Summit Gold mine continues in operation. A 15% decline has been driven to intercept the Summit vein from the east. Ore is hauled by truck to a mill in the Lordsburg district for processing. Second, the Billali mine, which includes the Hoover tunnel, located in the north portion of the district, has been core drilled in the past and now is being developed for gold production. Third, a new gold orebody has been discovered at the Jim Crow mine in the southern part of the district. Even though this orebody is small, plans are underway for production. This orebody has already produced some interesting minerals: Duftite, epitactic vanadinite along with mimetite, gold, and pyromorphite are notable.

Lordsburg district, Hidalgo County, New Mexico

Recent field exploration in the Lordsburg district has resulted in discovery of a large porphyry copper/gold deposit. This district in the past has produced numerous collectable minerals. Only those "new" mineral finds are listed below.

Locality	New finds
Atwood mine	olivenite
Waldo open cut	azurite
Pole Line prospects	wulfenite, barite, cerussite
CC23 claim	wulfenite, vanadinite, fluorite, rosasite, mottramite, hemimorphite
CC24 claim	wulfenite, mottramite, vanadinite, fluorite, descloizite, rosasite
Hilltop prospect	wulfenite, rosasite, barite, hemimorphite, cerussite, malachite
BB65 claim	wulfenite, gold, descloizite, jarosite, barite
Section 18 prospect	wulfenite, descloizite, mottramite
Hilltop East prospect	wulfenite, linarite, chlorargyrite
Cerussite prospect	wulfenite, cerussite, aurichalcite, dravite
Francis Kay mine	rhodochrosite
Walker prospect	wulfenite, smithsonite, mottramite, vanadinite, fluorite
Forks prospect	wulfenite, vanadinite
Blue Bird Draw prospect	wulfenite (new parallel growth xls)
Roadside prospect	wulfenite, bindheimite, vanadinite, azurite, aurichalcite

Georgtown district, Grant County, New Mexico

Even easily accessible and well-visited districts continue to produce mineral specimens. The McGregor mine at Georgetown recently produced collectable wulfenite and bromargyrite from dump material. However, that was brought to an abrupt halt when a new home and commercial cabins were constructed over the collecting area. However, another area near the Georgetown Cemetery has produced an interesting suite of collectable minerals. This site, hiding in rather plain sight, in full view from the Georgetown Road, is the Alhambra mine. It is located at the southwest corner of the cemetery and contains wulfenite, plattnerite, bromargyrite, vanadinite, cerussite, willemite, hemimorphite, and jarosite. The original shaft has been back-filled, but most of the dump remains. The Forgotten Group mine shaft, located 800 ft southeast of the Alhambra mine, recently produced plattnerite, rosasite, descloizite, willemite, and hemimorphite. The small Edith mine, located north of the cemetery and close to the south side of the main road to Georgetown site, has recently produced a limited amount of yellow-green bromargyrite.

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Victor—Colorado's city of mines: Its history, geology, mines, and minerals

Steven Wade Veatch, C. Robert Carnein, Marge Breth, Dan Alfrey, Wayne Johnston, Roger Loest, Dee Loest, Mary O'Donnell, Jo Beckwith, Judy St. Peter, Brent Geraughty, Lake George Gem and Mineral Club, Lake George, Colorado 80827

Since its beginnings in 1891, the Cripple Creek district's 500 or so mines have produced an estimated 22 to 24 million ounces of gold—more than half of Colorado's total output of gold. The Victor area included the district's four richest mines. The Portland, Cresson, Ajax, and Independence mines together produced more than one-third of the district's gold, and total gold production for the Victor area is about 12.5 million ounces (Jensen 2003). Victor is thus the heart of the most productive gold district in Colorado and the third most productive in the U.S.

The city of Victor, on the southwestern side of Pikes Peak, was founded by Frank and Harry Woods. The city began to take shape in 1891, shortly after W. S. Stratton discovered gold nearby. Victor quickly grew from a camp of tents and miners' shacks on the side of Battle Mountain to a platted city by 1893. The following year, Victor was incorporated. The arrival of the Florence and Cripple Creek Railroad in 1894 and the Midland Terminal Railroad the following year made Victor a center of commerce in the district. Soon Victor was one of the most prosperous and largest cities in Colorado. During the excavation of a hotel foundation in downtown Victor, workers discovered a rich gold vein. The Gold Coin mine was quickly established to work this vein. The Strong mine, another mine within the city limits, was also a big producer. Victor soon became known as the "City of Mines."

In August of 1899, a fire burned much of the city. Within 8 months, a new Victor emerged with a business district built mainly of brick (Feitz 1967). Many of those brick buildings survive.

Today, Victor is one if the best-preserved mining camps in Colorado, with period homes, turn-of-the century buildings, and historic gold mining structures. Currently, AngloGold Ashanti owns about 85% of the district's productive area, with recoverable gold reserves and resources amounting to several million ounces (T. Brown, pers. comm. 2008). Today, the Cripple Creek and Victor Gold Mining Company operates the largest open pit and heap-leach mine in Colorado. Low-grade disseminated gold (native gold attached to pyrite or within the molecular structure of pyrite) is the target of current mining operations (Hunter et al. 2009). Production for 2009 is estimated at 292,000 ounces of gold (T. Brown, pers. comm. 2009). A continuing exploration program, with the goal of defining additional resources, recently extended the mine's projected life to 2016.

Most of the district's gold has come from an altered Oligocene diatreme/intrusive complex exposed over an area of 18 km^2. The complex was emplaced along reactivated north-northwest-trending basement structures during the transition from Laramide compression to Rio Grande rift extension, between about 34 and 28 m.y. ago. The diatreme occupies a place where four Precambrian units come together: 1.7 Ga metasediments, metavolcanics, gneisses, and schists; 1.65 Ga syntectonic (augen) gneiss and feldspathic granite (known as the Ajax granite); 1.43 Ga leucogranite (the Cripple Creek Granite or Quartz Monzonite); and 1.05 Ga granite, alkali feldspar granite, fayalite syenite, and diabase (the Pikes Peak Granite).

The diatreme, which flares upward from three sub-basins at depth, is filled with an altered heterolithic breccia (the Cripple Creek breccia) that was intruded by hundreds of small plutons having a wide range of mainly phonolitic lithologies and alkaline compositions. Subsidence followed the emplacement of the diatreme. As a result of this subsidence and convection, carbonized wood fragments have been found to depths of more than 915 m (Hunter et al. 2009).

The parent magma, which probably came from the asthenosphere, was relatively unaffected by its transit through the lithosphere (Jensen 2003), but it differentiated with time. Hydrothermal alteration predated and accompanied formation of the diatremal and intrusive rocks, but gold mineralization mostly post-dated magmatism. Late, more mafic magmas may have supplied at least some gold and tellurium. The gold-bearing late hydrothermal fluids (about 28 Ma; T. Brown, pers. comm. 2008), which were mostly of magmatic origin, produced extensive carbonation and potassium metasomatism of the host rocks. Sodium and calcium in feldspathoids were replaced with potassium, forming "adularia" (Lindgren and Ransome 1906; Thompson et al. 1985). Mafic minerals in the host rocks were altered to dolomite, magnetite, pyrite, and fluorite, among others. Fluid-inclusion studies suggest temperatures of 125 to 220°C. Carbonates (i.e., calcite, dolomite) in the veins and altered rocks at depth buffer acids produced by the breakdown of pyrite near the surface, an important environmental advantage for the current mining operation.

Ore minerals, which are mostly gold and silver tellurides, were emplaced in a single phase in swarms of thin seams or narrow veins that sometimes form long, anastomosing or overlapping trends. Besides tellurides, the veins commonly contain quartz, fluorite, carbonates, "adularia," pyrite, celestine, barite, and base-metal sulfides (especially sphalerite, galena, and tetrahedrite). Gold mineralization accompanied boiling, cooling, and CO_2 effervescence of ascending fluids and is mainly confined to the upper 1,000 m of the deposit. However, deeper exploration targets for both gold and base metals may exist. A variety of hydrothermal breccias are locally important ores. In the upper 300 m, disseminated microcrystalline electrum (natural alloy of gold and silver) and tellurides accompany pyrite in abundant veinlets. These occur in permeable zones in various host rocks, mainly at structural intersections or along major northwest-trending shears (Pontius 1992). Throughout the district, mineralization typically shows little obvious relationship to particular host rocks, though more mafic rocks commonly occur nearby.

The complex geological history outlined above resulted in an unusually complicated mineralogy for an area of relatively small size. More than 120 minerals have been reported from the ores and host rocks of the district (Carnein and Bartos 2005), of which a small number are of economic or collector interest. The major historical ore minerals are calaverite, $AuTe_2$, sylvanite, $(Au, Ag)_2Te_4$, and krennerite, $(Au, Ag)Te_2$. Because these minerals are difficult to distinguish, their relative importances are unknown, but indirect evidence suggests that calaverite is far more important than other ore minerals (Jensen 2003).

Few records were kept of silver production, but it was probably significant. Although native gold was of little importance during the district's heyday, electrum is an important ore mineral in the current high-volume, low-grade, near-surface mining operation.

Attractive specimens of these and other minerals can be seen in museums and private collections, although native gold specimens of collector interest are very scarce. Other specimen-grade minerals include large amethyst crystals, yellow and purple fluorite, melonite, tellurium, turquoise, and, in a single occurrence from 2001, an attractive assemblage of botryoidal rhodochrosite, purple creedite, yellow and blue celestine, and gearksutite, all from the Cresson open pit. Aside from the recent Cresson finds, poor records were kept with most historical specimens, and locality information for fine specimens was often fabricated. As a result, and because the geochemistry and mineralogy of the productive zones were relatively uniform across the district (Jensen 2003), one cannot readily identify minerals that are unique to the Victor area.

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Hubnerite mineralization in the San Juan Mountains, southwestern Colorado

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Hubnerite occurred sparingly throughout the San Juan Mountains in polymetallic veins as micro to cabinet size free-growing crystals in vugs and bladed crystal groups embedded in quartz. The monoclinic crystals are typically flattened and elongated, commonly showing fine striations parallel to the C axis. The crystals show a wide range of color from ruby to dark red to brownish red to black.

The chemical formula for hubnerite is Mn_2+WO_4 and forms a solid solution series with ferberite (Fe_2+W0_4). Wolframite, $(Fe, Mn)W0_4$ is a discredited mineral name that was used for material that was classified as an iron-manganese tungstate. Specimens that contain more than 80% manganese are hubnerite and conversely specimens that contain more than 80% iron are ferberite. Ferberite has not been reported from the San Juans, but iron-rich hubnerite, labeled wolframite, occurred at scattered localities in San Juan County, especially the Little Dora mine.

The type locality for hubnerite was the Erie and Enterprise mines, Nye County, Nevada, where it occurred as coarse red-brown blades associated with scheelite and fluorite. The mineral was named after Professor Adolph Hubner, a German mining engineer at the Freiburg School of Mines, Saxony, Germany. In 1885, hubnerite was first found in Colorado at the Royal Albert mine, Ouray County, where it occurred as long-bladed, vertically striated crystals embedded in quartz.

Hubnerite occurred in Ouray County at a number of localities where it usually formed micro crystals associated with other minerals. At the Camp Bird mine it occurred as micro crystal inclusions in scheelite. The best locality in Ouray County was at the Grizzly Bear mine, where it formed beautiful free-growing micro crystals associated with quartz, rhodochrosite, pyrite, and sphalerite.

In San Miguel County, the best occurrence was in the Idarado mine where it formed ruby to dark red crystals up to 6 mm in length scattered on crystallized quartz.

The most outstanding localities for hubnerite are all located in San Juan County. The famous Sunnyside mine, known for outstanding rhodochrosite and fluorite crystal groups also produced beautiful specimens of free-growing hubnerite crystals up to 3 cm long. Most of the specimen-producing mines are in a belt along Cement Creek and locally have been called the "Cement Creek tungsten district." Commercial quantities of hubnerite in many of the veins along the belt were mined sporadically from 1900 to the 1980s. Much of the ore was hand-sorted, and the mines only operated during periods when the price of tungsten was high. Hundreds of high-quality specimens were produced over the years from this group of mines.

The premier locality for hubnerite in the San Juans is the Adams mine (aka Adams lode), located on Bonita Peak, San Juan County. At this locality, the hubnerite formed groups of long-bladed crystals up to 8 cm long. The reddish-brown crystals usually are embedded in a massive crystalline quartz and are etched with a hydrofluoric solution to remove the quartz. The resulting specimens are world-class and grace many major mineral collections.

Mining has ceased in the San Juans, but good micro crystals of hubnerite can be found on many of the mine dumps in Ouray and San Juan Counties.

Mine lighting—A hall of f(l)ame

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Flame lighting brought daylight underground to permit the mining industry to turn the nation's natural resources into sources of wealth and power. Light to extract coal from the eastern coal mines and metal ores from the western hard rock mines underwent a development of flame lighting technology that helped fuel the industrial growth of the U.S. for more than 100 yrs. Four types of flame lighting are examined in this paper: oil wick lamps, safety lamps, miners' candleholders, and carbide lamps. A Hall of Fame approach is used to identify the best and brightest of the individuals, companies, and lamps that were developed for underground use.

Records from the U.S. Patent Office provide a dated guide as to how each of these lighting types came into being, was developed, improved, and ultimately replaced with something better. The table below puts these lighting types and their patent history in perspective.

Type	Patent date range	Number of patents
Oil wick lamps	1858–1917	131
Safety lamps	1867–1938	64
Candleholders	1872–1927	91
Carbide lamps	1895–1976	316

A number of criteria were examined in this extremely subjective evaluation including industry leadership, outstanding designs or designer, elegant styles, innovative products, uniqueness, and performance, but the overriding decision for hall induction was based on the author's likes and dislikes. A nominating criterion is attached to each selectee. The number of inductees into the Hall of F(l)ame was based somewhat on the relative number of patents for that specific lighting type, but the final decisions were purely subjective. For each inductee, a selected group of photographs are included in the paper that serves as a pictorial history of mine lighting over the 100-yr period. Brief historical details for each are also identified. It is hoped that the presentation serves as an overview of mine lighting, especially for non-collectors, and can help to identify that rare lighting artifact to be found at flea markets, antique shops, grandpa's garage, or grandma's attic.

Oil wick lamp inductees

- John Christopher and George Anton—*Premier wick lamp makers in the U.S.*
- The Trethaway Brothers—Produced *most varieties of wick lamps.*
- Edward Rollins—*Patented lamp that was manufactured by 8 different companies over 40 yrs.*
- William Tunnessen—Second *largest producer of wick lamp models.*
- John James and George Grier—Early *manufacturer of a variety of wick lamps.*
- Lawrence and August Husson, Philip Knippenberg—Only *detachable and interchangeable lamp holder.*
- Honorable Mention: Beall Brothers, Martin Hardsocg, and John Dunlap.

Safety lamp inductees

- The Wolf Family of Lamps—The *mainstay of safety lamps in the U.S.*
- Davy and Clanny Lamps (American Safety Lamp and Mining Supply Co., Hughes Bros., and Everhart Brass Works)—Major *early suppliers (pre-1910) to the U.S. coal industry.*
- Ernest Koehler—First *safety lamp approved for use in the U.S. by Bureau of Mines 1915.*

Candleholder inductees

- Charles *Cleaves—Blacksmith extraordinaire.*
- John Lindahl—Most *distinctive candlestick.*
- August *Eck—Elegant and impractical design.*
- Nathan Varney—Most *prolific stick manufacturer in the U.S.*
- Ludlow-Saylor Wire *Co.—Second largest manufacturer of candlesticks.*
- Fancy *Sticks—Artistic and elegant craftsmanship.*
- Gabriel *Werntz—Mechanical ingenuity.*

Carbide lamp inductees

- Frederic *Baldwin—Father of carbide mining lamps.*
- Justrite Manufacturing Co.—Most *prolific manufacturer of carbide mining lamps in U.S.*
- Jacob Sherman—Most *successful businessman in carbide lamp manufacturing.*
- Frank Guy and George Shanklin—Most *successful association of inventor and manufacturer (Tie).*
- Frederic Baldwin and John Simmons—Most *successful association of inventor and manufacturer (Tie).*
- Ralph Arnold Most *unusual design.*
- Fred *Belt—The lamp that looks most like a hand grenade.*
- Augie Hansen—Premier *carbide lamp designer.*
- Charles *Hoppe—Designer of elegant lamps.*
- Honorable Mention: William Frisbie, Maple City Mfg. Co., Grier Bros., and Dewar Mfg. Co.

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L. E. Polhemus: Engineer, merchant, doctor, and scam artist

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Louis Polhemus is known to mining historians as an inventor and salesman of carbide lamps. He was a retail merchant in the copper mining town of Miami, Arizona, from 1915-30. He was a colorful and social character whose trademark was a pet parrot.

Polhemus reinvented himself several times, in both residence and vocation. His ancestry is traced to the Bahamas, and his youth was spent on the Texas Gulf Coast. As a young man, he declared himself an engineer, and found his first career in southern Mexico helping to develop a hydroelectric plant. After spending 15 yrs in Arizona, he traveled to Central America, and returned as a naturopathic doctor...or so it seemed. His final home was in Santa Fe, New Mexico.

This presentation will chronicle the life of Louis Polhemus as well as the artifacts that remain in his memory.

Pseudomorphs: They ain't what they used to be!

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The word pseudomorph itself means *'false form."* The *Manual of Mineralogy* by Hurlbut and Klein defines them thus: *The existence of a mineral with the outward crystal form of another mineral species is known as pseudomorphism. If a crystal of a mineral is altered so that the internal structure or chemical composition is changed but the external form is preserved, it is called a pseudomorph, or false form.* They are often downright ugly!

Pseudomorphs are found in most mineral collections and are probably the least understood of any class of minerals. Though specific occurrences have been studied quite extensively, little scientific information of them as a class is available. Yet the formation of pseudomorphs implies the original mineral becomes unstable under changed physical or chemical conditions. They can often provide valuable evidence in unblocking the geological history of the rocks containing them. They may indicate the nature and composition of circulation fluids. If stability fields of the original and replacing mineral are known, it may be possible to estimate temperature and pressure at the time of alteration.

The authors of this paper are collectors, and though in no sense professional authorities on any mineralogy subject, have tried to classify pseudomorphs into various groups according to their chemical constituents. The authors have drawn upon three well-known textbooks for collectors in developing this classification, using photos of their own specimens in the digital presentation. Those books are *Mineralogy: Concepts, Descriptions, Determinations,* Berry and Mason, 1959; *Dana's Manual of Mineralogy,* Hurlbut and Klein, 19th edition, 1977; and *Textbook of Mineralogy* by Dana, 4th edition.

The classification in general follows Berry and Mason's scheme, but with the addition of one type listed in the *Manual of Mineralogy*. There are two principal types, namely *paramorphs* in which no changes in chemistry occur, and the other in which there is addition of some element or elements and/or removal of others.

The second type is further subdivided as follows:

1. Loss of a constituent such as copper (Cu) after cuprite (Cu_2O).
2. Gain of a constituent or constituents such as malachite ($(Cu_2(CO_3)(OH)_2$ after cuprite (Cu_2O).
3. Partial change of constituents such as goethite ($Fe^{-3}0(OH)$) after pyrite (FeS_2).
4. Complete change of constituents such as quartz (SiO_2) after fluorite (CaF_2).
5. Encrustation pseudomorphs.

Berry and Mason do not list encrustation as a pseudomorph, but Hurlbut and Klein do. We have included the encrustation type because most collectors who exhibit in the Mineral Federation shows follow the display rules that allow encrustation as pseudomorphs.

A quick look at the chemical formula of both original and replacement minerals places a specimen in one of the above categories. In the case of polymorphs where there is no change in chemistry, there is a change in crystal structure. Many of the pseudomorphs in the first three subdivisions also change crystal system.

Since it is possible for remnants of the original mineral to remain in the pseudomorph, it follows that just as a change in environment causes the pseudomorphing to begin, a further change may stop the process. These changes in environment may be of several types, including changes in pressure and/or temperature, changes in availability of elements for growth or replacement, and ground water acidity changes. Oxidation chemistry plays a large part in forming many pseudomorphs. Particularly when there is a complete change of constituents, acidity is often the culprit responsible for removing the original mineral.

For the authors placing their specimens in specific categories helps them to learn and understand the mineralogical forces that caused the pseudomorphism. We hope it may also help others.

Acknowledgments

Dr. Peter Modreski has been most helpful in answering many questions about the mineralogy of pseudomorphs and searching for helpful articles about pseudomorphs. Thanks are also due him for his insightful suggestions in preparing this presentation.

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Heavy metal miners—Not a rock group: miners' tools of the trade

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The task of mining in the days before wide usage of electricity and internal combustion engines required a great deal of planning, fortitude, a new invention called dynamite, heavy iron tools, and luck. This presentation will focus on larger tools of the mining trade that often survive to stand testimony to the hard work and sometimes prosperity of the hard rock miner in the western U.S. Some of the manufacturers of these many tools will also be discussed.

Part 1: Prospectors and initial characterization of a mine—Hand tools, small buckets, windlasses, and other tools used in one-man operations. Some ghost towns will be shown as examples of unrealistic expectations or scams.

Part 2: Mine development—There will be a discussion of the influence of mail order catalogs in the early 1900s for choosing mining equipment. Shaft sinking methods and head frames, hoists, larger buckets, and incline car examples will be shown.

Part 3: Working the mine—Drilling and blasting, blasting caps and fuse, hand drills, air drills, drill poles and arms, compressors. Mucking and tramming, and carts used underground, such as flat cars, timber cars, tie cars, powder cars, latrine cars, mucking machines, air, and later Pelton wheels to produce electricity for underground lighting. Hoists will be discussed including those powered by horse, steam, electric, and gas. Stamp mills for ore processing will round out this discussion of tools.

Trials and tribulations of mining rust

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Overall history

(Lueth et al. 2004) It all started roughly 6.3-6.7 m.y. ago when the hydrothermal ore mineralization events took place in the northern section of the Chupadera Mountains in the Luis Lopez manganese district, southwest of Socorro, New Mexico. The Luis Lopez manganese district has a history of mining activity dating back to World War I and producing manganese ore (psilomelane, hollandite, coronadite, and cryptomelane) into 1970. During World War II the mines were very active, and production continued intermittently until 1951.

(Willard 1973) In November 1951 the General Services Administration under the Defense Production Act opened a manganese-purchasing depot in Deming, New Mexico. As a result production from most of the mines resumed until the depot closed in 1955. The production of manganese ore mined up to 1958 was 1.5 million tons and another 32,000 tons from 1958 to 1966 and from 1966 to 1970 was 10,000 to 15,000 tons from one mine. Active commercial mining ceased in 1970, due to increased mining costs. The production mainly came from the Black Canyon, Tower-Nancy, and Red Hill-Red Hill Extension mines (locally called the MCA mine).

Bursum mine

(Farnham 1961) "The Griffith group, also known as the Bursum, consists of nine claims...The claims were located in 1953 by the present owner W. E. Griffith of Socorro...About two years later H. 0. Bursum of Socorro obtained an option of the. During 1955 Bursum shipped several small lots of ore...to the depot in Deming. In 1957 Bursum mined about 1,500 tons, which was concentrated in the mill of Manganese Corporation of Arizona (MCA). About 119 long tons of concentrates...were recovered. In 1958 Rico Mining Company secured a sublease on the property and mined about 10,000 tons of ore, which was concentrated in the mill of Ambrosia Minerals, Inc. The resulting concentrates, 486 long tons, averaging 37.4% manganese, were sold to Socorro Manganese Company."

(Willard 1973) Goethite was also present in most deposits of the Luis Lopez ore and is a major constituent at the Bursum mine. Goethite is an orthorhombic hydrogen iron oxide ($HFeO_2$). Typically goethite is a secondary mineral derived by weathering from other iron-bearing minerals. However at the Bursum mine it formed as a low-temperature hydrothermal flow.

(Wikipedia http: / /en.wikipedia.org/wiki/Goethite) **Goethite** (FeO (OH)), (pronounced: "Gertite") named after the German polymath Johann Wolfgang von Goethe, is an iron bearing oxide mineral found in soil and other low-temperature environments...Goethite often forms through the weathering of other iron-rich minerals, and thus is a common component of soils. It may also be precipitated by groundwater or in other sedimentary conditions, or form as a primary mineral in hydrothermal deposits."

Hematite (Fe_20_3) also formed in the hydrothermal flow on contact surfaces with the rhyolite and on the outer surface of the goethite flows. The hematite glaze typically on some of the goethite is a very thin coating on top of the goethite, approximately 1/64" to 1/16" thick. However recently recovered specimens have a hematite thickness of up to 3/8" thick on top of the goethite. The specimens when buffed produce a lustrous gray-black metallic shine.

The mystery of the US 60 mine

The Bursum mine has been the name of the manganese ore mining and goethite collecting location since 1955; however, during the recent years I've heard it called the US 60 mine by several people who knew of the location. With the help of Virgil Lueth, he provided the document to which there is a reference to the US 60 mine. (Norman et al. 1983) "Hematite occurs in all deposits, but only major amounts in the Upper Tower and US 60 mines...The US 60 deposit is also known as the Bursum and the MCA deposit is also known as the Red Hill." This is the only reference I've found to where there is a mention of the US 60 mine. Why it got that name instead of the Bursum is a mystery, at least to me.

Richard's Glory Hole mine

Sometime in the spring of 2002 Ray DeMark inquired with me about the location of the MCA mine, and I said: "I'd be glad to take you there." Ray indicated he was interested in trying to find rhodochrosite, which is mentioned in the Norman reference above. After we visited there Ray wanted to go to another location nearby to collect goethite, which ended up being the Bursum-US 60 mine location. Initially I was not impressed with the material and just poked around the site while Ray spent time collecting. Later at the 2002 Mineral Symposium, Brian Huntsman was displaying some polished goethite specimens in a display case. Wow was I impressed. It was also during 2002 that I and Richard Overley developed our partnership in our business Rio Grande Rock & Gems. Certainly after the 2002 Mineral Symposium, Richard and I started collecting the goethite in earnest.

Richard and I went to the Deming Gem and Mineral Roundup Rock Show and the Albuquerque Gems and Mineral Club's treasures of the Earth sShow for the first time to sell in March of 2003. The goethite specimens were well received. Richard and I continued collecting more seriously at the lower Bursum mine location. During that spring of 2003 we noticed somebody had really been actively collecting there by digging a trench about 3 ft wide by 3 ft deep and about 10-12 ft long. A few weeks later the trench had been extended even more. Richard and I kind of felt violated after looking at the carnage! We decided that we needed to look into filing a claim. However, we didn't know how to go about it. After researching the rules and regulations of both New Mexico and the BLM, we had a grasp on what was involved. With a GPS in hand we located the area of interest, recorded the GPS coordinates, and went to the Socorro BLM office. The staff there was very helpful in finding a USGS map for the location and the forms to fill out to start a mining claim.

In filling out the BLM paperwork, it required a name for the claim. I was trying to come up with some off-the-wall name for the mine. In consulting with Richard he said Richard's Glory Hole mine, which stuck as the name for the claim. Later Richard confided that he'd not ever had anything named after him! In October of 2003 we filed our paperwork with the BLM and the Socorro County Clerk's Office. During the 2003 Mineral Symposium we let the word out that we had filed a claim on the location. As the word spread around the symposium, on Sunday, John Scully approached me in the parking lot asking "are you the guy that filed the claim on the US 60 mine?" I said with a grin "yes." During the conversation I believe that I was the first to say, "well, you had taught us a lesson." The lesson being that when a good find is made get a claim on it ASAP, as the prior spring carnage had upset Richard and me. Later on John said: "No, you taught us a lesson." As time went on I found out that it had been Rex Nelson, John Scully, and Klaus Althammer who had done so much digging that last spring. Ever since Rex and John have become very good friends with Richard and me.

From when Richard and I started the goethite digging it has been classified as a casual dig, which is 2 cubic yards of material/disturbance per year. However even a casual dig requires reclamation according to BLM regulations.

At last year's Mineral Symposium I decided that I was getting tired of just doing a casual dig at Richard's Glory Hole mine and wanted to get some heavy equipment up there. Since then it has been another learning experience.

Initially we sought to get a Dry General Permit for no more than 200 cubic yards of excavation and 2 acres of surface disturbance during a year period of time, costing only $50.00 for the permit. Last spring at the first site with Joe Mirabal (BLM) it was determined that we would exceed the Dry General Permit level of 200 cubic yards. Joe Mirabal referred us to Joe Vinson (MMD) for more site visits and collaboration with the state of New Mexico. So we started on the Minimal Impact Exploration Permit application, which allows up to 1,000 cubic yards of excavation and up to 5 acres of surface disturbance. However during March 2009 the application fees went from $100.00 to $500.00. So we spent a lot of our March rock show profits for the $500.00 fee. This September 2009 the BLM officials determined the reclamation cost would be $3,500.00 for when we complete our operations. This little thought of getting heavy equipment up to the claim has now got expensive, just to get some more rust!

Acknowledgments

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Miner's candlesticks of Colorado—Utilitarian tool to folk art

Tony Moon, Albuquerque, New Mexico

Presentation illustrates simple blacksmith examples through to three candlesticks known to be from Colorado that can be considered folk art. The presentation includes:

- Typical blacksmith-style candlesticks (good and bad!) with period photographs of them in use (all period photographs are from Colorado).
- The open loop, blacksmith-made style often found in the Leadville area and also made commercially as the "Ideal" manufactured by the Ludlow-Saylor Wire Company of St. Louis. Ludlow-Saylor also made two versions of a "Colorado" candlestick.
- Examples of the one piece candlesticks manufactured by Nathan Varney in Denver and sold under many different names.
- Examples of the patented candlesticks from Colorado patentees. There are a total of 87 miner's candlestick patents that have been identified. Colorado has the most patentees of any state at 24 (the next state is California with 11). One of these candlesticks was produced only as a patent model (located at the Ford Museum). However, 15 other patented candlesticks are known to have been produced. Some are known only as single specimens, but several were produced commercially. Examples of all 15 candlesticks have been located and photographed. Nine are from the author's collection with the remainder from collections in Wyoming and Colorado.
- Three presentation candlesticks known to be from Colorado. All are superb examples of the blacksmith's art and were never intended for use. Background information will be provided for all three candlesticks.

Basalt to wulfenite or how Arizona got so many minerals

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New ocean crust made of basalt is constantly being formed at the mid-ocean ridges. The Atlantic Ocean is growing at a rate of one or two centimeters per year. This basalt contains a small amount of metal. The amount of copper is about 100 ppm or 0.001%, the amount of molybdenum is about 2 ppm or 0.00002%, and the amount of lead is about 6 ppm or 0.00006%. There is a similar amount of gold and silver, and sulfur is present at about 800 ppm or 0.008%. Various geological processes enrich these very small amounts of metal to form the minerals that we find in Arizona.

As the basalt cools and cracks, seawater that is heated by the hot rocks, selectively leaches the metals and the sulfur from the basalt. When this hot seawater hits the cold ocean water, metal sulfides are deposited. These areas of deposition are known as black smokers. Pyrite (90% of the sulfides deposited), chalcopyrite, sphalerite, and galena are some of the minerals that are deposited at the vents of the black smokers. These sulfide deposits on the ocean floor are potential ore deposits, but they are so deep that it is not practical at present to mine them. But this process has concentrated the original 0.001% copper up to concentrations as high as 10% copper, a 10,000 times enrichment.

Sediments or volcanic rocks bury the black smoker deposits. As new ocean floor is formed the old ocean floor keeps moving away from the ocean ridge, carrying the sulfides with it. Two things can happen: The ocean floor and sulfides can be pushed up in mountain ranges as part of plate collisions, or the ocean plate can be subducted under a continental plate. When the sulfides are incorporated into mountain ranges, they are associated with metamorphism, igneous activity, and deformation (folding and faulting). They form orebodies known as volcanogenic massive sulfide deposits. In Arizona ore deposits of this type formed in the Precambrian (1.7 to 1.8 b.y. ago). The most famous of these are the United Verde mine and United Verde Extension mine in Jerome although there are other such deposits in Arizona including: the Iron King mine near Humbolt and the Old Dick mine and Copper Queen mine near Bagdad.

If the sulfide deposits are not pushed up into mountain ranges they are subducted under the continental crust. As the sulfides are buried with sediments, seawater, and ocean crust, the temperature rises until the mixture starts to melt. This melt moves into the continental crust where additional reactions can take place. The result is a complex series of intrusive and volcanic igneous rocks with associated ore deposits. The sulfur, the metals, and seawater that have been subducted make the ore forming solutions. In Arizona there is a complex history of the subduction of the Pacific plate under the North American plate. It starts about 80 m.y. ago and continues until about 20 m.y. ago when the subduction stops and the San Andreas fault forms. During this time of subduction there are two major periods of mineralization in Arizona. The first is called the Laramide from about 50 to 80 m.y. ago, and the second is called the mid-tertiary from about 20 to 35 m.y. ago. During the Laramide the major copper deposits in Arizona were formed including Bagdad, Christmas, Inspiration, Morenci, Ajo, Ray, Sierrita, Silver Bell, and many others. These are referred to as the porphyry copper deposits, as they are associated with an igneous porphyry intrusive. They are usually large with millions of tons of low-grade ore. The average copper content is around 0.5% (about 500 times enrichment over basalt) with varying amounts of molybdenum, gold, silver, lead, and zinc. During the mid-Tertiary the ore deposited contained copper, silver, lead, and gold. Some of the deposits of this age include the Silver district (Red Cloud mine), the Planet mine, the Mammoth—St. Anthony mine, Grand Reef mine, and many others. The metals in all of these deposits, Precambrian, Laramide, or mid-Tertiary, were initially deposited as sulfides. Gold is an exception to this and was deposited as native gold. Pyrite, chalcopyrite, bornite, galena, sphalerite, and molybdenite were the common sulfide minerals formed (primary ore).

When the sulfur in the sulfides reacts with oxygen in the air and ground water, sulfuric acid is formed. The metals, especially copper and iron, are dissolved in this acid solution and will percolate downward. If these solutions are neutralized, such as in contact with limestone, they will form carbonate minerals. If they reach the water table where conditions are more reducing the copper in solution will replace the iron in pyrite and chalcopyrite to form chalcocite. Chalcocite contains about 80% copper and forms rich supergene zones. In most of the major mining districts in Arizona, the early miners went for the supergene zones. They could have up to 12% copper. The present-day large copper mines are generally mining lower-grade primary ore.

Above the supergene zone and the water table is the oxidized zone. Many different minerals all containing oxygen as part of the formula can be found in this zone. There are several hundred different minerals with combinations of copper, lead, zinc, molybdenum, and other elements that can be found in this zone. The iron from the pyrite forms iron oxides, the most common minerals in this zone. The early prospectors would search for these rusty areas as clues to rich ore below. In the oxide zone the copper will form many minerals such as malachite, azurite, chrysocolla, and cuprite. Lead minerals include cerussite, anglesite, and vanadinite. Zinc minerals include smithsonite and hemimorphite.

So wulfenite (lead molybdate), that is so common in Arizona, starts as minute quantities of lead and molybdenum in basalt. The lead and molybdenum go through a series of geological processes including the formation of new sea floor, black smokers, subduction, igneous intrusions, weathering and oxidation, and eventually form wulfenite.

Thirty years of symposium presentations—A review

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It may seem as though the New Mexico Mineral Symposium has been around forever, but in reality, it was only an idea in the head of Pete Modreski in the spring of 1979. Pete discussed his idea with me, and we formed a committee composed of ourselves and Dr. Rod Ewing, at that time the chairman of the University of New Mexico Geology Department, to put the idea into reality.

The first symposium was held at the University of New Mexico. Notable attendees at that first symposium included Dr. Stuart Northrop (professor emeritus at the University of New Mexico), Robert M. North (curator of the mineral museum at the New Mexico Bureau of Mines and Mineral Resources), and Dr. Robert H. Weber (eminent geologist from the New Mexico Bureau of Mines and Mineral Resources). Speakers at the first symposium included Dr. Northrop (opening remarks), Dr. Ewing, Dr. Pete Modreski, Paul Hlava, Dr. Doug Brookins (UNM), Pat Haynes, Joe Taggart, and Dr. Gene Foord (USGS), and yours truly. The 81 attendees included four members of the Albuquerque Gem and Mineral Club (AGMC), Loyd Keller, Will Moats, Tom Schmierer, and Gary Young.

That this symposium has continued and flourished is a tribute first to Robert M. North who was able to enlist the support of the New Mexico Bureau of Mines and Mineral Resources to host and provide a venue for the next and following symposiums. The administration and financial support for the symposium by the NMBMMR was critical. With the departure of Bob North to private industry, the helm was passed to Dr. Virgil Lueth. Virgil, with the help of Bob Eveleth and the continued solid support of the NMBGMR, has given the symposium a new vitality that hopefully will continue for many years.

As for this review, it is a small sample of some of the new findings and timely information that has been presented by many speakers during the 30 yrs of the New Mexico Mineral Symposium.

Symposium	Topic presented
1. September 29–30, 1979	Mineralogy of the Red Cloud mining district, Gallinas Mountains, New Mexico • Agardite-(La) First New Mexico occurrence • Mimetite conichalcite, vanadinite, wulfenite, and mottramite–First reported from this location
2. October 25–26, 1980	Beryl at Iron Mountain, Sierra County, New Mexico • First report of beryl from Iron Mountain • Large helvite crystals from Scheelamite area
3. November 13–14, 1982	Minerals of Point of Rocks Mesa • Euhedral free-standing crystals of rare minerals found in vugs
4. November 12–13, 1983	Minerals of Point of Rocks: New findings • First report of lorenzenite and rasvumite from New Mexico • First report of sulphides (galena, sphalerite, and pyrrhotite) from Point of Rocks
5. November 10–11, 1984	Minerals of the Alhambra mine, Grant County, New Mexico • Discussion of uncommon minerals collected from stock piles in autumn, 1979
6. November 9–10, 1985	A micro mineral collector's tour of New Mexico • Twenty-eight locations briefly mentioned
7. November 8–9, 1986	A new occurrence of cyprine (blue idocrase) in New Mexico • Blue idocrase (now vesuvianite) found in Pilar Cliffs • Piedmontite, zoisite (thulite), grossular, dravite, andalusite (viridine) also found
8. November 14–15, 1987	Mining development and minerals of the Hansonburg mining district, Socorro County, New Mexico • Tennantite confirmed from Hansonburg copper mine. Olivenite and conichalcite confirmed • Recent discoveries: scrutinyite, antlerite, large selenite, and fluorite crystals from Sunshine #1 adit

Symposium	Topic presented
9. November 12–13, 1988	The Blanchard mine: New developments • Sunshine #6 adit reopened • Clarence Barrett workings smithsonite • Ore bin area specimens (wulfenite on fluorite and barite), cinnabar • Sunshine #4 discoveries (hemimorphite with cuprite and native copper, malachite pseudo after linarite, chalcanthite, and goslarite)
10. November 11–12, 1989	Minerals of the Carnahan mine, Santa Fe County, New Mexico, with Judith L. DeMark • Twenty new species added to list of minerals from the Carnahan mine (includes adamite and agardite–(y) • First reported occurrence of hetaerolite from New Mexico
11. November 10–11, 1990	New discoveries from the Cuchillo Negro, Sierra County, New Mexico • Dictator mine: large willemite crystals, smithsonite • Black Knife mine: scalenohedral calcite and pseudos with fluorite, mottramite, ramsdellite • Confidence mine: wulfenite, willemite, hemimorphite, vanadinite, linarite, and brochantite
12. November 9–10, 1991	The amazing Sunshine #1 tunnel, Blanchard mine, Bingham, New Mexico with Paul Hlava • February 1978–Linarite pseudos after galena on sale at Tucson Gem and Mineral Show • Late 1979–World-class linarite crystals discovered • 1988–Scrutinyite described; type location, Sunshine #1 adit • Caledonite confirmed and large crystal (7 mm) found • Otavite confirmed (first New Mexico occurrence with hydrozincite, pyromorphite, and corkite)
13. November 14–15, 1992	Spangolite and other secondary minerals from the Buckhorn mine, Lincoln County, New Mexico, with Paul Hlava • Noteworthy occurrence of spangolite • Twelve to thirteen species new to the mine reported (arsentsumebite needs XRD confirmation)
14. November 13–14, 1993	New developments and mineral occurrences at the Linchburg mine, Socorro County, New Mexico, with Chris DeWitt • Two new species for New Mexico–ktenasite and serpierite • Unknown zinc carbonate, sulphate, possible new species
15. November 12–13, 1994	A New Mexico fluorite dig, with Mike Sanders • Pine Canyon deposit. Located as Judith Lynn claim, April 1983 • Material erroneously reported as fluorite from Catron County, New Mexico • Dig conducted July 1–14, 1994
16. November 11–12, 1995	Carminite and other arsenates from Granite Gap, Hidalgo County, New Mexico, with Paul Hlava • First reported New Mexico occurrence of carminite • Large suite of colorful, secondary arsenate minerals and other uncommon minerals • Unknown copper arsenate found in red octahedrons
17. November 9–10, 1996	Gahnite, margarite, and other new mineral occurrences from Taos County, New Mexico, with Jesse Kline • First reported occurrence of margarite in New Mexico • First noteworthy occurrence of gahnite in New Mexico • Pilar Cliffs–fuchsite, purple muscovite
18. November 8–9, 1997	Mineral collecting in northern New Mexico • Tribute to Jesse Kline (chrysoberyl, gahnite, margarite) • Garnet altered to hisingerite • Kyanite (sillimanite) and andalusite (viridine) • Foitite • Mention of numerous northern New Mexico locations
19. November 7–8, 1998	New Mexico wulfenite • Historical locations–Stephenson-Bennett mine, Ground Hog mine, Lucky Bill mine • Fifty-five locations reported • Denver shaft
20. November 13–14, 1999	Mineral collecting in iron country • Famous mines • New discoveries • Shigaite
21. November 11–12, 2000	A new pseudobrookite location in Taos County, New Mexico, with Jesse Kline • Brushy Mountain, United Perlite Corporation open pit mine • New finds: pseudobrookite, aegirine, monazite, tridymite
22. November 10–11, 2001	Minerals of the Macy mine and other selected mines near Hillsboro, New Mexico • AKA: Percha (Macy's mine), Barking Frog, Bobbi-Dee • 1893 Columbian Exposition • Kentrolite discovery (1981)–Big Chief mine • Melanotekite

Symposium	Topic presented
23. November 9–10, 2002	Mines and minerals of Socorro Peak, New Mexico • May Flower mine • History of mines and Billing smelter • Listing of minerals
24. November 8–9, 2003	Native silver and wulfenite at the Anchor mine, Magdalena district, Socorro County, New Mexico • Silver and acanthite found on second level • Wulfenite on adit level • Other wulfenite occurrences in Magdalena district
25. November 13–14, 2004	New mineral occurrences from New Mexico's bootheel, with Paul Hlava • Apache mine–Ten new species from this location reported • Jixianite–Third world occurrence • Red Hill mine–wulfenite confirmed, pyromorphite, mimetite, and vanadinite
26. November 12–13, 2005	A review of New Mexico's great mineral specimen locations that are now lost, closed, abandoned, or otherwise extinct • New Mexico School of Mines fire, 1928 • Early eastern dealers and ads in The Mineral Collector • Listing of sites and status
27. November 11–12, 2006	Selected minerals from Grants uranium region • Mining activity from 1950s–1980 • Listing of uranium, uranium/vanadium, and vanadium minerals • Type of minerals (goldmanite, grantsite, santafeite), zippeite/uranopilite (?) • East Grants Ridge
28. November 10–11, 2007	Eminent New Mexico fluorites and collectors, with Mike Sanders • History of fluorite mining and specimen preservation in New Mexico • Obsessed and otherwise notorious New Mexico fluorite collectors
29. November 8–9, 2008	New Mexico vanadinite • History of New Mexico vanadinite discoveries and early distribution • Noteworthy locations

Tri-state mines and the Galena Mining and Historical Museum, Kansas

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The Tri-State mining region of Oklahoma, Kansas, and Missouri initially covered 1,100 square miles. The production of lead (galena) and zinc (sphalerite) ore from this area surpassed all other mining regions during its 100-yr-old history. Depending on whose report you read, the Kansas portion of the district alone produced more than 2.9 million tons of zinc valued at $426 million dollars and 60,000 tons of lead valued at $91 million dollars. There were more than 600 working mines in Galena, 45 of which were in the town itself or on the outskirts.

During the period between 1870 and 1970 some 81 communities in the Tri-State region were formed. The first towns were miner's shacks thrown together with what they could find. Later buildings constructed of local limestone, wood frame, and brick began to appear. An estimated 25,000 miners worked the mines during this period. Literally thousands of holes, which later had to be backfilled by reclamation, were dug in the Galena area known as "Hells Half Acre" and included parts of downtown. A tunnel under downtown Galena went all the way to Picher, Oklahoma, a distance of 12 miles. Of the 81 mining camps only a few remain today, including the modern cities of Webb City, Joplin, Carterville, and Carl Junction in Missouri, and Galena and Baxter Springs in Kansas. The famous mining towns of Oklahoma, such as Cardin and Picher, will soon only be a place name in history.

The host rocks for the deposits were laid down during Ordovician and Pennsylvanian times, and consist of layered, fossiliferous limestones covered by the "Boone" chert. Galena was most commonly found as a "sheet," layered in the chert. Massive galena crystals weighing tons were sometimes found in open cavities. The predominant minerals from the Tri-State region were galena (lead) and sphalerite (zinc). In the early days of mining the galena was the only mineral processed, and the sphalerite was thrown away. Later on zinc production became most important. Some copper minerals reported from the district include: covellite, cuprite, malachite, and azurite but only in trace amounts. Other minerals,such as leadhillite and linarite were reported from Granby. At Blue Mound, 20-inch-high scalenohedral crystals of calcite and dolomite were found. In addition Boodle Lane and Howard Litch found multi-colored smithsonites throughout the district. Commonly, locals would glean the old "chat" piles to make extra money by selling mineral specimens. From a present-day collecting standpoint, the chat piles are dangerous. The area abounds with uncovered and water-filled deep holes and tunnels. Sinkholes continue to develop suddenly over old stopes and tunnels. Collecting today is best achieved by "silver picking."

Howard Litch wanted to work in the mines, but his dad, being a widower, refused so Howard assisted in his dad's auto garage. Howard remained fully interested in mining after serving in World War II. He could see that one day the mining would end, and he soon amassed a large collection of equipment, memorabilia, and minerals. He filled numerous storage buildings and loaned things to other museums. Mining in the area ended in the 1970s with the closing of the mines and smelter. At the same time, the old 1903 Missouri, Kansas, and Texas (Katy) depot became vacant and was scheduled to be torn down. Howard was instrumental in getting the depot saved, and with the aid of Galena citizens and a donation of land, he moved the depot to its present location. His massive collection proudly went on display with museum doors opening in 1984. Howard

Litch (1906-1996) was designated "lifetime curator," and he lived to see the collection grow with donations and loans from many people. Although the museum is listed as Galena Mining and Historical Museum, the overhead sign at the entry reads, "The Howard Litch Mining Museum." Entry to the museum is free, and donations are welcomed. The mineral room of the museum highlights collections of both Howard Litch and Boodle Lane along with donations from others.

Born in Kansas, and a contemporary of Litch, Fred "Boodle" Lane came to Galena, Kansas, after serving in World War II. He got to know the miners and their companies and bought a farmhouse one mile west of Galena where he would give produce and cold cider to the miners coming off their shifts. He was very interested in minerals and often traded and purchased specimens from the miners. Visitors passing through town always went to his home to see what he had laid out on tables. When he wasn't helping his wife at home he was in the mines collecting "worthless minerals" like the giant calcites and dolomites. His collecting fame spread, and he traveled to both the east coast and west coast mineral shows and gave talks on Tri-State minerals. A number of his choice minerals were donated to the Smithsonian among other famous museums. If one owns a specimen from the Tri-State area, chances are it came from "Boodle." When he died his estate was sold, and a large specimen of galena and sphalerite was donated to the Galena Museum in his memory. It weighs an estimated 300 lbs and has at least 27,2-inch-diameter galena cubes on the specimen between completely terminated sphalerites.

Acknowledgments

I wish to acknowledge the memories of my friends who work in the Galena, (Kansas) Mining and Historical Museum and who have lived all their lives in Galena: Pansy Baker, Gene Russell, Joe Douffet, Bill Toney, Gary Kennedy, along with Jerry and Barbara Hichenbaugh. Thanks also to Marie Kennedy who wrote an article for the *Lapidary Journal* on her friendship with "Boodle" Lane and Gary Young who also knew "Boodle" and his superb minerals. Lastly, thanks to Joe McKenzie, who was my guide on the back roads of Oklahoma so many years ago!

Geologic settings of wulfenite in southwestern North America

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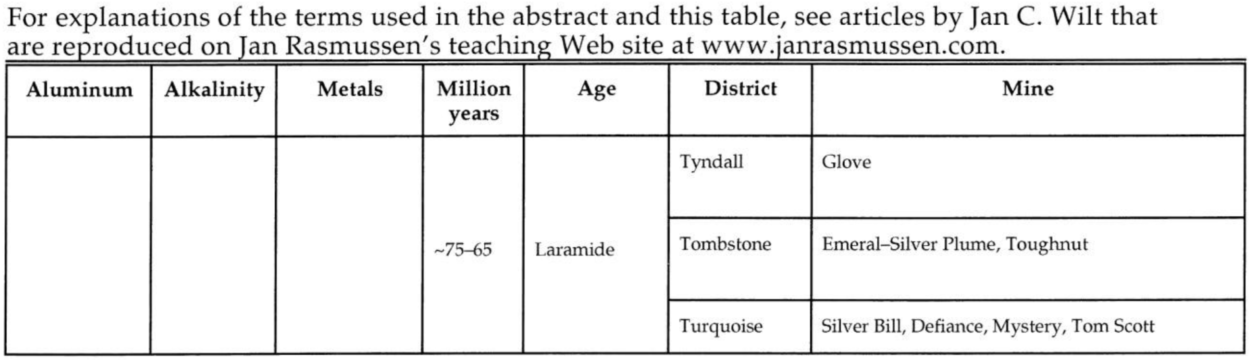
Spectacular wulfenite specimens occur in southwestern North America, particularly in Arizona. The butterscotch-colored, bladed crystals from the Glove mine in the Santa Rita Mountains south of Tucson and the bright red, chunky blades from the Red Cloud mine in the Silver district north of Yuma are prized highlights of many mineral collections. Most of these famous mineral localities are no longer available to collectors, making the historic specimens even more valuable.

Wulfenite, lead molybdate, $PbMoO_4$, forms in the oxidized zones of lead deposits where the white needle-like crystals of cerussite ($PbCO_3$) have developed. Surprisingly, the presence of molybdenite is not required. Wulfenite rarely occurs in the same mineral deposits as molybdenite, and then only in the later stages of the deposits. Even there, wulfenite does not occur unless soluble lead minerals, such as cerussite, are present. There had to be enough lead in the system in a relatively soluble mineral to allow the molybdenum in the ground water to combine with lead and oxygen as wulfenite.

Some of the most stunning collectable specimens of wulfenite occur in lead-zinc-silver districts. These mining districts are associated with igneous rocks whose whole rock chemistry plots in the alkali-calcic field in a diagram of whole rock geochemistry of $\%K_20$ versus $\%Si0_2$. Cooling of these types of igneous rocks produced hydrothermal fluids that contained lead, zinc, and silver in solution in the hot water. Other metals were sequestered in the mineral structures of the rock-forming minerals. The Pb-Zn-Ag-rich hydrothermal fluids then intruded into veins, stockworks, and fractures, and in some cases replaced limestone formations in the host rocks. The alkali-calcic districts that contain the most abundant and best specimens of wulfenite were deposited during two time periods: early Laramide (75-65 Ma) and mid-Tertiary (30-20 Ma).

Minerals associated with wulfenite in southwestern North America nearly always include cerussite, and sometimes include vanadinite or mimetite, although these latter minerals are generally found as overgrowths on the wulfenite. Wulfenite primarily occurs in the presence of and later than the lead carbonate, cerussite. The majority of the most collectible wulfenite localities are in lead-zinc-silver mining districts or in the lead-rich zones of other types of deposits. Galena has been oxidized to cerussite by circulating ground water, which may be the most likely source of the molybdenum in the molybdate. None of the mines with good wulfenite specimens contained the molybdenum sulfide, molybdenite (MoS_2). The best guide to good wulfenite localities is the presence of cerussite in lead-zinc-silver mining districts.



For explanations of the terms used in the abstract and this table, see articles by Jan C. Wilt that are reproduced on Jan Rasmussen's teaching Web site at www.janrasmussen.com.

Aluminum	Alkalinity	Metals	Million years	Age	District	Mine
			~75–65	Laramide	Tyndall	Glove
					Tombstone	Emeral–Silver Plume, Toughnut
					Turquoise	Silver Bill, Defiance, Mystery, Tom Scott

Aluminum	Alkalinity	Metals	Million years	Age	District	Mine
Metaluminous	Alkali-calcic	Pb-Zn-Ag				
					Empire	Total Wreck, Gopher, Prince (Hilton)
					Harshaw	Hardshell, Hermosa
					Vekol	Pomona
					Pajarito	Sunset
			~30–20	Mid-Tertiary	Silver	Red Cloud, Melissa, North Geronimo, Hamburg
					Aravaipa	
					California	Hilltop
					Castle Dome	Puzzler
						Hull
					Big Horn Mts.	Tonopah–Belmont
					White Picacho	Purple Passion
Metaluminous	Quartz alkalic	Au-base metal	~180	Jurassic	Warren	Bisbee (Campbell)
			~75	Laramide	Amole	Old Yuma
			~25–15	Mid-Tertiary	Tiger area	Mammoth–St. Anthony
					Painted Rock	Rowley
Metaluminous	Calc-alkalic stage 4	Late stage porphyry copper	~75–55	Mid-Laramide	Mineral Creek	79 mine, Finch
					Banner	Chilito, Christmas
Peraluminous	Calcic	Au-base metal	~1700	Precambrian	Cave Creek	Maricopa
					Hieroglyphic Mts.	Prince of Arizona

Aluminum	Alkalinity	Metals	Million years	Age	District	Mine
					White Picacho	Lucky Strike
			~175–155	Jurassic?	Western Arizona	
			~60–45	Late Laramide	Kofa	Kofa
						Vulture
					San Francisco	Ahumada (Mexico)
Peraluminous	Calc-alkalic	Base metal-W	~1700	Precambrian?	Eureka	Tungstona
					White Picacho	Outpost, Picacho View
			~175–160	Jurassic?	Cababi	Mildren, Steppe
			~60–45	Late Laramide	Campo Bonito	Three Musketeers, Bear Cat

The Boleo district—Recent investigations

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Mining in the Boleo district, near the town of Santa Rosalia, Baja California Sur, began in 1886 by a French company and continued until 1947. Subsequent to that small scale, miners continued until the mid-1970s. A modern development by both underground and surface mining is being undertaken by Baja Mining, a Canadian company. At present, development is on hold due to low copper prices.

The author and his wife have been returning at least twice a year for the past four years. We have encouraged and helped a local miner to re-enter the Amelia mine to collect boleite, pseudoboleite, and cumengeite. We have also found a rich outcrop of chrysocolla with interesting pseudomorphs south of the Amelia mine and along the same #3 ore horizon.

The marvelous agates of Luna County, New Mexico

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Ask any serious mineral collector what mineral specimen they would most covet from New Mexico and the almost universal reply would be Kelly smithsonite. However, ask any serious agate collector the same question and their almost unanimous response would be Baker Eggs from Luna County. Recent articles and editorials in the *Mineralogical Record* and *Rock and Mineral* magazines and other publications have drawn attention to outstanding agates and their collectability as serious mineral specimens. Anyone who is following the escalation in prices of fine minerals knows that exceptional minerals including fine agates are commanding higher and higher prices. This is a good time to take a closer look at what has been regarded as the stepchildren of the mineral world.

The area around Deming, New Mexico, has been known as a source for a variety of wonderful agate nodules and geodes for the past 60 yrs or more. It is home to the only state park in the country where rock hounds are allowed and encouraged to collect rocks. The Baker Egg mine in southern Luna County is well established as the source of some of the finest thunder eggs in the world. The Big Diggin's claim has produced a great variety of top quality vein agates. The Cooke's Peak area has produced its share of quality agates. This talk will be an overview of these areas and the agates they have produced. Hopefully participants will come away from this talk with a greater appreciation for some of New Mexico's most beautiful natural treasures.