MINERALS OF ARIZONA SYMPOSIUM

UARIZONA MINING, MINERAL AND NATURAL RESOURCE EDUCATION MUSEUM

APRIL 1ST, 2nd | 2022 | PHOENIX, ARIZONA

Vanadinite - Grey Horse Mine, Pinal County, AZ

Copper - Bay of Fundy, Nova Scotia, Canada

Chairperson
Les Presmyk

Co-Chairperson
Catie Carter-Sandoval

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Welcome to the 29th Annual Arizona Mineral Symposium

Les Presmyk, Flagg Mineral Foundation Board Chairman
Catie Carter-Sandoval, UArizona Mining, Mineral and Natural Resource Education Museum Collection Curator

Up until 2010, the Arizona Mineral Symposium took place in the Arizona Mining and Mineral Museum. When the museum was closed to prepare it for the centennial celebration of the State of Arizona. Since that time the Symposium has been held in several venues but this is changing in 2022. While the museum, since renamed the UArizona Mining, Mineral and Natural Resource Education Museum, is not yet open to the general public, Catie Carter-Sandoval has graciously agreed to open the doors for this year's Symposium.

As you will read very soon, the museum volunteer group, also know as the Monday Crew, lost one of its longest and most dedicated members, Charlie Connell. We are dedicating this Symposium to his memory and to honor all of the work he and his crew of volunteers have accomplished over the year. All of the mining equipment is a monument to his dedication to preserving Arizona's mining history and having it placed at this museum.

We have scheduled a micro mineral and micromounters workshop on Friday afternoon with presentations by Ron Gibbs and John Ebner. There are five mineral dealers to entice you with several new collections they are premiering at the Symposium. And there is a full schedule of presentations on Saturday ranging, from northeast Canada to the deserts of Arizona, from microscopic negative crystals to the possibility of using laser generated fluorescence on Mars. We hope you enjoy the mineral displays in the Copper Room including Bisbee minerals that continue the tribute and memory of Dick Graeme, cases of tribute to long-time collectors and Flagg Mineral Foundation members, Dawn Boushelle and Lavone Archer, along with mining artifacts and Foundation collection specimens.

We expect the museum will now be our home going forward. As you can see, the museum has a long way to go. It is truly a blank canvas and could become the premier earth science related museum in the Phoenix area, something that is sorely needed for a city the size of Phoenix. Over the years, the museum has and continues to have a group of dedicated volunteers. It will take significantly more than just this group to bring this museum back to its glory telling the story of how important all of the natural resources are to Arizona. It will millions of dollars and hopefully the fund-raising will start soon, especially not that the UArizona Alfie Norville Gem and Mineral Museum is completed and open to the public.

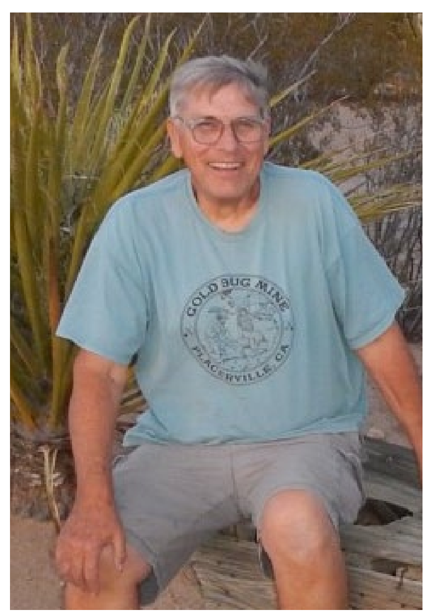
Please enjoy this Symposium. My thanks goes out to all of our speakers, Catie Carter-Sandoval, Don Boushelle for putting this proceedings together and to Bill Yedowitz for making sure the museum was ready to let all of you in.

Charlie Connell
Millwright & Monday Crew Coordinator

1947 - 2022

Charlie was born on July 29, 1947, in Albany, NY. His family home was in Voorheesville NY. Charlie's father was a sheet metal worker for the railroad and at a very young age Charlie began working with tools which led him to learn about sandblasting, metal and wood working, painting, staining and wood preservation. He also developed a love for chemistry which led to preforming adventurous experiments in the basement of the family home and worrying family members about him blowing up the house.

Charlie graduated high school in 1965 and went on to attend the Junior College of Albany, graduating in 1967. During this time Charlie needed a car to get to school. Being Chevy people the family went to a local Chevy dealer where his mother saw a car that she thought would be a good size car for young Charlie and bought it. Charlie was very lucky that his mother was only worried about the size of the car, so Charlie became the proud owner of a 1967 Camaro.



Charlie then went on to a four-year college but dropped out a few months later because he could not concentrate on his studies due to the activities of fellow students in the dormitory. Charlie went on to join the Navy as they offered him the ability to work with chemistry. Charlie was claustrophobic but ended up serving as a submariner. After his 6 years in the Navy, he began working at the Indian Point Nuclear Generating Station at Peekskill NY. While working at the station he earned his BA degree from Iona College.

Charlie and his daughter suffered from allergy problems, and he decided to move to Arizona for a better climate. He was offered a job at the Palo Verde Nuclear Generating Station by Arizona Public Service where he worked in Start-Up, Fire Protection and Quality Assurance.

Charlie joined the Arizona Prospectors Association which met at the Arizona Mining and Mineral Museum. When the museum moved to 1502 W Washington, Charlie began volunteering in 1993. Soon members from APA joined Charlie in volunteering and they became the Monday Crew. One day while in the basement of the museum Charlie saw various machine parts that he did not know what they were used for. He inquired about them and learned that they were the parts for a stamp mill. For Charlie a future Millman and Millwright was born and for all of us the rest is history.

Charlie was the heart and soul of the Mining Equipment displays at the Arizona Mining, Mineral, Natural Resource, Education Museum and other mining museums in Arizona and many other states. His knowledge of historic mining and milling equipment was extraordinary and he was an exceptional teacher to all.

Noted Micromounters, Their Mounts and Their Stories

by John Ebner

Prior to the four decades of the Victorian Era (1870 to 1910), scientists and hobbyists used glass slides as their medium of expression. With the advent of Rev. George G. Rakestraw and George W. Fiss making paper boxes for their micromounts, this all changed. Much larger specimens showing much more of the mineral featured, including more complete and perfectly formed crystalline examples rather than tiny chips which would fit under the cover glass or within the brass cell of the microscope slide. The next revolution was the introduction of mass-produced plastic boxes which offered precision and uniformity. These are still favored for micromounts today.

Thirteen of the men who were enthusiastic micromounters are discussed in some detail and examples of their mounts and minerals are shown. The men include:

George G. Rakestraw 1827 – 1904

George W. Fiss 1834 – 1925

Charles S. Bement 1843 – 1923

George English 1864 - 1944

Lazard Cahn 1865 - 1940

Frank J. Keeley 1868 – 1949

Charles Toothaker 1873 – 1952

Paul Seel 1904 – 1982

Hatfield Goudy 1906 - 1985

Lou Perloff 1907 - 2004

Neil Yedlin 1908 - 1977

Art Roe 1913 - 1993

Bill Hunt 1914 – 2014

One of these, Lazard Cahn, was a noted collector and dealer in minerals from Colorado Springs, Colorado. Cahn had a special table made so he could rotate his microscope on the table, so others could view the specimen at group meetings.

Micromineral Collecting

by Ron Gibbs

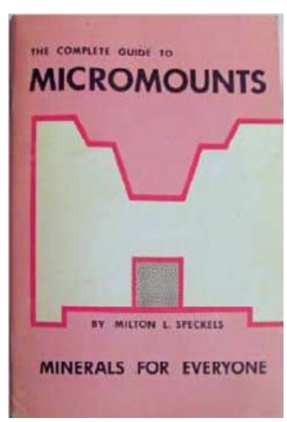
The study and enjoyment of microminerals began in the 1600's after the invention of the microscope. In 1667, Robert Hooke published a study of "minute bodies" that he observed under his microscope. This opened a whole new field to enthusiasts of the natural world. Others began to study anything that would fit under the microscope, including minerals. One of the earliest collections of mounted micromineral specimens was made by the renowned crystallographer Rene-just Hauy in the late 1700's. Microscope improved and began to appeal to a larger audience. The true hobby of micromounting began in the mid-1800's.

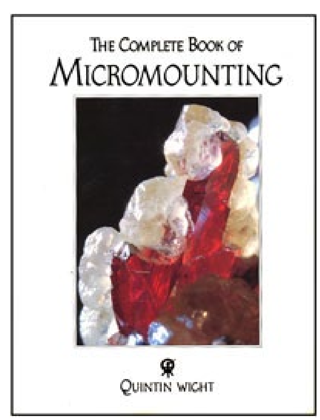
Larzard Cahn micromount, 1937

What is different today? Huge improvements in microscope technology have improved the image quality and lowered the cost bringing mineral microscopy into the home of the average collector. Photographic techniques have improved making it easy for hobbyists to share their specimens and collections with others. One of the early difficulties was determining the identity of the specimen but wet chemistry evolved into X-ray diffraction, raman spectroscopy, and scanning electron microscopy which not only made identification easier but vastly improved our knowledge of mineralogy.

Although the hobbyist does not usually have these expensive and complicated instruments, he has access to people that do and to a library of information to help him with identification. The internet has many sources of information such as mindat.org to help the collector learn about mineral localities, get lists of minerals reported, and view good pictures of what these minerals look like at the locality. Data and photos are also found at University of Arizona site, rruff.info. There are many websites offering hand lenses, microscopes, trimming equipment, tools, boxes, and just about everything a micromineral collector needs.

There are several good books introducing the micromineral and micromounting hobby. These books show you how to select, trim, and mount specimens and provide a wealth of information. The old standby is *The Complete Guide to Micromounts* by Milton Speckels published in 1965. A more detailed book is *The Complete Book of Micromounting* by Quintin Wight published in 1993.





Micromineral specimens are usually smaller than other types of specimens since the crystals of interest are also smaller, requiring magnification to truly enjoy. These specimens are usually placed in small boxes for protection and organization. Many people have specimens of various sizes which might contain many mineral species. The specimen can then be examined under the microscope at various angles to view all the species present. Sometimes the specimens are mounted in plastic boxes with putty making it easy to remove for photography or testing.

The true micromount is a specimen carefully chosen, trimmed, and permanently mounted on a pedestal or block to highlight the prominent crystals on the specimen. Care is taken to make a well-crafted mount. Micromounts are usually in a box less than 1 inch in size. This provides a safe and stable way to preserve specimens in a collection and is a good way to show off the collection.

As with all specimens, labeling is very important. Listing the important species present, associated species, locality, and source provides a record better than our memory. Small micromount boxes are usually labeled using computer generated labels printed in a small font so that the label will fit inside or on the micromount box.

In summary, why collect microminerals? There are several reasons people focus on microminerals including:

1. Size; an organized and labeled collection of 1,000 specimens takes up very little space.
2. Cost; self-collected specimens are “free” but in general, purchased specimens are much lower priced than larger specimens.
3. Variety; there are many more mineral species suitable to the micromounter compared with larger specimens since many species never occur in large crystals.

Only a few basic things are required to start a micromineral collection and then as you grow into the hobby you gather more experience, tools, and techniques:

1. Magnification, starting with a good 10X handlens.
2. Many low-cost binocular microscopes are now available and used ones can usually be found by asking other collectors or looking on eBay.
3. If you self-collect, the usual rockhounding tools are all that’s needed.
4. Trimming specimens can be done carefully with a hammer but screw trimmers or hydraulic trimmers are safer and more efficient.
5. Some cleaning tools such as brushes, dental picks, high-pressure water guns, and ultrasonic cleaners are very useful.

Arizona has many old prospects and mines, roadcuts and outcrops that provide a wealth of places for the self-collector to find exceptional and unusual micromineral specimens. There are groups of collectors associated with the Mineralogical Society of Arizona and the Tucson Gem and Mineral Society that can help the novice who is interested in microminerals.

Something to consider, nearly all the new mineral species being found today and subsequently approved by the International Mineralogical Association are microminerals. There are over 5,700 species on the current IMA list and the majority can be found or acquired as micromineral crystals. Micromineral collectors especially notice that there is a great variety among specimens of some common species. A collector of micro wulfenite crystals can soon have hundreds of habits and colors from many different localities.

Arizona Mining and Mineral Museum

by Charlie Connell

The following is a brief history of the outside exhibits constructed from 1993 to the present. This document is dedicated to the Monday Crew that spent thousands of Volunteer hours making the Outside Exhibits an operating reality. The group is still functioning and continues to support the Museum.

The photo below was taken in 2008 during the height of the museum's reign. As noted on the photo we had an accumulation of over 90 years of volunteer experience. Each volunteer contributed to the project with his/her expertise. The following volunteers were not in the picture.

Steve Sharley, retired APS Lineman, 5 years of volunteering, Roger Camplin, started January 2010, Kim Rose, retired Judge, Rick Herrem, and Bill Yedowitz.

Sadly, Kim Rose, Ev Dixon, Morris Jackson and Steve Sharley are no longer with us in body, but their spirit lives on with all of the work they contributed to the Arizona Mining & Mineral Museum.

The Museum was shuttered in April of 2011, but the Monday Crew never went away and continues to support the museum with any support requested. We spent too much time and effort making the museum what it is and will continue to support the reactivation of the museum under the new Arizona Mining Mineral & Natural Resource Education Museum. (AMMNREM)

NOTE: The group listed is the Original Monday Crew. Since the museum shuttered in 2011 we have added a number of individuals and now have over 70 members.

The following report has been compiled from information that I have saved since I first volunteered at the museum back in early 1993 and soon after the Monday Crew appeared a few volunteers at a time. There is a tremendous amount of material so I will try my best to bring out the information on each of the aspects of the Outside Exhibits.

<u>Original Members Listed Alphabetically</u>:

Rob Artac, George Busby, Roger Camplin, Charlie Connell, Eve Dixon, Rick Herrem, Stuart Harrah, John Hollas, Dave Huber, Barbara Hurst, Morris Jackson, Jerry Ohlund, Jeremy Pettingill, Kim Rose, Steve Sharley, Brian Savage, Tim White, and Bill Yedowitz.

Boras Headframe Move & Reassembly

December 1993 - May 1997

Boras Mine at Bisbee, AZ

Boras at Phoenix, AZ

Boras Mine 35’ Headframe

<u>History</u> The Boras Headframe was the last of the wooden headframes built in the Warren Mining District near Bisbee, Arizona. Erected in 1917, it hoisted over 50,000 tons of copper ores by 1926 when the mine was closed during the Depression. Production resumed in 1938 and continued to 1941. In 1952 the headframe was reconditioned and some of its wood supports were replaced with steel. Until 1975 it served as a ventilation and escape shaft for the interconnecting underground workings of the Dallas and Cole mines. The relocation to Phoenix was completed in 1997.

The shaft served by the Boras headframe was 1,034 feet deep. The hoist motor was manufactured by General Electric and rated at 521 horsepower at 550 rpm. Maximum Speed of the hoist was 1,200 feet per minute. The ride to work was a little less than a minute.

Funding The Arizona Heritage Fund and Phelps Dodge Corporation, Inc. provided restoration Funding.

Headframe Move Support Thanks to the many organizations that provided labor and materials for the project, along with APS hauling Services and Museum volunteer support, including the following:

Special thanks to the Hauling Services group of the Arizona Public Service Company for the use of their crane and operating crew. APS Hauling Services participants were Art Hamrick, John Field, Ron Beaty, Alex Boros, Bob Marino, Otis Hammonds, and George Mei.

Department of Mines supported the move under the guidance of Department of Mines Director, Mason Coggin.

Scope of the Job The Boras Headframe and hoist house were disassembled, then transported 240 miles from Bisbee to the Arizona Mining & Mineral Museum in Phoenix. The headframe arrived on site November 8, 1994.

Headframe Reassembly Once we got all of the pieces to the museum our work was just starting. We reassembled it by just reversing the procedure. One of the more challenging activities was pouring the concrete for the (6) foundations for the uprights and backstays that will support the artifact. This was no simple feat. Again APS brought a 30” auger and drilled down at least 12’. The soil in that area was sandy and the holes ended up much larger and we ended up pouring much more concrete than calculated. The standing of the main frame went well and there were no major issues.

The next part of the project was the construction of the hoist house. We poured the concrete foundation for the building and before we could construct the building we had to install the 19,600 pound double drum hoist on the foundation. Once it was in we were ready for the hoist house construction. Our original thought was to use the siding and the wood frame on the original hoist house, but it was in such bad shape we gave up on that idea. We ended up purchasing old galvanized siding and as luck would have it we found a hotel building in Mesa being demolished. One of our volunteers, master carpenter, Jeff Bawden found this unbelievable deal. To make it even better the 2X6 timbers used in this building was built in the 1920’s. With our motivated volunteers we had the building up in a matter of a few days. This completed the Boras Headframe disassemble, move and reassembly. Amen!

H & K Porter Locomotive Receipt

September 1, 1993


A crane gently lifts No. 5 from the wooden blocks in the foreground for the trip to Albuquerque. Battered, rusty and robbed of some of its parts by vandals, the old steamer will look a lot better soon.

Engine Offload at CEMCO (circa 1990)

Restored Engine at the Museum (circa 1994)

H & K Porter Locomotive

<u>History</u> The Arizona Copper Company of Morenci, Arizona purchased five of these locomotives between 1882 and 1886 to haul ore on the Coronado railroad. The H.K. Porter Company of Pittsburgh, Pennsylvania manufactured them in 1882.

Locomotive #2 ran on 20” tracks. This is 16” less than Narrow gauge, and 36 ½” less than standard gauge tracks. The small locomotive measures only 17 feet long, by 5 feet 5 inches wide and weighs just 11 tons. It was abandoned in 1923 at the top of the steep 1,200 foot Coronado Incline near Clifton along with two other locomotives of the same vintage. Phelps Dodge Morenci, Inc. recovered it in 1990 from the top of the incline at Morenci Mine and donated it to the Arizona Department of Mines and Mineral Resources.

<u>Acquisition</u> The engine was placed on loan to the museum by the Phelps Dodge Corporation Inc. Morenci. It subsequently had a cosmetic restoration at CEMCO, New Mexico in 1991 at a restoration cost ≈ $45,000 with funding provided by the Arizona Heritage Fund and Phelps Dodge Inc. Morenci.

<u>Arrival at the Museum</u> The restored engine arrived at the museum on September 1, 1993. In preparation for the engine’s arrival we put down ballast, ties and 30’ of rail and when the engine arrived it was paced on the track. Later Mason Coggin obtained (3) side dumper ore carts from Bisbee and they were hooked to the train. These were steel ore carts, but the original were of wood construction.

<u>Engine Relocation Support</u> Museum Curator, Glenn Miller, APS Hauling Services and Charlie Connell picked the train from the flatbed and placed it on the tracks that had been installed prior to the train’s arrival.

Scope of the Job: We removed the locomotive from a flatbed semi-truck using two cranes lifting at the same time. Two cranes were needed since the weight and shape of the component required both to balance and safely place it on the track. Everything went off without a hitch. This completed the H&K Porter Steam Locomotive donation, restoration, and move to the museum.

Swallow Mine Stamp Mill Move

Move April 1996 - March 2000
Restoration April 2000 – May 2007

Stamp Mill at Swallow Mine, near Briggs, AZ

Stamp Mill at 1502 Washington, Phoenix

Swallow Mine 5-Stamp Mill

Stamp Mill Operation The stamp mill was used to crush gold bearing ores and deposit the fine gold on mercury coated copper plates. It is 19 feet tall, and the large drive wheel is 7 feet in diameter. The mill is operated by a 10 horse power motor. The large metal structure at the base is called the mortar box, which contains the ore while it is being crushed. Water is used to move the materials out of the mortar box to a copper plate coated with mercury to absorb the gold as it leaves the mill. Each vertical rod (stamp) weighs 850 pounds and the stamp drops 82 to 85 times per minute from a height of 6 to 8 inches. The stamp mill operation crushes about 8 tons of ore in a 24 hour period.

History This stamp mill was originally installed during the 1890's at a small town called Briggs near Castle Creek, approximately three miles from the Swallow Mine. In the beginning the ore was transferred from the Swallow Mine to the mill, but after a few years the mill was disassembled and taken directly to the Mine. There are only two years of documented operation of the stamp mill during its service at the Swallow Mine. The first 1000 tons of material through the mill ran about $60.00 of gold per ton.

The picture to the left above taken in 1986 shows the stamp mill at the Swallow Mine before it was disassembled and brought back to Phoenix. The mill was already partially disassembled when it was donated to the museum. We moved quite a few items with the stamp mill. This include compressors, duplex water pumps, an air receiver, blower and several other smaller artifacts.

Donor The stamp mill was donated to the Arizona Mining & Mineral Museum by the owner of the Swallow Mine, Charles W. Brown of Sun City.

Move The move took from April 1996 to March 2000. Thanks to the many individuals who provided labor and materials to this project. The Monday Crew, a group of about 10 to 12 volunteers supported the move with directing the actions and making sure that we got all of the artifacts that were spread all over the mine site. Special thanks go to Arizona Public Service “Hauling Services” for their support in making this the move a reality. The following APS workers were involved: John Field, Fritz Rybenske, Doby Williams, Dave Miller, Bill Shank, Leroy Fink, Mike Northrop, and Wendy Morrison.

Scope of the Move The Stamp Mill was disassembled, then transported 120 miles from Briggs to the Arizona Mining & Mineral Museum in Phoenix. This task required the use of a hydrolift crane, flatbed trucks and knowledgeable personnel to operate the equipment and disassemble the mill.

Restoration The restoration took from April 2003 to May 2007 after we got all of the parts to the museum and did an inventory and evaluation of the scope of the restoration. This was a total restoration starting in April of 2003. The first rotation of any equipment was May of 2005. We used the original uprights and cross members, but needed to fabricate/repair many components. The bull wheel crown needed to be repaired and the jackstands wood needed to be replaced plus new stamp guides were needed and backstays constructed. The feeder needed to be totally rebuilt and a jackshaft and bearings needed to be obtained. Since we had no hill to build against we had to build a platform to gain access to the operator’s station and install an ore bin above the feeder. One of the main factors in the restoration was each component was sandblasted, primed and auto finish paint used to preserve the artifact. These were just some of the major artifacts that needed attention. Even though the restoration was completed in 2007 we continued to make the exhibit better. This completed the disassembly, move, and restoration of the Swallow Mine 5-Stamp Mill

Primary Crusher

July 2001

History The crusher was used at various mines in the Wickenburg area.

Acquisition The crusher was donated to the museum by Charlie Brown of Sun City, AZ.

Arrival at the Museum It was delivered to the museum in July of 2001.

Scope of the Job The crusher was sandblasted, painted and re-assembled. We obtained a motor and got the crusher running. It was moved twice and is shown in its present location.

Gold Wheel

Gold Wheel October 10, 2010

History There is very little information on the history of this Gold Wheel. This large device is fairly rare and this is the first one that I have seen. It functions just like the present day gold wheels in that it separates the gold from the concentrates and modern day ones are made with plastic and sheet metal and are about ¼ the size of this wheel.

Acquisition This was acquired like many of the artifacts that we received. We were called by a lady in Phoenix and told her son had passed away and she had the artifact in her back yard and wanted to get rid of it.

Arrival at the Museum We picked it up and delivered it to the museum in late 2006.

Scope of the Job We disassembled the apparatus to move it, sand blasted, repaired and re-assembled the wheel. The 4' cast iron wheel weighs over 200 pounds and was a challenge to work on. The first operation was on April 16, 2007 and we have used it quite a bit since.

Gardner Denver Mucker

Move March 1996
Restoration April 1996 - May 2008

Red Rover Mine March 1996

AMMM October 2008

History The mucker was used at the Red Rover Mine during underground operations that processed large amounts of Silver ore from about 1930's until about 1972 when the mine closed down.

Acquisition Ted Tozier, owner of the Red Rover mine donated the (2) GD-9 muckers to the museum back in March of 1996. He also donated a large amount of core samples and some other mining artifacts.

Arrival at the Museum The (2) Gardner Denver Muckers were transported separately to the museum. The picture to the left above shows Mason Coggin (far left white shirt) directing the raising of the mucker off the ground with cribbing to allow the machine to be rolled into the bed of a pickup truck. Both of the muckers arrived on site in the Months of March and April 1996. They were loaded onto pickup trucks and transported to the museum. It was quite a task to load the 4,200 pound machines onto the trucks. That is a separate story.

Scope of the Job We sandblasted, primed and painted the muckers the original Gardner Denver green. One of the muckers was given a cosmetic restoration, no disassembly, and set outside the front of the museum for display. The other mucker was disassembled repaired and restored back to operation. This took some time since both air motors operators had been sitting for almost 50 years. They cleaned up very well with only some minor air leakage. The work was just starting since we needed track laid, turn-table built and the primary crusher moved to its new location at the end of the mucker track layout and a security fence. This took years to complete the entire setup.

Honey Dipper

Move September 2002

History This Honey Dipper (sanitary cart) spent its life in the mines in Butte, MT. These devices came about through a *Department of Interior, Technical Paper 132 for Underground Latrines for Mines*. This document, was generated in 1916 to prevent the spread of diseases as a result of committing nuisances indiscriminately in a mine. In plain English, do not relieve yourself just anywhere while working in the mine. It was determined that underground latrines should be installed in mines as a protection against Hookworm infection, and as a guard against Typhoid Fever, Tuberculosis, promote general cleanliness, convenience, and safety. Up until this time the miners were using the ditches and abandon rooms in the mines. The style of the cart indicates that it was probably about a 1930's vintage.

Acquisition It was on display at the World Museum of Mining, Butte MT. They had several of the carts and were willing to place one on loan to our museum. The paperwork was assembled in December 2001.

Arrival at the Museum After some time it was brought to the museum by one of our volunteers, John Hollas. This occurred in September 2002. Since then the artifacts ownership was transferred to the museum.

Scope of the Job The only thing we had to do was to muck out the remnants of stuff out of the cart and place the Honey Dipper on some track by the H&K Porter Locomotive.

Collecting on the Bay of Fundy Coast, Nova Scotia

by David Joyce

The northeastern-most part of the Bay of Fundy, Nova Scotia has outcroppings of Mesozoic basalts and sediments, rich with zeolites and other minerals resulting from hydrothermal alteration and hydrothermal deposition of various forms of silica, silicate minerals and others such as native copper. The orientation of the basalts coupled with the presence of the highest (50+ feet) and most powerful ocean tides in the world have provided the perfect environment for the recovery of high quality mineral specimens. This presentation will cover several prime localities and the crystallized minerals that can be recovered there.

Copper - Bay of Fundy, Nova Scotia, Canada

Stilbite - Bay of Fundy, Nova Scotia, Canada

Analcime - Bay of Fundy, Nova Scotia, Canada

Negative Crystals: very small specimens that are not really there

by Dick Zimmermann

Mindat.org defines a negative crystal as “a cavity within a crystal bounded by the crystal faces of that crystal.” At the time of crystal growth, it begins as a fluid inclusion within the crystal and has a rounded or irregular shape. The fluid usually contains dissolved gases such as CO_2 or methane as well as liquid, and may also contain dissolved minerals other than the mineral comprising the host crystal. If the pressure, temperature, and solution concentrations are suitable, the void in the crystal may eventually transform into a negative crystals. This happens because a curved or irregular crystal surface has higher surface energy than a flat surface. According to the Wulff theorem (construction) the flat surfaces that develop are aligned with a crystal form consistent with the chemistry of the host crystal. The result is a void that has the shape of a small crystal and still contains the fluid and other dissolved minerals that were in the initial irregular or spherical inclusion.

Most fluid inclusions do not become negative crystals, but fluid inclusions themselves are extremely common. At a high magnification of 1000x, fluid inclusions can be found in nearly all rock and mineral samples. Milky quartz may contain over 100 small fluid inclusions per cubic centimeter. The literature shows that most fluid inclusions are not round. Usually, they have one or more flat sides and an irregular shape, with curved areas between flat surfaces. This indicates many fluid inclusions begin the transition to a negative crystal form during crystal growth, but do not complete it during the limited period of favorable conditions.

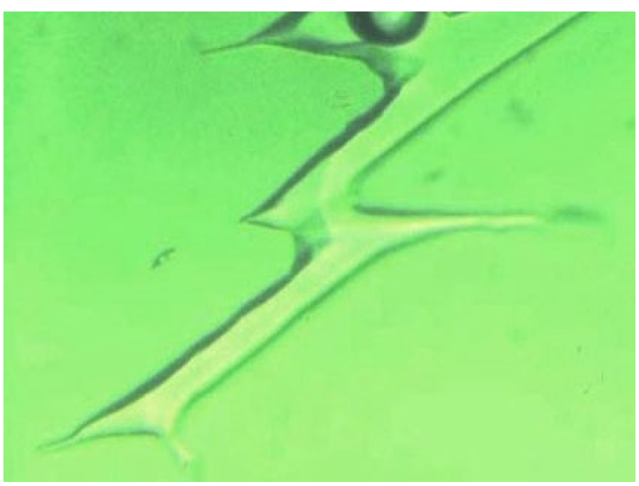
As the fluid in the void cools, gasses may come out of solution and form a bubble in the void. If the fluid solution contains minerals other than that of the host crystal, small crystals of the other minerals may also form within the negative crystal. They are known as “daughter crystals.” Sometimes, negative crystals contain a half dozen or more daughter crystals, one or more liquids, and a gas bubble. Common liquids are water and petroleum.

All of this is usually contained in a very small void. Negative crystals are typically measured in millimeters or even micrometers. Like very small crystals, small negative crystals are often very perfectly formed. It they are not, it is because suitable conditions (temperature, pressure, and solution concentrations) did not persist long enough for the transformation from fluid inclusion to negative crystal to be completed.

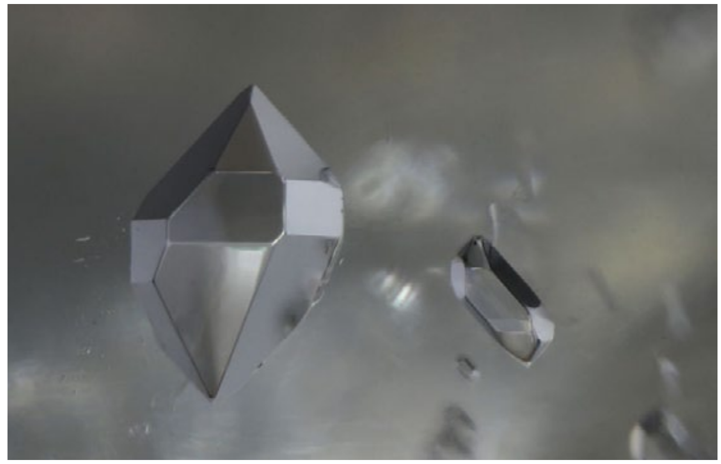
The initial fluid inclusions may form in a variety of ways. They include starvation of nutrients at the centers of crystal faces, irregularities formed by very rapid growth, etching during interrupted growth, and obstruction by foreign material on the crystal surface. Fluid inclusions may also form if the crystal is cracked and surrounding fluids enter the crack. Fluid inclusions formed due to cracking are called secondary inclusions. The relative position of a sequence of negative crystals usually reveals their origin. If they are aligned with a face the host crystal would have had at some time during its growth, they are primary. If they are not, they lie along a crack and are secondary.

Although not as easily viewed, negative crystals form in opaque minerals as well as transparent ones. They are identified by x-ray or by microscopic examination of a cleaved surface.

The fluid contents of negative crystals may be under very high pressure if the crystal captured them during high pressure, hydrothermal growth. Therefore, the crystal around the void is under high stress when the ambient pressure dissipates. There are reported incidents of negative crystals exploding when a crystal is faceted and the stress in the remaining crystal material is thereby increased due to the removal of surrounding material.



Because they are usually not visible without magnification, negative crystals do not attract the attention of most mineral collectors. They are however, of great interest to geologists and gemologists. Because negative crystals contain a sample of the material that was present when the crystal grew, they contain information related to the formation of rock and mineral deposits. That information can help mining companies locate ore bodies and petroleum companies locate oil reservoirs. Gemologists also examine fluid inclusions very carefully. In addition to using fluid inclusions to verify the source and authenticity (natural or lab grown) of gemstones, they sometimes feature larger inclusions in cut stones to add interest to a piece of jewelry. Inclusion photos in the literature show that gemologists are more skilled in photographing inclusions than geologists are, and/or may have better equipment. Whatever the reason, they do tend to produce higher quality microphotographs of negative crystals.



Determining whether some inclusions are a negative crystal or a solid inclusion of a different, transparent mineral can be difficult. In some cases, it is not possible to do so by visual examination, even with magnification. Certain optical techniques, such as ones that can detect possible bifringence in a solid inclusion, may detect the difference. However, in some cases, only chemical analysis of the inclusion contents can determine the difference. Raman spectroscopy is usually able to provide the necessary information on inclusion chemistry.
Another clue is the form of the cavity in the host crystal. If it is not a form that the host mineral could have developed under some condition of temperature and pressure and solution chemistry, then the cavity is not a negative crystal. The cavity is also not a negative crystal if it is not aligned with a host crystal axis. In either of the former cases, the inclusion is a solid inclusion of a transparent mineral. However, if the cavity contains bubbles, then it is obviously a negative crystal.

A unique feature of negative crystals and fluid inclusions in general, is that their appearance may change with temperature. Warming may cause bubbles to shrink or vanish as gas is dissolved into the liquid. Warming may also cause daughter crystals to disappear as they dissolve.

When aware of them, mineral dealers and collectors often call all fluid inclusions enhydros, but the scientific literature does not. The American Geological Institute's Glossary of Geological Terms (Bates and Jackson, 1987) defines an enhydro as "a hollow nodule or geode of chalcedony containing water, sometimes in large amounts." In the scientific literature, the term "negative crystal" is reserved for a fluid inclusion with euhedral surfaces that is usually quite small.

Although usually unnoticed by dealers and collectors, an awareness of negative crystals can add considerable interest to a crystal collection. Given appropriate magnification and photography equipment, photomicrographs of negative crystals can reveal aesthetic features that may rival the beauty of the host crystals themselves. Some microphotographs of negative crystals are actually sold by art dealers.

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Vanadinite in Arizona

by Raymond Grant

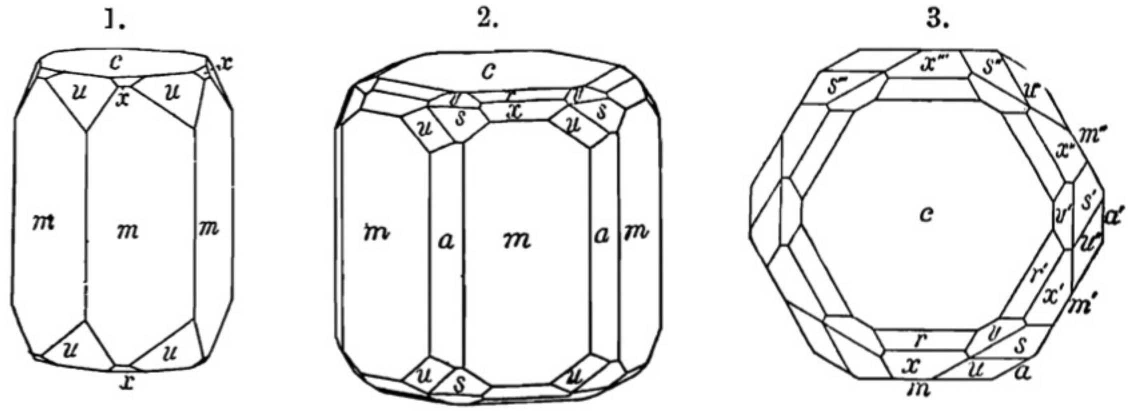
Vanadinite - Grey Horse Mine, Pinal County, AZ
Les and Paula Presmyk collection

Vanadinite is found in 13 of the 15 counties in Arizona and well over a hundred localities have been reported. One of the earliest reports of vanadinite from Arizona is by Benjamin Silliman in the America Journal of Science in 1881. He writes about Arizona vanadinite from the Silver District in Yuma County: "I have obtained vanadinite of remarkable beauty of color and perfection of crystalline form". He also states, "This hitherto rare species promises now to be comparatively abundant." Geo. L. English & Co's Catalog of Minerals in 1890 has the following: "The specimens from the Hamburg and other neighboring mines in the Silver District, Yuma County, are unquestionably the most beautiful Vanadinites in the world. Mr. English visited this district in May 1889 and secured by far the largest and most varied lot of specimens ever shipped from Yuma County. As already noted our stock of Vanadinite is very large."

Over the next 50 years many vanadinite localities were found and in 1942, Arthur Flagg wrote an unpublished report, Vanadium Report Book I to Book VIII for the Arizona Department of Mines and Mineral Resources. He described about a hundred localities for Arizona, essentially most of those known today. This was in response to the need for vanadium in World War II to make a hard steel alloy. Only a small amount of vanadinite has been mined in Arizona for vanadium ore.

One problem is that many mines in Arizona have multiple names so specimens from the same locality will have different labels. A good example is a vanadinite locality in Superior. Vanadinite was described in 1884 by Francis Blake from the "Black Prince Mine," Pioneer Mining District, Pinal County, Arizona. The Goodwin collection at the Arizona Mining, Mineral and Natural Resources Museum has a specimen labeled Hancock Arizona That I believe is the same locality. More recent specimens from there are labeled Olsen Mine. The Arizona Geological Survey Mining files do not have any of these names but have a file for the Roosevelt Group with Arizona Hancock and Columbia Roosevelt as alternate names and in the report list Bob Olsen as an owner of the mine. So, for this one locality we have Black Prince, Hancock Arizona, Arizona Hancock, Roosevelt, Columbia Roosevelt, and Olsen as names at different times.

The localities that have produced the best vanadinite specimens and are best known to collectors include the Apache Mine, Gila County, the Hamburg Mine and Pure Potential Mines, La Paz County, the Western Union Mine, Mohave County, the Old Yuma Mine, Pima County, the Grey Horse Mine, Pinal County, and the J. C. Holmes claims, Santa Cruz County. Good specimens have been found at many of the other localities but not in as large amounts.



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Vanadinite – Field Collecting in Western Arizona

by Mark Hay

The 1980's and 90's were a good time to field collect vanadinite in Arizona. The classic producers like the Apache and Old Yuma mines were held by private specimen recovery operations and were off limits to weekend collectors. However, there were numerous other occurrences to be found by those willing to do the leg-work.

Vanadinite localities that were found or rediscovered in these years include the JC Holmes, North Geronimo, Puzzler, Ramsey and Western Union. All of them produced collector quality specimens of vanadinite. This presentation will focus on three of them:

- Puzzler Mine, Castle Dome Mountains, Yuma County
- Ramsey Mine, Plomosa Mountains, La Paz County
- Western Union Mine, Cerbat Mountains, Mohave County

Vanadinite - Puzzler Mine 6 cm across

Vanadinite - Western Union Mine 4.3 cm tall

Vanadinite - Ramsey Mine 7.3 cm across

Bio

Mark grew up in southwest Colorado where he developed a love of mountains, rocks and nature. His family moved to Scottsdale when he was in high school. After graduating from Arizona State University with a degree in geology, he worked at the Magma Mine in Superior, Arizona. Magma was an underground, hardrock copper mine known for its beautifully crystallized specimens of barite, calcite and pyrite. It was there that his interest in mineral collecting began. That was over 40 years ago. Today, he specializes in Arizona minerals but has an appreciation for minerals from anywhere. He and Dick Morris, his long-time partner, did extensive field collecting in Arizona starting in the mid-1980s. This led to Minerals of Arizona, a retail mineral business he shared with Dick. Additionally, Mark has authored or co-authored numerous articles for the Mineralogical Record.

Hidden Treasures of the Natural History Museum of Los Angeles County

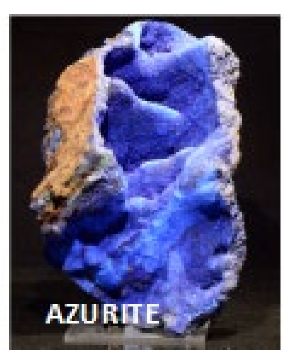
by Stan Celestian

Like any large museum the Natural History Museum of Los Angeles County has many more specimens than can possibly be displayed. Thousands of wonderful specimens are thus held in storage for possible future displays, research or other educational purposes. The Museum's storage of specimens includes many display-worthy crystals, as well as wonderful gemstones. Many of the specimens are unique in provenance, association or crystal form. My presentation focuses primarily on cabinet sized specimens although the Museum is home to thousands of thumbnail specimens and many thousands of micro-minerals.

I am uniquely poised in space and time to access these amazing specimens and to photographically capture many of these specimens to create a Museum resource. To date I have created 1297 images and have posted onto my Flickr website in an album called "Natural History Museum of Los Angeles". Here is a link to that album:
https://www.flickr.com/photos/usageology/albums/72157670924944275

Also, in no small way, I am well qualified to recognize geologically significant and interesting specimens, due to my 40+ years of geology education, being a mineral dealer, as well as being an avid rockhound. Additionally, I have a degree of experience as a macro photographer.

Sadly, my qualifications would not grant me access to the back rooms of all of the world's top museums. My relationship to the Natural History Museum of Los Angeles County is rather unique in that the Curator of the Gem and Mineral Hall is my son, Dr. Aaron Celestian. He has a great deal of trust in me, and I have a great deal of respect for every mineral, rock or gemstone I come across and handle at the Museum. Also of significance is the fact that I volunteer at the Museum (I work for free), and I take the curator to lunch daily.



Laser Stimulated Fluorescence from Earth to Mars

by Tom Kaye

Fluorescence is well known in the mineral community and laser stimulated fluorescence (LSF) is widely used in biology on organic molecules. In the past decade, the development of near-UV lasers with high power have become available and affordable. The laser, in particular, is powerful enough to produce fluorescence in minerals that are virtually undetectable under lamp-based UV stimulation and can image fluorescence at great distances.

For the past 7 years my team has been developing LSF imaging techniques. A custom laser scanner has been developed that is small enough to take in the field at night, or deep into caves (Fig. 1). The laser beam is spread out into a line using a special lens, then the vertical line is scanned sideways across the area of interest while a camera does a time exposure. A blocking filter keeps out the intense laser light and only allows the fluorescence to show up in the picture. Post processing then maximizes the number of colors in the image so one hue does not dominate the others.

Typically, the technique is used on well preserved fossils to detect preservation of skin and soft tissues unseen in white light (Fig. 2). This has led to some amazing discoveries including the first body outline of a feathered dinosaur from actual data. The technique has also found applications in long range imaging of cave formations where a large wall of cave fluorescence can be imaged, and comparisons of the different colors can tell things about the evolution and growth of the speleothems (Fig. 3). Our most advanced technique uses an autonomous night flying drone equipped with a laser and video camera to scan the badlands at night looking for fluorescent fossils (Fig. 4).

Fluorescence in minerals comes from contaminates that induce defects in the mineral lattice. Even at the parts per billion level, fluorescence can still be detected with this simple tool. In essence fluorescence is an extremely sensitive geochemical analytical technique and at the parts per billion level, cannot be duplicated in a small handheld device. The downside is that the color of the fluorescence is not necessarily characteristic of a particular chemistry but differences in color confirm a difference in geochemistry that may identify the need for further investigation.

Experiments have shown that the laser can fluoresce rock faces up to half a mile away. It has also demonstrated the ability to identify outliers in an otherwise homogenous looking group of minerals or formations. For this reason, we conclude that this type of laser system would be well suited to work at night on Mars when no other science is happening. Its ability to distinguish rare and unusual targets in the landscape would be extremely useful to make new and exciting discoveries. The fact fossils often glow differently than the surrounding rock, suggests that fluorescence may be a premier way to detect remnants of past life on other planets.

Fig. 1. Typical LSF setup: SLR camera with laser blocking filter, scanning laser on tripod that is motorized to scan left and right using hand control. This setup was taken underground to image cave formations.

Fig. 2. Toe and claw of small, feathered dinosaur from China. LSF shows tremendous detail in the footpad and scales only revealed by fluorescence.

Fig. 4. Autonomous night flying drone equipped with 405nm laser, low-light video, LiDAR for altitude control, GPS and strobe light to record position on the ground. Deployed to search for fossils in the badlands.

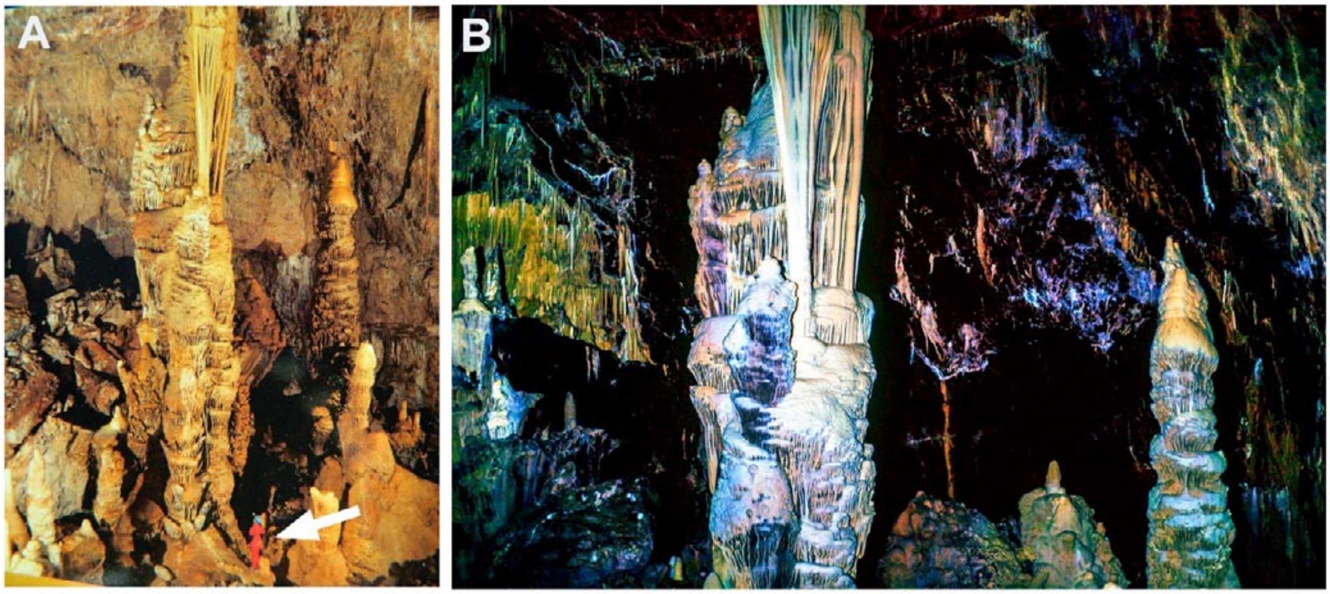


Fig. 3. Large scale LSF imaging in Kartchner Caverns. (A) Image in white light of cave column. Named “Kubla Kahn”, it is 50 feet high and not accessible to humans. (note arrow showing human for scale). (B) Kubla Kahn fluoresced with LSF at a distance of ~100 feet. Differences in color shows growth sequences.

Related publications with details on our work can be found at: Researchgate.net
researchgate.net/profile/Thomas-Kaye-2

Mineral Lighting
How your minerals, your lights, and your eyes all interact

by Anthony Gleckler, Ph.D.

While anyone can point a light onto a rock, getting your specimen to look right is surprisingly hard—and getting it to look right for all the specimens on your shelf tends to be a frustrating endeavor for many mineral collectors.

The reason for this difficulty is that multiple factors affect the optimal viewing of a mineral, of which most people only understand a few. Your lights, your minerals, and your eyes all interact to produce a combination of effects that impact your viewing pleasure…or displeasure. Properly lighting your minerals is a surprisingly difficult task that we seek to simplify.

We start with the fundamental part of seeing. In other words, how the human eyes works—at least as far as viewing minerals is concerned. What catches your eye? What allows your eye to see your minerals better? How are colors perceived?

After that, we discuss the various types of lighting available: halogens, fluorescent bulbs, and the popular "white light" light-emitting diodes (LEDs). What most don't understand is that most "white lights" may fool your eye and appear white, but they are not. We demystify this assumption and explain how different lighting types affect the color and look of your minerals.

Using the information on lighting and how the eye works, we then provide information on how to light your minerals, what kind of lights to order, and how much light should you put on your minerals. This comes with Tony's three big rules on mineral lighting, which will aid you in understanding the things to look out for when designing and installing your own lighting.

About the speaker

Dr. Gleckler has his Ph.D. in Optical Sciences and is the CEO of GEOST, an aerospace company that builds optical sensors for spacecraft. In his spare time, he is an avid mineral collector as well as a mineral photographer. He's given talks on mineral lighting to museums and groups, all with the purpose of better educating the community and enabling people to enjoy their rocks even more.

The Mines and Minerals of the area surrounding Pearce & Courtland, Cochise County, Arizona

by Anna M. Domitrovic
Earth Sciences, Mineral Curator *Emerata*
Arizona-Sonora Desert Museum, Tucson, Arizona

At the 17th Annual Symposium in 2009, I presented a program on the Turquoise District, Courtland and Gleeson, Cochise County, Arizona. I am revisiting that District but eliminating Gleeson and adding Pearce. Pearce is an unincorporated community, along with Sunsites, in the Sulfur Springs Valley on the eastern flanks of the Dragoon Mountains. The ghost town of Courtland is also on the eastern flanks of the Dragoons, about 10 miles south of Pearce. Pearce was named after a Cornishman, James Pearce, who discovered gold at would be the Commonwealth Mine. While the gold discovery established the town of Pearce, it was silver that made the Commonwealth a major silver producer from the late 1800's to pre-World War II. A post office was established in Pearce on March 6, 1896. The railroad came through in 1903. By 1919, the population was about 1,500. The 2010 census noted a population of 1,983, which included Pearce and surrounding areas, all of which share the same current zip code.

Courtland was named after Courtland Young who was a part owner of the Great Western Mining Company which operated in the area, along with at least three other companies. At its peak, about 1909, Courtland had a population of nearly 5,000. At that time, the town boasted such amenities as a bakery and ice cream parlor, a car dealership and a baseball field and horse racing track. The rush to mine in the Courtland area only lasted about 10 years. But the post office, established on March 13, 1909, did not close until September 30, 1942.

Regionally, mineralization occurred in volcanic rocks (tuffs and basalts) of Cenozoic age, about 7–40 mya. In Pearce, mainly the Commonwealth Mine, mineralization was discovered in veins and fault zones and included silver and gold halides and some sulfo-salts and manganese. Mining operations included shafts and about 20 miles of underground workings. And the mines surrounding Fluorine Hill produced fluorspar and silver-bearing silica rocks. Some uranium minerals were associated with the fluorspar with minor silver and gold in veins. Workings were mainly surficial with some underground work from a single shaft.
The Courtland mines exploited copper and lead-zinc-silver deposits and near-surface resulting in oxidation mineralization. While some workings were surficial, much of the ore production came from the underground. A few of the more notable mines in the Courtland area include the Last Chance and the Mystery Tunnel, an extension of the Silver Bill Mine in Gleeson.

THE MINES - PEARCE, COCHISE COUNTY, ARIZONA

COMMONWEALTH

FLUORINE HILL

LITTLE MARY

PITTSBURG

THE MINES - COURTLAND, COCHISE COUNTY, ARIZONA

CASEY

CYCLONE

GOLD BAND

LAST CHANCE

MONA

MYSTERY TUNNEL

THE MINERALS - COURTLAND, COCHISE COUNTY, ARIZONA

The species listed in BOLD are documented in the Permanent Mineral Collection at the Arizona-Sonora Desert Museum. MinDat lists nearly 100 additional valid species for the Courtland area.

Allophane

Anglesite

Aurichalcite

Azurite

Birnessite

Calcite

Cerussite

Chrysocolla

Conichalcite

Cuprite

Cyanotrichite

Galena

Hematite

Hemimorphite

Jarosite

Limonite

Malachite

Manganite

Microcline

Mimetite

Plattnerite

Pyrite

Quartz

Rosasite

Smithsonite

Spangolite

Sphalerite

Tenorite

Todorokite

Turquoise

Wulfenite

THE MINERALS - PEARCE, COCHISE COUNTY, ARIZONA

There are no species documented in the Permanent Mineral Collection at the Arizona-Sonora Desert Museum. MinDat lists an additional 30 – 34 species from the mines in the Pearce area.

Autunite (?)

Calcite

Chlorargyrite

Feldspar

Fluorite

Halides

Hematite

Gold

Manganese

Quartz

Sericite

Siderite

Silver

Sulfo-salts

Turquoise

Uranophane (?)

PRINCIPAL REFERENCES

Arizona Place Names
Arizona-Sonora Desert Museum Permanent Mineral Collection
Ghost Towns of Arizona, the Sherman's
MinDat
Wikipedia references on Courtland and Pearce