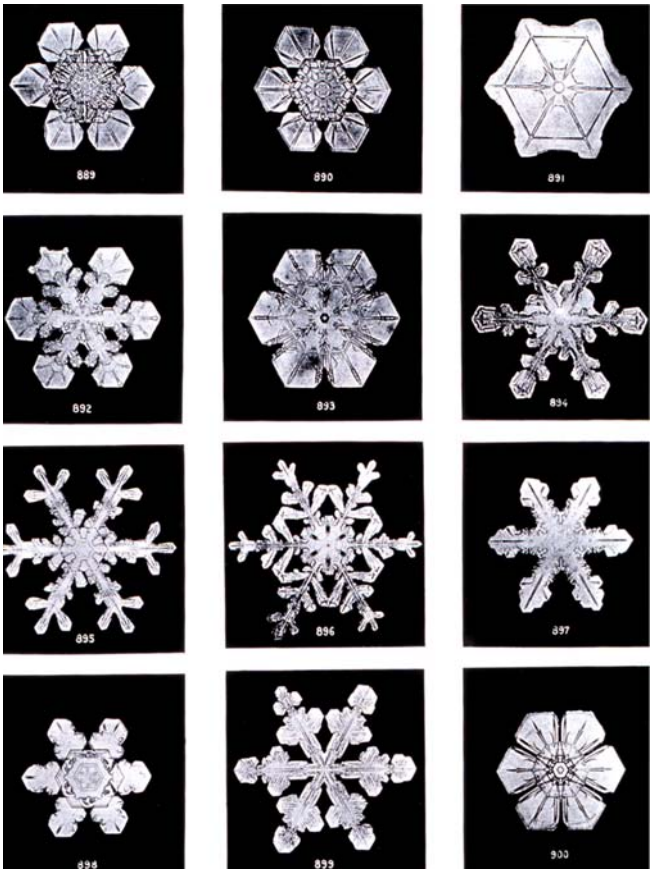
Mini Miners Monthly

Vol. 8 No. 2 **A Monthly Publication for Young Mineral Collectors** February 2014



Let it snow, Let it snow, Let it snow!

Mineral collectors should be the happiest people in the world this winter. Crystals are falling all around us week after week. From Georgia to Maine, ice and snow have been piling up everywhere.

While Mini Miners are out making snow angels and snow forts, Moms, Dads and neighbors are shoveling tons of minerals - over and over again!

How can snow be a mineral? Simply because it meets the definition of a mineral: it is a natural substance with a regular chemical formula; it is not made by humans and is inorganic (which means it is not a piece of a living organism like a plant or animal); AND it has a regular crystal form: snow crystallizes in the hexagonal crystal system. Hex- is Latin for "six": snow shows beautiful six-fold symmetry. Look at these crystal photographs (yes, they are photographs, not drawings) by Wilson Bentley. Wilson Bentley was a farmer who photographed snowflakes as a hobby. He was so good at photographing snowflakes that he was known as "The Snowflake Man." These snowflakes are from "Studies Among the Snow Crystals." (The picture is Public Domain.)

> Snow?
> A mineral?
> Can you say "hexagonal system"?

And if you live where there is no snow, or you want even more of it around you, you can visit any of these websites to learn how to make some really cool (get it??!!) paper snowflakes:

http://www.instructables.com/id/How-to-Make-6-Pointed-Paper-Snowflakes/
http://www.highhopes.com/snowflakes.html

In honor of the Tucson Gem & Mineral Show™ we are presenting in this issue sample pages of the mineral activity books that have been published for this world-class show. Last month we shared pages from the first 8 years of these publications. This month we are pleased to share with you samples from the last 8 - including some pages from this year's special theme: *"60 Years of Diamonds, Gems, Silver and Gold."*

Earning Your Cub Scout Geology Belt Loop

By Emma Fajcz

Figure 1: From left to right: Gareth Ireland, Michelle Haggerty, Connor Haggerty, and Nolan Hartley. Mrs. Haggerty is the Den 6 leader.

My local gem and mineral club had six Webelos I Cub Scouts, in fourth grade, Pack 207, come to the January 27th, 2014 meeting to get some help from the club members to earn their Geology activity badge. If you are a Webelos scout or know one, I will be giving an example of how to answer the three requirements to get your Cub Scout Academics Geology belt loop, which you can earn in addition to your Geology activity badge.

To earn your Geology activity badge, you must complete five of the following:

1. Collect five geologic specimens that have important uses.
2. Rock and minerals are used in metals, glass, jewelry, road-building products, and fertilizer. Give examples of minerals used in these products.
3. Make a scale of mineral hardness for objects found at home. Show how to use the scale by finding the relative hardness of three samples.
4. List some of the geologic material used in building your home.
5. Make a drawing that shows the cause of the volcano, a geyser, or an earthquake.
6. Explain one way in which mountains are formed.
7. Describe what a fossil is. How is it used to tell how old a formation is? Find two examples of fossils in your area.
8. Take a field trip to a geological site, geological laboratory, or rock show. Discuss what you learned at your next Webelos den meeting.
9. While you are a Webelos scout, earn the Cub Scout Academics belt loop for Geology.

The following are three requirements you must meet to earn your geology belt loop.

1. Explain to your den or an adult family member what *geology* means.
2. Collect samples of igneous, sedimentary, and metamorphic rocks. Explain how each was formed.
3. Collect samples of three minerals. Explain to your family or den what a mineral is and show and tell about the minerals you collected.

Figure 2: The Webelos Colors. The Geology activity pin is on the green rope.

Here are my examples of how to answer these three requirements.

1. The Merriam-Webster online dictionary's first definition of geology is "a science that studies rocks, layers of soil, etc., in order to learn about the history of the Earth and its life."[1] This means that geologists learn all they can about their field of study: rocks, minerals, fossils, volcanoes, earthquakes, groundwater, mountain formation, petroleum, or natural gas. Geologists try to determine what, when, how, where, and why certain things happened in the earth's past and relay that knowledge to others.

2. When lava or magma cools, it forms *igneous* rock. Molten rock below the earth's surface is called magma, and molten rock above the earth's surface is called lava. Three examples of igneous rock include obsidian, basalt, and granite. Stone Mountain, in Georgia, is mostly made of quartz monozonite, a type of granite.[2]

Igneous or sedimentary rocks subjected to extreme heat and enormous pressures, such as heat from magma or pressure from the plates of the earth's crust, can change into *metamorphic* rock. Marble, slate, and gneiss are metamorphic rocks.[3] The statue of Lincoln, located in the Lincoln Memorial, is made out of marble.

When erosion begins to work on a rock, it breaks off tiny pieces of that rock. These tiny pieces are called sediment. The sediment gets deposited and eventually hardens, forming *sedimentary* rock. Sandstone, shale, and breccia are three kinds of sedimentary rock. The Hopewell Rocks in the Bay of Fundy, New Brunswick, Canada contain some sandstone.

3. Next, I will discuss three of my favorite minerals from my collection. A mineral is an inorganic substance, made up of elements, that often combines with other minerals to create rocks.

- Malachite — I got this specimen from a rock shop in Elora, Ontario, Canada several years ago. Malachite, a beautiful green mineral often used in jewelry, contains the elements copper, carbon, oxygen, and hydrogen. Many malachite specimens come from the Democratic Republic of the Congo, a country in Africa.

- Chalcedony — This mineral is a microcrystalline variety of quartz. It occurs in numerous colors, including blue, green, black, and brown. In Victorian times, onyx, a variety of chalcedony, was used to make cameos. I purchased my specimen of Holly Blue chalcedony at a rock and mineral show in Jacksonville, Florida.

- Peridot — Peridot is the name given to olivine that is of sufficient quality to cut and facet for jewelry. I thought it was interesting that "it [peridot] is one of the "idiochromatic" gems, meaning its color comes from the basic chemical composition of the mineral itself, not from minor impurities, and therefore will only be found in shades of green. As a matter of fact peridot is one of the few gemstones found in only one color."[4] I bought my specimen of peridot from a rock and mineral show in Jacksonville, Florida.

Now you should have a better idea of how to fulfill these three requirements. Webelos scouts, have fun earning your Geology activity badge or belt loop!

Photography Credits: James and Brooke Fajcz

Footnotes

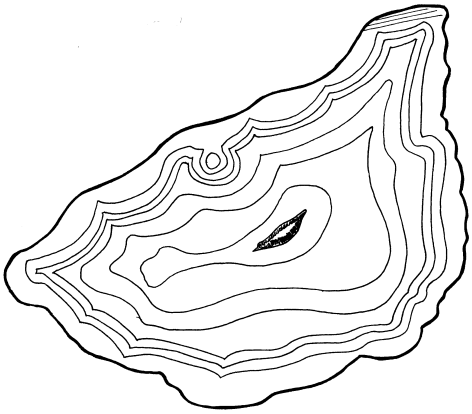
1. http://www.merriam-webster.com/dictionary/geology (accessed 1/29/14)
2. http://en.wikipedia.org/wiki/Stone_Mountain and http://en.wikipedia.org/wiki/Quartz_monzonite (both accessed 2/2/14)
3. http://skywalker.cochise.edu/wellerr/GLG101/GLG101-metamorphic-rocks.htm (accessed 1/29/14)
4. http://www.gemselect.com/gem-info/peridot/peridot-info.php (accessed 1/31/14)

The 52nd Tucson Gem & Mineral Show™
Presents . . .

Gems & Minerals of Canada

This book is presented to you by the Tucson Gem & Mineral Society.

Agate

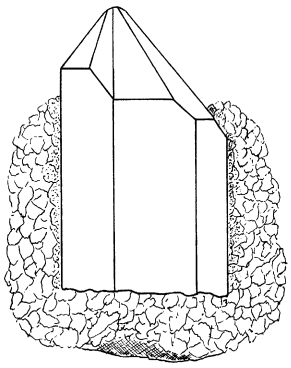


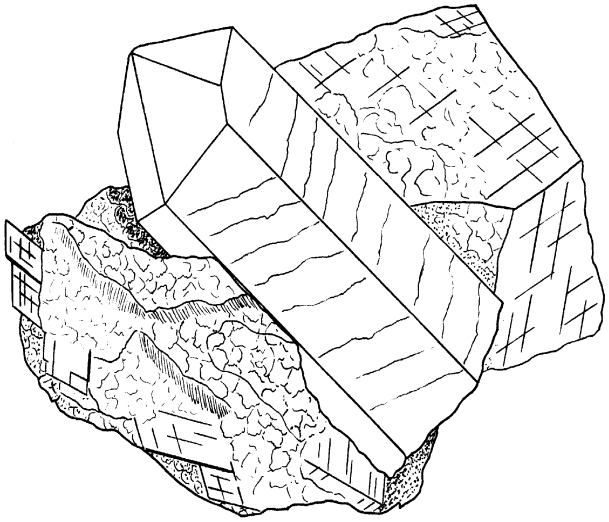
A banded agate from the shores of Lake Superior.

Agate is considered a ***semi-precious gem***. This means that it is less valuable than a true gem, but is still used to make jewelry and decorative items.

This specimen is called ***banded agate***. Each band can be a different color. The bands can be gray, white, orange, and red.

Apatite

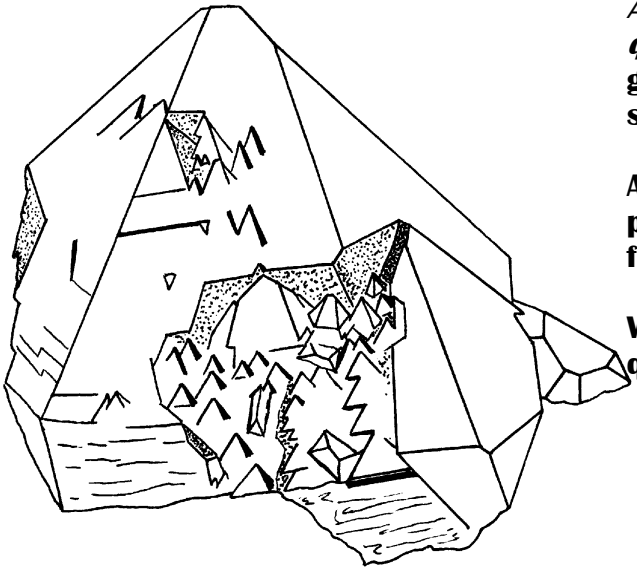




Clear and flawless apatite crystals can be cut into gemstones. Apatite is number 5 on the hardness scale, so it is too soft to be used in jewelry. If it were, it would be easily scratched or damaged.

Above: A dark green apatite crystal on orange calcite.
Left: A dark blue apatite crystal on orange calcite.
Both specimens are from Wilberforce, Ontario.

Amethyst



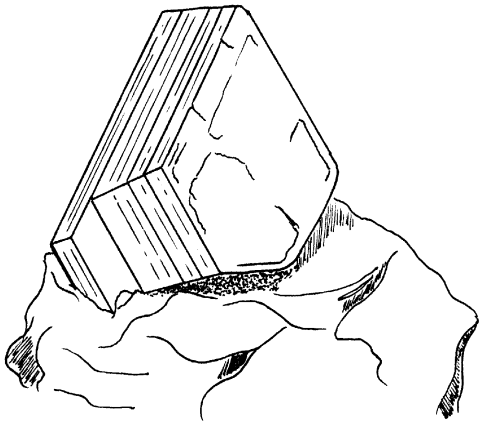
Amethyst **is the purple gem variety of the mineral** ***quartz*****. The ancient Egyptians used amethyst as a gemstone. Amethyst beads have been discovered in some very old graves in England.**

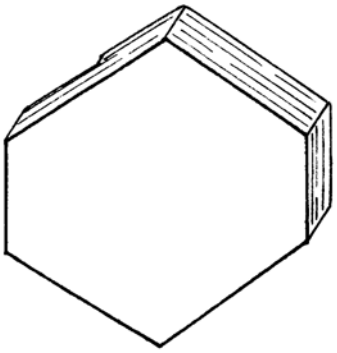
Amethyst is found all over the world. Clear, dark purple, gem-quality amethyst, however, is difficult to find.

When amethyst is heated it turns yellow. Yellow quartz is called ***citrine*****.**

Dark purple amethyst from Thunder Bay, Ontario.

Biotite



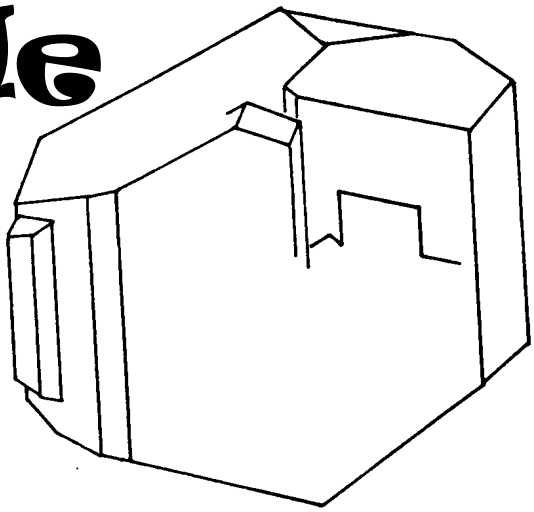


Biotite **is one variety of the mineral group called** ***mica*****. All mica minerals break or cleave into very thin sheets. Mineralogists call this** ***micaceous cleavage.*** **All mica minerals form six-sided crystals. Biotite contains iron and so it is also called** ***iron mica*****. The iron makes biotite black. It is soft at only 2.5 to 3 on the hardness scale.**

Above left: **A perfect, six-sided biotite crystal.**

Above: **Biotite crystals from North Burgess Township, Lanark County, Ontario.**

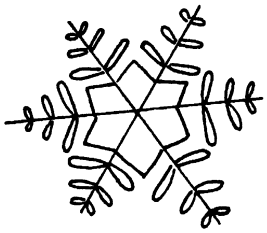
Hornblende



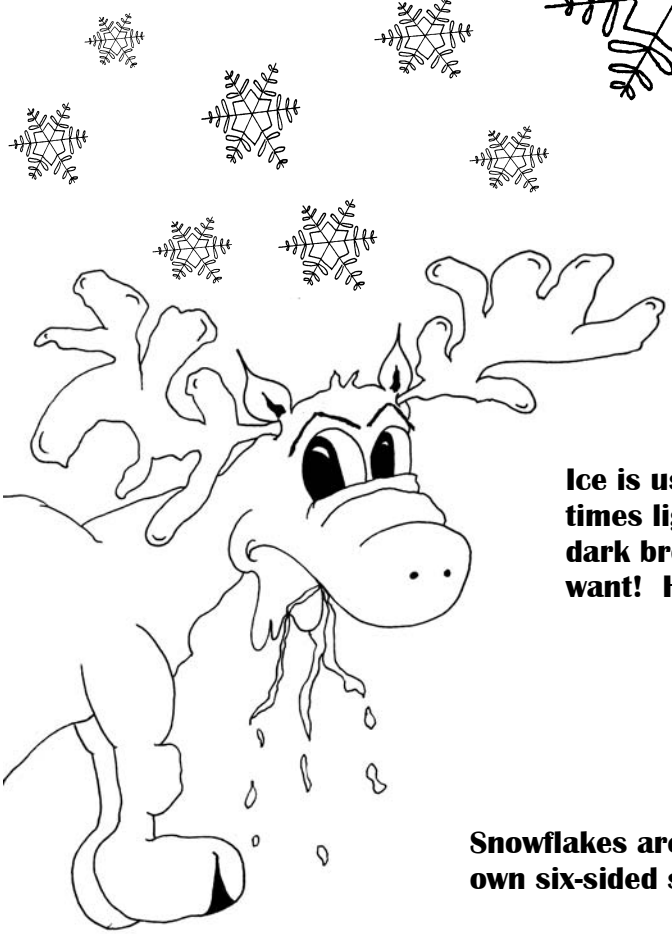
The name "hornblende" is a general name for a number of similar dark-colored minerals. Hornblendes are found in metamorphic rocks like schist and igneous rocks like basalt. They are usually brown or black, but can also be green or greenish-brown.

There is no use for hornblende minerals. They are mostly interesting to mineral collectors and geologists.

A very large, dark brown hornblende crystal from Bear Lake Road, Gooderham, Ontario.



Ice



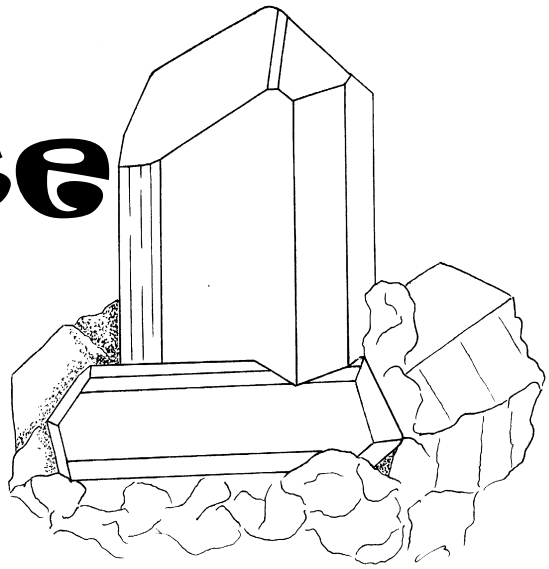
Believe it or not, ice is a mineral!

Canada has a LOT of it.

Ice is usually colorless or white and sometimes light blue. You can color the moose dark brown (and its antlers any color you want! Have fun.)

Snowflakes are six-sided water crystals. Create your own six-sided snowflakes here.

Scapolite



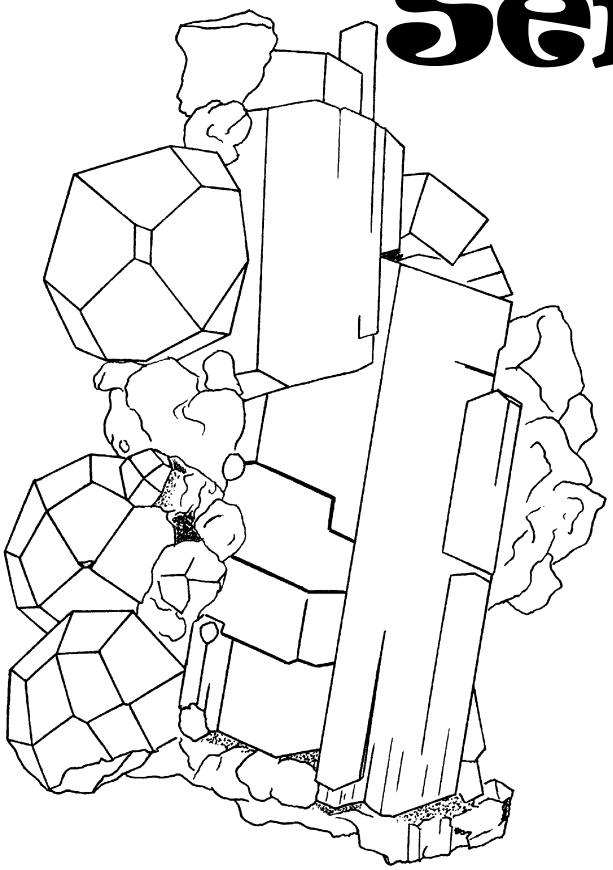
The name *scapolite* actually refers to a group of minerals that have similar chemical and physical properties. The scapolite crystals found in Canada can be large.

Scapolite is light green or white to gray. Its name is from two Greek words that mean *rod stone,* because scapolite crystals can look like long rods.

Scapolite does not have a use in industry or the home. Its crystals are very interesting to mineral collectors, though.

Two large, light green scapolite crystals. They were discovered at Leslie Lake, Pontiac County, Quebec.

Serandite



Serandite is a rare and very beautiful mineral. Some of the very best serandite crystals have been found at the world-famous mine at Mont Saint-Hilaire, Quebec. Mont Saint-Hilaire is the source for dozens of rare and beautiful minerals, some of which are found no where else in the world.

On the right side of this picture are some long, orange serandite crystals. On the left side of the specimen are white analcime crystals.

Canadian Mineral Word Search

Below are names of minerals that are found in Canada. Most of them are found in this book. Some are not. Can you find them? The names run left to right, right to left, up, down and diagonally.

H	O	R	N	B	L	E	N	D	E	R	L	M	C	M
A	S	C	A	P	O	L	I	T	E	A	U	Y	O	A
L	Q	I	G	U	F	H	C	D	L	O	G	L	B	L
I	R	P	L	A	G	N	E	T	I	R	Y	P	A	A
T	A	L	C	V	R	I	R	S	G	B	P	O	L	C
E	N	Q	B	R	E	N	T	P	D	J	S	R	T	H
C	M	U	O	C	G	R	E	E	I	A	U	B	F	I
A	E	A	A	O	A	S	N	T	O	S	M	E	Y	T
L	T	R	G	P	R	I	O	U	P	P	O	R	S	E
C	I	T	A	P	T	T	C	K	S	E	L	Y	U	T
I	N	Z	T	E	E	A	R	N	I	R	H	L	L	I
T	A	X	E	R	T	P	I	A	D	T	M	S	P	R
E	T	I	T	A	P	A	Z	L	E	A	I	U	H	U
B	I	J	A	D	E	M	O	M	B	N	C	N	U	Z
E	T	I	T	E	N	G	A	M	A	D	A	W	R	A

Words to find in this word search puzzle:

Agate Amethyst Apatite Augite Azurite Beryl Calcite Cobalt Copper Diopside Garnet Gold (x2) Gypsum Halite Hornblende Ice Jade Jasper Magnetite Malachite Mica Molybdenite Pyrite Quartz Scapolite Silver Sulphur Talc Titanite Zircon

The 53rd Tucson Gem & Mineral Show™
Presents . . .

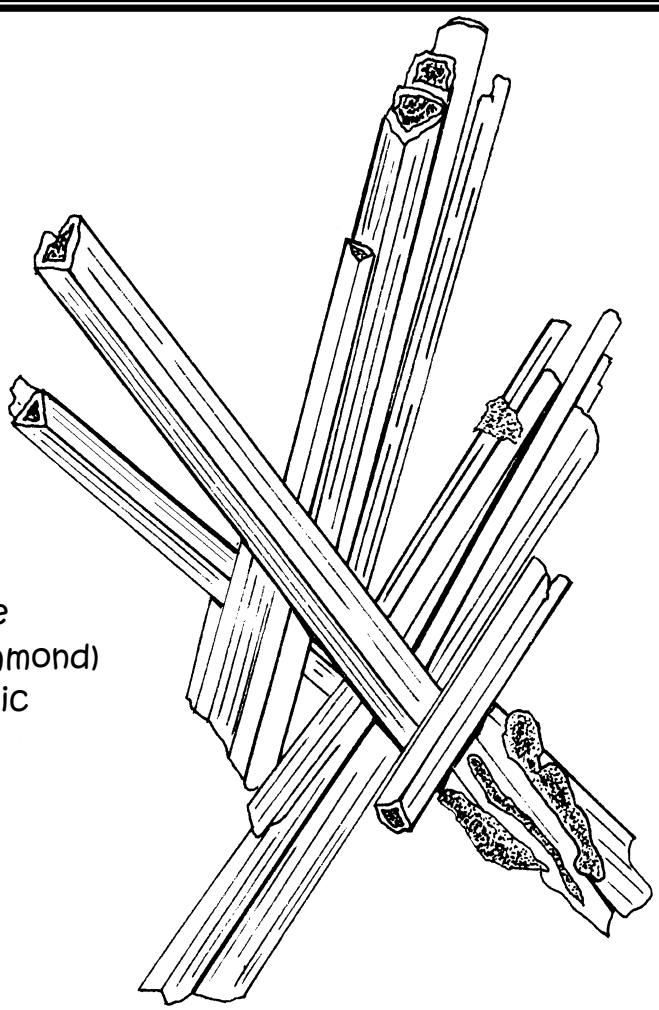
AUSTRALIA

MINERALS FROM DOWN UNDER

This book is presented to you by the Tucson Gem & Mineral Society.

Crocoite

$PbCrO_4$
Lead Chromate



H: 2 1/2—3
Sp. Gr.: 6.0
Cleavage: Poor
Color: Bright red-orange
Luster: Adamantine (like a diamond)
Crystal System: Monoclinic

Red Lead mine, Tasmania

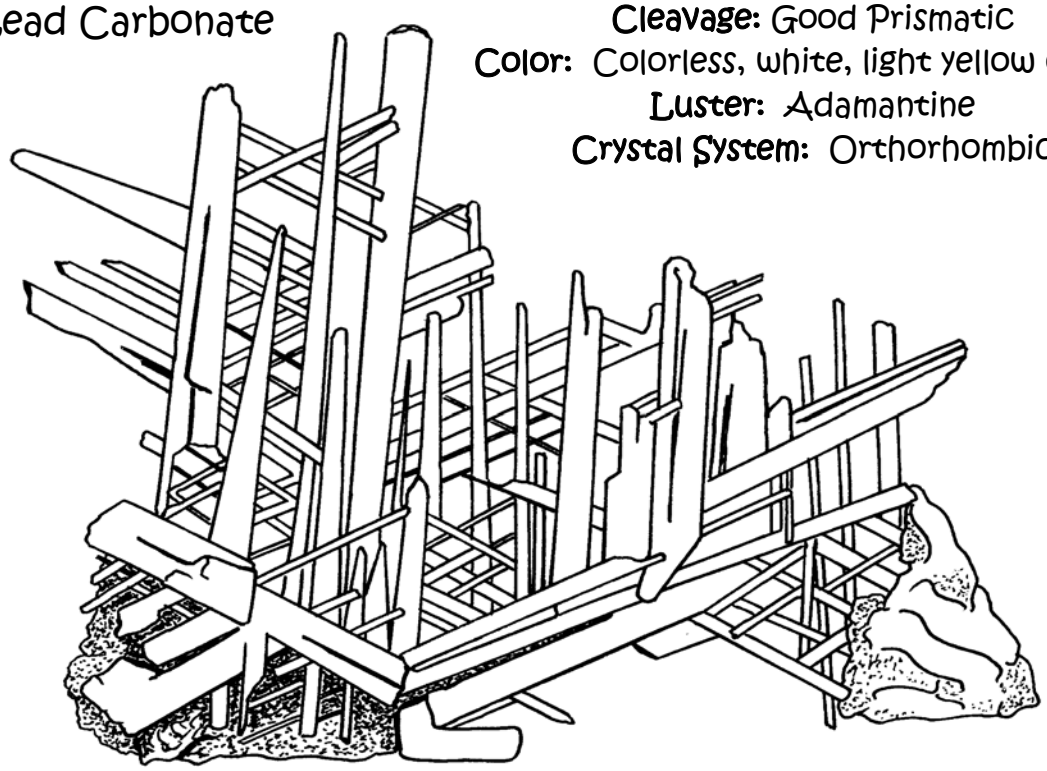
Large and important deposits of gold, tin, silver, lead, zinc, copper and iron have been discovered in the western part of the Australian island known as Tasmania. An explorer and prospector named James Smith discovered tin in Tasmania in 1871. Gold was discovered in 1879. Silver and lead minerals were discovered in 1882.

One of the most colorful and popular minerals found anywhere in the world are the bright orange-red crocoite crystals. Tasmania's crocoite are considered to be the best in the world.

Cerussite

$PbCO_3$
Lead Carbonate

H: 3—3 1/2
Sp. Gr.: 6.5
Cleavage: Good Prismatic
Color: Colorless, white, light yellow or gray
Luster: Adamantine
Crystal System: Orthorhombic



Broken Hill, New South Wales

The mines of the region known as Broken Hill is found in the Barrier Ranges in western New South Wales. These mines have been some of the most important sources of silver, zinc and lead in the entire world. Some of the world's very best mineral specimens have been discovered here. In this book you will see a number of different examples of these minerals. It is funny that many prospectors walked over the Broken Hill region for many years without noticing the valuable minerals below their feet. The true value of the minerals found here was not discovered until around 1886!

Here is a spectacular specimen of the lead mineral cerussite. Other minerals from Broken Hill include azurite, calcite, anglesite, antimony and silver, to name only a few!

Gold

H: 2 1/2—3
Sp. Gr.: 19.3
Cleavage: None
Color: Deep yellow to light, silvery yellow
Luster: Metallic
Crystal System: Isometric (Cubic)

Au

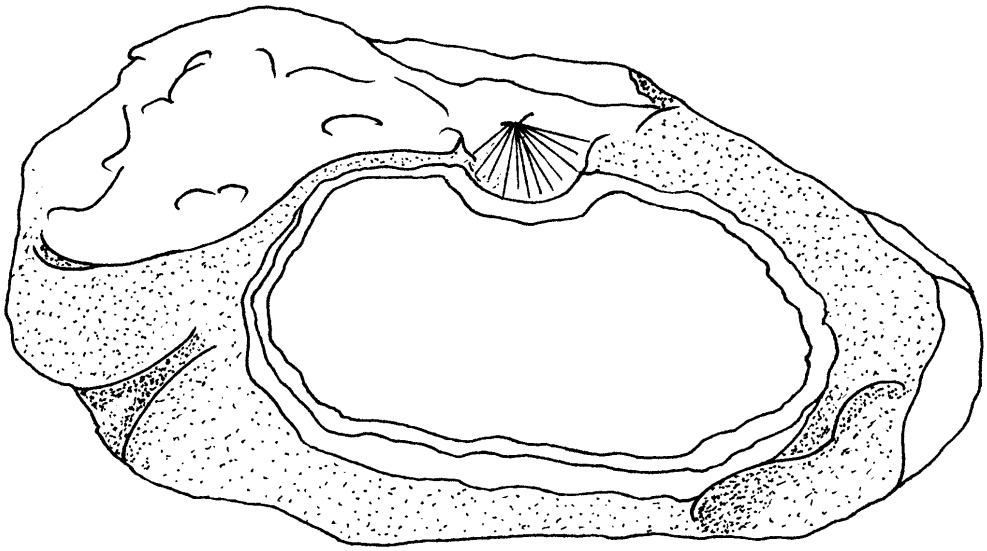
Kingower, Victoria

This gold nugget is called the "Hand of Faith." It weighs 845 ounces and was discovered in 1980. The first important gold discoveries in Australia occurred shortly after the "Gold Rush" in the United States in 1849. In the early years, the law said that all gold found in Australia belonged to the King of England. So, people didn't go looking for gold since they couldn't keep it. Eventually the laws changed and people could make money finding gold. In 1851 a man named Edmund Hargraves discovered gold near Bathurst. A rush to find more gold soon began. Many very large nuggets, smaller nuggets and vein gold (that is found with veins of quartz) have been discovered and mined in Australia.

Opal

SiO_2*nH_2O

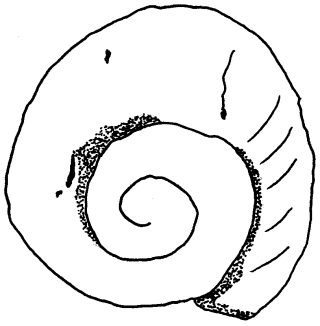
Hydrated Silicon Dioxide



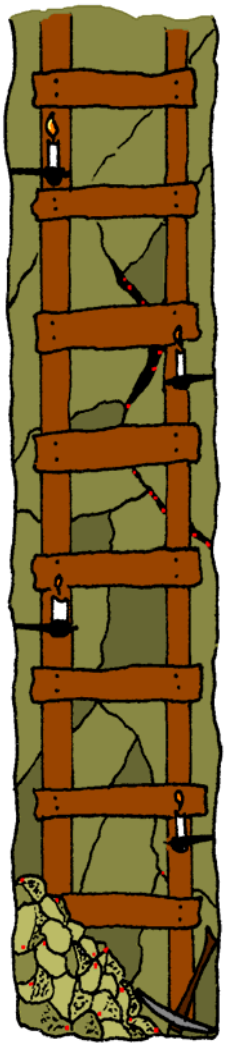
Aeromaga area, Queensland

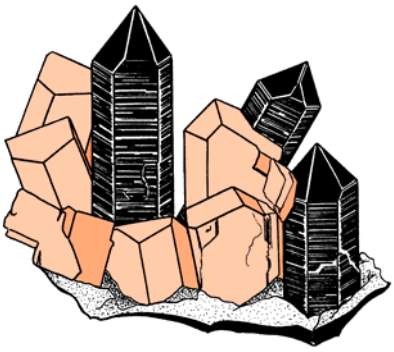
When scientists looked at opal with a very powerful electron microscope, they discovered that opal isn't a crystal: it is a collection of microscopic balls of silicon dioxide (quartz) with some water in it.

Some of the world's finest *precious opal* has been discovered in Coober Pedy, South Australia. Precious opal, like this specimen from Aeromaga Area, Queensland, has flashes of purple, blue, green and red in it. Color the center part of this specimen with little patches of purple, blue, green and red. The rest of the rock is rust red.

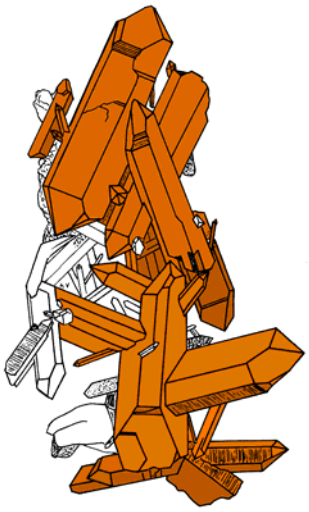


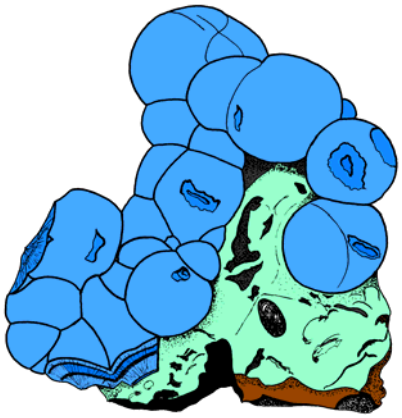
Here is a very interesting opal specimen. It is a fossil gastropod (snail) that is now all opal. Geologists say that it is "opalized." It was discovered in Coober Pedy, South Australia.

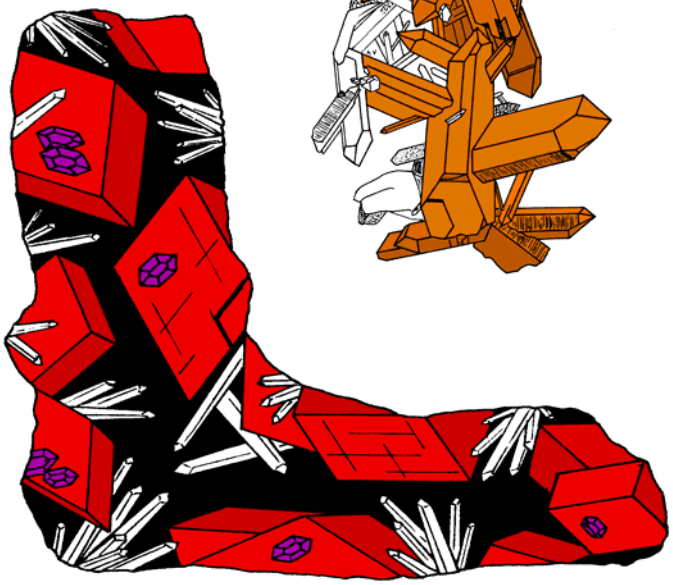


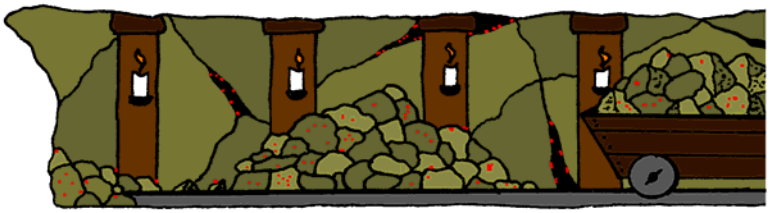


Minerals of the U.S.A.





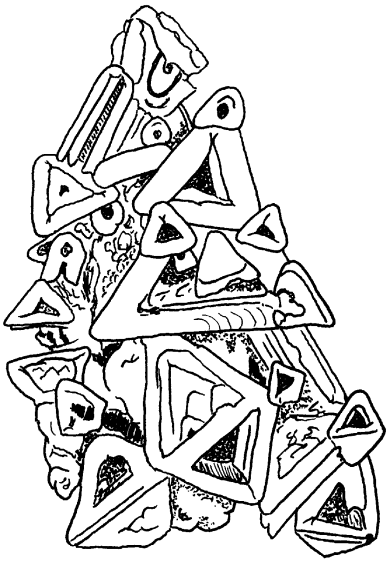




Gold

The first major gold discovery by Europeans in the United States happened in northern Georgia. Certainly Native Americans collected gold in the Chattahoochee River for centuries. Hernando de Soto and the Spanish settled in Georgia and searched for gold from 1540 until as late as the early 1700's.

In 1848, James Marshall discovered gold discovered on the American River at Sutter's Sawmill. Word spread of this discovery very quickly. By 1849, thousands of people from all over the world rushed to California hoping to discover their own gold and become extremely rich. Some of these "Miner 49ers" were very successful. Most were not.



Gold was discovered in other states, too. Leadville, Cripple Creek and Rico, Colorado are just a few of the communities which owe their beginnings to the discovery of GOLD! The richest gold district in Colorado was Cripple Creek which produced 21 million ounces of gold. The total amount of gold mined in Colorado is estimated to be over 42 million ounces!

Gold was first discovered in North Carolina in 1799 by a 12-year-old boy named Conrad Reed. He was out fishing in Meadow Creek and found a shiny yellow "rock" in the water. His pretty rock weighed about 17 pounds. His family used it as a doorstop for three years. They eventually sold it for $3.50. A jeweler later discovered that their "doorstop" was a huge nugget of gold that was estimated to be worth about $3,600!

Top Right: Gold on milky quartz from Jamestown, California.
Above Left: Triangle-shaped gold crystals from the Mockingbird mine, Mariposa County, California.
Above Right: Abandoned gold mine, San Juan Mountains, Colorado.

Copper and Silver

Copper was mined by Native peoples in Michigan's Upper Peninsula as far back as 5,000 years ago. The French tried to mine for copper here in the early 1700's, but didn't have much success. By 1771, a small group of Englishmen tried mining for copper near a large copper boulder that weighed three tons!

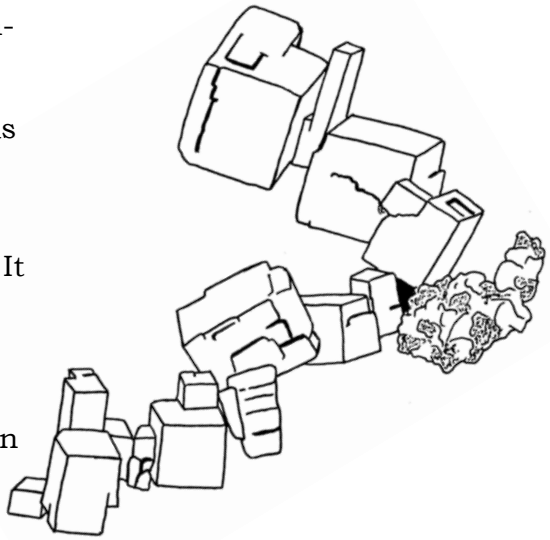
Michigan's Keweenaw Peninsula is also called "Copper Country." A unique deposit of massive amounts of native copper can be found here. "Native copper" means that the element, copper, is found in its native form, not as part of another mineral like azurite or malachite.

The first European to own a piece of this copper was Samuel de Champlain (who lived from 1567 to 1635). He was given a large piece by his friends, the Algonquin Indians.

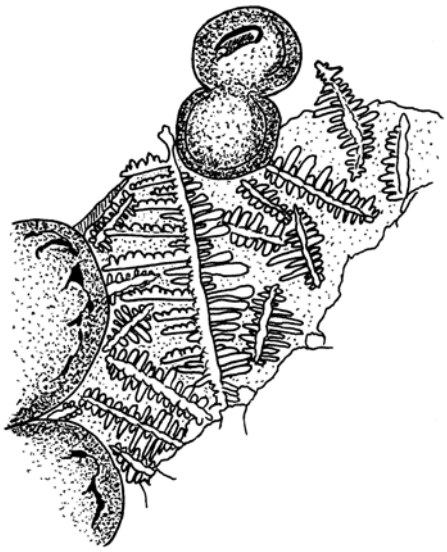
The Quincy mine, the Hecla mine, and the Tamarack mine, for example, all produced tons of native copper.

Native copper is very hard to mine out of the ground. It is very soft. Dynamite won't break it into smaller pieces. Long ago, large masses of copper had to be cut up by hand using chisels.

In addition to copper, beautiful specimens of native silver have been found in Michigan's Keweenaw Peninsula. In fact, there is a little silver mixed in with the massive native copper.



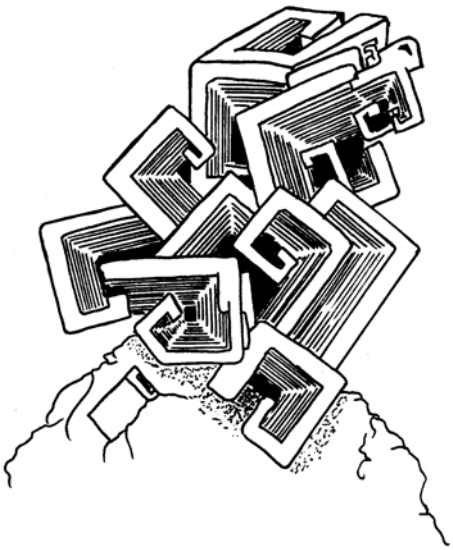
Top: Cubic copper crystals from the Ahmeek mine, Michigan. These crystals are described as *hopper crystals* because the edges have grown faster than the faces, leaving depressions in each of the crystals.



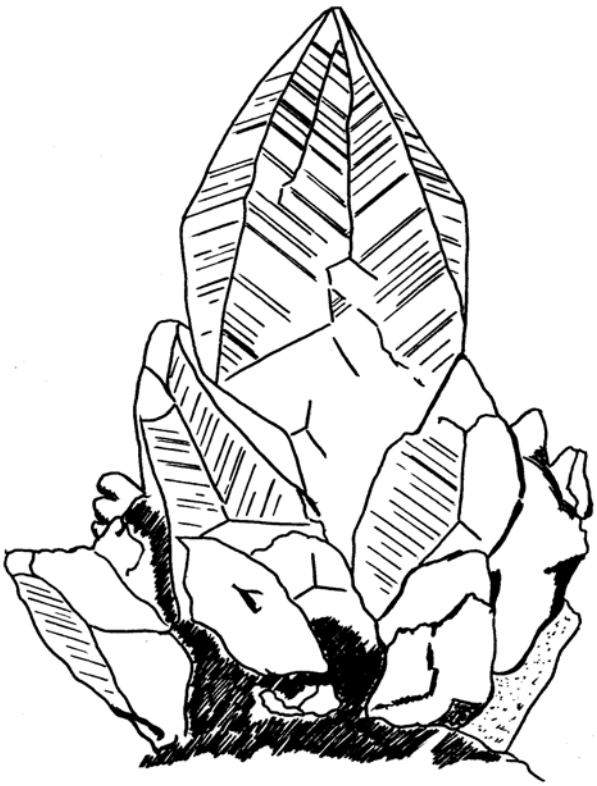
Above Middle: A group of copper crystals (cubes) from the White Pine mine, Ontonagon County, Michigan.

Left: Silver "dendrites" and masses from the White Pine mine, Ontonagon County, Michigan.

Right: Hopper crystals of silver from a location near the Copper Falls mine, Keweenaw County, Michigan. Do you remember what a "hopper crystal" is?



Calcite



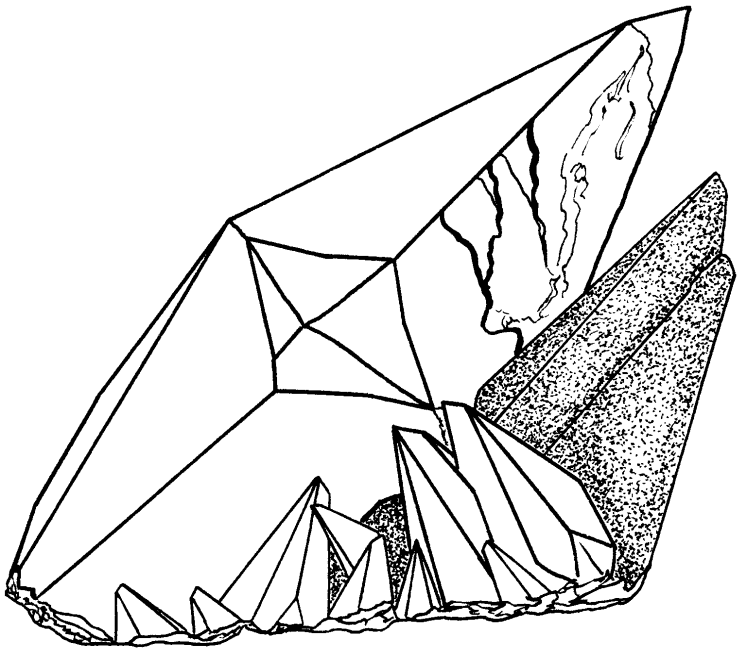
Nearly every state in the United States produces calcite in one form or another. In many cases the calcite is white or yellow and usually forms "dogtooth" crystals. The scientific word for these crystals is *scalenohedral*. Here at the Tucson Show you will see calcite crystals from Ohio, Tennessee, Michigan, Missouri and more.

To the right is a fine calcite crystal from the Upper Peninsula of Michigan. This part of the United States is known as "Copper Country." This calcite specimen has copper in it, so it is a bright, metallic, copper-red color!

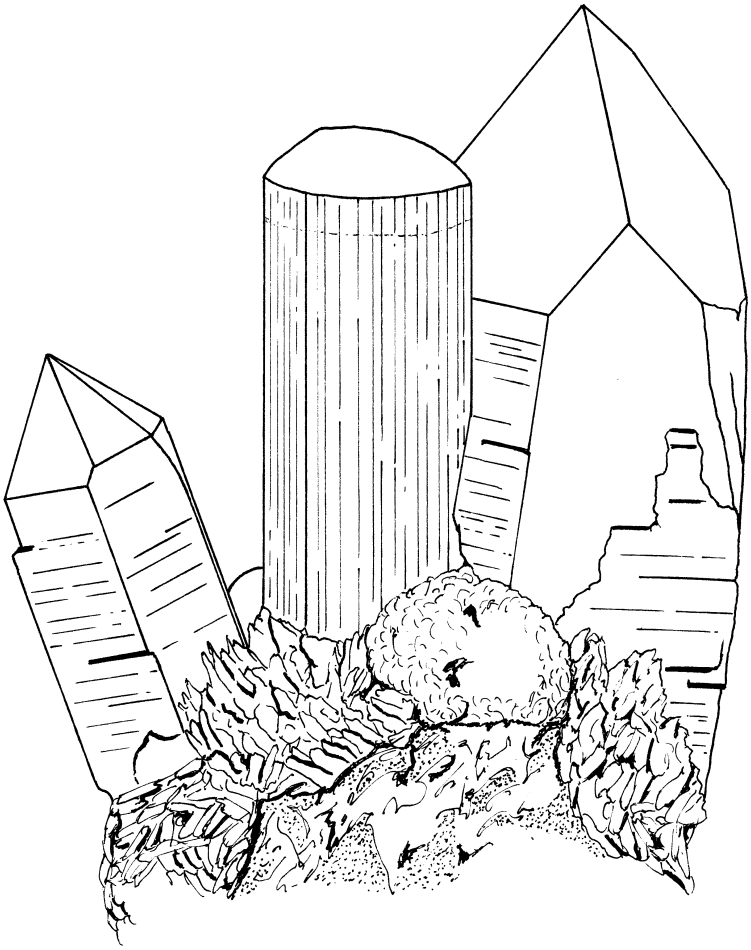
The Brushy Creek mine near Salem, Missouri is an important lead mine. In the 1970's miners discovered a large, clear lake 1,100 feet <u>under ground!</u> Above this lake were very large, well-formed, gray calcite crystals. Some of the calcites were covered with tiny marcasite crystals that had tarnished to bright rainbow colors of purple, blue and red.

Mining companies usually don't save mineral specimens. It takes too much time to carefully remove them and this costs a lot of money. The mine also loses the money it could make by removing valuable ore. At the Brushy Creek mine, however, the mine owners made a business agreement with two mineral dealers to carefully remove and preserve these wonderful calcite specimens.

Today you will see many of these specimens in museums, private collections and for sale. One of these crystal groups is pictured to the left.



Tourmaline



Pictured to the left is the famous "Postage Stamp Tourmaline." This specimen was featured on one of the four 10 cent mineral stamps issued by the US Post Office in 1974. (The set also included rhodochrosite, amethyst and petrified wood.)

This tourmaline specimen was discovered in the Tourmaline Queen mine in 1913. The Tourmaline Queen is in Pala, San Diego County, California.

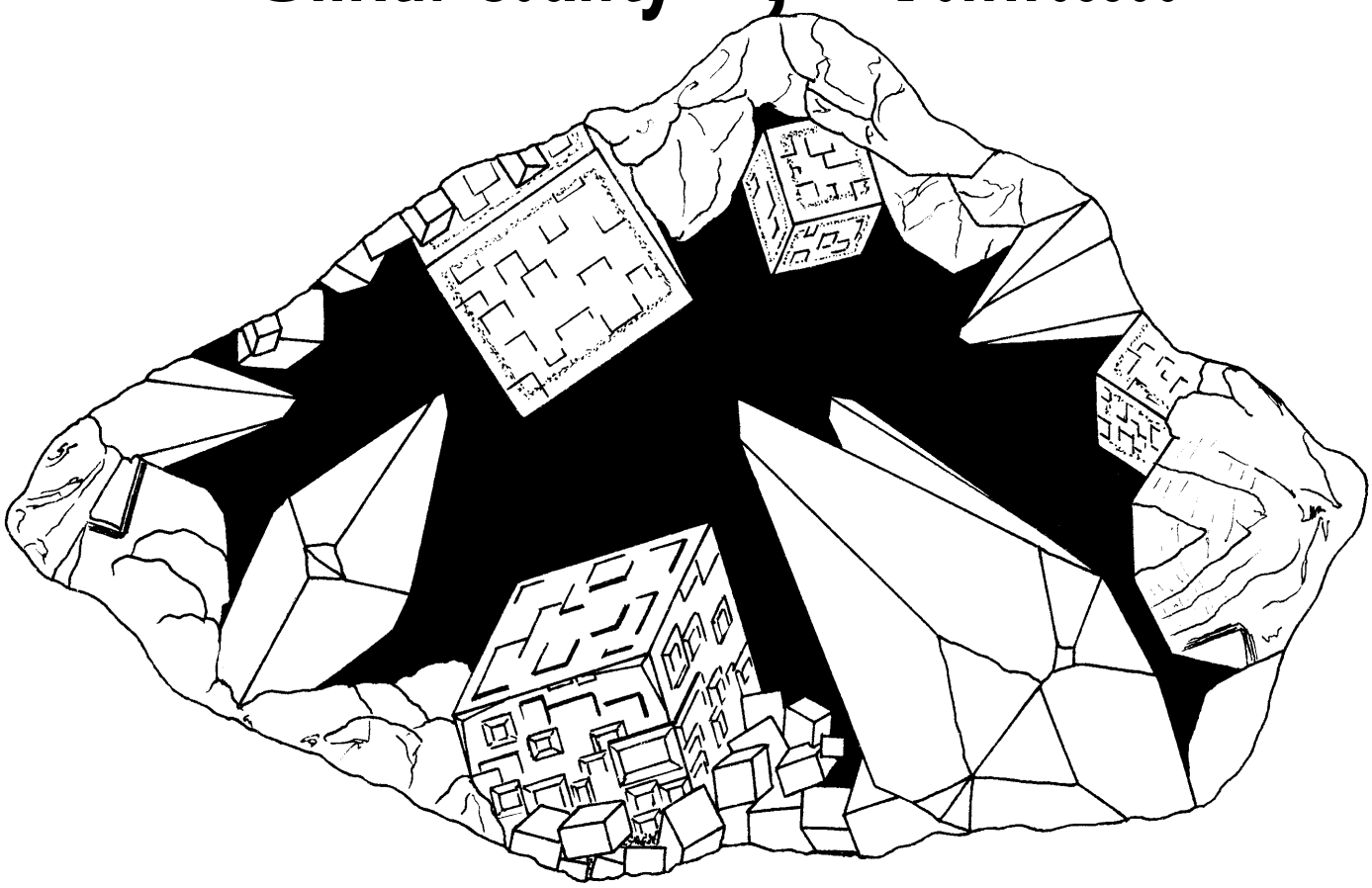
In the center of this outstanding specimen is a single tourmaline that is deep pink with blue on the top. It is surrounded by grayish-white quartz crystals. Just below the tourmaline is light purple lepidolite and white albite.

Through the years, this wonderful specimen has been owned by a number of distinguished collectors and museums.

Right: A block of the 10 cent mineral stamps issued by the United States Post Office on June 13, 1974 which includes the "Postage Stamp Tourmaline." In addition to being the first stamps issued in the U.S. featuring minerals, it was also the first stamp designed in a diamond shape. They are officially called "Our Mineral Heritage" stamps.

Elmwood Mine

Smith County , Tennessee



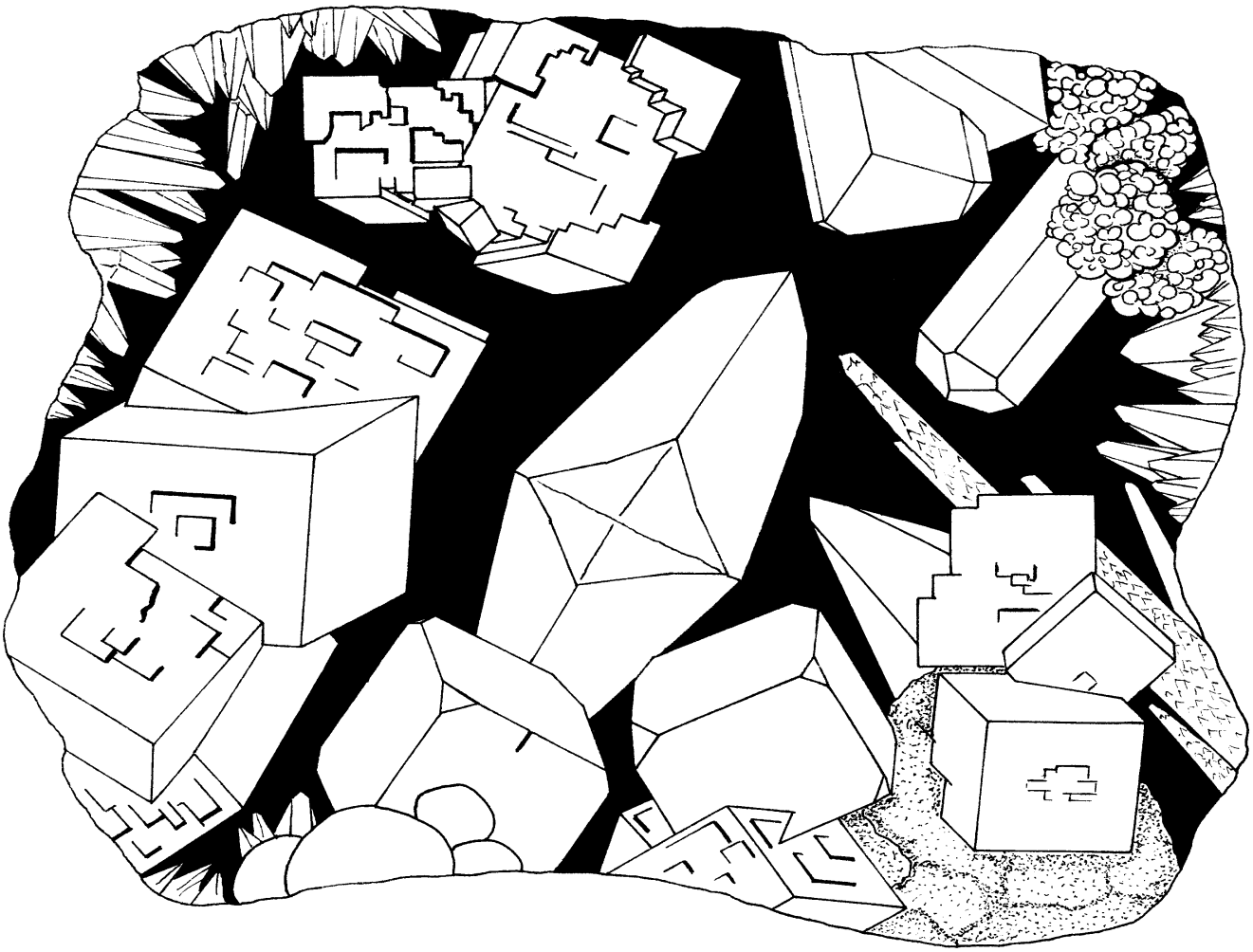
The different minerals found in the Elmwood district of Tennessee are some of the best in the world. The Elmwood district is about 50 miles east of Nashville. There are a number of mines in the district, including the Elmwood mine, the Gordonsville mine and the Cumberland mine. The Elmwood district mines were mined for the mineral sphalerite. Sphalerite is the source of the element *zinc*.

The minerals grew in large holes in the rock. The miners called these mineral-filled holes "bugholes." The bugholes range in size from very small to caverns. The minerals found in these bugholes included calcite, fluorite, sphalerite, barite, galena, pyrite, chalcopyrite, strontianite and dolomite. Fluorite, calcite and sphalerite are the most famous. Some of the calcite crystals were so large that they could not be removed without seriously damaging them.

Above is a picture of a typical bughole. The square minerals are deep purple fluorite cubes. The large pointed crystals are golden brown calcite crystals. The rest are flat, deep red crystals of sphalerite.

Cave in Rock

Illinois



Nearly every public and private mineral collection in the United States has fluorite from the Illinois-Kentucky fluorite district. This region had over 200 mines which were mined for their fluorite and galena (lead ore). The region was mined for over 175 years; mining there ended in 1995. Native Americans carved fluorite pieces to make ornaments.

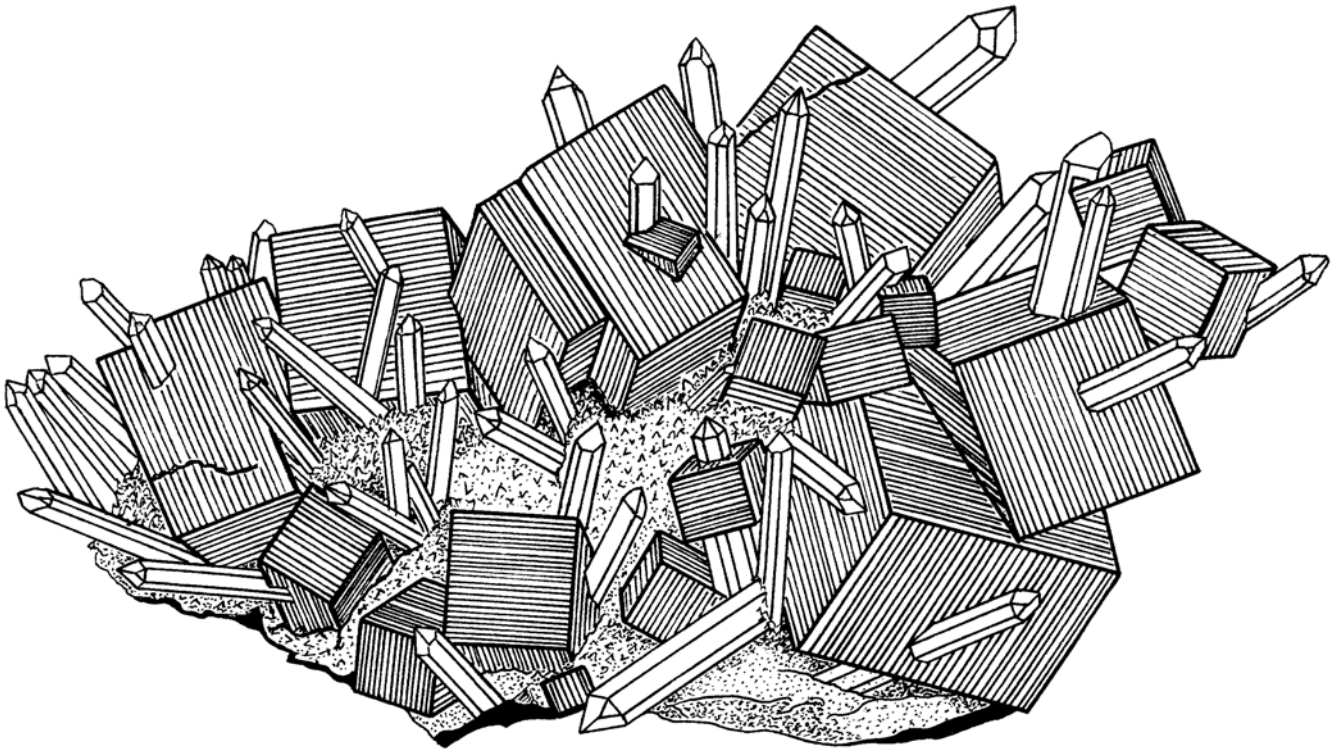
Tons of fluorite and galena were mined in the district. Other beautiful minerals were also retrieved from these mines. The minerals found here include beautiful calcite, chalcopyrite, strontianite, sphalerite, smithsonite, witherite, and barite, to name a few.

The fluorite from this district is found in a rainbow of colors, such as yellow, dark and light purple, dark and light blue, and yellow.

In this "Fantasy Pocket" of minerals from Cave-in-Rock, Illinois you find (clockwise from the lower left): yellow fluorite cubes, small orange calcite crystals, purple fluorite cubes, light blue celestite, greenish chalcopyrite balls on a light yellow calcite crystal, more orange calcites, long grayish-white strontianite, light blue fluorite cubes in front of a large orange calcite, a single gray galena cube on purple fluorite and a second galena cube on light yellow calcite spheres.

Pyrite and Quartz

Spruce Ridge claim
King County, Washington

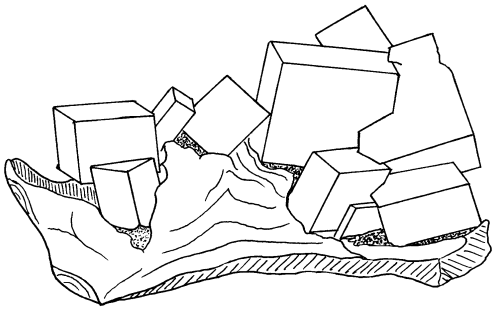


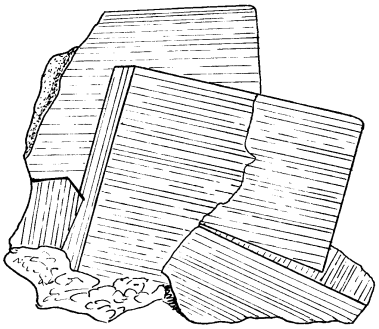
High-quality pyrite specimens can be found throughout the United States. Some of the most interesting and beautiful are the pyrite cubes and quartz groups that were discovered at King County in Washington State.

The pyrite cubes have lines (called *striations*) across all of the crystal faces. The lines form because as the crystal grew, two different crystal forms alternated with each other (for the experts out there, the cube and the pyritohedron).

You can see in this specimen that quartz crystals are coming right out of the pyrite crystals. This tells us that the quartz crystals grew first and then the pyrite crystals grew over the quartz.

Below are some pyrite cubes from New York (left) and Colorado (right).



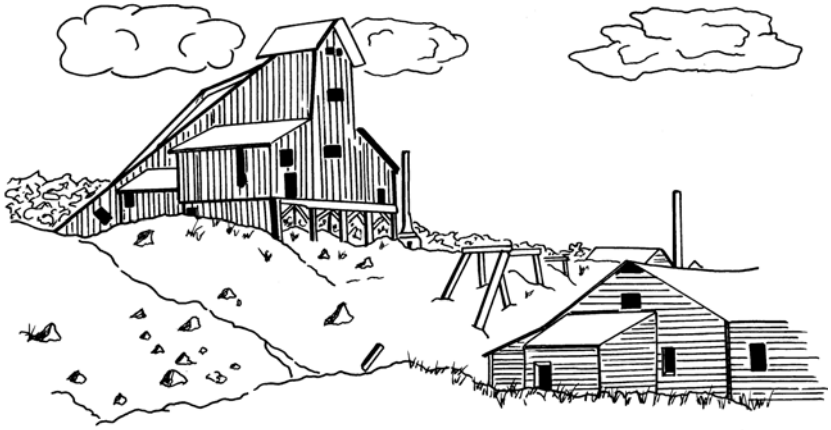


Minerals in the U.S.A.

In this word search are the names of minerals found in the United States of America.
The names can run left to right, right to left, top to bottom, bottom to top or diagonally.
When you are done, use the internet and find information and pictures of each mineral.

R	A	R	S	T	A	U	R	O	L	I	T	E	F	T
Q	H	P	E	T	I	R	A	B	A	M	W	T	R	O
U	R	O	C	V	T	O	P	A	Z	U	A	G	A	U
A	F	R	D	G	L	K	T	A	B	S	V	B	N	R
R	F	L	U	O	R	I	T	E	U	C	E	Z	K	M
T	N	A	I	L	C	X	S	L	P	O	L	E	L	A
Z	E	J	E	D	S	H	F	Y	G	V	L	T	I	L
O	P	M	E	R	C	U	R	Y	Y	I	I	I	N	I
S	T	B	V	I	R	I	U	O	P	T	T	O	I	N
K	U	N	Z	I	T	E	T	S	S	E	E	T	T	E
B	N	I	E	E	S	H	I	Z	U	I	K	I	E	T
D	I	A	M	O	N	D	L	B	M	E	T	N	N	R
E	T	I	L	A	H	P	E	C	O	P	P	E	R	O
D	E	T	I	C	L	A	C	V	D	W	R	B	A	N
D	A	T	O	L	I	T	E	A	N	E	L	A	G	A

Mineral names in this word search:
Copper; Fluorite; Galena; Staurolite; Rhodochrosite; Tourmaline; Garnet; Gold; Silver; Pyrite; Halite; Benitoite; Neptunite; Wavellite; Quartz; Barite; Diamond; Mercury; Sulfur; Gypsum; Topaz; Kunzite; Rutile; Trona; Muscovite; Datolite; Calcite; Franklinite.



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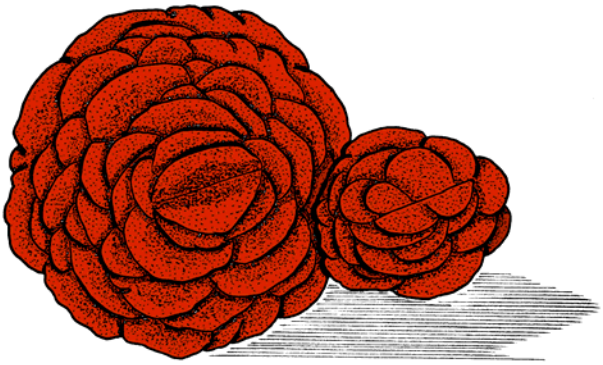
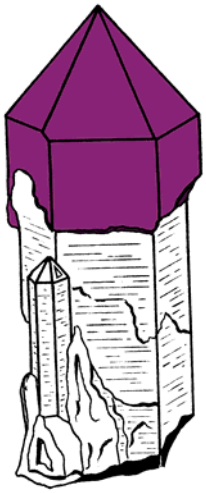


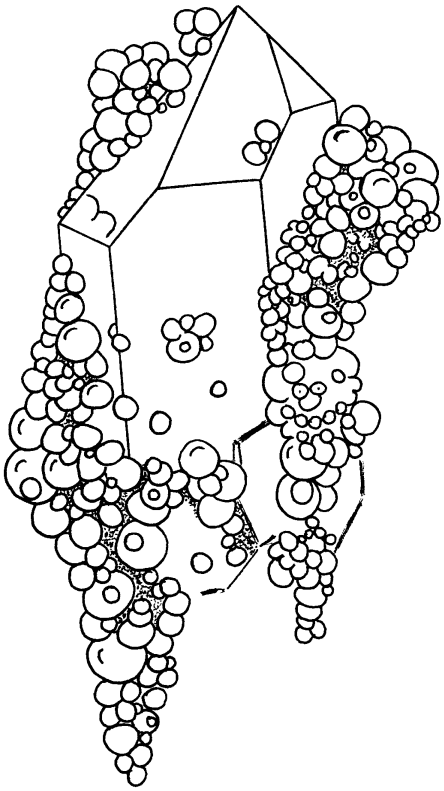


Mineral Oddities

A Dictionary of Mineral Pranks

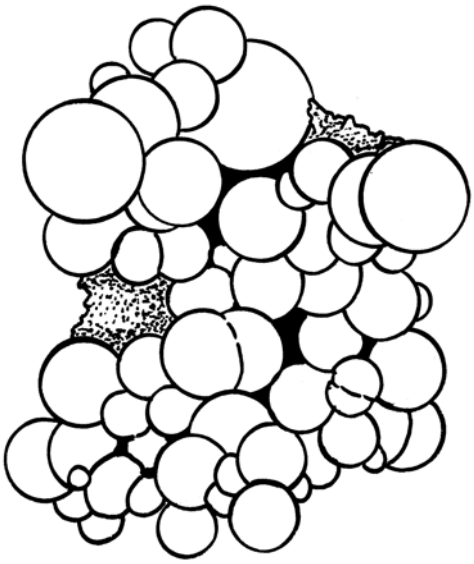
Their Strange & Wonderful Forms

Botryoidal



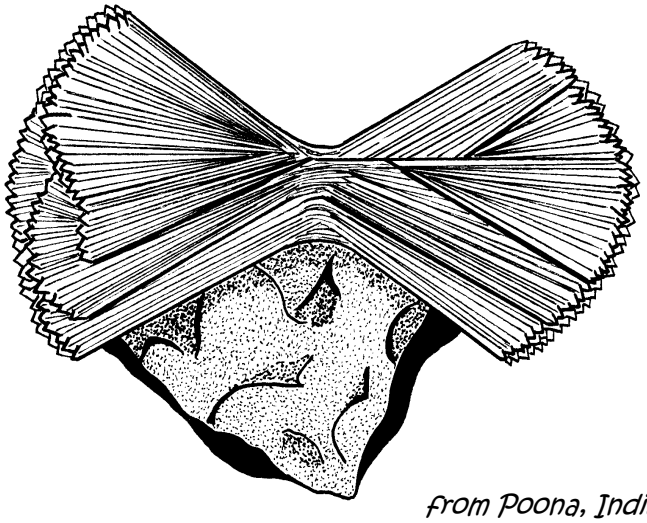
"Grape-Like"

Under the right conditions, some minerals form clusters of round balls that look like bunches of grapes. Mineralogists call this form *botryoidal*. *Botryoidal* comes from the Greek word *botrys* which means *bunch of grapes*.



Left: Hematite on quartz from Graves Mountain, Georgia.
Right: Malachite from Morenci, Arizona.

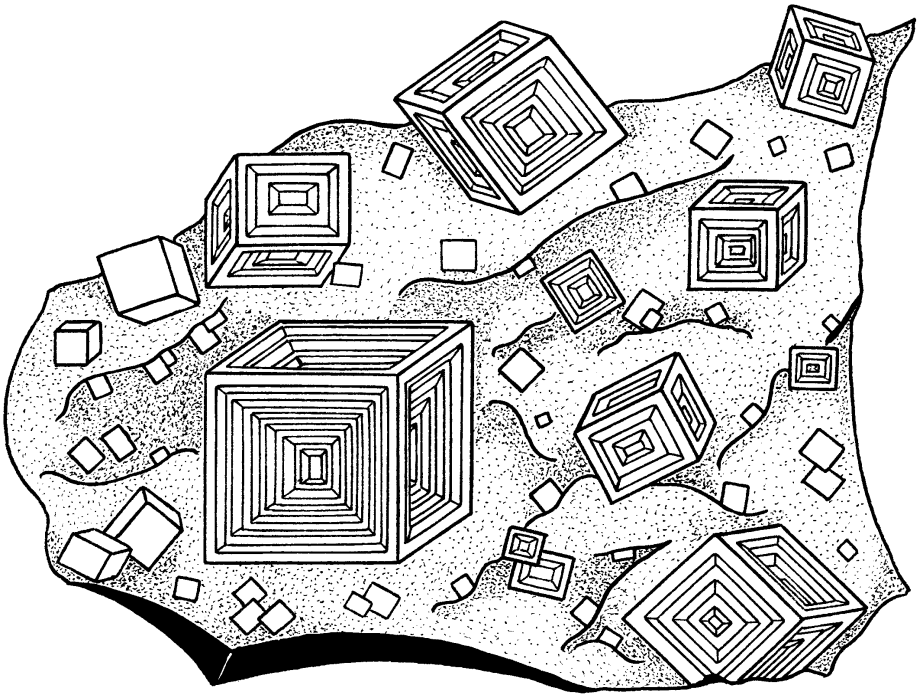
Bow-Tie Crystals



from Poona, India.

A single stilbite crystal looks like a thin blade. But when thousands of stilbite crystals grow together, they can form groupings of crystals, like this specimen from India, that look like an old-fashioned bow tie. If you look carefully you can see how a number of crystal groups have grown over each other to create the bow-tie shape.

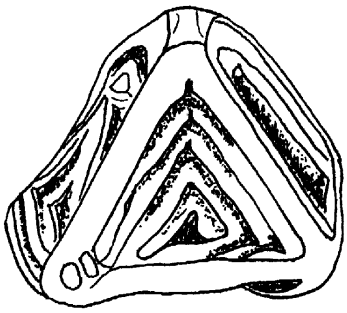
Hopper Crystals

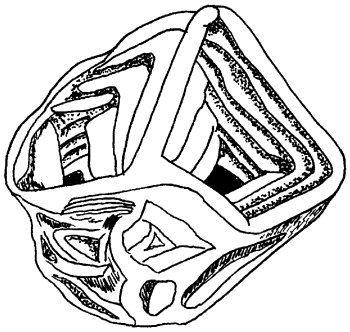


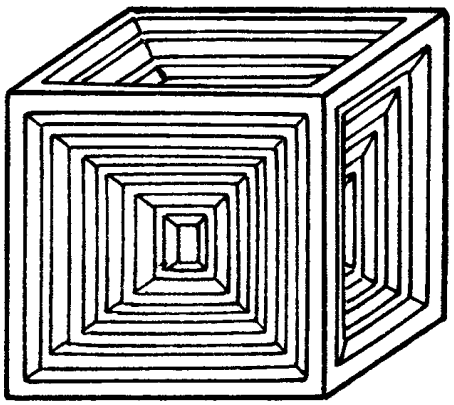
A "hopper" is a funnel-shaped box that is used to store and pour out things like coal and grain. A hopper crystal is a crystal where the edges of the crystal have grown faster than the faces. This creates a hollow space that makes the crystal look like a funnel-shaped box.

Above are pink halite crystals from Searles Lake, California that grew together on a matrix of halite (salt).

Below left are two gold crystals from Peru.





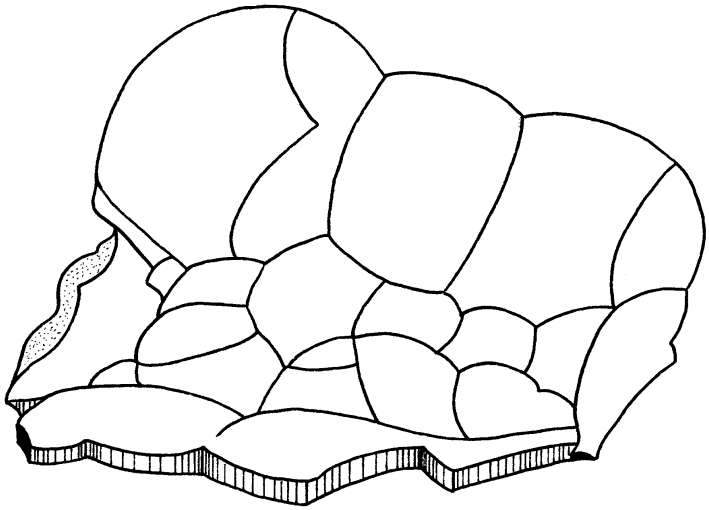


Ram's Horn Selenite

Ram's Horn Selenite is a popular name given to gypsum specimens that form in curved growths that look like rams' horns. These beautiful and delicate specimens grow in caves where the air is very dry and where they will not be disturbed or damaged. Water that carries dissolved gypsum seeps out of the cave walls. When the water hits the dry cave air, the water evaporates and gypsum solidifies on the cave wall. As more water seeps out and evaporates, more gypsum is deposited on the cave wall. This new gypsum pushes the older gypsum away from the cave wall. This process continues, making the gypsum deposit longer and longer and longer. The gypsum curves because more gypsum is deposited on one side than the other, causing one side to grow faster than the other.

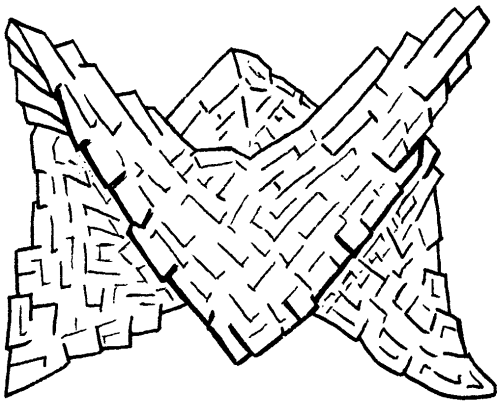
This is a Ram's Horn Selenite specimen from the mines in the Santa Eulalia District, Chihuahua, Mexico. Specimens like this one have also been found in Kentucky and Texas in the United States, and also in Morocco.

Reniform



The word *reniform* is from the Latin words *renes* which means *kidney* and *formis* which means *form*. In other words, it describes a mineral that looks like a kidney. Here is a specimen of hematite from Cumberland, England. The miners called this shape *kidney ore* because the dark, blood red, rounded masses of hematite look like kidneys. Notice that the hematite is rounded, but not in individual balls that look like grapes. Do you remember what mineralogists call specimens that look like bunches of grapes?

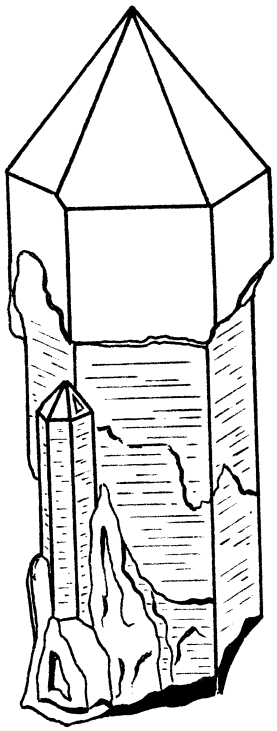
Saddle-Shaped Crystals



Under the right conditions, groups of dolomite crystals grow together and form a curving shape that looks like a horse's saddle. Other minerals that can form saddle-shaped crystals are calcite, ankerite, siderite and rhodochrosite. All of these minerals have similar chemical compositions and crystallize in the same crystal system.

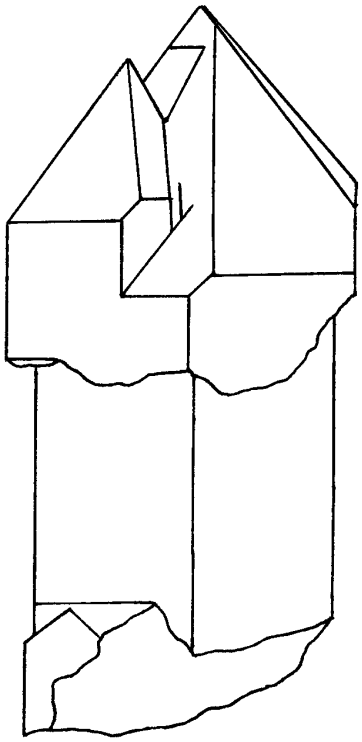
Excellent saddle-shaped specimens have recently been discovered in Shangbao, Leiyang, Hunan Province, China.

Scepter Crystals



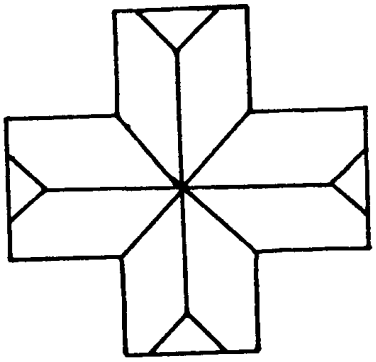
A *scepter* is a long stick that is held by a King as a sign of the King's power and authority. The end of the King's scepter is topped with a large ornament that is covered with beautiful jewels.

A *scepter* crystal is one in which there is a long, lower portion that is topped with a larger, wider crystal termination. Mineralogists call the lower portion of the scepter crystal the *prism* of the crystal.

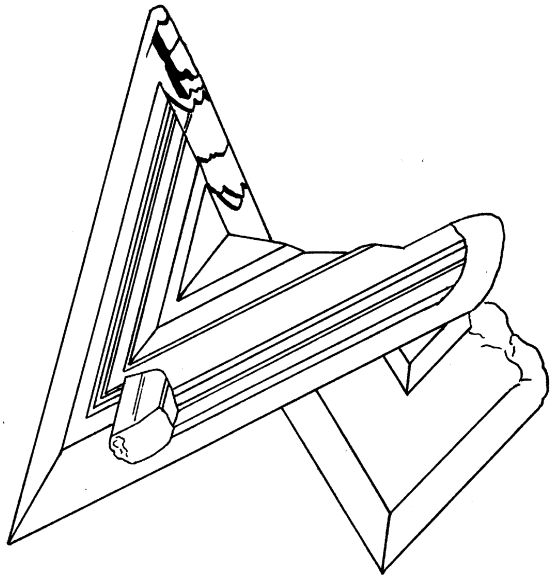


To the left is a scepter crystal from Namibia (Africa) with a white, milky quartz prism and a purple, amethyst termination. To the right is a white scepter quartz crystal from Brazil.

Twinned Crystals

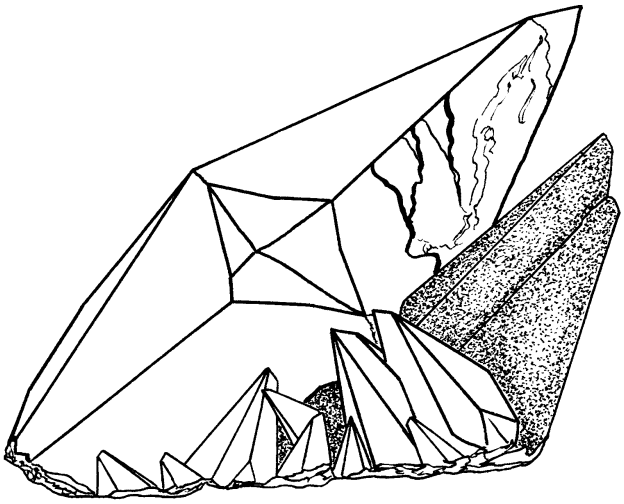


Most often, minerals form single crystals or groups of single crystals. There are times, though, when two or more crystals grow together. When two crystals grow together, at a specific angle, a *twinned crystal* is formed.

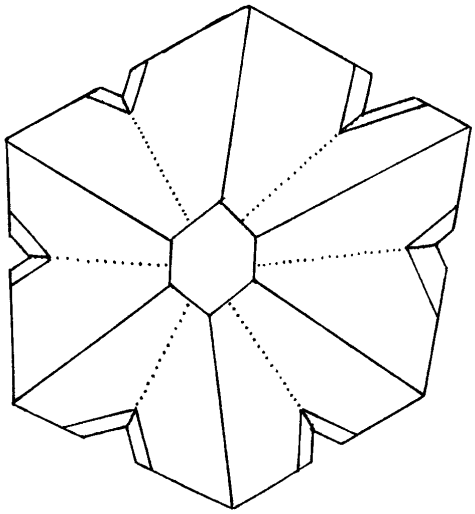


To the left (above) is a staurolite twin. In this specimen two individual crystals have grown together in a cross formation.

The crystal below (left) is a large twin crystal of calcite surrounded by a number of smaller individual calcite crystals. The diamond-shaped portion in the center indicates where the two individual crystals connect to each other.



The crystal to the right (above) is a twin crystal of the lead mineral called cerussite. The individual crystals attach to one another creating a V-shape.



The crystal to the right is an interesting "twin" of the mineral chrysoberyl. It is actually much more than a "twin." Mineralogists call it a *sixling* because six individual crystals have grown together to form a single, wheel-shaped crystal.

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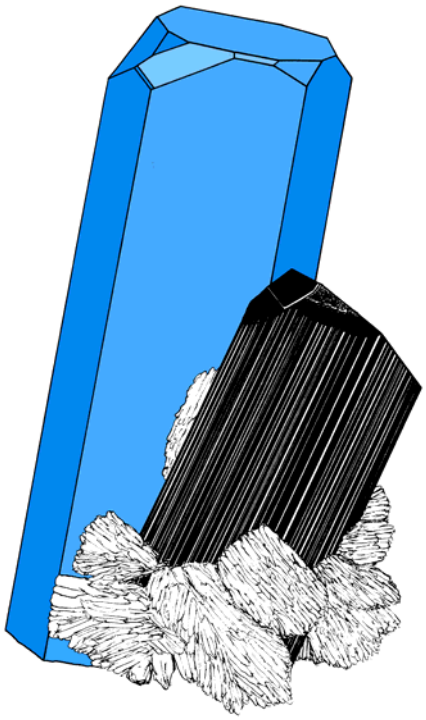
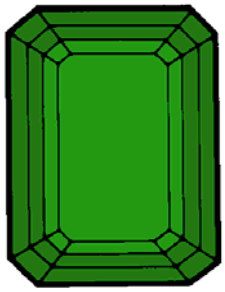
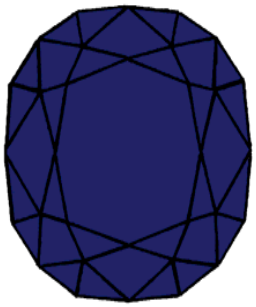
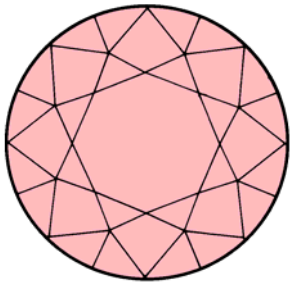
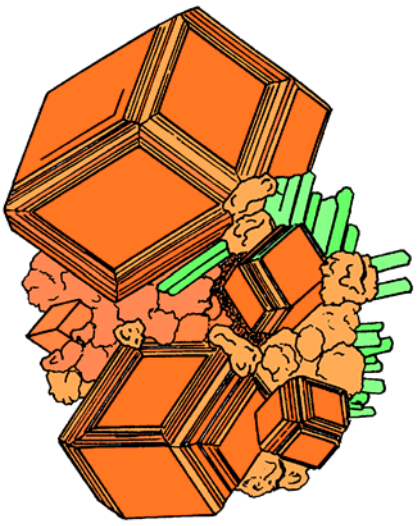


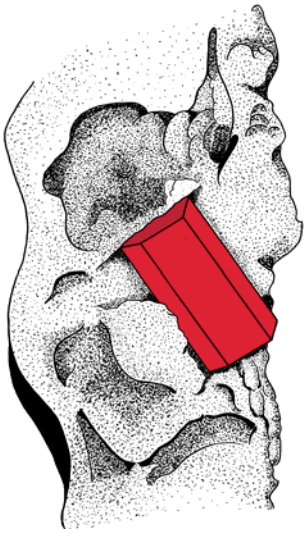
GEMS & GEM MINERALS

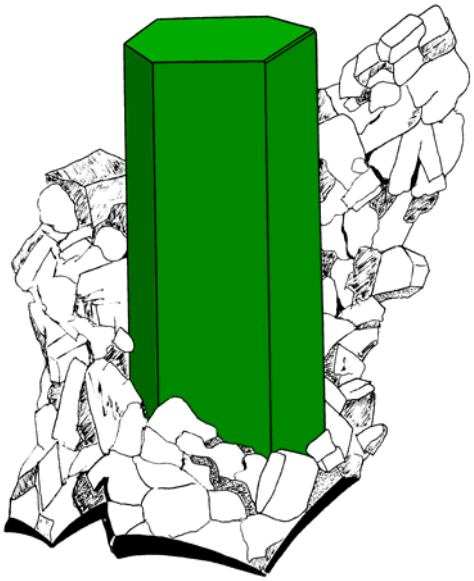






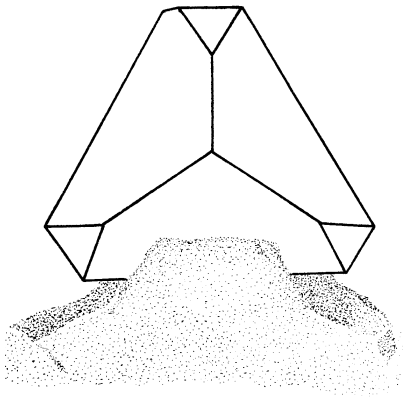






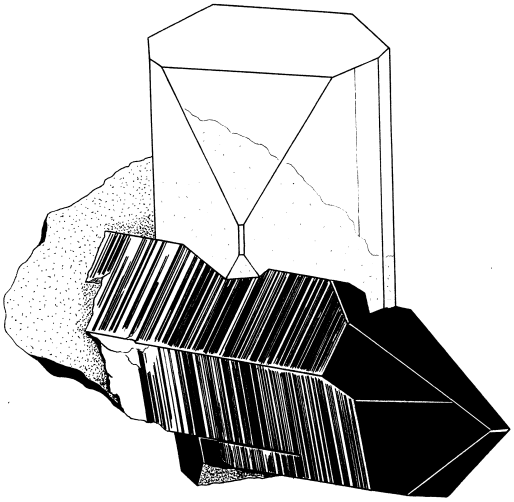
WHAT IS A GEM?

There is a difference between a "gem" and a "gemstone." A gem is the final cut and polished object. A gemstone is usually a mineral, but sometimes another natural material, in its untouched, natural form.

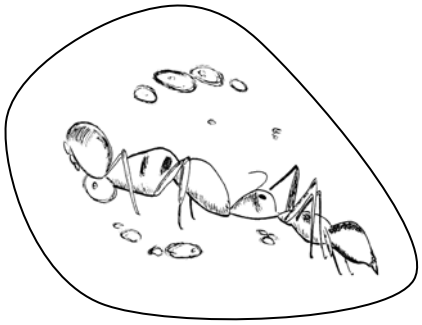


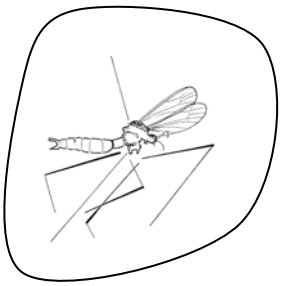
For a mineral to be considered a gemstone, it has to have three basic properties. First, it has to be colorful and beautiful to look at. Second, it has to be hard enough to be able to be shaped, cut or polished. Its hardness is also important because gems are worn in jewelry, so a gemstone has to be hard enough to be worn in jewelry without being easily scratched, chipped or damaged.

Most gemstones are minerals. A mineral is a naturally occurring substance that was not created by a living organism and that has a known chemical formula and a regular internal crystal structure. Diamonds, rubies and emeralds are minerals.



There are also some gemstones that are naturally occurring, but were created by living organisms. Well-known examples of this category are amber and pearls.

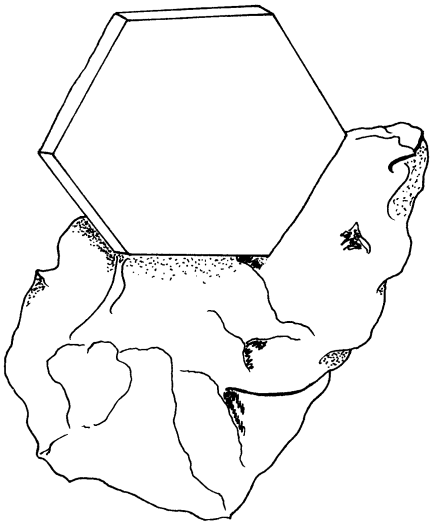




Ants and a Crane fly in Amber.

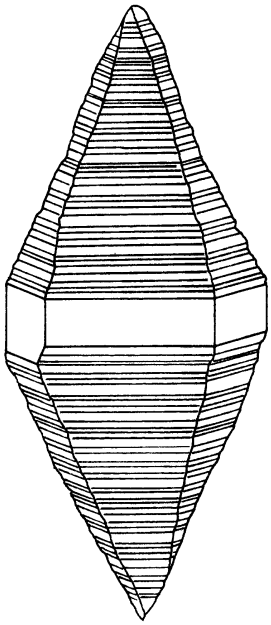
CORUNDUM

RUBIES & SAPPHIRES



Sapphire is the blue, yellow and colorless variety of the mineral *corundum*. It is number 9 on the Mohs' Hardness Scale. Because it is so hard, corundum is used to make grinding wheels and papers for grinding and polishing softer materials like porcelain, metals and wood, for example. Pure corundum is aluminum oxide, Al_2O_3, and is colorless. But, if it has small amounts of the element *chromium* it becomes red. Red corundum is called *ruby*. The presence of the elements *iron* and *titanium* in corundum gives a blue color. Blue corundum is called *sapphire*. When gem-quality corundum is another color like yellow, for example, it is called *yellow sapphire* or very simply *fancy corundum*.

In ancient times people believed sapphire had special powers or properties. Some believed that a king who wore sapphire jewelry would be protected from harm. In Europe, people believed sapphire could protect its owner from ever being poor. Others believed wearing a sapphire would bring intelligence and wisdom, especially to someone who is "stupid." There were also legends about the powers of ruby. Some thought rubies would keep a person healthy. Others believed they would take away evil thoughts. One legend tells us that the first wife of England's King Henry VIII (Catherine of Aragon) predicted there would be many troubles in her life because her ruby was getting darker and darker!

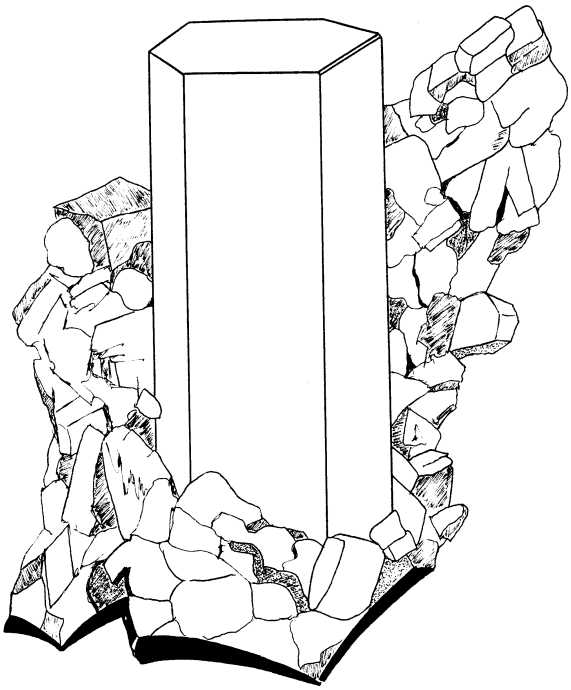


Gemologists discovered that lighter blue sapphires can be made dark blue by heating them. A natural, dark blue sapphire is a very valuable gem. Many of the dark blue sapphires sold in jewelry stores have been heat-treated to make them darker.

Above left: A bright red ruby crystal in matrix from Australia.
Above right: a single, doubly terminated sapphire crystal from Sri Lanka.

BERYL

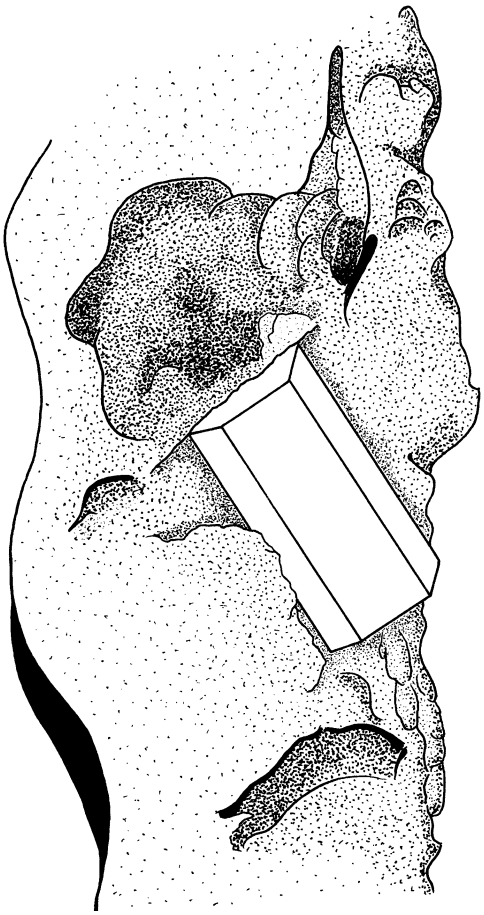
EMERALD, AQUAMARINE, HELIODOR & MORE



Beryl is the name of a group of minerals that are different only in color. All their other physical properties are the same. They all crystallize in the hexagonal system, have a chemical formula of $Be_3Al_2Si_6O_{18}$, and have a hardness of 7 1/2 to 8.

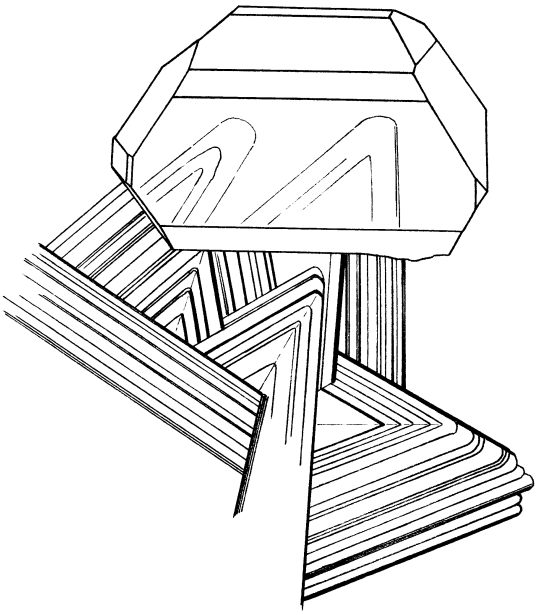
Each color variety has its own name. Green beryl is called *emerald*; blue is called *aquamarine*; yellow is called *heliodor*; pink is called *morganite*. Red beryl is also known as *bixbite*.

Emerald is the green variety of *beryl*. People have believed emerald to have many different "powers" through the ages. The Romans thought it was a symbol of the power of nature to reproduce. The ancient Greek philosopher/scientist, Theophrastus, claimed emeralds could bring rest to the eyes and relieve eye problems. In the 1600's emerald was thought to have the "power" to stop bleeding and take away fevers. Others believed an emerald could help a person predict the future.



Above: Emerald from Colombia.
Right: Red Beryl from the Wah Wah Mountains, Beaver County, Utah.

BRAZILIANITE

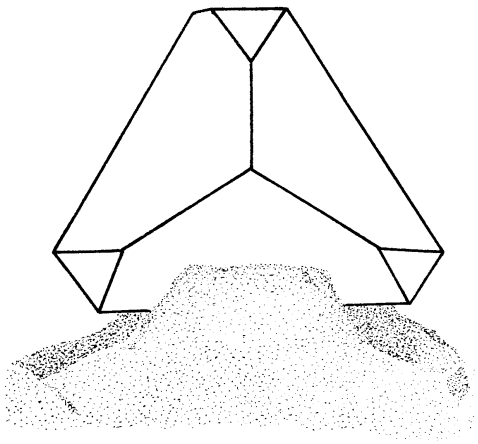


Brazilianite was named after the country in which it was first discovered, Brazil. It is yellow to yellow-green, rarely occurring as dark, olive green specimens. It was discovered in 1945 making it a fairly new gemstone. Brazilianite is often found growing on and with silvery muscovite crystals. These muscovite crystals form a shape that looks like a star, as seen in this drawing of a Brazilianite crystal on mica from Minas Gerais, Brazil. As with the gemstone *zoisite*, Brazilianite is a newer gemstone and does not have old legends of healing or powers associated with it. However, some people today believe that Brazilianite helps a person meditate.

Above: Greenish-yellow Brazilianite on silvery "star mica" from Minas Gerais, Brazil.

BENITOITE

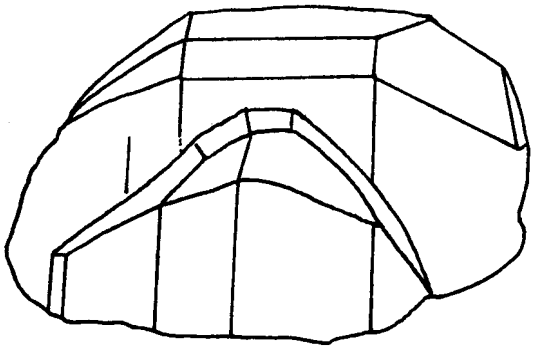
Benitoite is yet another new gemstone. It was first discovered in 1906 in San Benito County, California (can you see how it got its name?!) by James M. Couch who was camping in the hills. The story goes that he woke up to find the sunshine bouncing off of the faces of benitoite crystals that were on the ground around his campsite. Not only is benitoite a rare mineral but gem-quality crystals are even rarer. It is only found at this locality in California - it has never been found anywhere else in the world. Because of this fact, California adopted benitoite as its official state gem on October 1, 1985.



Right: A single benitoite crystal from San Benito County, California.

PERIDOT

OLIVINE



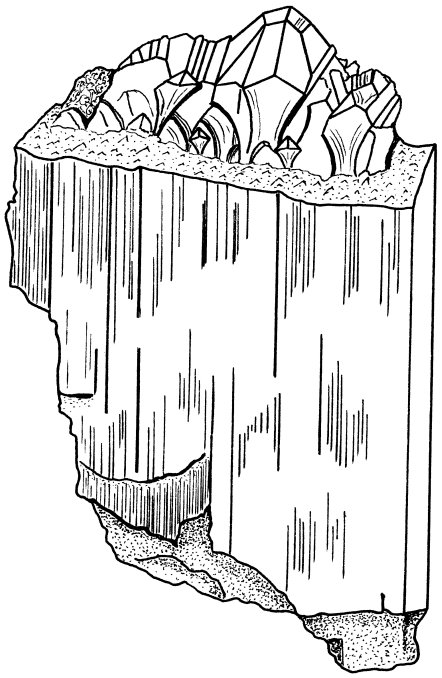
Olivine is a silicate mineral that contains iron and magnesium. It is one of the most common minerals on Earth and is even found on the moon and in meteorites. It forms in dark igneous rock like basalt.

Gem quality olivine is called *peridot*. Even though olivine is very common, gem quality olivine is rarer. It is grass green. The more desired peridot gems are darker green. Peridot is the birthstone for the month of August. Peridot is found in a type of meteorite known as *Pallasite meteorites*. It is, in fact, the only gemstone found in meteorites!

There are different legends about peridot. People in the Middle Ages believed wearing peridot would protect a person from evil spirits. Others thought it could make a person wealthy.

TANZANITE

ZOISITE



Tanzanite is a deep blue to purple variety of the mineral *zoisite*. This gemstone is one of the most recent gemstone discoveries. It was first discovered in 1967 in the country of Tanzania, from which it gets its name. Tanzanite has quickly become a very popular gemstone.

Some gems change color depending on how they are held in the light. This is a property called *pleochroism*. Most gems display two colors. Zoisite, however, displays *three* different colors depending on how it is held in the light. The color changes from blue, light purple and deep red. Because it shows three colors, it is described as being *trichroic*.

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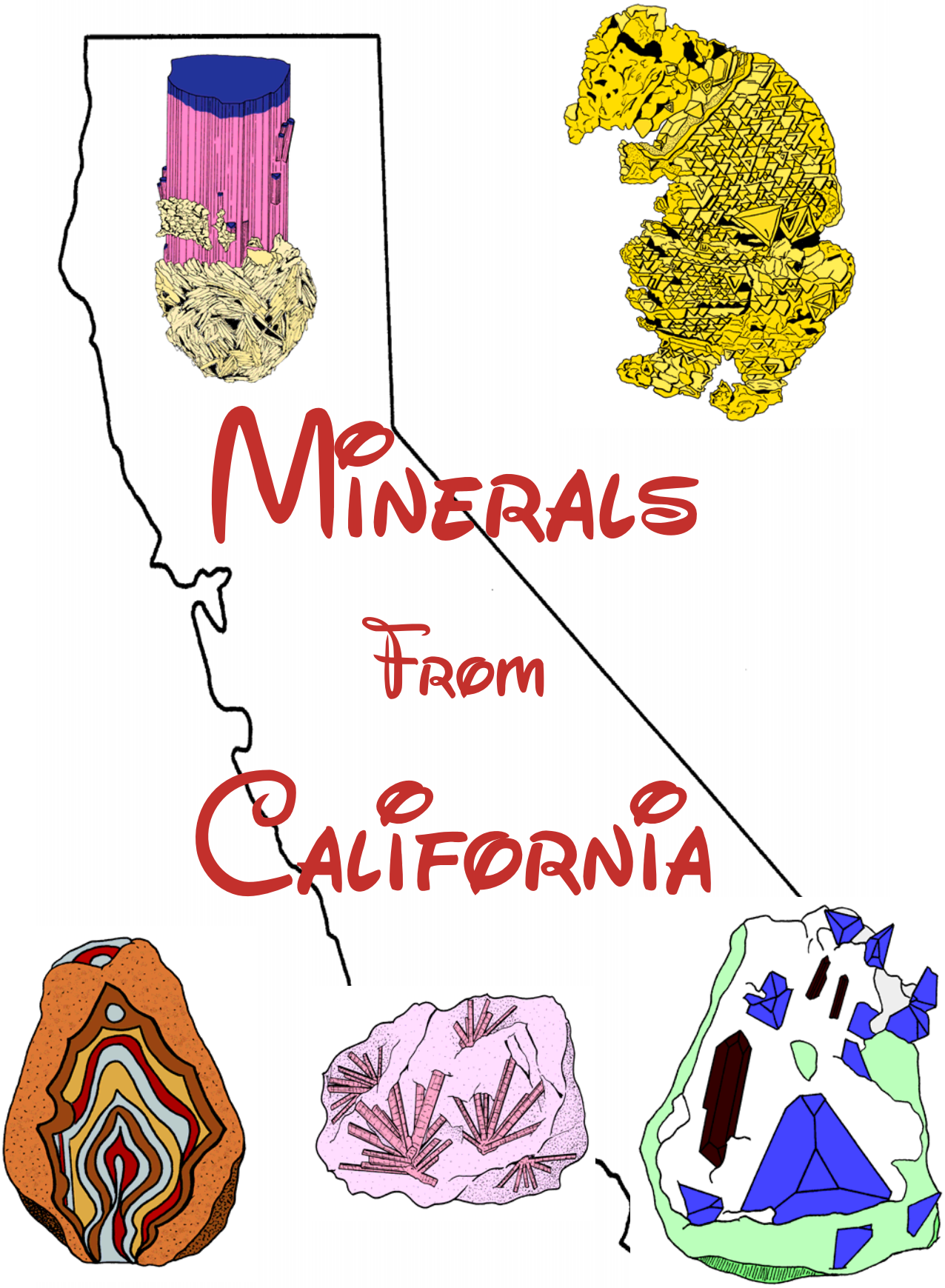
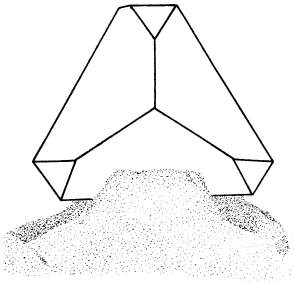


Minerals From California

California's Official Minerals

Benitoite, Native Gold, Serpentine



Two minerals and a rock have received recognition as the "official" minerals and stone of the State of California.

Benitoite became California's official state gemstone in 1984. This unique mineral, which is often cut into beautiful blue gems, was first discovered in San Benito County. It has not been found anywhere else in the world.

Native gold was declared The Golden State's official state mineral in 1965. (Yes, California is also known as "The Golden State.") Gold was first discovered in 1848 on the American River at Sutter's Sawmill. Once word got out that gold was to be found in California, the great gold rush was on! It is estimated that over 125 million ounces of gold were recovered in California during the gold rush. In only four years, California's population grew from 14,000 to over 250,000 as people poured in to find their golden fortune.

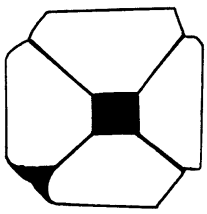
Serpentine was selected as California's official state rock in 1965. As a matter of fact, California was the first state in the United States to choose an official state rock. Serpentine is a metamorphic rock that is shiny and dark green to blue-green. Found with serpentine deposits are other important minerals like cinnabar and chromite.

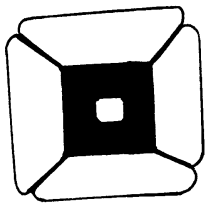
Andalusite var. Chiastolite

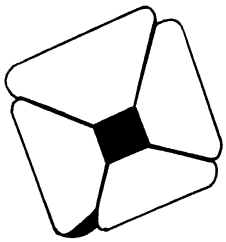
Al_2SiO_5 ~ Aluminum Silicate

Andalusite forms under high temperature and pressure conditions in metamorphic rocks. It has the same chemical composition as Kyanite and Sillimanite but they form in different crystal systems. When two or more minerals have the same chemical formula but different crystal forms, they are called *polymorphs*. Andalusite, Kyanite and Sillimanite are polymorphs of one another.

It is not unusual for andalusite crystals to include carbon or clay in the crystals. When these andalusite crystals are cut across the crystal (called a "cross section") the carbon can be seen in the form of a cross, like the specimens pictured here. Mineralogists call this variety of andalusite *chiastolite* which is from the Greek language and it means *cross-stone*. These specimens are from Georgetown, California.

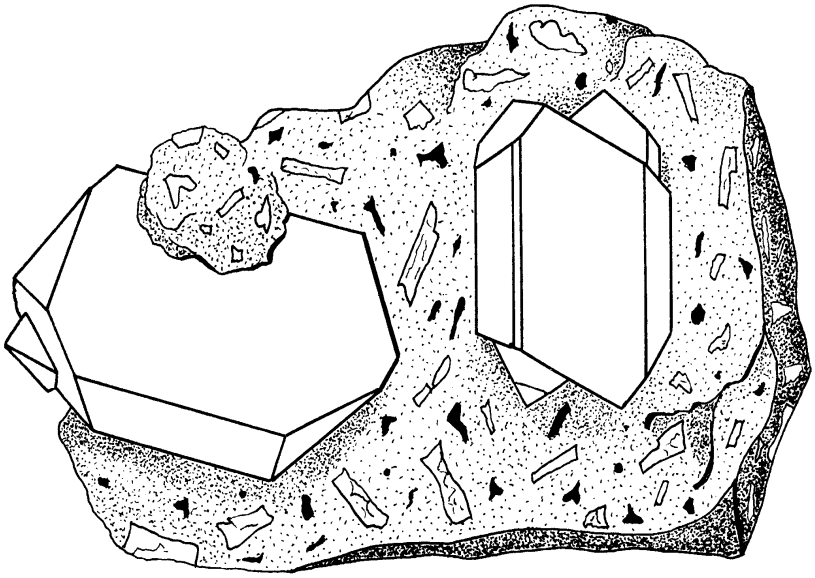






Feldspar var. Orthoclase

$KAlSi_3O_8$ ~ Potassium Aluminum Silicate

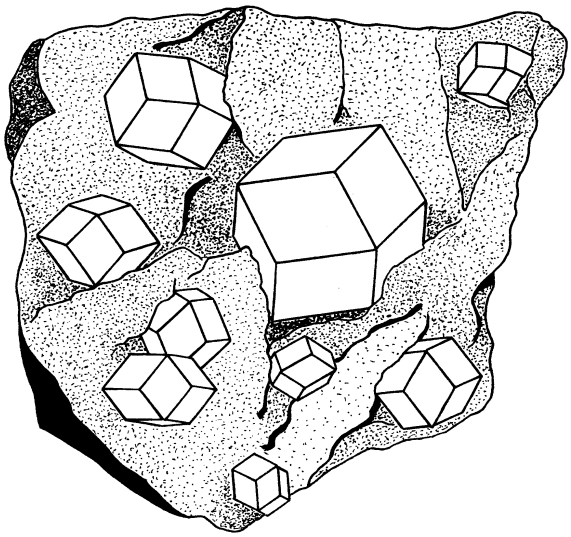


Pictured in this specimen are two "Twinned Crystals" of orthoclase feldspar. This particular twin form is called a *Carlsbad Twin*. Twin crystals form when two individual crystals grow together in a definite formation. A "twin boundary" separates the two crystals. Other minerals that form crystal twins are quartz, rutile, staurolite, gypsum, chrysoberyl, and aragonite (to name a few).

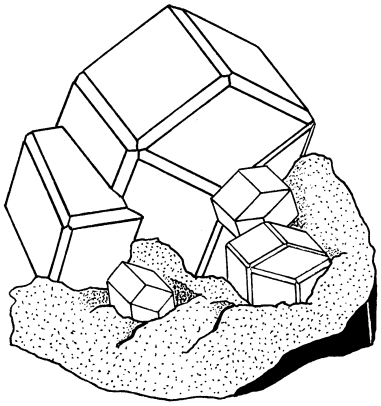
The specimen pictured here was collected in Water Canyon, near Cinco, Kern County. The two large orthoclase crystals are white to tan. They sit in a dull green matrix of igneous rock. You can also see small, poorly formed feldspar crystals. They look like they are floating in the igneous rock.

Garnet var. Andradite

$Ca_3Fe_2(SiO_4)_3$ ~ Calcium iron silicate

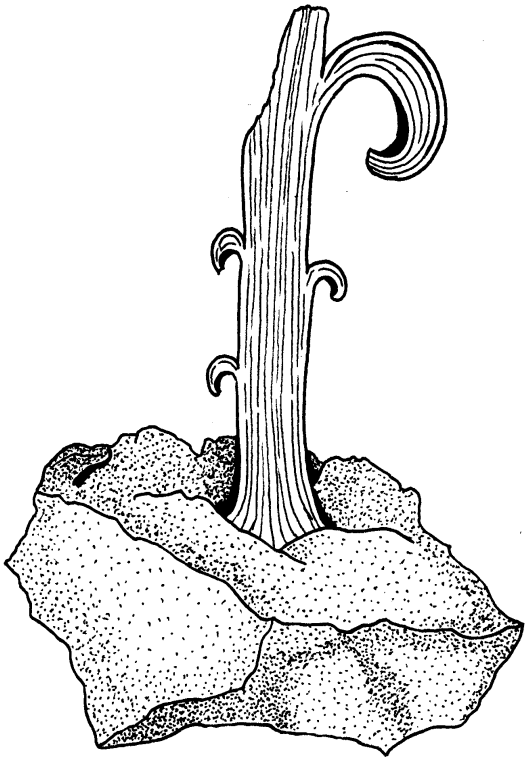


Garnet is found in both metamorphic and igneous rocks in California. Pictured to the right are light green, simple *dodecahedral* andradite garnet crystals from the Idria region of central California. They sit in a light bluish-green matrix. A "dodecahedral" crystal is one that contains 12 faces and each face has four sides. To the left are dark green to brown andradite crystals from Volcano, Amador County. These crystals also have the 12-sided (dodecahedral) form, but they are also a little more complex. Volcano was actually a gold mining town in California's "Mother Lode" district. The story goes that one miner discovered a pocket there that contained 28 pounds of gold! Garnet crystals are a wonderful extra discovery for mineral collectors that dig in the area today.



Gypsum

$CaSO_4 \cdot 2(H_2O)$, ~ Hydrated Calcium Sulfate

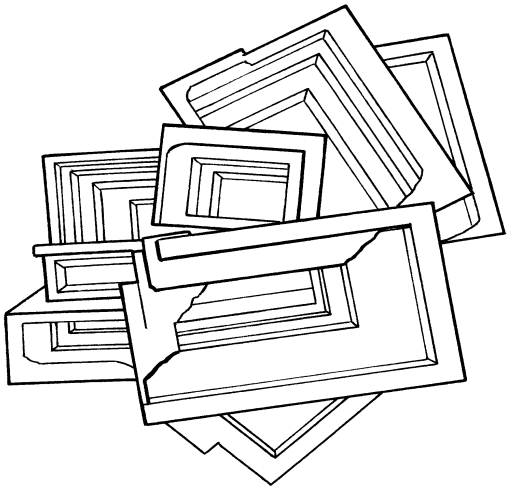


Gypsum is mined in a number of places in California. Enormous gypsum deposits have been mined in the Mojave Desert, at the very southern end of Death Valley. It has also been mined in Inyo, Kern, Los Angeles, Ventura and Santa Barbara Counties. Gypsum is used to make plaster. Its most common use today is in the manufacture of "wall board" or "sheet rock" which is gypsum plaster sandwiched between layers of paper. This wall board is used to make walls and ceilings in homes and offices. In California, gypsum plaster is mixed with other materials like sand to make stucco for the outside walls of homes and other buildings.

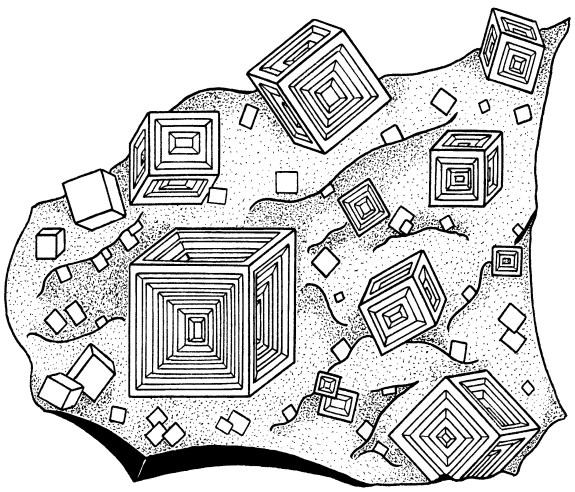
This interesting cave growth of gypsum (right) is from Del Mar, San Diego County. It formed as gypsum-bearing water slowly oozed out of a cave wall. As the water evaporated, the gypsum in the water solidified, adding a little at a time, eventually creating this attractive "Ram's Horn" shape.

Halite

NaCl ~ Sodium Chloride



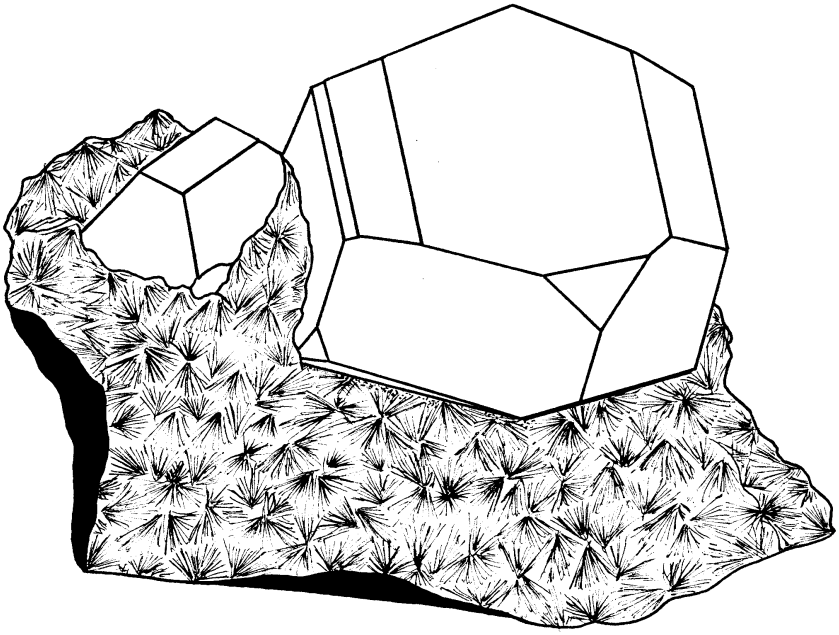
You use halite every day. You know it as *salt*. The halite crystals that form at Searles Lake are unique and beautiful. They usually form as *hopper crystals*. A "hopper crystal" is a crystal in which the edges grew faster than the faces creating hollow indentations at the crystal faces. The Searles Lake halite is also unique because it is a pretty shade of light pink. A bacteria lives in the salt pools where the halite crystals form (called *brine pools*). When the bacteria dies, it turns the salt water red. The halite crystals get redder as the summer goes on. This is due to the fact that the bacteria has had a whole summer to grow, die and accumulate in the brine ponds.



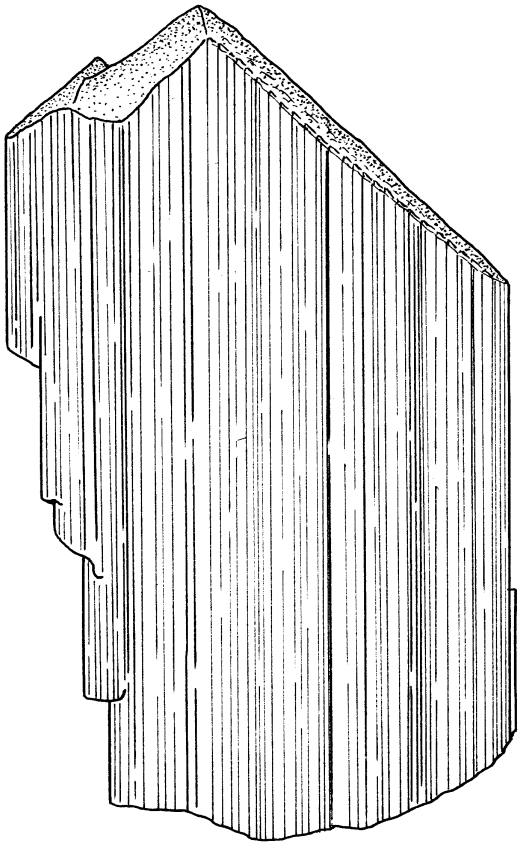
Rutile on Pyrophyllite

Rutile: TiO_2 ~ Titanium Oxide; Pyrophyllite: $AlSi_2O_5OH$ ~ Aluminum Silicate Hydroxide

Pictured here are two sharp rutile crystals sitting on small clusters of pyrophyllite crystals. The rutile is shiny and metallic and dark steel-gray to black. If the light hits an edge just right, you will see a flash of deep red. The pyrophyllite is reddish-tan because it is stained with iron oxide.



This specimen was mined at the Champion mine, White Mountain, Mono County. The Champion Sillimanite mine is actually a number of smaller mines that are spread out over a large area. Other minerals found in this mine include andalusite, barite, corundum, goethite, lazulite, muscovite, orthoclase, pyrite, quartz, schorl, sulfur and topaz. The rutile crystals found here are some of the best crystallized rutile specimens found anywhere in the world.



Spodumene var. Kunzite

$LiAlSi_2O_6$ ~ Lithium Aluminum Silicate

The very first crystals of kunzite were discovered just over a mile from Pala, San Diego County. It was first discovered in 1903. Careful study showed that this light purple, lilac-colored mineral was actually a gem variety of the very common mineral *spodumene*. This discovery was important not only because a new gem of beautiful color had been discovered, but because the crystals themselves were so large. This variety of spodumene was named after George Frederic Kunz in honor of his contributions to gemology. He was, at the time of its discovery, the chief gemologist for the well-known jewelry company, Tiffany's of New York.

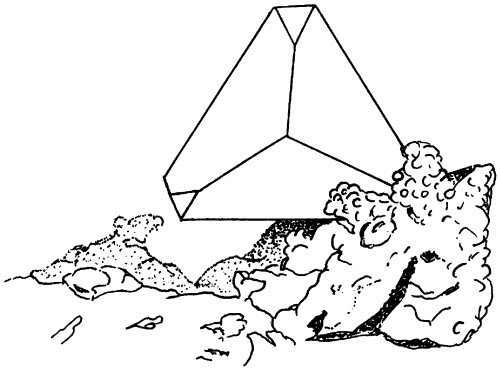
Pictured here is a famous specimen of kunzite from the Pala mine, Pala district, San Diego County.

Minerals Named after Places in California

1. **Benitoite** was named after San Benito County where it was first discovered.
2. **Coyoteite** was named after Coyote Peak volcanic pipe, which is 16 miles SW of Orick, Humboldt County.
3. **Fresnoite** was named after Fresno County where it was discovered at the Big Creek - Rush Creek sanbornite deposit, near the town of Trimmer.
4. **Haiweeite** was named after the Haiwee Reservoir in Inyo County.
5. **Inyoite** was named after Inyo County where it was found at the Mount Blanco mine, Mount Blanco, Black Mountains, Death Valley.
6. **Melonite** was named after the Melones mine, Carson Hill, Calaveras County.
7. **Redingtonite** was named after the Redington mine, Knoxville, Napa County.
8. **Redledgeite** was named after the Red Ledge mine, south of Washington, Nevada County.
9. **Riversideite** was named after the town of Riverside where it was found in the Crestmore quarry, near Riverside in Riverside County.
10. **Santaclaraite** was named after Santa Clara County where it was found in the Pennsylvania mine, on the southwest side of San Antonio Valley, near Mount Hamilton.
11. **Searlesite** was named after Searles Lake, San Bernardino County.
12. **Stewartite** was named after the Stewart mine, Queen Mountain, Pala, San Diego County.

Make Your Own Map

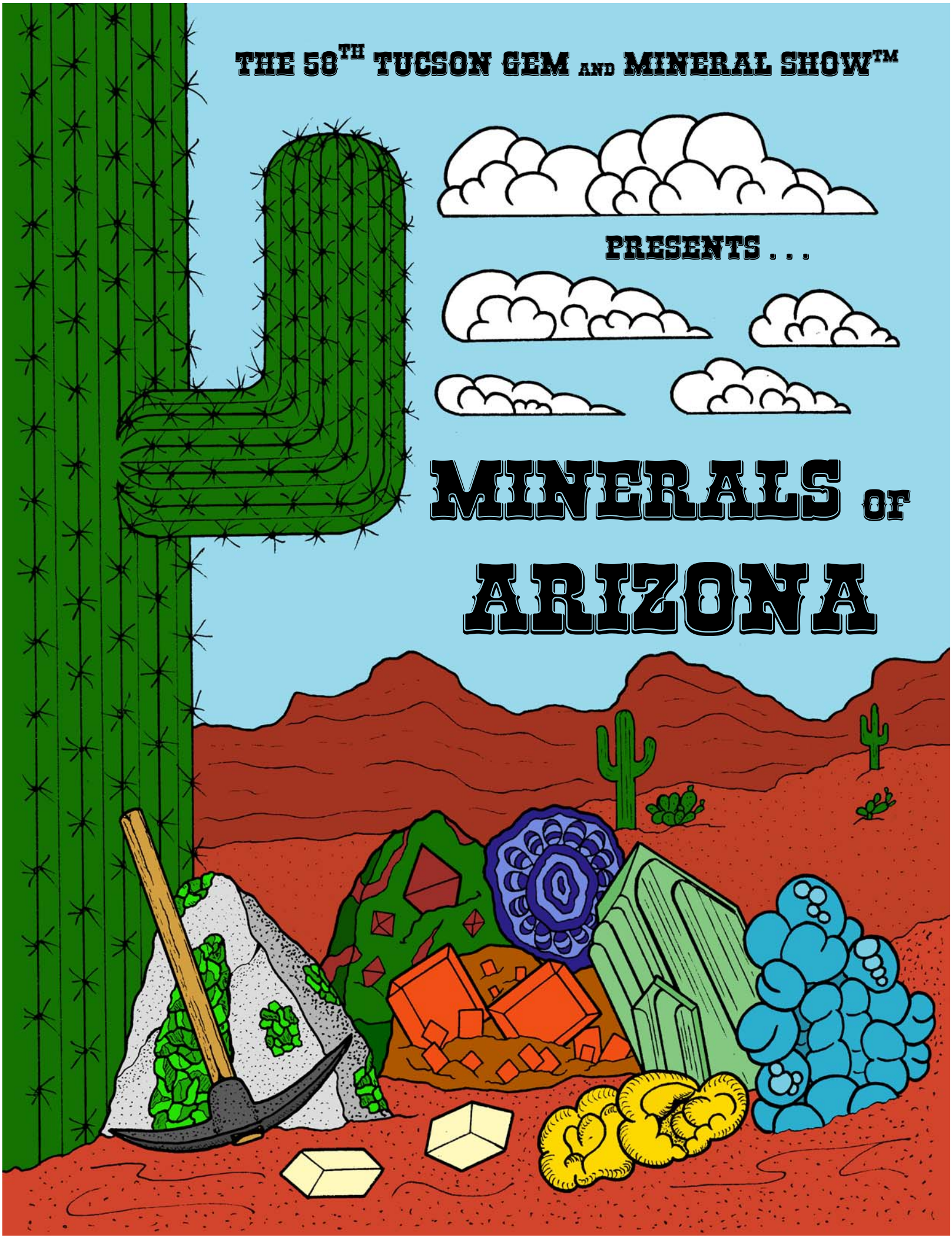
Using an atlas or internet resources, research the places named above and mark them on this map of California.



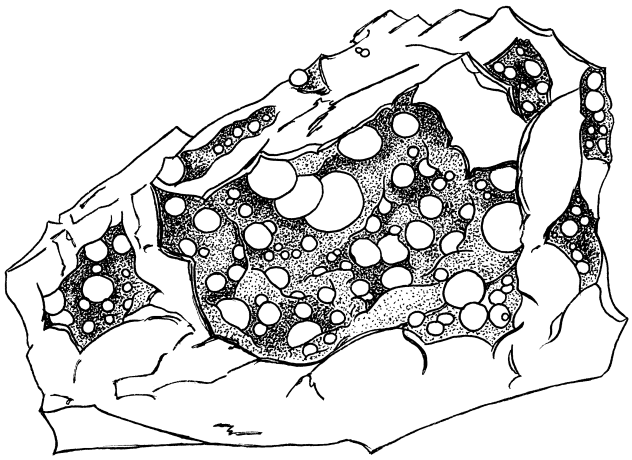
THE 58TH TUCSON GEM AND MINERAL SHOW™

PRESENTS . . .

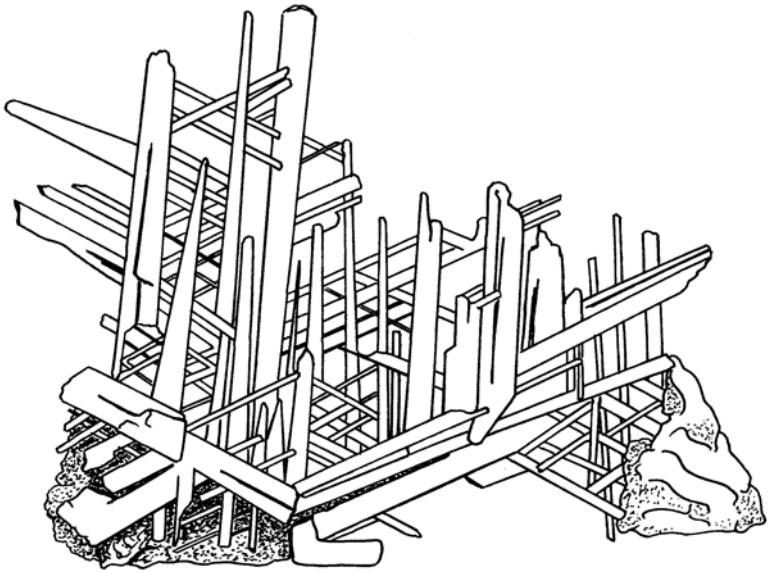
MINERALS OF ARIZONA



Copper Mining in Arizona



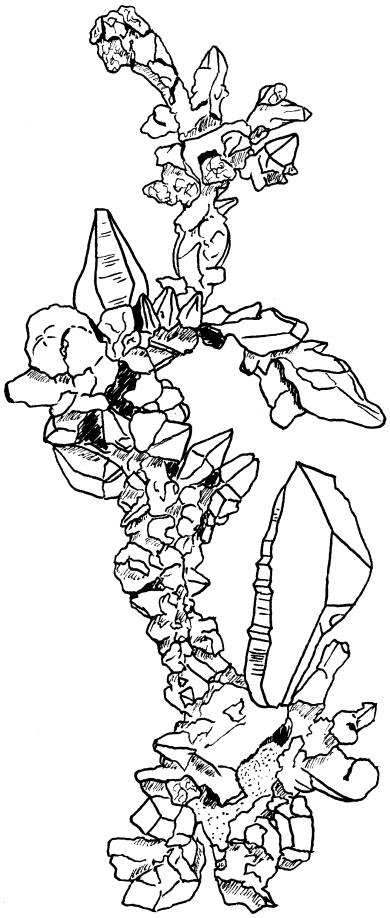
When miners and mineral collectors hear the name Bisbee, they think of one of the greatest mining regions in the history of the world. In its earliest days, Bisbee was known as Mule Gulch. The United States government sent a man named John Dunn along with a small group of men to explore the Mule Gulch region to find a source of good, fresh water. He discovered a spring near the present-day town of Castle Rock. He also discovered a piece of cerussite. With a thought and hope that this piece of lead ore was a sign of mineral wealth beneath his feet, Dunn continued to explore the area. Pretty soon he discovered a very large outcrop of hematite (this hematite formation was given the colorful name "The Iron Monster.") John Dunn and some others staked the first claim in this region in August of 1877. With this, the mining history of Bisbee began.



As the search party headed back to camp, Mr. Dunn met a wandering prospector named George Warren. George Warren staked many claims in the region. He never made any money, though, from his prospecting efforts. He died a poor man in 1895. Even though George Warren is a sad character, he will be forever honored by the fact that one of the world's greatest mining regions -- Bisbee, Arizona -- is in what is known to this day as the Warren Mining District. Bisbee is famous for its enormous open pit mines. In addition, over 2000 miles of underground tunnels were dug to remove the rich ore.

When miners and mineral collectors hear "Bisbee," they also think of copper and copper minerals like azurite, malachite and cuprite. Mining began in Bisbee in 1877 and continued for nearly 100 years right up to 1975. In its 100 years of production, the mines of the Bisbee region produced over 200 different mineral species!

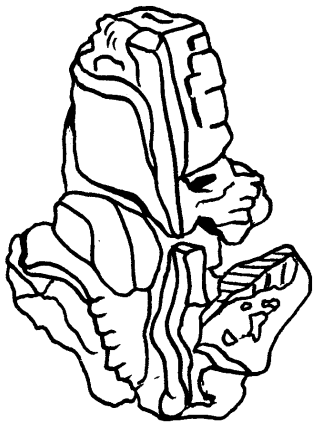
Copper



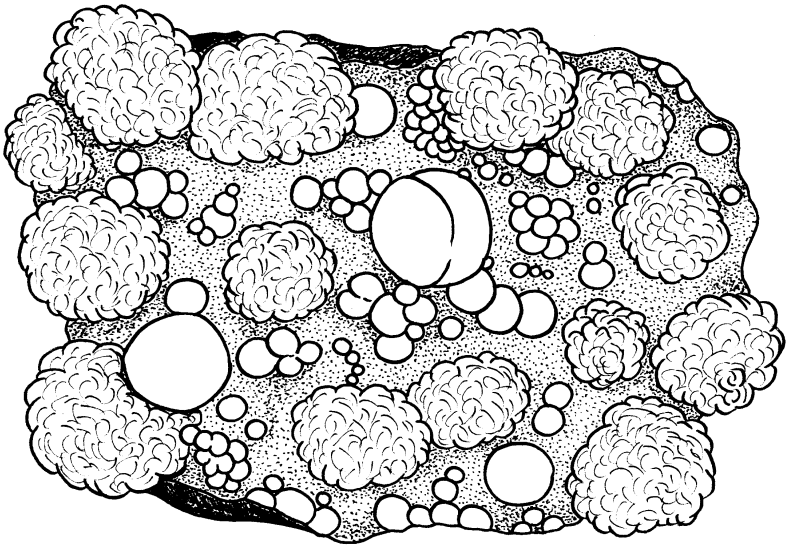
European explorers came to Arizona hungry for fortunes of silver and gold. They heard legends of towns where the streets were paved with gold. No one can say how many people died in the search for silver and gold, but certainly many hundreds lost their lives in search of precious metals. And, yes, plenty of silver and gold has been mined in Arizona. However, it is most accurate to say that **copper** is the metal that made fortunes for many people in Arizona. So much copper has been mined in Arizona that it is officially known as **The Copper State**.

It takes a very special geologic situation for copper masses and crystals to be formed in the earth. Usually the copper combines with other elements to form many different minerals. And yes, Arizona is one of those special places where natural copper can be found in large quantities. **Native copper**, as mineralogists call it, has been mined in the Ray mine, the New Cornelia mine, and other mines in the Ajo and Mineral Creek Districts. As you can see from these specimen drawings, some of the best copper crystals found anywhere in the world have come from mines in Arizona.

Above Right: Copper crystal, Ajo District, Pima County.
Above Left: Crystallized copper from the Ray mine, Mineral Creek District, Pinal County.
Lower Left: Twinned copper crystal group, Ray mine, Mineral Creek District, Pinal County.
Lower Right: Copper crystal from the New Cornelia mine, Ajo District, Pima County.



Azurite & Malachite

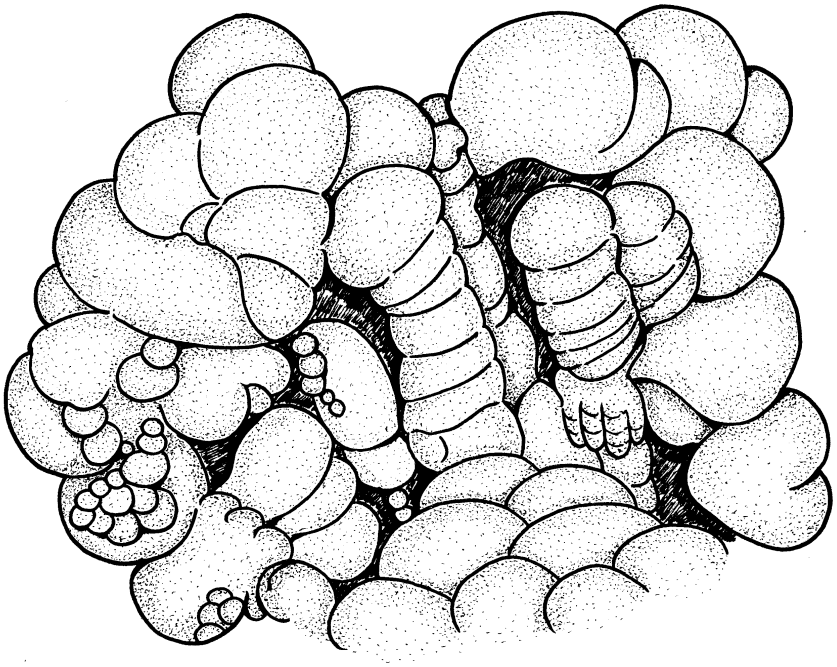


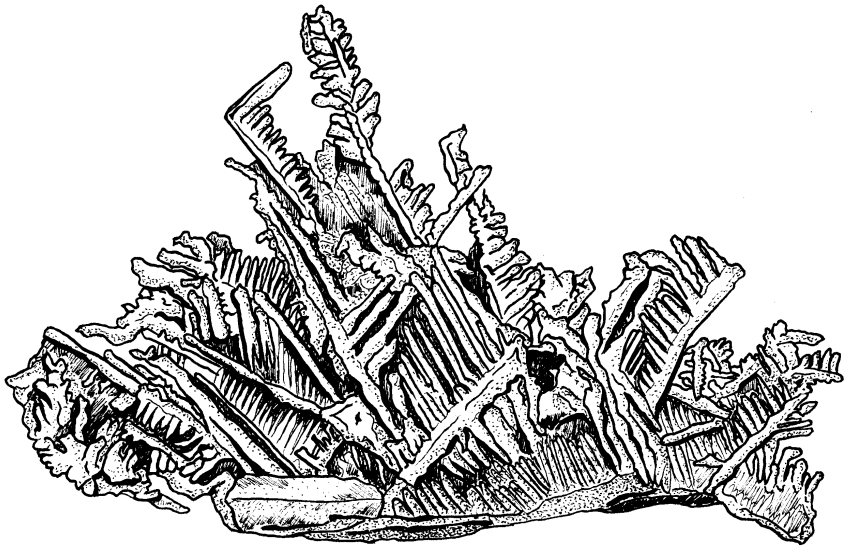
Spectacular azurite and malachite specimens have been found in copper mines all over the world. Some of the most famous and highest quality azurites and malachites have been found in Arizona. The next two pages are devoted to these wonderful specimens to show you their amazing and wonderful forms.

To the left is a specimen of deep blue azurite crystal groups that formed together with light green malachite spheres on light tan matrix. This specimen came from the Morenci mine. Today, the Morenci mine is an open pit mine and is the largest mine and the largest producer of copper in North America. It is also one of the largest copper mines in the world. Since the 1870's it has produced copper, turquoise, silver and gold.

Below is a lumpy mass of light blue azurite from the Junction mine in the Bisbee Mining District. Mineralogists describe this form as botryoidal which means grape-like because it looks a bit like a bunch of grapes. The Bisbee mining district has also produced green malachite specimens that look just like this azurite! Of course if you saw the actual specimens you would immediately be able to tell one from the other. But since this drawing is in black and white, you can decide whether it should be light blue azurite or green malachite.

Besides their colors, what is the difference between azurite and malachite? Both are copper minerals. The difference can be seen in their chemical formulas. Azurite's chemical formula is $Cu_3(CO_3)_2(OH)_2$. Malachite's chemical formula is $Cu_2CO_3(OH)_2$. Look carefully: azurite has one more atom of copper and one more carbonate molecule (CO_3) than malachite. There isn't a big difference in their chemical formulas, is there?! As a matter of fact, many azurite specimens become malachite and turn from blue to green. (Don't worry. This takes thousands of years to occur.)





Silver

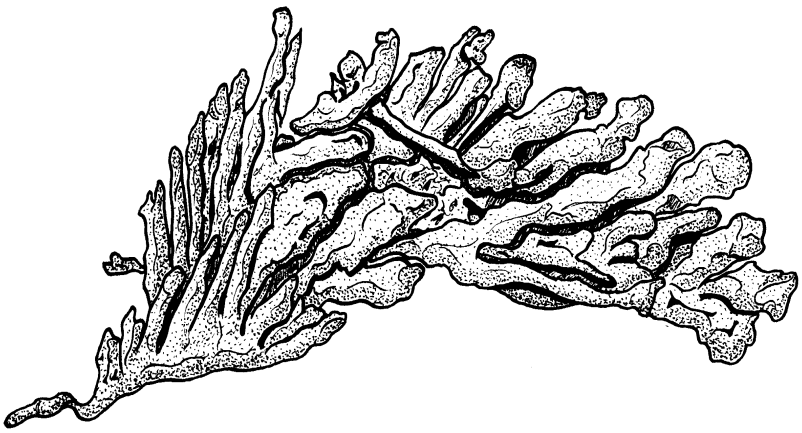
The origin of the name Arizona is not known for certain. It came from a Native language, but exactly which one is not known. Some think that it came from the Aztec Indian word *arizuma* which means *silver-bearing*. On the other hand, it may have come from a Pima Indian word *arizonac* which means *little spring place* as a description for a natural spring of water. Others claim it came from the Spanish phrase *arida zona* which means *arid zone* (that is, a very, very dry place!). All of these explanations make sense. Mineral collectors would like the *arizuma* explanation best.

Explorers came to Arizona to seek fortunes in silver and gold. Spanish explorers, for example, were sent by Spain to find riches for their nation. Silver and gold were found, in important amounts. In many mines, silver was found not as native silver or as silver ore, but trapped in galena (lead ore). In some places, however, native silver was mined in large amounts.

Pictured above is an awesome crystallized specimen of native silver from the Stonewall Jackson mine, Globe-Miami District, Gila County. The Stonewall Jackson mine was an underground mine that was mined for its copper, lead and silver. It was first discovered in 1876 and was a working mine until 1947. Found in this mine was a thick vein of silver ore. But within this ore was a layer (miners call this layer a *horizon*) 1 to 2 inches thick of pure, native silver!

One great silver discovery from the early days of Spanish exploration in Arizona is worth sharing. In 1736 an Indian miner from the Yaqui tribe discovered native silver lying on the surface of the ground! The silver was described as “large balls and slabs” and the location was named Las Planchas de Plata meaning The Plates of Silver. One plate of silver weighed 3,500 pounds! In a very short time, thousands of people arrived to find their fortune and quickly turned the little ranch into a full-blown mining town which they called Real de Arissona.

To the right is another crystallized native silver specimen. This specimen was found in Maricopa County, a region known for its silver mines.



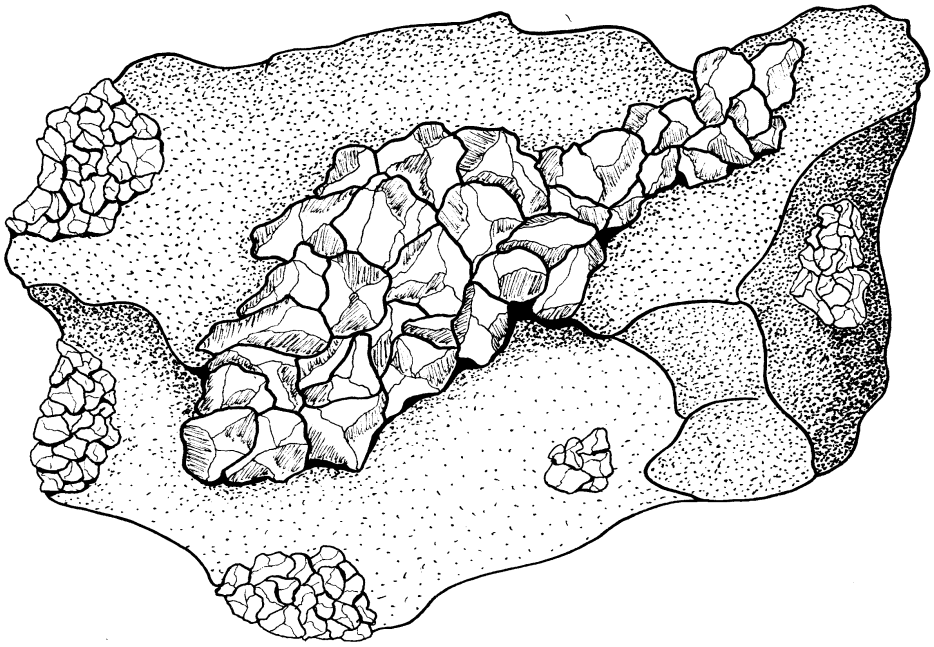
Olivine var. Peridot

Olivine is the name of a group of minerals that form in the dark, igneous rock called basalt. Olivine itself contains differing amounts of the elements iron and magnesium. Peridot is a special variety of olivine that has both iron and magnesium in its crystal structure. Its beautiful grass-green color is created by the iron. Its color can be yellow-green to dark green. The most desired peridot gemstones are dark green. Peridot is the birthstone for the month of August.

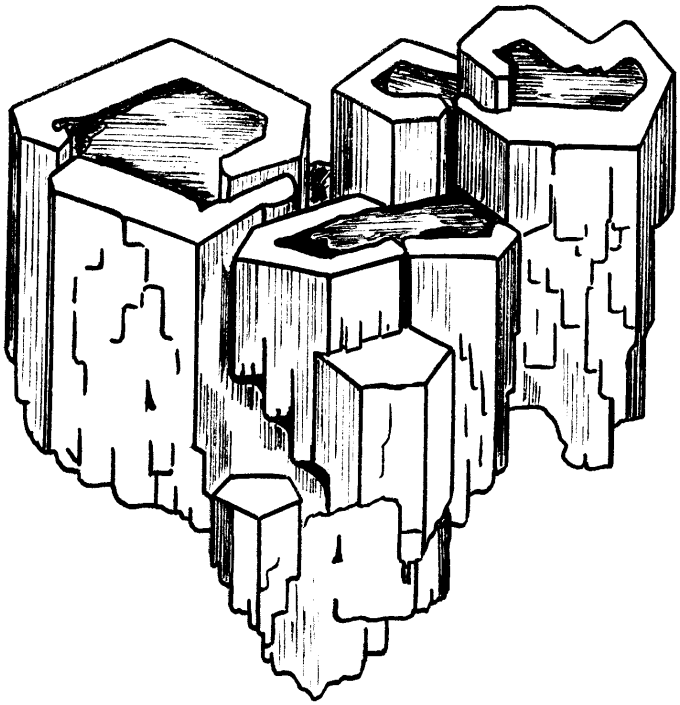
Only a few localities around the world have produced gem-quality peridot. For example, they can be found in Myanmar (a country that used to be known as Burma) and on St. John's Island in the Red Sea. In the United States, large quantities of gem-quality peridot can only be found near San Carlos, Gila County, approximately 100 miles east of Phoenix.

San Carlos peridot is found as fractured masses in basalt. Basalt covers this portion of Arizona. The peridot is found on Peridot Mesa, on land that belongs to the Apache Ndeh Nation. The "Apache" Nation is actually a group of Native Americans who are related to the traditional Apache peoples. Those who live in the San Carlos area are known as the San Carlos Nation.

Since the land is owned by the Apache Ndeh people, Peridot Mesa is not open to public collecting. The people of the San Carlos Nation use hand tools to break apart the basalt and carefully remove the fractured peridot. Smaller, lower-quality pieces are generally polished and made into beads. These beads are usually strung together to make necklaces, earrings and other jewelry. Only the rare, larger gem-quality pieces are cut as gemstones.



Vanadinite



High quality, well-formed, bright red and glassy vanadinite specimens are among the many mineral treasures of Arizona. As a matter of fact, some of the best vanadinite specimens ever discovered came from Yuma County's "Silver District."

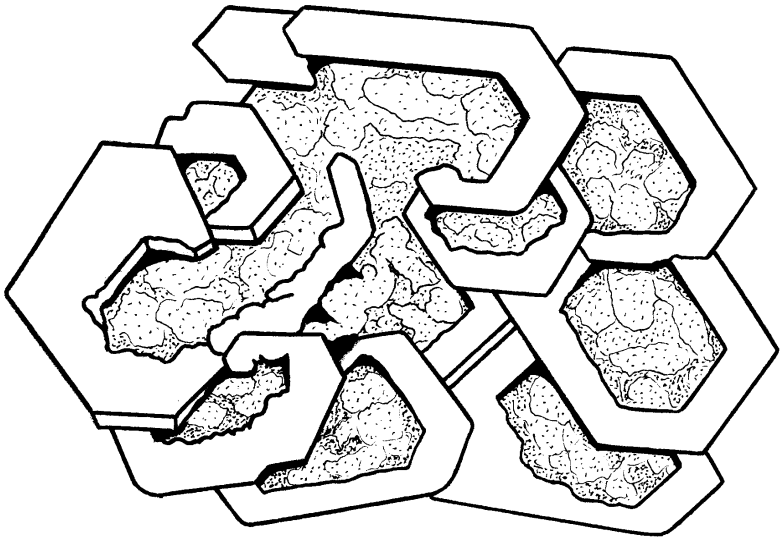
The "Silver District" was discovered in 1860. As you can tell by its name, silver ore was the treasure in the mines of this region. One of the more famous mines of the region (at least to mineral collectors) is the Hamburg mine. It is interesting to learn that the Hamburg mine never produced any silver ore. What it did produce, however, were some excellent vanadinite crystals. These wonderful crystals formed in cracks in the quartz and calcite. Some of the cracks are very thin; others are wide. The larger crystals formed in the wider cracks.

The Old Yuma mine near Tucson produced some of the finest vanadinites in the world. It opened in 1885 and produced lead in the form of the mineral galena. The color of the vanadinite from the Old Yuma mine has been described as "fiery red." It also produced fine wulfenite crystals.

There are a lot of mysteries surrounding mines and minerals in Arizona. For example, there is a long list of "lost" mines, that is, mines whose locations were kept secret so well that they were never found again! Another mineral mystery surrounds a mine known as "The Romaldo Pacheco Mine." This mine is the locality of some of the best vanadinite specimens ever found in Arizona. Some of these specimens are in the mineral collection of the Smithsonian in Washington, D.C. The drawing below is a specimen from this mysterious mine. The "mystery" is that no one knows where this mine was or is! Many mineralogists believe that the mine which is known today as The Pure Potential mine (also commonly known as the North Geronimo) is the Romaldo Pacheco mine.

Above Left: The author's version of an old drawing originally published by V.R. Zepharovich in 1889. Experts believe that it is a drawing of a vanadinite specimen from the Hamburg mine, Yuma County.

Below: A group of bright red, intergrown, vanadinite crystals from the Romaldo Pacheco mine, Yuma County.



The Great Arizona Mineral Search

Literally hundreds of different minerals have been found in Arizona. As you read earlier, the mines of the Bisbee District alone have produced over 200 different mineral species. Hidden in this word search are minerals from Arizona for you to find. Some of them are common minerals that you already know. Others are very rare and you may be seeing their names here for the first time. When you have finished the word search challenge, you can do some research and learn about all of these wonderful mineral species.

The words can be found going left to right, right to left, top to bottom, bottom to top, and diagonally. Good luck!

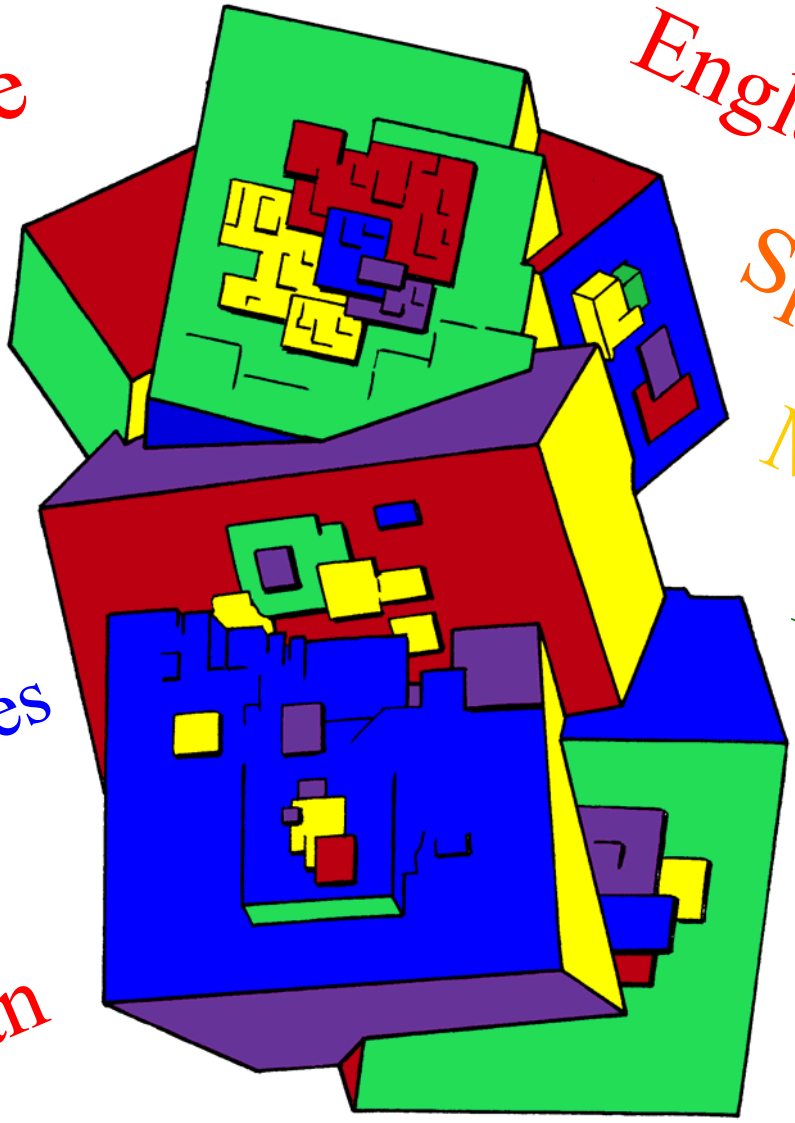
A	W	C	A	M	E	T	H	Y	S	T	R	P	T	Y
J	U	E	D	I	A	B	O	L	E	I	T	E	A	V
B	L	R	L	I	N	A	R	I	T	E	T	R	L	A
G	F	U	I	O	K	P	O	B	C	I	L	I	C	N
L	E	S	X	C	Y	T	O	M	C	D	A	D	F	A
A	N	S	F	R	H	R	M	L	H	P	G	O	L	D
U	I	I	I	T	N	A	A	G	O	L	D	T	B	I
B	T	T	O	I	Z	C	L	G	A	L	E	N	A	N
E	E	E	T	U	W	P	A	C	O	P	P	E	R	I
R	B	E	R	W	E	S	C	U	I	H	A	N	I	T
I	S	I	L	V	E	R	H	P	D	T	P	O	T	E
T	T	M	I	C	A	S	I	R	T	O	E	W	E	R
E	A	J	O	I	T	E	T	I	Q	U	A	R	T	Z
D	I	O	P	T	A	S	E	T	I	L	A	H	C	E
T	U	R	Q	U	O	I	S	E	N	I	V	I	L	O

Ajoite; Amethyst; Aurichalcite; Azurite; Barite; Bornite; Calcite; Cerussite; Copper; Cuprite; Diaboleite; Dioptase; Galena; Glauberite; Gold (x2); Halite; Linarite; Malachite; Mica; Olivine; Peridot; Pyrite; Quartz; Silver; Talc; Turquoise; Vanadinite; Wulfenite

The 59th Tucson Gem and Mineral Show™ presents . . .

FLUORITE

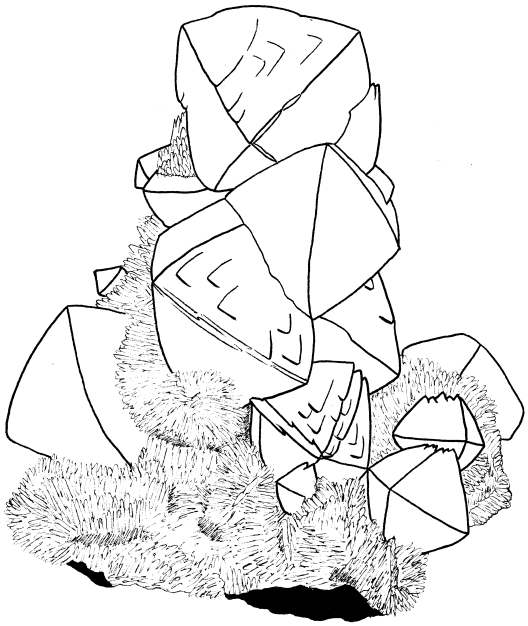
Greece
Canada
China
Russia
United States
Korea
Pakistan



England
Spain
Mexico
Italy
Namibia
Japan
India

Colors of the Rainbow

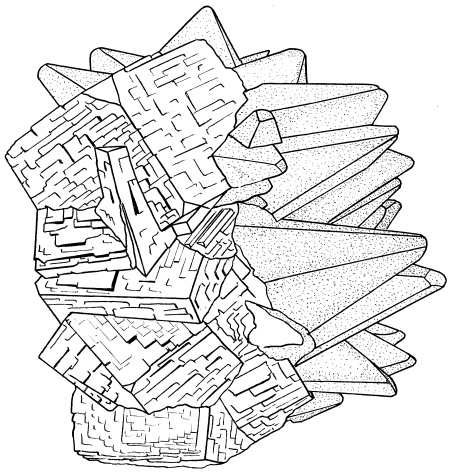
Fluorite's Physical Properties



Chemical Formula: CaF_2 ~ Calcium Fluoride
Crystal System: Isometric (also called "Cubic")
Luster: Vitreous (also called "glassy")
Hardness: 4
Specific Gravity: 3.0 - 3.3
Fracture: Conchoidal (also called "shell-like")
Cleavage: Perfect Octahedral. This means that with care, you can break a piece of fluorite into a perfect, 8-sided diamond shape which is called *an octahedron*.

Transparent. Often fluorescent.

The Name "Fluorite"



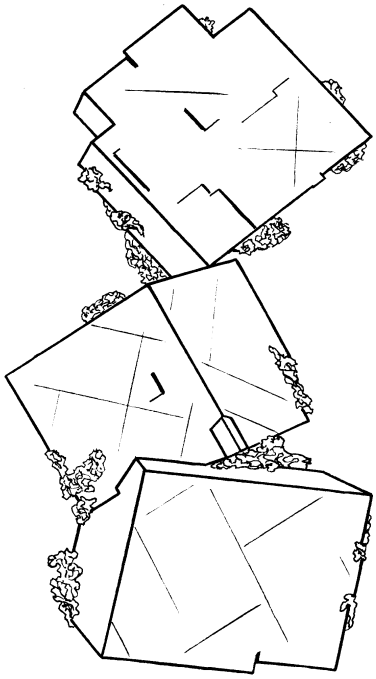
The name "Fluorite" was created from the Latin word *fluere* which means *to flow*. You see, fluorite is what metallurgists call *a flux*. Smelting is the process of removing valuable metal from its ore. For example, when an ore, like the iron ore *hematite* is smelted, it is heated to very high temperatures to make the metal (iron) come out of the ore. But this takes a LOT of heat! When the flux mineral (fluorite) is added to the hematite, the iron comes out of the ore *at a lower temperature!* So, the flux mineral called fluorite makes iron *flow* out of iron ore at a lower temperature! This makes it easier to remove the iron and saves a lot of money because it takes less fuel to heat the ore.

There are a number of other words that come from the mineral name *Fluorite*. One of the elements removed from fluorite is *fluorine* which is used to make the chemical *fluoride* that is used in toothpaste. The special property of *fluorescence* where ultraviolet light creates different colors in minerals was probably first seen in the mineral fluorite and so was named after this special mineral species.

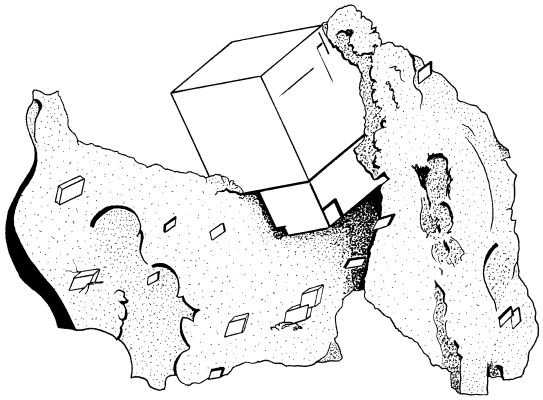
Colorful Fluorite

Some have called fluorite "The most colorful mineral in the world!" Others have described it "like a bouquet of flowers." Without a doubt, fluorite can be found in all the colors of the rainbow - and more!

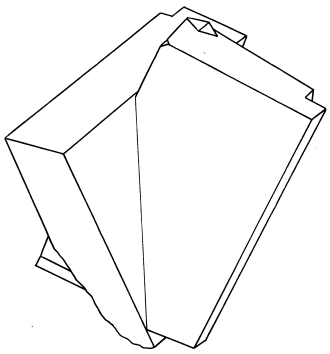
Pure fluorite contains only two elements, **calcium and fluorine**. Its chemical formula is CaF_2. When you find pure fluorite in nature, it is colorless and clear as glass. But pure minerals are not often found in nature. They usually contain small amounts of other elements or have defects in the crystals and these "**impurities**" create color in fluorite. It is difficult to describe what causes color in fluorite without talking about chemistry, and a lot of our young mineral students don't know a lot of chemistry yet. So, here is a very simple description. Maybe you can study some chemistry with your teacher or family!



Green in fluorite can be created when some of the calcium (Ca) is replaced by the element samarium (Sm). *Green fluorite cubes from China.* ►

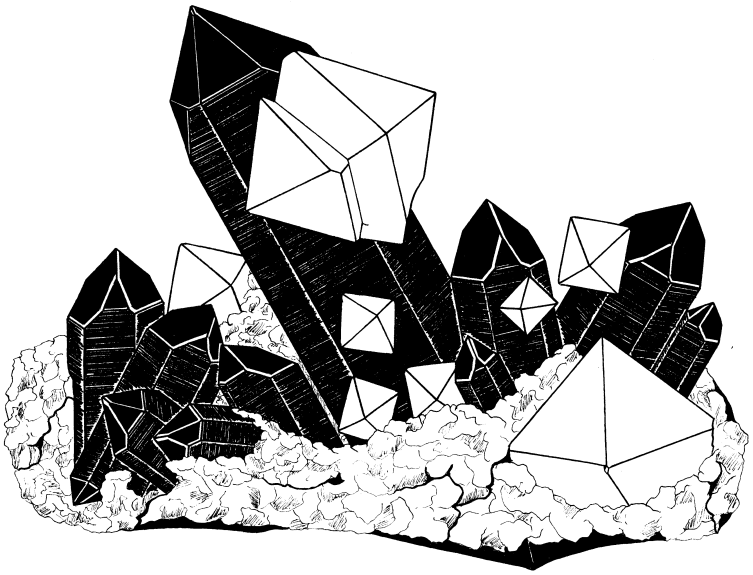


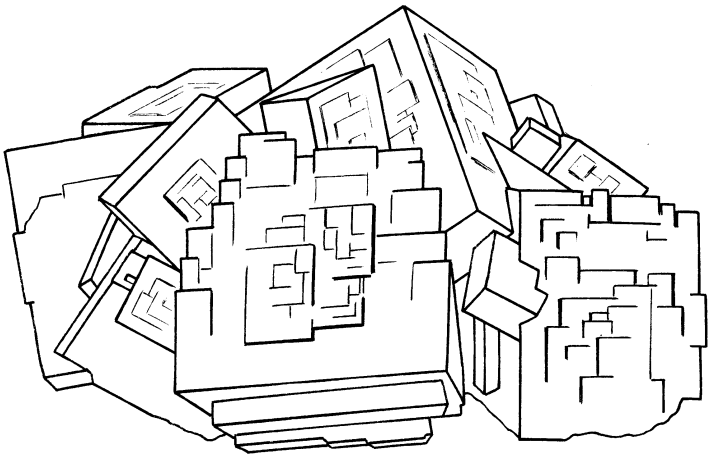
◄**Purple** in fluorite can be created when radiation causes special changes in the crystal structure. The presence of something mineralogists call **calcium colloids** can create colors that range from **blue to darkest purple**. This can get very complicated, but you can think of a "calcium colloid" as bunches of special calcium atoms. *Above left: Deep purple fluorite cubes from Penfield Quarry, Penfield, New York, USA*



◄**Yellow** in fluorite is also created by special chemical changes inside the crystal. Yellow fluorite forms when two fluorine ions (F) are replaced by one oxygen (O) ion. *Intergrown yellow fluorite cubes from the Hilton mine, Scordale, Westmoreland, England.*

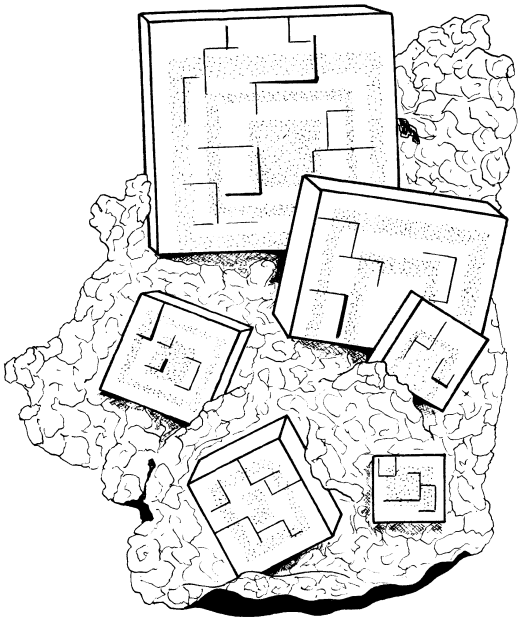
Pink and red in fluorite is created by a very complicated chemical change in the fluorite that involves the elements yttrium (Y) and oxygen (O). We'll leave the details to the experts, but it is fun for you to learn that small changes inside a fluorite crystal can create very different colors. *Pink octahedral fluorite crystals on smoky quartz from The Goscheneralp, Uri, Switzerland* ►

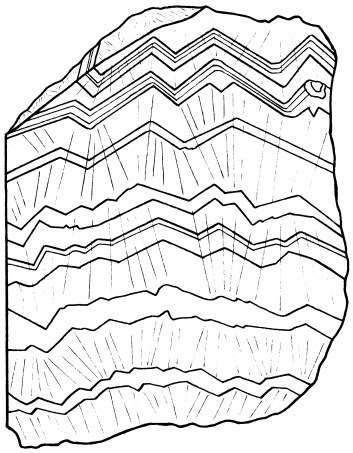




◄**Light blue** in fluorite can be created when the rare element yttrium (Y) takes the place of some of the calcium (Ca) atoms. *Lilac purple fluorite with blue edges from the Bingham mine, Socorro County, New Mexico, USA.*

Brown in fluorite is created by impurities of hyrdrocarbon material like oil or tar that are trapped in the fluorite crystal structure. "Hydrocarbons" are materials that were created by decaying plants that were trapped in sediments. Later, when the sediments became rock, the plant material broke down (decayed) into large molecules made up of hydrogen and carbon. *Brown fluorite cubes from Clay Center, Ohio, USA.* ►





◄**Color Zones** in fluorite are created when there are differences in the chemical environment as the fluorite formed over thousands and millions of years. Sometimes the changes go back and forth, back and forth and create zones that look like layers, like this slice of "Blue John" fluorite from England.

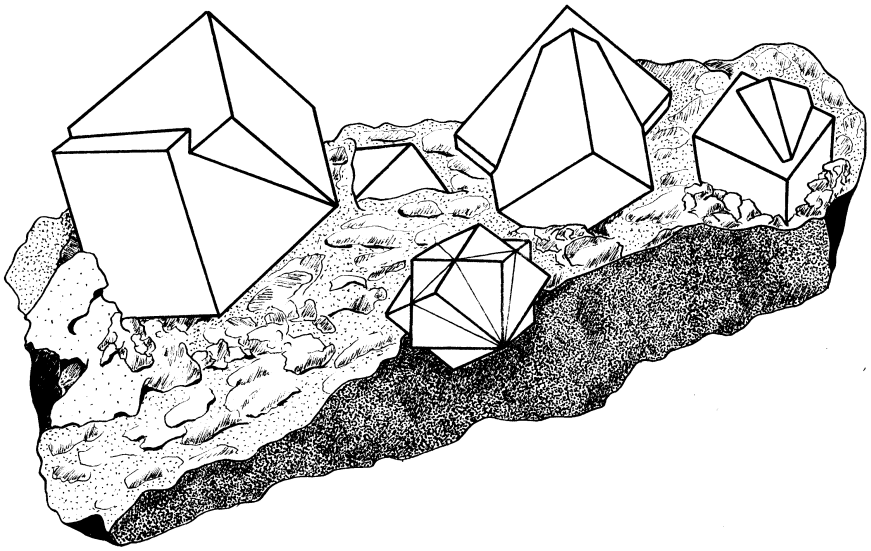
Hidden Colors in Fluorite

"Firefly Stone" - 螢石

On a warm summer night, you might see special insects flying around the woods and fields. If you watch closely, you will see them light up, like little yellow light bulbs. On and off, on and off . . . they sparkle in the air. These wonderful beetles are called fireflies or lightning bugs. If you catch one in a jar, you will see that the end of their bodies really do light up! The light is created by a chemical reaction. This is called bioluminescence.

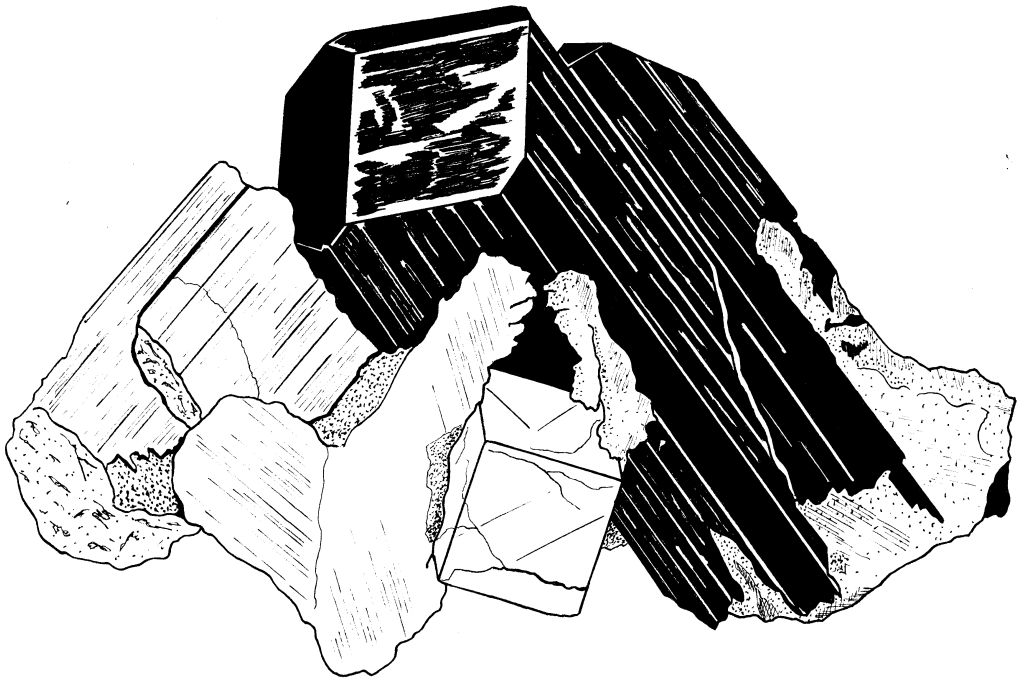
Fluorite can light up like a light bulb, too. Hundreds, maybe even thousands of years ago, people noticed that some fluorite specimens would glow a bluish-white color after being removed from sunlight and put in the dark. English miners and mineral collectors noticed that fluorite specimens from the Rogerley mine in Weardale, England would glow in the dark after they sat in sunlight. This natural phenomenon is called phosphorescence. This may be the reason that the Japanese call fluorite Firefly Stone. The characters in the Japanese language look like this, 螢石 and are pronounced Hotaruishi. To the Japanese, some fluorite specimens can glow in the dark - just like a firefly!

Here at the Tucson Gem and Mineral Show™ we are featuring the many different colors of fluorite. There are also *other* colors that are created by different kinds of light. When fluorite is placed under ultraviolet light it can be fluorescent blue, red, yellow, white and green. Ultraviolet light is light that cannot be seen by the human eye. However, when it is absorbed by a mineral, ultraviolet light can create wonderful colors in the mineral. Look for the displays of ultraviolet fluorite specimens here at the show.

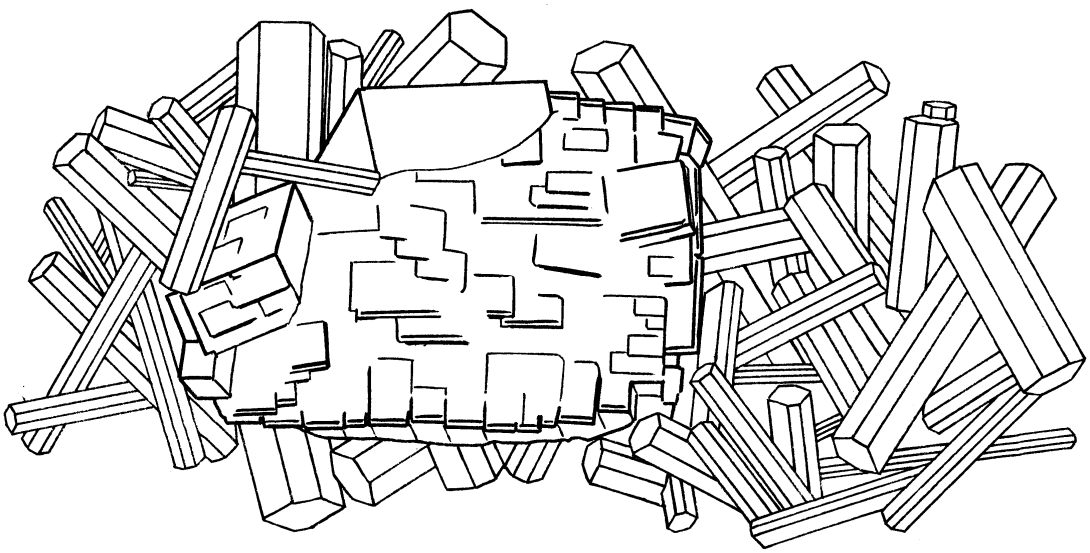


Minerals Associated With Fluorite

As you look through this book and the specimens at the Tucson Gem and Mineral Show™ you will see the many different minerals that are associated with fluorite. A number of examples are scattered throughout this book.

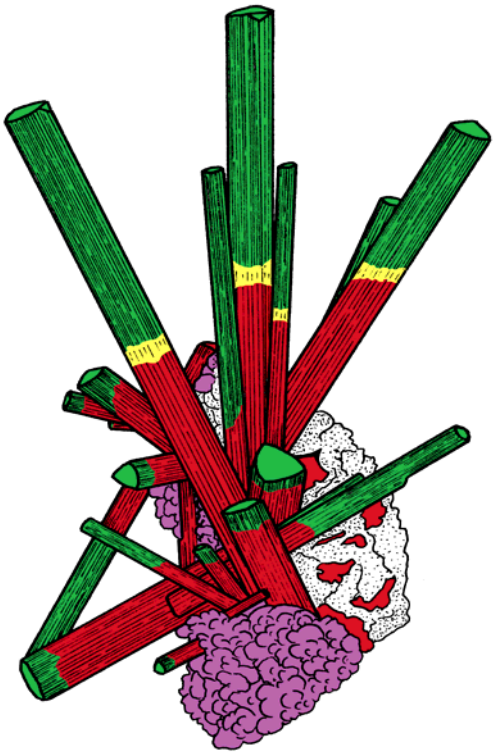


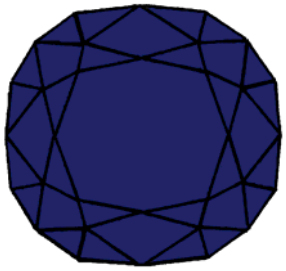
Above is a simple green fluorite cube (notice it has some cracks in it). It has grown with large, black tourmaline crystals (black tourmaline is called *schorl*) and rough, creamy feldspar crystals. This specimen is from Erongo, Namibia, Africa. Below is another incredible fluorite specimen from Erongo. It is dark green with dark purple edges! It has grown with gemmy, glassy, light blue beryl crystals. Light blue beryl is called *aquamarine*. Fluorite is also associated with calcite, barite, quartz, and galena.

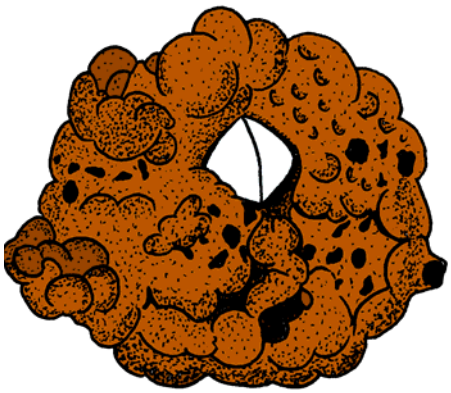


The 60th Annual Tucson Gem & Mineral Show™ presents . . .

Sixty Years of Mineral Treasures of Yesterday

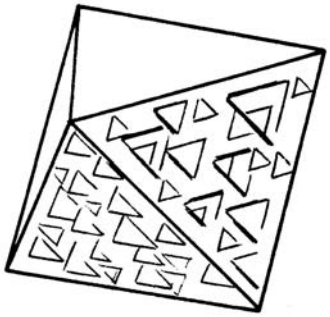






Diamonds

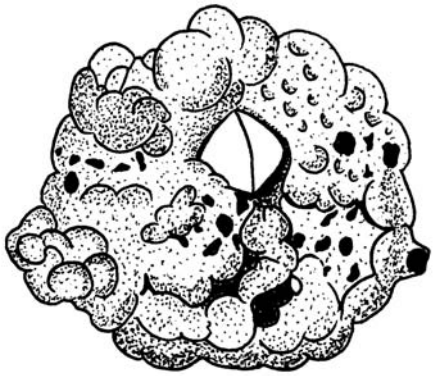
Diamond is **pure carbon** and is the hardest substance on earth. This is due to the way the carbon atoms connect with each other. Graphite is another mineral that is also pure carbon. It is the softest mineral in the mineral kingdom because its carbon atoms connect with each other in a very different way.



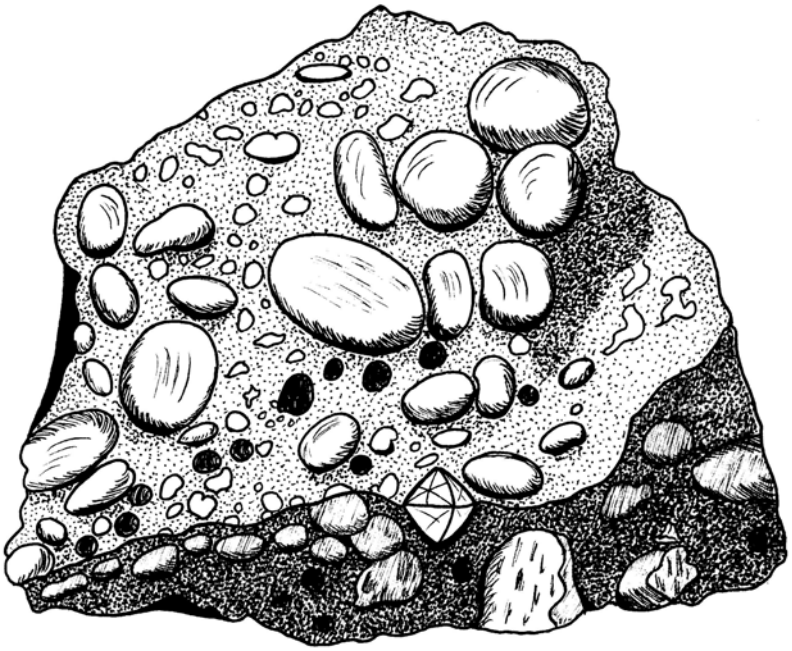
Diamonds form at tremendous **pressures and temperatures** that are found at over 100 miles beneath the earth's surface where temperatures are 2000 to 3000 degrees F.

80% of the diamonds found are not gem quality.

They are brought to the earth's surface by volcanic activity. They are associated with igneous formations known as **kimberlite pipes**.



Pure diamonds are colorless. Impurities create blue, red and yellow diamonds. The most common colored diamonds are brown and yellow. The specimen above is a yellow diamond from South Africa.

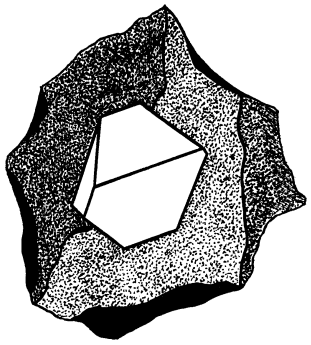


The earliest diamond discoveries were in India, like the specimen in matrix pictured to the right. By 1725, diamonds were discovered in Minas Gerais, Brazil. Can you find the diamond trapped in the conglomerate matrix below?

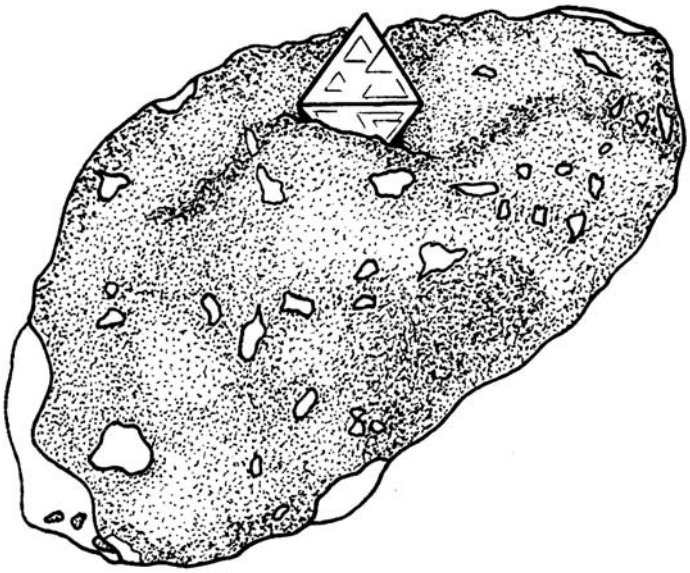
Today, Russia produces the most diamonds by weight. They are also mined in South Africa, Botswana, Canada, and other African nations. In the United States, some gemmy diamonds have been discovered at the Crater of Diamonds State Park in Arkansas.

Diamonds, continued

In South Africa, diamond crystals are found in **kimberlite**, a dark blue to black igneous rock that is also known as *blue ground*.

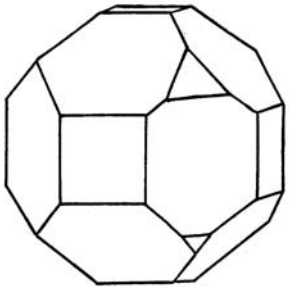


Pictured to the right is a colorless, gemmy diamond in blue ground. To the left is a brown, gemmy diamond, also in blue ground matrix.



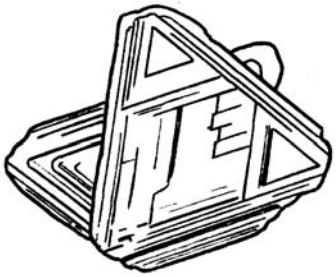
Diamond crystallizes in the **isometric** (cubic) crystal system. It forms simple cubes and simple octahedra, the 8-sided crystal form that is so common to diamonds that it is known as **"diamond-shaped."** Many octahedral diamond crystals are **hopper** crystals (left) in which the edges of the faces grew faster than the faces themselves.

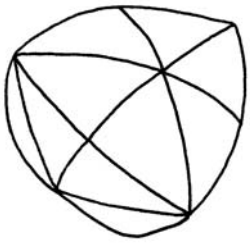
The crystal pictured to the right is a combination of the octahedra and cube.



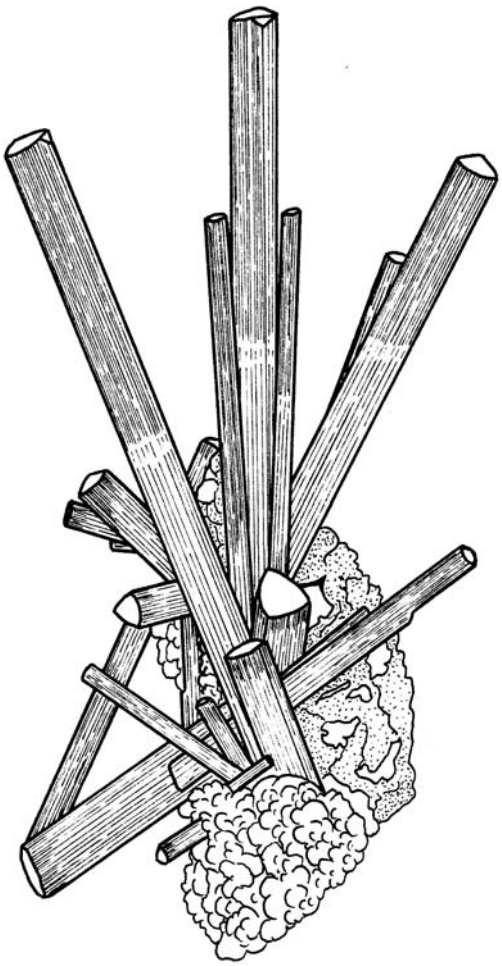
Diamonds can form *twin crystals* like the two pictured to the left. These twins are called *macles*. Macles are flat and look like triangles.

It is not unusual for the faces of diamond crystals to have little triangular growths. These growths are called *trigons* because they are triangles (with three - tri - angles and sides).

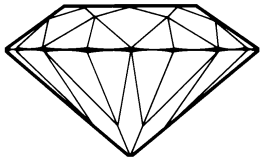




To the left is another special form in the isometric system. This single crystal is a modified tetrahedral crystal form.



Gems

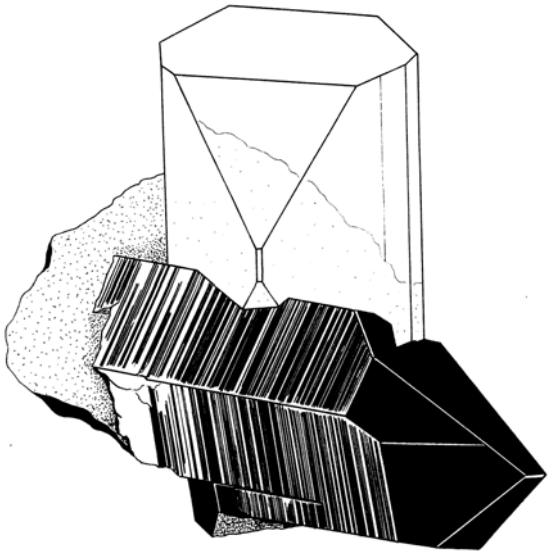


A gem is a valuable stone that has been polished and/or cut to be set in a piece of jewelry. Notice that this definition is not specifically about minerals! Yes, many minerals can be cut into gems. Such minerals are usually hard, glassy and clear. Good examples of are the tourmaline crystals pictured to the left. This specimen was found in Minas Gerais, Brazil. Each crystal is dark green on the top end and deep red on the bottom. The three crystals in the center of the specimen also have a band of yellow in the middle. Topaz, like the large, orange crystal pictured below, is perfectly clear. If carefully cut by a professional gemologist, this beautiful crystal could produce a large, colorful, perfectly clear gemstone.

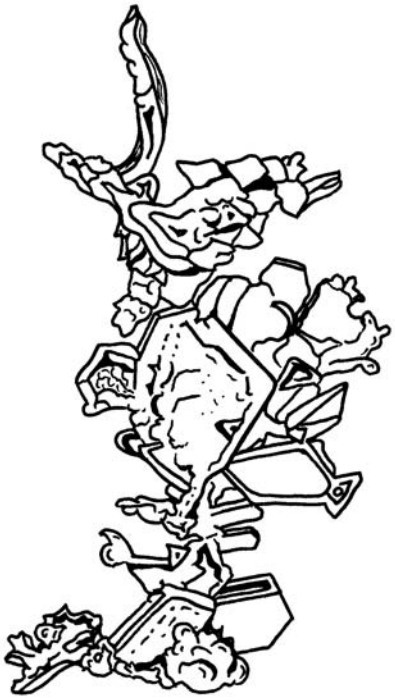
Gemstones can be divided into two categories, precious and semi-precious gemstones. One list of the precious gems includes diamond, ruby, sapphire, and emerald. In ancient times, the purple variety of quartz, amethyst, was called a precious stone. Since the middle of the 1800's, all other gems have been called semi-precious gems. In general, a precious gem is a gemstone that is of the most rare combination of size, color, clarity and perfection and, therefore, is very, very valuable.

There are some materials that are not minerals but which have also been called "gems" by some. Pearls, which are made by molluscs like pearl oysters and mussels are a good example. Amber (fossilized tree sap) and jet (a very hard variety of anthracite coal) are also organic materials that are used to make gemstones.

There are also some rock materials that are semi-precious gems. Lapis lazuli is one example. Sometimes simply known as "lapis," this gorgeous, deep blue rock is a combination of lazurite with small amounts of white calcite and shiny, brassy pyrite.



Right: A beautiful, water-clear, orange topaz crystal sitting on a smoky quartz crystal. This specimen is from Pakistan.



GOLD

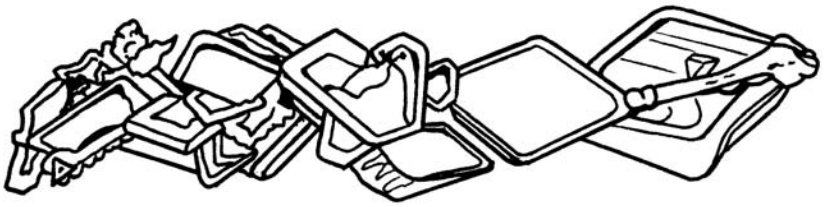
Gold is an element. Its symbol is Au which is from the Latin word, Aurum, which means "shining dawn" or "glow of sunrise." It is one of the most stable elements in nature. This means that it does not easily attach to other elements. As a result, gold is almost always found as a native metal. (Yes, there are three very rare gold minerals: calaverite, sylvanite, and petzite. Look carefully and you may see samples of these minerals here at the Tucson Show!)

Gold crystallizes in the isometric (cubic) crystal system, so when crystals are found, they are usually cubes or octahedra. Rarely, gold crystals in the form of a dodecahedron have been found. (A dodecahedron is a crystal with 12 faces.)

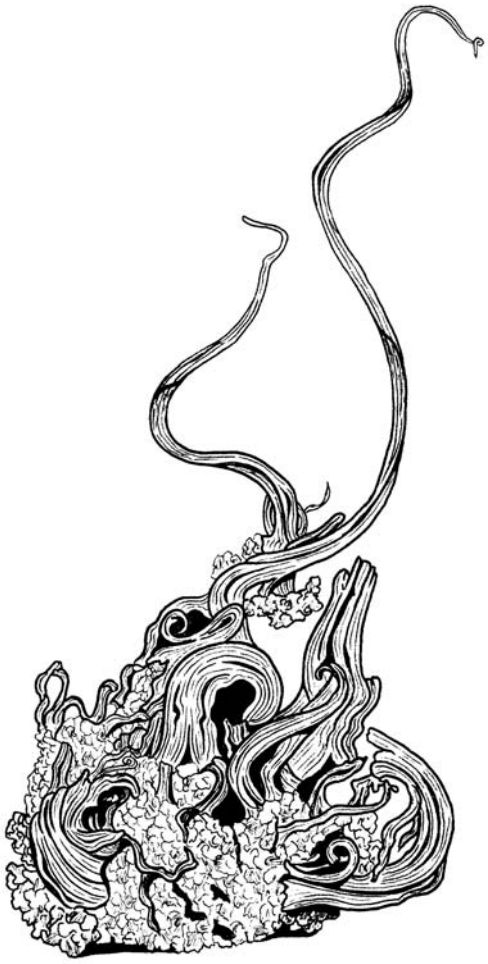
Gold is very dense and, therefore, very heavy. Instead of density, mineralogists refer to the Specific Gravity of a mineral which is its density compared to the density of an equal amount of water. In other words, gold has a very high specific gravity, 19.3. This means a piece of pure gold 1 inch square is 19.3 times heavier than an equal amount of water.

Gold is malleable and ductile. Malleable means it can be hammered into very thin sheets without breaking. Ductile means it can be pulled into long, thin wires, also without breaking.

Where did all this gold come from? If all the gold that we find on the surface of the earth's crust were present when the earth first formed, it would have moved toward the center of the earth. Scientists say this because gold is so dense and would naturally move toward the center of a liquid, cooling planet. Earth scientists today have proposed that the gold we now find in the earth's crust was put here by meteorites that fell to the earth almost 4 billion years ago. Read more about this fascinating theory at http://news.discovery.com/space/astronomy/earth-meteorites-gold-metals-110907.htm



Silver



Like gold and diamond, silver is an element. Its symbol is Ag from the Latin word, Argentum. Pure silver has a brilliant metallic luster and is nearly bright white in color. However, it reacts with sulfur in the air and quickly tarnishes to dark gray to black.

Silver can be found in many parts of the world as a native element. The wire silver specimens pictured below are from the Silver King Mine, near Superior, Arizona. The specimen on the left is native silver in matrix. The specimen to the right is a cluster of intergrown silver wire bundles. The history of the Silver King Mine is fascinating. A soldier named Sullivan was under the command of General George Stoneman during the Apache Wars. In 1870 the General ordered his men to build a new road. During its construction, soldier Sullivan discovered some heavy, metallic "rocks" that were easily flattened when hammered. He saved some samples, kept his discovery secret and waited for the end of his service. It is not known what happened to Sullivan. It was assumed he had been killed. But he had shown off his "nugget silver" to so many people, that some went searching for Sullivan's discovery. In 1875, a man named Isaac Copeland found the source of Sullivan's silver. This discovery eventually became the Silver King Mine. The silver in The Silver King Mine was mostly mined out by 1889. In its history, it produced over 6 million ounces of silver! The value of this silver in 1889 was $6,526,094.