Guest Editorial:

COLLECTING IN ABANDONED MINES

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If you're a mineral collector, you know what it's like to be a bit unsatisfied with the typically abraded specimens you've found in the old mine dumps. And you've probably looked long and hard at the portal or shaft of abandoned mines and wondered if far better material might not be found in the underground workings.

Everyone has heard repeated warnings about entering old mine workings. But, face it, those deep, open shafts and dark tunnel portals seem to whisper promises of adventure, of mysteries to be solved, even perhaps of riches to be claimed. It's easy to imagine a virgin pocket of intact, glittering crystals or an overlooked vein of gold-bearing quartz that would not only provide spectacular specimens but might pay off the car as well. It's not surprising that many, perhaps even most collectors have ventured at least a short distance into abandoned mines.

Abandoned mines certainly aren't hard to find. Colorado alone has 15,000—most of them underground metal mines. The U.S. Bureau of Mines estimates that there are well over 100,000 throughout the West. These mines come in every size and configuration, most ranging in age from very recent to over 130 years old. They produced everything from gold and silver to base metals, coal, uranium and non-metallic minerals. A few hit it big, but many more went broke.

For all their diversity, abandoned mines share one commonality: They can be very dangerous. Each year mine rescue specialists and conventional search and rescue teams aid dozens of individuals who have somehow gotten hurt or become trapped in old mines. The lucky ones are found cold, hungry, wet, bruised and scared out of their wits; the less fortunate may be severely injured. The least lucky of all—usually 10 to 12 people a year—are hauled out dead. Some bodies are never recovered.

Whether to collect or for any other purpose, the physical risks of venturing into abandoned underground mines usually far outweigh any possible rewards. Generally, dangers can be grouped into five classifications: unstable ground, deteriorated ground support systems, bad air, fire and unsafe water.

The hazards of old underground mines actually extend to adjacent surface areas. Statistically, shafts are the most dangerous part of any mine; 90 percent of all accidents and entrapments in abandoned mines are shaft-related. Collars—the tops of shafts—are particularly dangerous, for exposure to the elements will have rotted timbers and eroded adjacent ground, making collapse likely. A fall, whether a few dozen feet or several hundred, will at least cause severe injury. Typically, old shafts contain projecting timbers and rusted pipes and the bottoms, or sumps are flooded with deep, cold water.

Tunnel portals may also be dangerous—especially if caved, as many are, just beyond the portal timbers. The last thing many early miners did before abandoning their mines was to dynamite the roof, not for reasons of safety, but to attempt to protect their work should they ever decide to return. Although it's possible to climb over the caved debris to enter such tunnels, dynamited roof sections are exceedingly unstable.

Never equate mines with caves. Caves—natural chambers thousands of years old—are usually chemically and physically stable. Mines, however, are not natural and are much more recent in origin; most are subject to both continuous chemical oxidation and physical rock stress. Historically, roof collapse in caves is rare; caving in abandoned and even working mines is rather common.

Mines are usually stabilized by ground support systems. Small workings and roof arches provide some natural ground support. The most common form of artificial ground support is timbering. In some old districts, entire forests have gone into underground mines to help support "bad ground." Timbers, of course, are susceptible to long, slow rotting processes. The loss of structural strength compromises the effectiveness of any ground support.

Some rock, or "ground," such as that near fault zones or certain sandstones, never stabilizes, but continues to experience enormous constricting forces which make caving inevitable. When timbers take on weight, or become severely stressed, they can literally explode into splinters when disturbed. In the narrow confines of an underground mine, shattering timbers can be as deadly as the rock fall which will probably follow.

Rock bolts—steel rods two to ten feet long—came into use as ground support devices after World War II. These bolts are inserted into overhead drill holes and tightened against expanding heads. When installed in fan patterns, they achieve support by locking fractured rock sections together. Rock bolts are also used to suspend compressed air, water and sump pipes, ventilation components and other mine fixtures.

Some tunnels are "bald-headed," having no timbering or rock bolts. This does not necessarily indicate stable rock. To save time and cut costs, miners sometimes crossed their fingers and let marginal ground take care of itself. Also, rock that was stable 50 or 100 years ago is not necessarily stable today.

Blasting is a heavy-handed process that, by its nature, not only removes designated rock but tends to fracture and loosen adjacent

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rock. Never disturb any ground support system. Underground cave-ins rarely happen as portrayed in the movies, where some rock comes down followed by a little more, all of which, of course, provides the time for an exciting escape. In real life everything lets go at once, and a massive cave-in may trigger more extensive caving. Entrapment by cave-in can cause death by suffocation, starvation, thirst or even sheer fright. Western rural law enforcement agencies know that the answers to some of their missing persons cases lie—literally—in abandoned mines.

The underground environment can best be described as hostile and foreign. There is nothing as utterly and frighteningly dark as a mine when the lights go out. The darkness is so absolute that it sometimes causes panic and disorientation. Some misguided underground explorers foolishly rely on matches, candles, makeshift torches or flashlights for light. Not only are open-flame light sources easily extinguished, but they may result in fire or explosion. Flashlight batteries were never designed for long-term, reliable power; nor are conventional flashlights waterproof or up to rugged underground use.

The most practical underground light source is the cap-mounted, electric miner's lamp. It's sealed, extremely durable and allows free use of the hands; the rechargeable wet-cell battery provides about 18 hours of dependable light. Miners' lamps make two other recommended pieces of underground equipment necessary: a protective hard hat on which to mount the lamp and a heavy safety belt to carry the battery. In an accident, the D-ring on the safety belt can also be a vital rescue device.

Miner's cap lamps take a bit of getting used to. Since the light beam moves with the head, peripheral vision is effectively eliminated. First-time users tend to assume there is nothing at the edge of their vision. Many new miners have spent long, bruising first shifts getting used to their cap lamps—by turning and walking into pipes and timbers.

After mines have been abandoned, many flood—at least partially. When walking through shallow water covering a tunnel floor, don't ever bet on the continuity of the unseen floor. You wouldn't be the first to plunge into vertical workings like winzes (steeply inclined passageways), ore chutes or sumps. If you must walk through a partially flooded mine, always probe the floor ahead with a stick.

One of the biggest problems in old mines is bad air, air that will not sustain life. The danger is normally not from poisonous gases, but from air in which the oxygen has been consumed or displaced. Working metal mines are rarely classified as gassy, that is, likely to accumulate potentially explosive levels of methane gas. But in abandoned mines, decaying organic matter—anything from old timbers to animal carcasses—may, under the right conditions, generate methane gas. Remember, old mines are unventilated. Although methane is not poisonous, it can accumulate to displace oxygen. Oxygen deficiency causes light-headedness, shortness of breath and general weakness. Any of these symptoms means *get out of the mine immediately.* Remember, too, that an open-flame light source in a methane-rich atmosphere can create an explosion.

The Colorado Bureau of Mines warns that bad air in old shafts can create a special hazard. A descent into an old shaft (which puts a lot of blind faith into old ladders and timbers) requires minimal exertion, meaning that the effects of bad air may not be noticed. Oxygen deficiency at the bottom, however, may make the more strenuous climb back up impossible.

If you insist on entering an old mine, it pays to know what the mine produced. Coal mines and some uranium mines are classified as gassy, indicating that methane accumulation in the unventilated workings is probable. Also, old uranium mines almost certainly contain hazardous levels of radon gas.

Oxidation is a natural chemical reaction affecting most mines, especially metal sulfide mines or those in which pyrite, is plentiful. Upon exposure to air, sulfide minerals begin to oxidize; metal sulfides combine with oxygen in air and water to form free metal ions and sulfuric acid. Mining, of course, can expose huge quantities of metal sulfides to the atmosphere. In some mines, the oxidation process actually makes the rock warm to the touch.

Oxidation will adversely affect rock stability and deplete oxygen in unventilated mines. Sulfide-bearing rock may have been stable when first exposed, but oxidation will eventually make it crumbly, loose and prone to cave, even in bald-headed tunnels. The sulfuric acid produced by oxidation can also, in time, weaken or dissolve the steel in rock bolts and cables. Never put weight on suspended pipes or other fixtures underground.

Oxidation causes mine drainage pollution problems that plague most old mining districts, near which stream beds and drainages are stained a characteristic yellow-orange. The highly acidic mine water loads on dissolved iron from pyrite. Surface dilution soon reduces the acidity, causing large quantities of iron to precipitate out of solution as yellow-orange iron hydroxide. Mine-polluted water almost always carries concentrations of far more toxic elements, too, like cadmium, silver, lead, zinc and copper—even extremely toxic elements like mercury and arsenic. In the underground, mine water is still highly acidic (pH may be as low as 3.0!) and may appear as crystal-clear as Perrier. Don't ever be fooled into filling a canteen with the stuff.

The possibility of fire in the underground poses another deadly hazard. Open-flame light sources may ignite highly flammable dry-rotted timbers as well as solvents, liquid fuels or explosives that early miners may have left behind. Underground fires consume the limited oxygen supply, while producing carbon monoxide. Carbon monoxide is so poisonous that levels of only 100 parts per million can be fatal.

Carbon monoxide from even small fires is so deadly that it is illegal for miners to enter the underground without a Self-Rescuer, an emergency personal breathing device. The Self-Rescuer is a catalytic breathing filter fitted with a SCUBA-like mouthpiece and is contained in a metal cannister worn on the safety belt. In use, it converts poisonous carbon monoxide in each inhalation to nonpoisonous carbon dioxide. Although the heat generated is enough to scorch the inside of the user's mouth, it will provide an extra hour in which to reach safety.

Explosives, such as dynamite and detonating caps, pose yet another potential hazard. Dynamites are "high" explosives that, in turn, require a high explosive trigger—the cap—to initiate detonation. Early caps, such as those found in abandoned mines, employed fulminate of mercury, a compound so shock-sensitive that merely dropping a cap sometimes causes detonation. In an unstable old mine, the concussion from the detonation of a single mercury cap can bring the roof down.

Early dynamite, originally called "giant powder," was simply nitroglycerin mixed with an inert filler—anything from sawdust to diatomaceous earth—which absorbed the nitroglycerin in solid form and reduced shock sensitivity to manageable—barely—limits. Unfortunately, time and temperature change often separated the components. Old dynamite may be dripping with a clear-to-yellow syrupy liquid. Don't play with it! It's pure nitroglycerin, with every bit of its notorious hair-trigger shock sensitivity.

Beware, too, of nitroglycerin fumes. Nitroglycerin has long been prescribed for heart patients; small amounts relax capillary walls, decreasing blood pressure and heart strain. The increased blood flow through the brain, however, can create blinding headaches. Just a few moments of inhaling concentrated nitroglycerin fumes in an unventilated old mine can bring on a debilitating headache when you need one least.

Now, if you still insist on venturing into abandoned underground mines, at least familiarize yourself with mining tools and methods, talk with some experienced miners, and procure and learn to use the basic safety equipment. Never enter an old mine alone. Someone must also remain outside the workings to go for help should trouble arise.

(See "A guide to underground collecting" by Wendell Wilson, vol. 5, no. 3, p. 128–137.)

In the underground, any sound or vibration, such as those caused by hammering, chiseling or levering specimens out of in situ rock, can cause rockfall. Also, blast-fractured rock may be delicately "keyed" in place. Disturbing the keystone can bring everything down, and it takes considerable experience to identify that keystone. Stressed rock can sometimes "talk," that is, emit an eerie, oddly humanlike groaning sound. Old miners will always tell you "rock that talks ain't happy, and it ain't gonna get happy til it moves." Talking rock is usually telling you to get out of the mine!

Should rescue from an abandoned mine become necessary, a regular search and rescue team or the local fire department may not have the equipment or experience to handle the job. A specialized mine rescue team may have to be called; since there are only a handful of fully-equipped, mobile mine rescue stations in the West, the nearest team may easily be hundreds of miles and many hours away from an accident site.

One mineral collector who fully understands the level of danger in abandoned mines is Joe Nachtrieb, a hardrock miner with 16 years experience, now Director of Operations at the Central Colorado Mine Rescue Station.

"Mine rescue stations were originally established to provide emergency backup for small mining operations," Nachtrieb says. "But the role is changing. More people than ever are using mountains, deserts and old mining districts for recreational purposes. And mixing too many inexperienced people with old mines guarantees trouble. Old mines aren't recreational resources. They're much more dangerous than sheer cliffs or white-water rivers. I think you need to have been a miner to really understand the risks you're taking when you enter old workings. If you haven't mined, you'll probably think the warnings are an exaggeration."

Even if you are rescued uninjured from an old mine, your troubles may just be starting. Since most mine sites—abandoned or not—are still on private property or valid claims, you could face trespassing charges. And in some states and counties you may even be liable for the costs incurred in your own rescue—which are never cheap.

There may be readers who have entered abandoned mines and walked out with no trouble whatever. Well, they were lucky, that's all. But don't think the points made here have been exaggerated. Every single potential danger we've discussed is real—and has caused disaster at one time or another.

There are lots of specimens waiting in the dumps. Remember, to paraphrase Chuck Yeager, there are *old* miners and there are *bold* miners, but there are no *old bold* miners. Old, happy, healthy collectors got that way because they generally did their collecting on the dumps, not in abandoned underground mines.