HSA BULLETIN February 1997

C O N T E N T S

By Mark J. Crawford

Star Trek's famous Captain Kirk is not the only one to "boldly go where no man has gone before."

Here on earth, miners do it every day, some tunneling deep into an unknown world as dark and mysterious as outer space. They also use some of the same tools in their quest: lasers, complex computers, remote sensing devices, and sophisticated communication tools otherwise known as satellite telephones.

But while the popular television characters had no trouble locating new worlds in each episode, miners have a much tougher time unearthing what they need.

Ore bodies are getting harder and harder to find. The more that are put into production, the fewer there are left to discover. And in the process, mines are becoming harder and more expensive to permit.

So mining companies are eager to find those "world-class" deposits that are big enough and rich enough to pay for themselves, even during economic or political downturns—both in the United States and in the host of other countries now opening their doors to foreign investment.

The problem is there just aren't that many world-class deposits to go around. Most of the "easy" ones have been found, and there is a huge inventory of mineral resources—especially industrial and precious metals—discovered by mining companies that are too deep, too low-grade, metallurgically complex, or environmentally sensitive to tackle.

But thanks to new technological advances that are mindful of environmental trends, many of these resources will become working mines. For instance, biological and hydrometallur-

Portable global positioning systems provide satellite-assisted accuracy for mining surveyors

gical processes are being applied to copper, gold and other metals, reducing the need for smelters. These new techniques are environmentally friendly and can even make small, or remotely located, mineral deposits economically feasible.

Problems such as mine waste, old dumps and acid mine drainage also can be remediated more easily and at lower cost because of advances in technology. In situ mining will allow the removal of metals without digging up the surface. And computer modeling and global positioning systems (GPS) are making mines safer, more efficient and more profitable.

In the Process

Many of today's mines could never have been opened if it weren't for advances in processing technologies, enabling the safe and economically feasible extraction of low-grade ore. Three of the major developments in this area are bioleaching, hydrometallurgy and in situ mining.

Bioleaching

Biological processes have widespread uses that are revolutionizing ore processing and remediation. "Biological processes are the future." says Netty Buras, president of Bioremediation, Inc. "They are present in different media, and need to be discovered or rediscovered, because they do so many things so well."

So what are these biological wonders? Billions and billions of bacteria—different species for different ores, pressures, temperatures and climates. The bacteria eat sulfur, a common element in most ores. The copper and gold are "loosened" from mineral structure, and are then leached by solutions. The bacteria can neutralize acid mine drainage and remove the toxic metals. Mineral buildup from mine pipes can be broken down by bacteria. Environmental engineers use bacteria to clean up waste oil and coal gasification waste. When added to old cyanide heap leach pads, bacteria even decompose cyanide.

Leslie Thompson, of Pintail Systems, Inc., has been exploring biological treatment of mine waste since the mid-1980s. Early results from an EPA Innovative Site Technology Grant at the Summitville Gold Mine in Colorado show that bacteria actually induce a reattachment of metal onto the spent ore piles—reducing the metal content of the runoff.

Test work by Bioremediation, Inc. at Magma Copper's Supper Mine in Arizona has shown that treating acid mine drainage with bacteria neutralized the acid, removed heavy metals, and met federal water regulations.

Six commercial bioleaching plants for gold are presently in operation, and a few copper projects are already underway. The process will soon be applied to other metals like zinc, bismuth, tin and indium. Newmont Mining Company will be the first to use bacteria on a heap leach scale to break down gold ore prior to leaching.

Biological processes in wetlands can detoxify mine or industrial waste and concentrate metals. "Constructed wetlands that remediate acid mine drainage have become accepted in recent years," reports Corale Brierley of the VistaTech I Partnership. "In addition to microbes, plants play a major role in accumulating and immobilizing metals." (Although effective in cleaning up acid mine discharge, toxic levels of metals in wetland plants may be consumed by

wildlife. The metal-rich sediments in the wetland will also need to be removed when the wetland is decommissioned.)

Bacterial methods have great advantages over conventional processes: lower coal, faster metal release, higher metal recoveries, the ability to detoxify cyanide and the ending of long-term environmental liability. As an alternative to roasting or smelting, bioleaching does not produce toxic emissions, has a shorter construction time, and is better for the environment. It is a simple, safe and low cost process that can make a variety of deposits (especially small ones) economic winners.

Hydrometallurgy

There is a definite trend away from the roasting and smelting of ores (pyrometallurgy) and toward hydrometallurgy—using water with acids or bases to process metal. Smelters are expensive to construct and maintain, particularly in order to meet current environmental standards. And it is expensive to ship ore concentrates to a smelter.

One of the simplest processes is heap leaching, where broken pieces of copper or gold ore are piled on vinyl liners and sprinkled with a solution that leaches the metal. This "pregnant" solution is then collected and stripped of its metal content.

AuGMENT Technologies has recently patented a new technology called CU/AUT that leaches both copper and gold using cyanide, and recovers about 90 percent of the cyanide for reuse. This process has a wide range of applications, especially for low-grade ore, gold mill tailings that still contain metal and gold-bearing copper plant cleaner tails.

Cyanisorb, a new process from Coeur d'Alene Mining Company recycles cyanide from gold operations. It obviously has important environmental benefits: wildlife mortality from cyanide is greatly reduced, as is the risk of cyanide leakage. In fact, because of the Cyanisorb process, a vinyl liner under the leach pads at the Golden Cross Mine in New Zealand was not required.

Newmont Mining Company has also patented a process that uses ammonium thiosulfate to heap leach gold ore—this will be used for the first time on a heap leach project around 1998. Research is also being conducted into the leaching qualities of nitric acid and bromine.

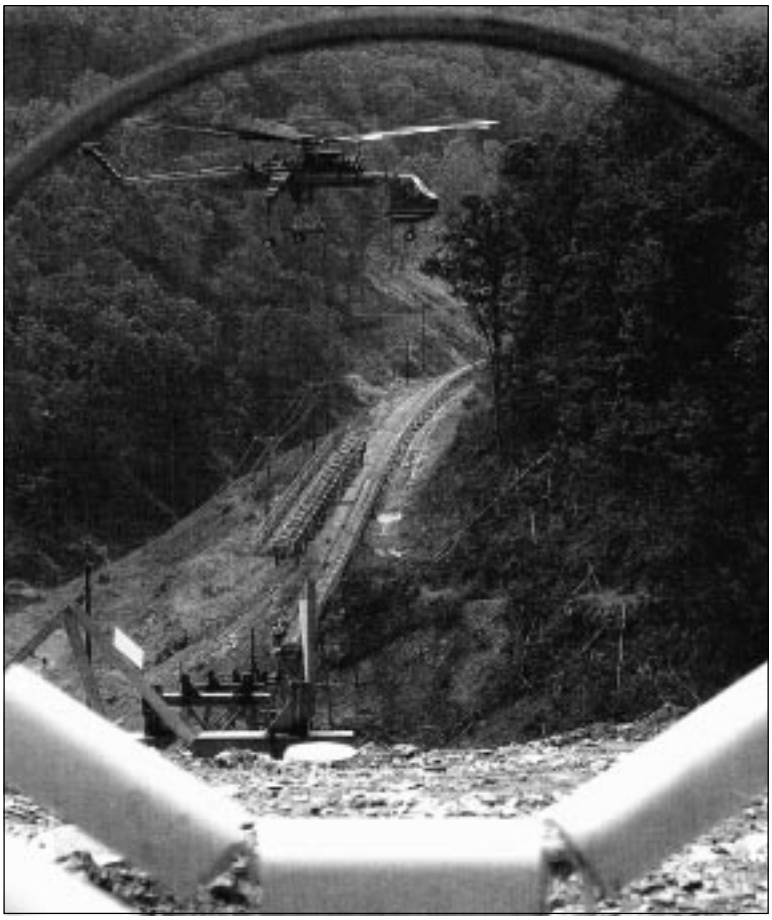
SX-EW (otherwise known as solvent extraction electro-winning) has been around for a number of years, and is the mainstay of the porphyry copper industry. Low-grade copper oxide ores are heaped on a pad and leached, and the copper-rich solution then plates its copper to a charged electrode. In the past six years there have been many advances in developing different organic extractants for the leach solutions. This "customizes" SX-EW for a greater variety of ore types and climatic conditions.

All hydrometallurgical processes will benefit from the use of high pressure roll grinding. Common for years in the cement industry, the technique is just now being added to mineral processing flowsheets. Broken pieces of ore are fed through the rolls and are compressed and microfractured. This speeds up leach kinetics on the dumps, frees more metal, and improves recoveries.

High pressure roll grinding could turn lower grade copper and gold deposits into productive mines, especially when combined with bioleaching.

In situ mining

Prior to the demise of the U.S.



Technology aids every phase of the mining process. Here, a helicopter assists in constructing a coal conveyor system.

Bureau of Mines earlier this year, its personnel were working with Asarco Mining Company to do extensive research on in situ mining as a copper recovery technique. "In situ leach mining will take us away from bulk handling of ore," said William Larson, former manager of the Bureau's Advanced Mining Division. "There'll be no need for pits, shafts and tailings, so there will he no subsidence or land damage."

Leach solutions that selectively dissolve metals would be pumped into the ore body through cased injection wells. Under pressure, the solutions move through the cracks in the ore-bearing rock, leaching metal. The metal-rich solution is then drawn to the surface and processed. Cyprus Amax, Asarco and Magma Copper Mining Companies are the leaders in applying this technology to copper.

"Our work with Asarco on their Santa Cruz deposit in Arizona is a great example of cooperative government-industry work that will have a tremendous impact," said Larson. "It is a very exciting time now—the industry is just starting to field-test this research on their own deposits."

A similar strategy will be used in the many miles of deep underground workings at Copper Range's White Pine Mine in northern Michigan. Over 50,000 remaining pillars containing over one billion pounds of recoverable copper will be blasted into rubble. Injected solutions will leach copper from the rubble and later be recovered at an SX-EW plant on the surface.

In situ leaching is especially suited for ores that are too deep or low grade to mine economically today. Deposits that lie underneath sensitive environmental areas could be mined from outside those areas using in situ methods and directional drilling technology. Future in situ research will test the leachability of gold, manganese and copper sulfide deposits. And there is the very real possibility of combining biological and in situ methods in the near future—strains of bacteria are known to survive in the higher pressures and temperatures that are found underground.

Quick and painless

Major advances in mining technology are toward autonomous operations, safer mine conditions, and less downtime. Much of this is driven by GPS—global positioning systems—and other visual/navigational computer systems. GPS is a precise measuring device that ties into an array of 24 satellites. GPS can be used to control grades on benches, slopes, shovel positions, and truck and rail dispatching.

And the precision is getting even better—with the advent of Differential GPS, movements to within a few centimeters can be programmed. (The laser gyro, a spinning wheel with a coiled fiber optic cable, is used in underground mines where GPS can't "see" the sky.)

Manufacturers of heavy equipment are putting computer systems on board trucks and shovels. "The heavy equipment market is without a doubt one of the most exciting new avenues for GPS integration," says Jim Sorden, executive vice president for surveying and mapping at Trimble Corporation, a GPS designer. The computers assist in the operation of the equipment and can detect failure situations before they happen, which keeps repair costs (and downtime) to a minimum.

Fred Loeber, director of engineering for P&H Mining Equipment, talks about the company's new GUI (Graphic User Interface) System: "These portable computers have touchscreen—you just point to a command with a finger. There are colored schematics and diagnostic prompts, and a machine log; so if there is a failure, you can go back and reconstruct it—it helps track down elusive gremlins."

Caterpillar has a similar setup called VIMS (Vital Information Management System). Caterpillar is also working on fully autonomous mining trucks that will be able to go at speeds up to 30 mph with their positions controllable to within half a centimeter—all thanks to GPS.

Safety first

The safety of the mine worker is always a top concern in any mining environment. GPS additions make the equipment safer and easier to run, with less operator fatigue. GPS-inspired automatic mining equipment allows miners to stay a safer distance from the face.

The Department of Energy Pittsburgh Research Center in Pennsylvania constantly researches mine safety. Studies, conducted previously with the Bureau of Mines' Lake Lynne Underground Laboratory, focused on occupational health, ground control, subsidence control, fire extinguishers, suppression techniques for coal dust explosions, conveyor belt fires and mine safety systems. Advanced computer programs model support requirements, pillar design and roof control Radar is used to measure the thickness of coal seams and detect roof hazards. Prior to its closing, the Bureau developed an instrument that gives a readout of the rock/coal dust ratio in coal mines in a matter of seconds. This ratio is critical for preventing deadly coal dust explosions. In the past mines often had to wait for days for laboratory analyses to come in that might identify dangerous conditions—now those conditions can be remedied immediately.

Mine Safety Appliances, Inc. has recently developed a smaller oxygen self-rescuer that can be worn at all times. It is lighter in weight, can be donned with one arm, and has voice communication abilities. This company also has designed a mine monitoring system with sensors that

measure carbon monoxide and oxygen levels in coal mines. "It can be hooked into any existing system, without need for electrical devices or computers" says John Hierbaum, product manager. "It will especially improve safety in small mines where they can't afford sophisticated computer systems."

Computer age

There is no question that mining is a computerized field, and becoming more so every day. Computers are involved in every aspect of the mining industry, from mineral exploration to machine design and grade control. Engineers, geologists, and operators are becoming more computer-literate and cross-trained. Portable computers are routinely tossed into field trucks or taken underground.

Computer programming is having a huge impact on coal mining in particular. It is used to study geology, ventilation systems, particle size on conveyor belts, accident analysis, ground subsidence, data collection, spontaneous combustion and controlling myriad electrical systems. Subsidence modeling has led to more accurate predictions about surface effects, which has reduced liability. The use of computers has tripled production of underground longwall mining in the past ten years.

Computerized automatic mining methods have improved safety by reducing the number of miners on the face. The addition of GUI systems on machinery has reduced breakdowns—this results in fewer accidents and injuries, which often result from rushing to fix broken equipment during a production cycle. According to Lee Saperstein, dean and professor of mining engineering at the University of Missouri-Rolla, "We soon will have a computer-controlled [coal] mine that delivers a uniform product at minimum cost and at maximum productivity."

One of the keys to this prediction is the use of real-time" mineral analysis, where the measuring device is deployed on the cutting head of the longwall miner.

Some of this technology is available today. Metorex, Inc. has developed hand-held X-ray fluorescence analyzers that can measure the levels of most elements in about 30 seconds. New computer advances have done a better job of controlling the tube parameters, which gives lower detection limits. With these real-time results ore contacts can be located on the face, and the measurements are reliable enough for grade control and reserve calculations. Contamination levels in concentrates, slags and the surrounding environment can also be determined.

Computer/laser technologies have developed surveying equipment that can measure objects up to 40.000 feet away. Criterion's Autoscan system doesn't need reflectors or multi-man crews, for instance. Volume determinations are precise enough that mine face measurements before and after a shift can determine how much ore was removed. The volume of ore in stockpiles can also be calculated.

Modern mineral exploration is dependent on computer-defined technologies such as satellite imagery, conductive, magnetic, and radiometric geophysical surveys, data processing radar and geochemical surveys. Thematic mapping works well in and terrains that have little vegetation. Deeper-penetrating geophysical techniques will be critical to the discovery of buried ore deposits.

An abundance of geoscience and

New graphic user interface systems enable equipment operators to detect failure situations before they occur.

engineering software is available to geologists, engineers and metallurgists. The use of mine planning and optimization software can lead to major operational savings due to better design and control. A new classification of software called "data visualization" takes special data and represents it in three dimensions with color and rendering. According to Betty Gibbs of Biggs Associates, "this kind of representation has been available in the past through large, expensive [$50,000] integrated programs. Now for about $1,000, you can get these results on your PC."

Geographical Information Systems (GIS) like GRASSLAND by L.A.S. Inc. help plan, manage, and track land-oriented operations. In mineral exploration such a system allows the user to establish a map or satellite image base on which geologic or satellite thematic layers can be superimposed.

Topcon manufactures a pocket-sized, real-time graphic mapping GPS/GIS system. The user preloads a base map that shows the target area, and it will continually display and update the users location in real time—with a "you-are-here" simplicity.

The Internet is becoming more of a force in the mining industry as well. Computer communications between industry, academia, and government—even across national borders—has helped the exchange of new ideas and insights. A new unity is emerging where major leaders in mining are establishing sites on the Internet, such as the Mine Safety and Health Administration, the National Mining Association, Northwest Mining Association, United Mine Workers of America and various international mining research groups.

Staying in touch

Instant communication is critical in the business world these days, and something we have come to expect. Communication links are important for changing itineraries, business deals, safety of field crews and fixing downed equipment.

But the mining business faces a unique set of communication obstacles. Like other executives, mining personnel travel frequently, but they tend to travel to locations far more remote. Although about half of the United States can be accessed via the cellular phone network, mining and exploration always seem to be in the other half! Fortunately, phone calls, faxes, and the transfer of digital data are becoming more affordable through satellite transmissions.

Mobile phone service is becoming more widespread. In the United States, the American Mobile Satellite Corporation (Skycell) offers coverage over most of North America, Hawaii, and Central America for close to cellular phone rates. It is also growing in other countries where mining is prevalent. In Australia, for instance mobile phone service is available across the entire nation and up to 200 kilometers out to sea via a domestic satellite. Upgrades will soon allow communications from moving vehicles.

Eye on the future

Society will make increasing environmental demands on the mining industry. Population will continue to increase and spread into what were once rural areas, where exploration and mining could function with minimal socioeconomic impact. Mineral deposits will continue to be depleted—yet demand will rise, and also environmental and aesthetic expectations.

As the "easy" deposits are mined away (and fewer are discovered), companies will refocus on those "other" resources that have feasibility problems. Many of these, having been idle for so many years, are already closer to people, homes and growing communities. Geologists, engineers, metallurgists and computer specialists are committed to helping develop advanced technologies that will meet the new challenges that face exploration and mining today, and in the future.

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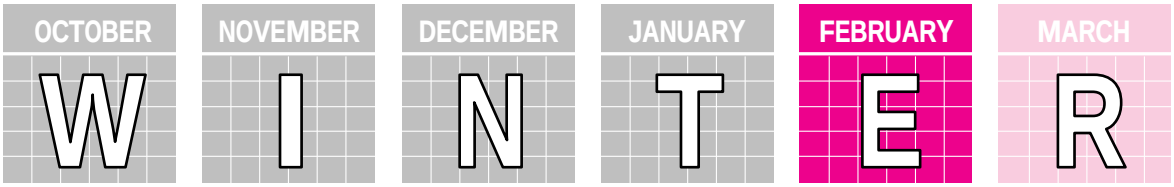

ALERT reminder: ● ***Always maintain adequate mine ventilation and make frequent checks for methane and proper airflow.*** ● ***Know your mine's ventilation plan and escapeways. Properly maintain methane detection devices. Communicate changing mine conditions to one another during each shift and to the oncoming shift.*** ● ***Control coal dust with frequent applications of rock dust.*** ● ***Make frequent visual and sound checks of mine roof during each shift. NEVER travel under unsupported roof.***

Real case of safety at work in the mines

A different point of view

By Jim Ball, Bradford Stuart Industries

Mining is a tough business filled with great expectations and heartaches. It's a business that has no equal when it comes to pride and satisfaction or no equal when it comes to danger. In the twenty or more years that I have been in this business, I have seen many changes. There was a time when it was said that solid state electronics would never be in the mining industry. Today you will find that the average superintendent keeps track of production, maintenance and his payroll with a computer. This is a far cry from the days not so long ago when we used to haul coal out with the old mule.

The question that we may ask of ourselves… "is this industry advancing or in a point of stagnation?" If we look at all the records compared to the past, we will find out that today's miner produces more coal, metal, or non-metal products than at any other time in history. This is done with few accidents and with a more educated and adequately trained miner than ever before.

What does all this technology and training mean to the average person? I think that if we would take a few moments to peer back into our pasts and remember, we will all know of someone that has been lost to this industry. This loss is felt far greater by the immediate loved ones left behind, but it also has a lasting effect on all of our lives. This industry is dangerous, but certainly not as dangerous as it was in days past. In the past 16 years, I have been involved in companies that manufacture electronic equipment for the mining industry. I would have to say that the majority of these electronic gadgets, gismos, or real products have had safety as the guiding light for their development. Certainly more than a few have been guided by MSHA through their years of experience and study of this industry.

One thing that bothers me is that we have a tendency to complain about laws or products that assure our families that when we leave for that shift, we will be returning safely. I think that we should start thinking more in terms of how safety has helped, instead of lost-time accidents or fatality reports. I am not saying that we should forget about accidents, but think of safety in terms of our every day lives and how technology and some rules have helped us. I would like you individual miners, companies, or inspectors to have a different view of our industry. I think that we could start focusing on how people have been saved by laws as well as technology.

Why not see reports where someone was saved or not injured, because of technology. I would like to start the ball rolling with a story that has stuck in my mind for many years. I will not mention the actual name of the company or individuals involved. I would like this story to be viewed in the "someone saved" aspect of thinking.

I was working on a project with a company installing a new ground monitor. The purpose of the ground monitor is to assure that the ground conductor stays intact at all times while electrical equipment is operating. If this ground wire is broken, the electrical circuit must be deenergized. We had installed this device and had met with the usual resistance about technology, laws, and other things. We were even told by one fellow that this new device was not safe. The system had been in operation for a while, and one day they needed to do some maintenance on the junction boxes. Two electricians had the circuit de-energized and proceeded to work on different boxes. One electrician was around a hill from the other electrician and could not be seen. The first electrician completed his task and called to say that he was finished. Someone at the substation thought that this was an okay to put power back on. He energized the circuit and it tripped as soon as he energized it. The electrician that had finished realized what happened and told them not to energize the power. He ran to where his buddy was working. His buddy had been in the box with a crescent wrench on a phase conductor when the power was energized.

There is a happy ending to this story. Before the electrician had started working on the box, he disconnected the ground wire and used it to bleed the capacitance from the system. He then left the ground wire disconnected and started working on the box. When the circuit was energized the ground monitor immediately tripped the circuit out. The only thing that happened to this individual was a couple of red spots on his knees, where he was touching the box. He was sent to the hospital and released in short order.

In this case, if we had not had a ground wire monitor or ground monitoring laws, we would have another family without a husband or father. The next time you wonder about those new high tech gadgets or gismos or all these laws, try to think of this story for the answer.

Reprinted from the March 1996 issue of ***COAL PEOPLE MAGAZINE****, Vol. 20, No. 7,*

Idaho production might break records

University of Idaho Geological Survey officials say a boom in Idaho's gold production might break records for the second year in a row.

More than 300,000 ounces of gold was mined from Idaho in 1995, University of Idaho College of Mines Dean Robert Bartlett said Jan. 21.

Bartlett was meeting with the legislative budget committee. "Gold production is twice what it was during the Depression. Mining is not what it was in 1870, but it's better in absolute dollars than it has ever been," Bartlett said in response to a request from Rep. Jack Barraclough, R-Idaho Falls, for a "state of the state" review of mining in Idaho.

The state's gold production topped $1.1 billion in 1995 and the 1996 predictions are more optimistic, Earl H. Bennett said, who is the state geologist and associate director of the Idaho Geological Survey. Gold production is predicted to reach nearly 320,000 ounces for 1996 as a result of a major exploration push in the Western United States in 1989 and 1990.

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Environmental group seeks warnings for abandoned mine sites in Arizona

The Sierra Club is pushing for legislation that would help mine inspectors identify abandoned mines and shafts that have caused deaths in the past.

More than 100,000 abandoned mine sites around Arizona need to be safeguarded, according to the Sierra Club. The group is working with state mine inspectors to push for legislation that would tack another $10 on top of the $100 filing fee that individuals and mining companies pay each year to keep a mining claim active.

That money would be used to find more abandoned mines and to put up warning signs on property.

With about 30,000 active claims, the plan could generate $300,000 a year for the state Mine Inspector's Office.

Chuck Shipley, a spokesman for the Arizona Mining Assn. said his group is still deciding whether to support the bill, which would be introduced in the upcoming legislative session. However, "it may be wise to set up some type of program to at least inventory and locate where these so-called abandoned mines are."

Identifying old mines has become difficult in recent years because cities in Arizona keep spreading out, assistant state mine inspector Bill Hawes said.

At the same tirne, more people are using off-terrain vehicles to explore remote mining sites that were once thought inaccessible.

To fix the problem, legislation was passed in 1987 giving the mine inspector's office jurisdiction over old mines. But Hawes said the office has never had enough money to identify where they are or do much about them.

The Bureau of Land Management provided the state with a small grant to map abandoned mines on BLM land. Last session, the state forked over a minuscule amount of general funds for fences and signs.

"Unfortunately our mandate is to inspect active mines," Hamm said. "We're at a catch-22. We couldn't get funding until we knew how many there were and we don't know how many there are without funding."

So far, the agency has surveyed about 6,000 old mines.

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Four climbers rescued from N.J. mine shaft

Four inexperienced spelunkers have given up on underground climbing after an outing left them stuck in a 100-foot mine shaft for more than 12 hours before being rescued.

"I've been spelunking for one week and that's one week too long," said Ray Zeglin, 30, of Randolph, N.J. "Go with the professional. It is not a sport to venture out on your own."

Zeglin, Frank Wainen, 21, of Dover, and Keith Sargent, 23, and James Comeskey, 23, both of Randolph, were found by rescuers shortly after 2 a.m. Dec. 30, more than 12 hours after they rappelled into the abandoned mine shaft in Rockaway Township, N.J. All but Comeskey had rock climbing experience. Zeglin had begun underground exploring only a week earlier.

They tried to climb out, but ice, water and moss made the trip back up too slick and strenuous. Several friends and relatives knew their general location and they just waited for help to come. "Everybody kept a cool head," Zeglin said. "We made a bed out of debris and tried to keep each other warm. It was like being in a refrigerator. It was just a matter of time. We figured they'd start looking in the morning."

With no food, water or other survival gear and clad only in sweatshirts and jackets, they passed time by trying to sleep, ignoring the sounds of bats and rushing water elsewhere underground and yelling for help whenever they thought they heard noises from above.

Police were called late Sunday night by family members, and authorities found the shaft about 2:10 a.m. Monday. All were pulled to the top using the harnesses they wore to rappel into the shaft, and the rescue was completed by 5 a.m. With abrasions to their hands and faces, all were treated at a hospital and released.

"They were very fortunate that the weather was not worse," said Lt. Walter Kimble of the Rockaway Township Police Dept. "It was a relatively mild evening, in the 40s most of the night, and the shaft where they were was a little warmer than the outside air."

Zeglin said he learned of the site through others who had climbed into the former ore mine. All declined to say whether they knew they were trespassing. "If they wanted to keep people out, they could have done a much better job," said Zeglin.

Police said it depended on property owners, whom they did not identify, whether trespassing charges would be filed. None of the four would comment on whether signs were posted or if they had seen any.

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MSHA suggests traffic controls, communication standards for haul roads

Because haulage accidents are the leading cause of death for miners, MSHA is suggesting traffic control and communication measures that all operators should take to prevent these accidents.

According to Program Information Bulletin P96-26, a review of surface haulage truck accidents that occurred between January 1990 and July 1996 discloses that lack of communication between drivers of the vehicles or with a dispatcher and inadequate traffic controls contributed to many of these accidents.

Fatal accidents have also occurred when maintenance or utility trucks or pedestrians were run over by haulage trucks. Many of the fatal accidents involving collisions may have been avoided had the drivers of the vehicles been aware of traffic activities at the mine through some means of communication between them.

In order to minimize surface haulage accidents MSHA is suggesting that:

- Mine operators should establish adequate and appropriate rules and warning signs indicating any unusual or potentially dangerous road conditions.
- Signs should be uniform in appearance and location and must be clearly posted, that is, placed at locations where they can be observed.
- Mine operators should provide training to truck drivers to become familiar with traffic patterns and any changes in these patterns.
- Equipment operators should be alert to and anticipate changes in road conditions, especially with changes in weather conditions.
- Equipment operators should obey traffic rules and take the necessary precautions to respond to warning signs.

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Danger in and around mines

FATAL ALERT

North Carolina suffered its second fatal mining accident of 1996 in October.

On a rainy morning at a dimension stone mine, a block of granite weighing 14 tons fell while being stacked. The victim, with eighteen years experience, was caught between the falling block and adjacent blocks, causing massive injury to the lower chest and hip area.

The victim assisted in rigging the wire rope slings around the block for unloading and directed the overhead crane operator to “double stack” the block on a smaller block of granite. The top block was positioned off center, and no cross timbers were used for support. Both the top and bottom blocks had rounded and uneven surfaces.

The victim signaled for the crane operator to set the block and give him slack. The larger block sat for one or two minutes while the victim unhooked one side of the sling from the crane. He walked along the length of the stacked blocks to unhook the other sling when the top block of granite fell off the smaller block.

Cause of the accident

1. The top block was not properly centered. 2. The top block (3’-6" x 5’-9" x 10’-4") was stacked on a smaller block (4' x 4' x 7'). 3. The stacking surface of the two blocks was rounded and uneven. 4. The two blocks were not provided with timbers for support between them. 5. The victim crossed along side of the stacked blocks without leaving himself clearance or a means of escape when the block fell.

Corrective action to prevent similar accidents

1. The bottom block must be larger or of equal size of the top block when stacked. 2. All blocks that are stacked must have level surfaces. 3. Timbers are to be used between blocks to help insure the top block is stable. 4. Timbers are to be used to help prevent damage to the wire rope slings. 5. Procedures for unhooking wire rope slings must place miners clear of suspended or unstable loads.

SAFETY REMINDER: Failure to lock out

Don't become the next victim

Providing the right equipment and procedures for lockout is only half the battle. Workers must be educated to use them, and must follow through without exception.

If some immediate, obvious hazard was threatening us or our co-workers—a fire, for example, or a stack of boxes about to topple over—we would act quickly and decisively to ensure our safety and the safety of others.

In the natural resource industries, relatively few injuries and deaths are caused by fires or falling boxes. But many, many workers are hurt, maimed and even killed by equipment or machinery that has not been properly locked out. Examples are presented regularly in this magazine.

The underlying causes for lockout-related accidents vary. Maybe the workers weren't provided with the means or the know-how to lock out properly. Maybe they were trying to keep production rolling smoothly, to avoid shutting down the line. Maybe they were thinking of something else.

What does not vary, it seems, is the constant threat that failure to lock out poses in our industries. Every day, the accident tally climbs higher and higher.

These accidents are all the more tragic because they could be prevented if every workplace took the following steps:

- Identify all tasks and equipment that require lockout.
- Develop a lockout policy and detailed procedures that are practical to follow day-in and day-out.
- Educate and train all personnel in the procedures that apply to their specific tasks.
- Enforce the written policy and procedures.

When an immediate threat like fire looms, it's generally clear what steps must be taken to stay safe, and there's plenty of incentive to take them. When it comes to lockout, the hazard is one that may develop as a result of an action or decision we don't take, rather than something we do. The danger is more remote. Perhaps that's why lockout continues to be one of the most devastating threats in our industries. But it shouldn't take a tragedy like the ones presented in this magazine to bring home the importance of lockout. The appropriate procedures must be put

in place, and they must be followed to the letter, every time. Where there are exceptions, it's only a matter of time until tragedy follows.

Reprinted from the January/February 1997 edition of Ontario [Canada's] Natural Resources Safety Association's ***Health & Safety RESOURCE.***

HAZARD ALERT… Warning issued on working from buckets

MSHA has just released a "hazard alert" noting the recent deaths of miners who were working from loader buckets.

In the past five years, four metal/nonmetal miners have died from accidents related to standing on, or in, front-end loader buckets. The most recent accident happened on June 29, 1996, killing Jonnie Brown, a laborer with Bailey's Limestone Quarry in Wewoka, Okla. (3 MSHN SY7).

In all the fatalities, the loader buckets were inadvertently tilted or lowered. MSHA noted that § 56./57.14211 prohibits raising, lowering or moving people in loader buckets. The regulation specifically prohibits work from a raised, unblocked component of mobile equipment.

MSHA said that operators should:

- Provide work platforms or equipment designed for elevated work.
- Develop safe procedures for maintenance work and for handling equipment and supplies.
- Forbid improper use of loader buckets.
- Train personnel in safe work procedures.

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Blocking truck before working on it could have saved mechanic's life

Failure to block a vehicle against hazardous motion before performing maintenance was the direct cause of a powered haulage accident that killed mechanic Harold L. Thomas July 8, 1996 at the Central Stone Co.'s Colchester Plant No. 51 in Colchester, III.

Thomas, 52, had continued work from the previous day on the Wabco truck fuel injectors. After installing the fuel injectors, Thomas attempted to start the truck, but the batteries were low. Superintendent Larry Wolfmeyer told him to hook up the battery charger, then he left to check on workers in the pit. Thomas, who had five years' experience as a mechanic, attached the charger to the battery cables at the starter behind the left front wheel. It is surmised that he climbed into the truck cab and started the engine.

Crushing plant operator Bobby Fawcett was working on the plant and heard the truck start, then rev up and down a few times, before returning to idle. A short time later, he heard the truck engine accelerate wide open. Looking up, he saw the truck crash through the shop door. He ran to the plant switch house and shut off electric power before running to the shop. Fawcett and Wolfmeyer arrived at the shop at the same time.

The truck had stopped against the west wall with a large amount of debris between it and the wall. Wolfmeyer entered the truck cab through the right cab door and attempted to shut the truck off but was unsuccessful due to his unfamiliarity with the truck's shut-down procedure and a faulty emergency air shut-off cable. He then crawled under the truck to the fuel shut-off valve behind the left front wheel and shut off the valve. At the same time, truck driver Michael Dean arrived at the scene and manually tripped the engine air shut-off, which stopped the engine.

After the truck was shut down, Wolfmeyer observed Thomas' feet on the truck access ladder. The truck was pulled back about four feet from the wall to remove him.

Based on information obtained at the scene, testing of the truck, and interviews, it was determined that the following occurred: Thomas was positioned on the forward-mounted access ladder when the engine revved and the truck pulled through the park brake and smashed through the shop. The throttle return spring had either been left unattached or had unattached itself. From the time the spring was disconnected, the engine would have gone from low idle to wide open in 22 to 30 seconds.

MSHA concluded that failure to block the truck against hazardous motion before maintenance work began was the direct cause of the accident. The truck transmission and throttle linkage defects, and the truck being able to drive though the functional park brake system when it rewed up also contributed to the accident.

MSHA issued a citation for an alleged violation of § 56.14100(b), which requires that defects on machinery that affect safety be repaired in a timely manner. Tests after the accident revealed that the transmission would remain in gear, even though the gear selector had been returned to neutral. Also, the throttle linkage return spring was not attached on the linkage end of the spring. The original hook on the linkage end of the spring had broken off, and the spring had been bent to reattach it to the linkage.

MSHA also issued a citation for an alleged violation of § 56.14105, which requires that equipment be blocked against hazardous motion before working on the equipment.

Five rescued after material collapse; miner injured in roof fall

Five miners were rescued on Dec. 30 after material in a surge tunnel collapsed, trapping two of the five miners for almost five hours.

The collapse occurred about 10:00 a.m. at Angell Brothers Inc.'s gravel operation in Portland, Ore.

The miners were in the process of unplugging a draw-off chute from inside a surge tunnel, which had become plugged due to heavy rain. The miners were using high pressure water hoses to try and unplug the mud and dirt in the chute when the material in the chute suddenly collapsed, trapping the five in the tunnel.

The operation is a multiple bench hillside crushed rock operation. The rock is pushed off the benches onto a surge pile. The pile varies in height

from 50 to 100 feet high. The surge tunnel under the pile is 200 feet long and lined with a semi-circular tunnel liner approximately 6 feet in radius. The draw-off chute is approximately 170 feet inside the tunnel.

The material/mud that collapsed in from the draw chute filled the area around the draw off point in varying depths from 3 to 5 feet. Two miners were trapped thigh-high in the mud. A third miner was shoved down the conveyor belt. A fourth miner was on top of the mid pile about one foot from the roof and the fifth was trapped at the end of the tunnel behind five feet of mud.

The Portland Fire Dept. was the first to respond and rescued three of the miners by 1:30 p.m. and the other two were rescued by 3:00 p.m.

Miner injured in roof fall

MSHA reports that Kimberly Edwards, 50, a shuttle car operator with Parts Corp. of American's Mine No. 4 in Dewey, Va., was seriously injured in a roof fall accident on Dec. 12.

Edwards, who has 20 years' mining experience, was operating a shuttle car, which was being loaded by a remote-control continuous mining machine during retreat mining. He was inby permanent roof support when the roof fall occurred.

MSHA has just recently issued a new poster warning miners of going inby supported roof. The poster shows a hard hat that was crushed in a roof fall where a miner had gone inby. The miner's crushed hard hat has a sticker on it stating "INBY IS OUT." For copies of the poster call MSHA's information office at 703-235-1452.

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Safety is everyone's responsibility; and statutorily, engineers!

By Sam Johnson, President Johnson & Moore Consulting Inc.

This artcle represents the views of the guest columnist and not necessarily the views of this publication. MSHN welcomes contributions from all of our readers. If you are interested in writing a column or seeing a specific subject covered, please contact Ellen Smith at 703-276-9796.

Engineers, to a great extent, have long been regarded as the designers of our environment.[1] Generally state registration boards for professional engineers have been born out of statutes whose foundation is that professional engineers are to safeguard the life, health, property, and welfare of the public.

State and federal laws governing mining and environmental protection require that the accuracy of certain designs, plans and maps be certified by a professional engineer.

All will agree that today's professional engineers are statutorily in the business of safety!

There are those in the mining industry who only use the services of professional engineers when they need a permit to do something, or when their operations are shut down, or in litigation. Others have in-house staffs that may include multiple professional engineering discipline, ie., mining, civil, chemical, mechanical and/or electrical. A select few may employ professional engineers who have specific duties regarding the health and safety at the mining operation. It is time for the mining industry to realize that there is a statutory requirement that obligates all professional engineers to make safety foremost in the execution of their duties.

Regulatory enforcement against professional engineers does exist, although it is generally limited to actions by registration boards. The acts or omission by professional engineers with ties to those mining operations where serious injury or death has occurred are under closer scrutiny by enforcement agencies.

In out litigious society, professional engineers are more frequently being named in litigation. Workers' compensation laws have lawyers grasping for deep pockets. The purpose of this article is not to address legal history or legal issues, but to address some instances where professional engineers and mine management have the same objective: to safeguard the life, health, property and welfare of the miner and of the public.

Plans should reflect safety first, then affordability

No one designs or plans a mining operation with the intent of injuring anyone. Design objectives are functional and safe first, and then affordable.

In response to our increasingly competitive mining industry, mining operations are becoming complex, productive, and cost efficient. Great attention to detail is required to achieve desired results. Mine safety principles, when incorporated into the mine planning process by professional engineers, ensures that mining's single largest operating cost—labor—is minimized.

The total cost of a mining accident or fatality far exceeds the

cost of allowing engineering participation from concept to closure of a mine. Although worn by use, but always true, the slogan "SAFETY PAYS" is more certain by the participation of professional engineers ar all levels in the mining industry.

With the on-going consolidation of the mining industry, professional engineers are taking on more, and in some instances new duties. It is not uncommon to see professional engineers in the role of sales or marketing, senior administration or operations. Those professional engineers who are foremen, managers and superintendents are at risk! Risk brought on by not having time or needed resources.

The pressure of production and cost containment does not relieve one of the duty of safety. It has been stated that an engineer is someone who can do what any fool can do, but only needs half the time, people and/or money.

Professional engineers with mandatory safety responsibility under state and/or federal mining laws must use their ingenuity to meet their management responsibilities while fulfilling their professional duty to the public.

When you can't do both, you get out.

Commitment to safety comes first

Professional engineers who certify the accuracy of designs, plans and maps, whether they are employed or retained by the mining company, are compelled to perform the work or to supervise the work that is being certified.

Permits are always holding up operations. Requests or needs for mine maps are always at the last moment. Engineering fees will always be judged high. Get used to it! Find time to do your duty!

A gas well or line left off a mine map may cost thousands of dollars more than the cost to make sure it is on the map before you certify it.

An improper blast design may cost hundreds of thousands of dollars in damages and disruption to the mining operations.

Ponds are designed to hold water and stay built.

How many hours of engineering time will be expended to explain why one mine cut into another mine? Assuredly, it will take more time to explain how it happened than the time required to thoroughly locate the mines correctly in the first place.

The bottom line is failure to do your job can cause death, injury, and at a minimum, financial loss. If anything fails due to poor engineering or something that the engineer missed — it is your professional license on the line.

Unfortunately, there are some professional engineers that are no longer practicing due to industry cutbacks. Let that choice be yours, rather than the result of litigation or de-certification.

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[1] J. Kemper, The Engineer and His Profession 1 (2nd Ed. 1975)

Sam Johnson is the President of Johnson & Moore Consulting, Inc. He is the former Deputy Commissioner of the Kentucky Dept. of Mines and Minerals and a registered professional engineer. He co-authored "Questions and Answers on Rescue and Recovery Operations Following Coal Mine Fires and Explosions," and has won numerous distinguished service awards for his achievements in engineering and safety. He can be reached at (606) 252-1640.

Taconite producers predict 1997 will be best year in last 16

Iron Range taconite producers are predicting that 1997 will be the best production year in 16 years, possibly yielding more than 47 million tons of the pellets.

If their predictions hold true, 1997 would be the fourth most productive year ever. The 1990s have proved to be the most stable years of all for the plants.

Part of the high production levels can be attributed to a strong national economy and part to the taconite companies, which have trimmed costs, reinvested wisely and become more competitive.

"I think the story for the taconite industry is that the 1990s have been a very strong decade," said Wayne Brandt, president of the Iron Mining Association of Minnesota. "We're in a period right now where it's been the strongest production ever in the industry."

As a result, several of the companies have added more employees.

U.S. Steel's Minntac Mine in Mountain Iron added 33 new employees in 1996, bringing its work force to 1,760. Northshore Mining Co. added 40 employees over the year for a total of 510. About 6,200 people work at the taconite plants.

The area's seven taconite plants will finish 1996 having produced nearly 46 million tons of taconite pellets. That's about 2.3 million tons less than what they had predicted for the year. Many of the taconite plants lost production when storage bins froze and equipment was slowed during last January and February's harsh winter weather.

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Wearing worn-out athletic footwear can cause pain in the feet, legs, and back

By Carol Krucoff

I know it's time to buy new running shoes when an old ankle injury that seldom bothers me begins to send brief flashes of dull pain. Typically, this occurs every six months, when I've run about 400 miles in the shoes. Even though the outsides usually still look pretty good, I've learned that shelling out the bucks for a new pair makes a critical difference in my health and enjoyment of the sport. Because with new shoes, the pain disappears.

Yet many people don't recognize that discomfort in their legs, feet, and back can come from working out in worn-out shoes. "It's a [leading] culprit when people start feeling aches and pains," says orthopedic surgeon Carol Frey, director of the Los Angeles Orthopedic Hospital's Foot and Ankle Center. "Fifty percent of a shoe's shock-absorbing capacity is gone at 300 miles of running or walking or 300 hours of aerobics class Eighty percent is gone at 500 miles or 500 hours."

Since this breakdown occurs in a nearly hidden part of the shoe called the midsole, people are often unaware that their shoes are dead. The midsole is the slice of cushioning material sandwiched between the outsole and the upper. Made of a synthetic rubber compound, the midsole also may include added impact reducers such as Nike's Air or Asics' Gel. Its function is to provide stability and shock absorption, and every step you take dulls its effectiveness.

The life of an athletic shoe varies depending on the sport and the wearer, says J.D. Denton, owner of Fleet Feet Sports in Davis, Calif., who answers shoe questions from runners around the world over the Internet. "The average person should be able to get 400 to 600 healthy miles to a pair of running shoes," he notes. But "heavier people are harder on shoes, as are people with less-efficient biomechanics."

Running tends to be tough on shoes since it's usually done on asphalt, which "chews up shoes," Denton notes. Also, unlike court sports that involve varied motions, such as jumping, turning, and sprinting, running is an activity that puts the same pattern of wear on the shoe over and over.

To extend the life of your shoes, air them out after use by pulling out the insoles, stuffing them with newspaper or paper towels and placing them in a well-ventilated area away from heat. Never leave shoes in the sun or a hot car or toss them in the washing machine. And don't make the common mistake of trying to resuscitate dead shoes with new insoles. "Insoles are designed to adjust the support," Denton says, "not to revive a shoe that's already dead."

Denying shoe death comes in part because they're so pricey. The average cost of a pair of fitness walking shoes is $55, according to the National Sporting Goods Association. Running shoes average $60 and basketball shoes $68.

But the tendency to hang on to athletic shoes too long comes not just because we're being cheap. "People are constantly adapting to their shoes and don't realize how worn they've become," says Tom Brunick, director of the Athlete's Foot WearTest Center at North Central College in Naperville, Ill. Since many people won't keep a log of miles or hours that they've worn their shoes, he recommends this strategy to diagnose shoe death: About a month after you buy new athletic shoes, purchase a second pair of the same or similar shoes. Then, once a week, wear the newer shoes. This will let you compare how a good, cushioned midsole feels, so you'll know when the old pair is dead. A month after you switch to the newer pair, buy brand new shoes and start the process over.

Another method, from orthopedist Frey: Place the shoes on a counter and examine them from behind. If they roll in or out too much, they've deformed and should be replaced.

"Athletic shoes should protect you from injury and enhance your performance," she says. "Once they're worn down, they no longer act as athletic shoes, but are mere foot coverings. Save them for gardening."

Resources:

- *For expert advice on athletic shoes, e-mail J.D. Denton at JDShoeguy@AOL.com or sign on to the Athlete's Foot's web site: WWW.Theathletesfoot.com.*
- *For free pamphlets on athletic shoes, call the American Academy of Orthopaedic Surgeons at 800 346-AAOS, the Athlete's Foot at 800-353-FOOT; or send a SASE to the American Academy of Podiatric Sports Medicine, 1729 Glastonberry Rd., Potomac, Md.20854.*

*Reprinted from the October 15, 1996, edition of the **Washington Post** Health section, p. 24.*