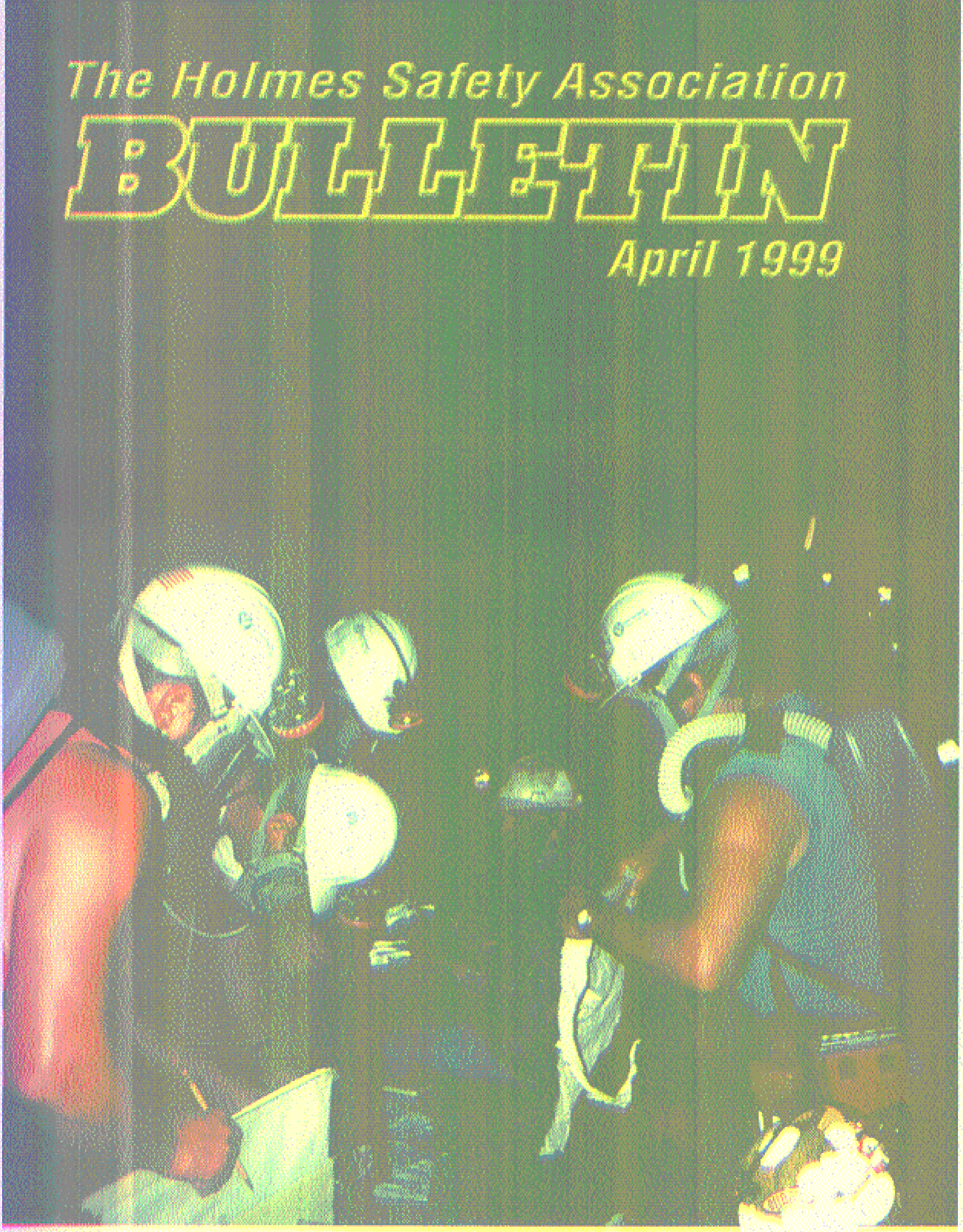
The Holmes Safety Association

BULLETIN

April 1999



contents:

The **Holmes Safety Association Bulletin** contains safety articles on a variety of subjects: fatal accident abstracts, studies, posters, and other health- and safety-related topics. This information is provided free of charge and is designed to assist in presentations to groups of mine and plant workers during on-the-job safety meetings. For more information visit the *MSHA Home Page* at ***www.msha.gov***

PLEASE NOTE: The views and conclusions expressed in Bulletin articles are those of the authors and should not be interpreted as representing official policy or, in the case of a product, represent endorsement by the Mine Safety and Health Administration.

COVER: This super photo was sent to us by Terry Jacobs, Safety Director for Gouverneur Talc Co. The shot (taken 17 June 1994) depicts the Gouverneur Talc and the Zinc Corp. of America mine rescue teams working a problem where an underground derailment and fire were used as a simulation. The individuals in the photo are, left-to-right: Dominic Bango, map man; Kevin Hurley, first aid man; Steve Sullivan, tail captain; patient (unknown); Sheldon Maine, Captain—all members of the Gouverneur Talc mine rescue team. If you have a potential cover photo, please send an 8" x 10" print to the editor, Fred Bigio, MSHA, 5th floor—EPD #535, 4015 Wilson Blvd., Arlington, VA 22203-1984

KEEP US IN CIRCULATION
PASS US ALONG

Fatalities resulting from hazards on coal surge piles

Alarming number of surge pile fatalities have occurred since 1980

The coal mining industry continues to experience fatalities resulting from surge piles. Since 1980 there have been 13 surge pile accidents in which 17 miners have lost their lives—10 of these 17 fatalities were bulldozer operators. One particular accident claimed the lives of five miners.

Surge piles at coal mines present several hazardous conditions. When coal is drawn from an overlying surge pile, a visible cone will usually form above an active feeder. The size of this cone will vary due to many factors, including size and density of the coal compaction, moisture content, etc. On occasion a cone does not form on the surge pile above the feeder. This is an indication that a void space may be developing above the feeder. On the surface of the surge pile everything appears normal, but the weight and vibrations from equipment operating above the void, or miners walking on the surge pile above the void, could cause it to collapse. Twelve of the 13 fatal accidents occurred when a void collapsed. Some feeders are not equipped with gates that can be closed when the feeder is not active. With these feeders, coal can discharge from the surge pile through the feeder even when the feeder is not active. This can be hazardous because equipment operators have no way of knowing when or where coal is being removed from the surge pile through these "inactive" feeders.

Surge pile operations can be hazardous if proper safety precautions are not taken. Every coal mine operator should formulate a plan incorporating the following best safety practices:

1. Provide training to every person that works on or near surge piles to alert them of the associated dangers and to the stipulations in the safety program.
2. Indicate the location of feeder points with an overhead marker and provide an indicator to show if the feeder is in use.
3. Use equipment with a fully enclosed cab equipped with high-strength windows. Provide the window glass with structural support to prevent it from being pushed into the cab by outside pressure.
4. Establish a system of communication so that the equipment operators working on the surge pile are aware of plans to open or close feeders. Every feeder should be installed with the ability to fully close and open the feeder gates.
5. Permit no one to go near the surge pile if a cone is not visible on the surge pile. Never push material to an active feeder until a cone begins to form on the surface of the surge pile and always push perpendicular to the cone.
6. Ensure that mine management is notified immediately if a cone does not form above an activated feeder. This is an indication that a void has formed above the feeder and corrective actions must be taken to eliminate the void.

The agency's inspection personnel will be sharing this and other accident prevention information with miners, mine operators, and independent contractors.

Background

On November 22, an accident occurred on a coal surge pile resulting in a fatality. The accident occurred when a bulldozer collapsed into an unknown void above a feeder. Coal then completely engulfed the bulldozer causing fatal injuries to the operator.

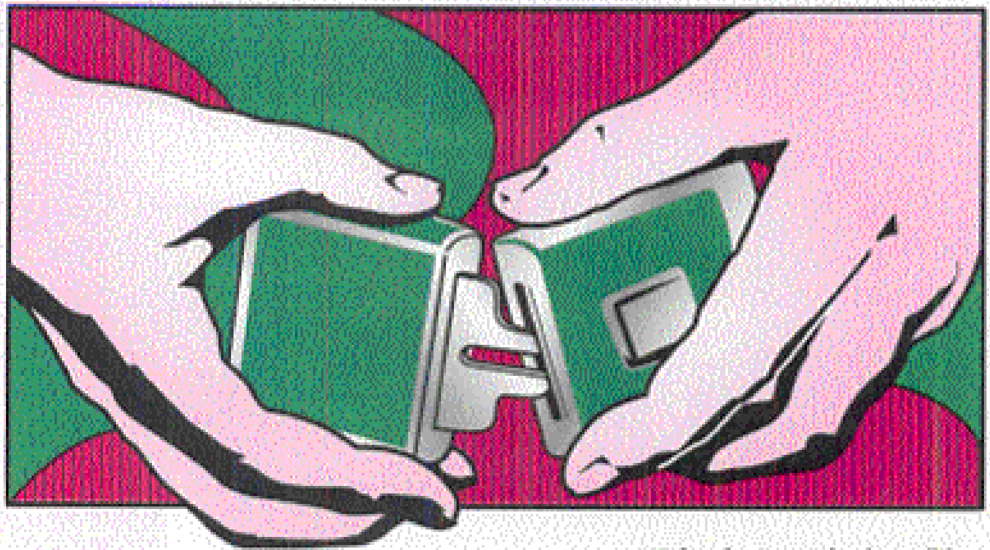
Edited from a February 1999 MSHA PIB. Issuing Office and Contact Person: Coal Mine Safety and Health, Office of the Administrator, Allyn Davis (703) 235-1915

Seat belt saves life of quarry driver

Truck falls 88 feet over

It was a freak accident. It was an accident that probably could not have been prevented. It was an accident that could have had a disastrous, fatal outcome, but didn't.

At about 10 pm on March 10 at Martin Marietta Aggregate's Cave-In-Rock Quarry in Illinois, 38 year-old Greg Cruson was coming out of the bottom of the pit and was almost at the top of the quarry on the way to the primary crusher when the drive shaft broke on his straight-frame Rimpull 85-ton loaded haul truck.



Cruson believes that when the drive shaft broke, it took out an air line because he suddenly had no hydraulics. Not knowing what had happened—only that the truck was moving backwards, he tried his brakes and emergency brakes. Nothing worked. He immediately called out on the radio that the "engine died and brakes failed!"

As his truck was traveling backwards at about 35-40 MPH, he had switched to emergency steering, which is supposed to work if the engine dies.

"I don't know if the steering worked or not. It was hard to steer. I never had to use emergency steering before, and I know that it doesn't steer the same as when the engine is running," Cruson told Mine Safety and Health News (MSHN).

He also explained that while all of this was going on, he knew where all of the emergency brakes and emergency switches were. "I didn't get all that excited, I knew where everything was by feel." Cruson has five year's driving experience at the Cave-In-Rock operation.

Cruson and his truck then traveled almost 300 feet down the hill, but then came to a curve and a highwall.

"I thought, 'I can't hit that wall because the bed and cab will come off,' so I tried to steer around it," Cruson explained. The truck left skid marks where Cruson slid around the 60 degree turn.

The truck then traveled another 400 feet. It broke through and went over a 7 to 8-foot-high berm, which knocked the rear axle off the truck, and then truck, with Cruson still in the cab, dropped 88-feet to the bench below.

"The next thing I knew there was a big explosion and then I was in a pickup truck. I don't remember getting out of the haul truck," Cruson said, "but they said I had a flashlight and I was looking at the highwall when they got to me, but I don't remember that."

Cruson was taken to the hospital, and released with only scrapes and bruises.

Cruson did everything right.

Cruson said that the cab protected him in the fall. While the door posts were bent and broken, the cab pretty much stayed intact. "The truck also had a high back bucket seat that came above my head, and I believe that protected me too," he explained.

But more importantly, he used his seat belt, and he didn't try to jump from of the out-of-control truck.

Did he think to jump? "That never crossed my mind. I didn't have time to think of jumping" Cruson told MSHN.

While he does have scrapes and bruises, and he says he's "really sore," the bottom line is that, unlike others who have died in less severe accidents because they didn't wear their seatbelt, Cruson gets to go home every night to his wife and his two sons, ages 8 and 11. He's not dead.

Cruson said "from day one on the job, seatbelts were stressed, and I always wore mine… Hopefully, someone who doesn't wear a seatbelt will listen to my story and buckle-up."

The facts on seat belt use

A 1991 Bureau of Mines study of serious accidents at surface mines shows that Cruson's survival in this haulage accident isn't an anomaly.

The study looked at 163 accidents involving seat belt usage. Seat belts were worn in 89 of the accidents and not worn in 74.

The bottom line: No miners were killed in haulage accidents when wearing their seat belt.

When seat belts were worn, the lost time accident rate averaged 31 lost workdays and zero fatalities.

But when seat belts were not worn, there was an average of 41 lost workdays and eight fatalities.

In addition, there was no lost time reported in 25 percent of the accidents when seat belts were worn, compared to a 7 percent no lost time ratio when seat belts were not worn.

The difference between wearing and not wearing a seat belt is magnified when one looks at accidents where the driver lost control of the vehicle and the vehicle rolled over.

In the study, there were zero fatalities and an average of 18 lost workdays if the accident involved a roll-over and the driver was wearing a seat belt.

In rollover accidents where the driver was not wearing a seat belt, there were four fatalities and 44 lost workdays.

In cases where the driver was thrown from the vehicle, there were six fatalities and 55 lost workdays.

When the operator jumped from the vehicle, there were four fatalities and 36 lost workdays.

The bottom line is it is better to stay in the cab with the seat belt on rather than to try to jump clear of the vehicle or machine.

Even the drivers who didn't die trying to jump clear from the out-of-control vehicle still had more severe injuries than those who rode out the accident with their seat belts on.

And Cruson is just one more reminder of these facts.

*Reprinted from the March 19, 1999 issue of **Mine Safety and Health News**, Vol. 6, No. 6.*

The Tonopah Historic Mining Park

Located on the site of Belle and Jim Butler's original mining claim which started the rush to Tonopah making it the "Queen of the Silver Camps." This strike in 1900 brought the United States into the 20th century. Many mining and processing techniques developed here are still used in mining today.

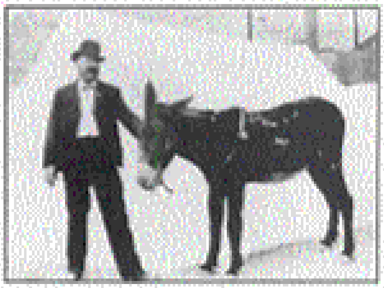
The mining park, encompassing portions of four of the major mining companies and covering over 70 acres, preserves this rich history and brings it to life with exhibits of equipment and imaginative guided tours. The park collects, restores and displays mining artifacts on the site and in the original buildings.

Over a century of mining...

In the spring of 1900, Jim Butler was camping around Tonopah Springs. As the story goes, his burro wandered off, and while searching for it, Jim picked up some promising looking ore. He continued his journey, showing samples to others, but they showed little interest in them. He returned to his home in Belmont, Nevada and told a young attorney named Tasker Oddie about his discovery. Oddie had a friend who taught chemistry and he had the samples assayed and the ore proved to be valued at over $200 a ton. At the behest of Jim's wife, Belle, they traveled again to the site of the original find and filed eight claims, removing several tons of ore. For a one quarter share, Wilse Brougher hauled the ore by horse and wagon to Austin, then by rail to Salt Lake City for smelting. That first shipment netted the partners $500.00, which was used to buy equipment needed for further development.

As venture capital was difficult to obtain, Jim, Belle and their partners implemented the unusual concept of mine claim leasing by the "foot." These leases, which were sealed by a handshake, gave the lessor 75% of all profits from his claim and greatly speeded the development of the district. Many of the miners got rich under this arrangement. The practice quickly spread to other mining districts.

The Butlers eventually sold their interests in the properties to a Philadelphia financier, who formed the Tonopah Mining Co., with assets of over one million dollars. Tasker Oddie formed the Tonopah Belmont Development Co. and between these two companies produced over half of the precious metals from this mining district.



Upper photo: Jim Butler and the reason for his ultimate wealth; Lower: Unidentified miner

History tells us that production of the mines from this district produced in excess of five million tons of ore. At today's market the value of precious metals produced would be in excess of $1,200,000,000 and a few cents...

And there were no taxes!

TECHNICAL NOTE

Laboratory assessment of the rock fragmentation process by continuous miners

Introduction

Laboratory studies were carried out at West Virginia University to investigate the rock-fragmentation mechanism of continuous miners using an automated rotary cutting simulator. The primary factors influencing the fragmentation process were found to be bit spacing, bit geometry, depth of cut and cutting-drum rotational speed. This paper presents a discussion of the effects of these parameters in achieving optimum energy consumption and minimizing dust generation during rock fragmentation. The removal of rock ridges/walls between adjacent grooves is analyzed with three bits mounted simultaneously on the cutting head, while the bit tip angle was varied from 60° to 90°. Bit spacing was varied from 25.4 to 50.8 mm (1 to 2 in.) while the cutting process was assessed for varying cutting depths. Respirable dusts generated during the course of the experiments were analyzed utilizing cascade impactors. Assessment of these parameters has led to a better understanding of the cutting mechanism of continuous miners in terms of energy consumption and dust generation.

A review of the literature revealed that a considerable amount of research has been carried out on rockcutting processes. Many authors agree that the mechanical cutting efficiencies of mining machines (e.g., continuous miners, shearers and road headers) are affected by a host of parameters. Some of these parameters are machine controlled, some are operator controlled, while others are uncontrollable. Efforts were focused on understanding the influence of parameters such as bit spacing, cutting depth, attack angle, bit type, drum speed, bit geometry (i.e., tip size, shape and tip angle) and rock type on the cutting process efficiency in terms of specific energy consumption and respirable dust generation (Strebig et al., 1975, Hanson et al., 1979, Khair et al., 1989). Roepke et al. (1976) in an attempt to study the dust and energy generated during coal cutting using point attack bits found that the dust and the specific energy consumed both decrease as the depth of cut increases. The four fundamental stages of dust generation during rock fragmentation are identified by Zipf and Bieniawski (1989). Coal breakage by various types of wedges was assessed by Evans and Pomeroy (1966) in an extensive experimental study on British coals. Yet the industry today requires further attention and guidance to optimize the energy consumption and dust generation during the rockbreakage process. This paper attempts to give a better understanding of the influence of some of the parameters listed above and focuses on further improvement in the rock-cutting process. The specific energy consumed for different types of bits used and the respirable dust generated are analyzed in the context of the variation of a few other parameters.

Laboratory investigation

The experiments were performed in the Rock Mechanics Laboratories located at West Virginia University. A rock-cutting simulator designed and fabricated by Khair (1984) was utilized for this purpose. The details of this machine are available in the literature (see Khair 1984). For this study, a series of preliminary experiments was carried out to determine the optimum cutting frame advance speed. This was intended to facilitate a maximum cut depth of 31.75 mm (1.25 in.) at an advance rate of 0.525 mm/s (0.0207 ips) for all types of bits being used and various bit spacings being considered. To look into the cutting-process efficiency of a continuous miner in the laboratory, several parameters of influence are being considered. Besides the bit-geometry parameters, machine and operator-controlled parameters, such as spacing of bits on the cutting head, the cutting head rotational speed and the total cutting depth during an experiment, are varied. At the time this paper was written, only part of the completed experiments were analyzed, and a number of experiments were still being carried out following an orthogonal fractional factorial experimental plan to assess the effect of all of the above mentioned parameters on the cutting efficiency in terms of energy consumption and dust generation.

Three different types of tip angles, namely, 60°, 75° and 90°, and two different tip sizes, namely, diameters of 7.94 and 24.61 mm (0.313 and 0.969 in.), were used. At present, only one rotational speed of the cutting head (90 rpm) was being used while, in the course of further study, at least two other speeds will be considered. The cuts were made progressively until predetermined depths of 10.16,20.32 and 31.75 mm (0.40, 0.80, and 1.25 in.) at each stage were reached. The spacing between the two adjacent bits was varied from 25.4 to 50.8 mm (1 and 2 in.) with an interval of 12.7 mm (0.50 in.). The parameters monitored include cutting pressure and penetration pressure of the cutting head, cutting depth, and acoustic emission in terms of total counts generated. A strip-chart recorder (Model 1246 from Soltec Corp., San Fernando, CA) was used to record the data, and a pressure transducer (Model 303H2 from the Hedland Division of tration and the settled dust were recorded. The dust measurements were conducted at the end of maximum depth of cut as the cut progressed from 10.16 to 20.3 mm (0.4 to 0.8 in.) and then to 38.1 mm (1.5 in.). The ratio of spacing to cutting depth was also assessed at each stage of cutting depth while a close monitoring of the ridge failure between any two adjacent grooves was made to look into the rock removal mechanism during the cutting process. The intention was to evaluate the energy requirements to induce a ridge failure as the cutting progresses. As a matter of fact this was the guiding reason in using three bits simultaneously on the cutting head. It may be noted that the bits attack the rock block at predetermined spacing, while the time of attack for each bit was different, depending on its position on the cutting drum. Figure 3 shows the typical arrangement of the bits on the cutting head blocks.

A set of preliminary experiments was performed to materialize the above-mentioned experimental plan. The maximum cut depth and the advance rate of the cutting platform were maximized for different kinds of bits to be used and the different bit spacings to be considered. Therefore, a maximum depth of cut, say 31.8 mm (1.25 in.), was held constant for all the experiments at a constant advance rate of 0.525 mm/s (0.021 ips) of the cutting platform. A few experiments were also conducted at a bit spacing of 76.2 mm (3 in.) to find out the maximum bit spacing resulting in ridge failure. The results obtained were analyzed in the following sections.

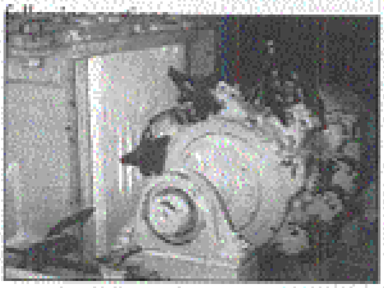
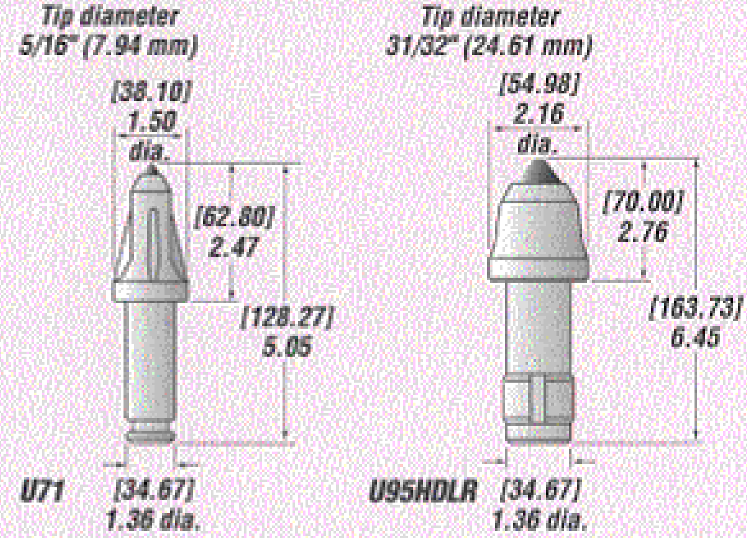


Figure 1.—Details of cutting bits used in the current study.



Results and discussion

The results indicate that the spacing and size of the bits and the tip angle affect the specific energy consumed and the respirable dust generated during the cutting process. The rock-removal process due to ridge failure was found to be complete at a smaller bit spacing, say 25.4 and 38.1 mm (1 to 1.5 in.), while the larger bit spacing demanded more cutting forces and specific energy. The results were mixed in several other respects. The following discussion addresses only part of the experiments carried out so far. It should be mentioned that the current experimental plan was still in the process of investigating these factors.

Energy consumption. The specific energy required was defined as the amount of energy consumed in removing a unit amount of rock material (Roepke and Hanson, 1981). To investigate the specific energy requirements during the rock fragmentation process, a variation of several parameters was considered. The variation in average specific energy consumed vs. the bit spacing was shown in Fig. 4. The results shown here were for all the three cutting bits against increasing cutting depth. Figure 5 indicates the effect of tip angle of the bit on the specific energy required. As the tip angle was increased, the required specific energy also increases with increasing cutting depth. The change in bit spacing resulted in some mixed but interesting results. The larger the spacing, the higher the required specific energy. For the maximum depth of cut used at larger bit spacing, the rock ridges could not be induced to fracture. Figure 6 shows a typical rock block with 50.8 mm (2 in.) spacing cuts made until the maximum cutting depth. It can be seen that the ridges still remain intact, so the rock fragmentation was incomplete. However, it was observed that the smaller bit spacing and tip angle of 75° has resulted in complete rock removal in the cut path and also smooth cuts inflicting minimum wear on the bit.

Dust generation. As mentioned earlier, two cascade impactors were used to collect the respirable dust during each experiment. The impactors were mounted around the cutting head, one at the top and the other at the bottom. Each impactor has three through eight stages to collect the dust, with the dust collected on Stage 3 having a larger particle size than Stage 8. The rock-cutting simulator was provided with a dust shield (see Khair, 1984) to trap the airborne

Machine Federated Inc., Racine, WI) was used to monitor the pressures from which the cutting force, torque and energy consumption were calculated. The cutting depth was monitored utilizing a linear variable differential transformer mounted on the cutting platform. Three bits were simultaneously mounted on the cutting head during each experiment. The attack angle was maintained constant (at 45°) for all the experiments. The failure process of the ridges/walls between the adjacent cuts after a cut sequence and the corresponding spacing to cutting depth ratio were observed in order to understand the cutting process.

The weight and height losses of the cutting bits and the dust generated, both in respirable and settled form, were some of the other parameters monitored for each experiment. The respirable dust was measured utilizing a pair of Series 296 Marple personal cascade impactors (Greasby Andersen Corporation) with three through eight stages of dust collected on each of them. These impactors were installed around the cutting head, one at the bottom and the other one at the middle. Du Pont air pumps (Du Pont constant flow sampler, Model P2500, E.I. du Pont de Nemours and Co. Inc., Wilmington, DE) were used with the cascade impactors, and the air flow rate was maintained at 2 L/min.

The rock blocks utilized in this study (see Table 1) were firmly placed in the confinement chamber of the rock cutting simulator with a uniform pressure applied on all sides, leaving one side open for the cuts to be performed. The confinement pressure was maintained constant during the course of all experiments. A Model 204G AE System (Acoustic Emission Technology Corp.) was utilized to measure the number of acoustic emission (AK) counts during each experiments.

Rock material characteristics. Rock blocks of Indiana limestone, which were obtained from Bedford Limestone Suppliers Inc., Bedford, IN, were being utilized in this study. All the test blocks were finished to a size of 483.6 x 317.5 x 152.4 mm (19 x 12.5 x 6 in.) to suit the testing conditions of the confinement chamber on the continuous miner simulator. The rock material, popularly known as "standard buff," was an oolitic limestone. It consists of a calcite cemented, calcareous stone formed of shells and shell fragments and was practically noncrystalline in character. The rock was found in massive deposits located almost entirely in Lawrence, Monroe and Owen counties in Indiana. This limestone was characteristically a freestone, without pronounced cleavage planes, possessing a remarkable uniformity of composition, texture and structure. It has high internal elasticity, adapting itself without much damage to extreme temperature changes. The Indiana Limestone consists of 46% calcite ooids, 23% calcite fossils, 15% calcite cement, 12% porosity and 3% calcite pellets.The limestone also contains traces of pyrite. Table 1 describes the physical properties of this rock material. The samples were obtained from the quarry and measured in the laboratory.

Table 1.—Physical properties of Indiana limestone.

Rock property	Variable range
Weight (dry, seasoned), kg/m³	2,250-2,400
Specific gravity	2.1-2.75/2.18*
Absorption by weight	0.6-7.47
Compressive strength, MPa	27.6-82.7/32.8*
Modulus of rupture, MPa	4.8-11.0
Tensile strength, MPa	2.1-5.0/3.04*
Modulus of elasticity, MPa	22,750-39,989/17,324*
Poisson's ratio	0.25*
Shear strength, MPa	6.2-12.4
Abrasive resistance	5.8-17.4/4.7*

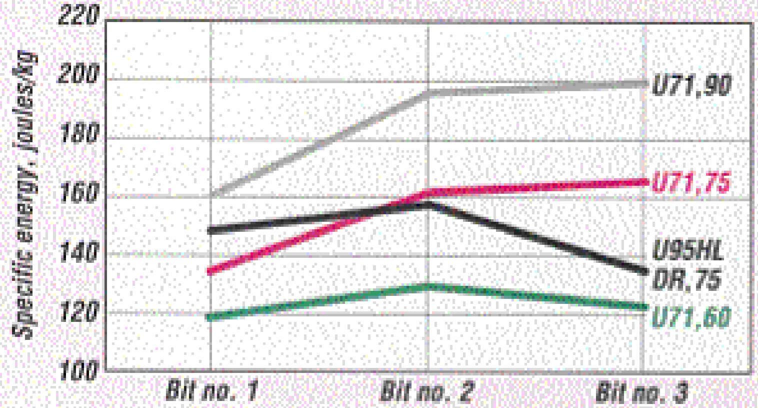
** Measured in the laboratory (see Gebi and Khair, 1994)*

Characteristics of cutting bits. The cutting bits (obtained from Kennametal Inc., Bedford, PA) that were utilized in this study were all of the conical type. They were typically made of 15B35 steel and were simultaneously brazed and heat treated. The tips were composed of tungsten carbide (WC). This insert has an average density of 14.6 g/cm3 and a hardness of 86.3 to 86.6 RW A. It consists of 8.2% to 8.8% cobalt. The bits utilized in this study include the U71 type with three different tip angles, namely, 60•, 75• and 90•, and the U95HDLR type with a tip angle of 75•. The U71 type bits have a shank diameter of 25.4 mm (1 in.) and a tip diameter of 7.94 mm (0.31 in.). The U95HDLR bits have a shank diameter of 34.67 mm (1.36 in.) and a tip diameter of 24.61 mm (0.969 in.). Figure 1 shows the details of dimensions of these two types of bits.

Experimental setup and test procedure. The experimental setup utilized in this study was shown in Fig. 2. The observational parameters, such as cutting pressure, penetration pressure, cutting depth and AE counts, were recorded on a Model 1246 strip-chart recorder in real time. The study so far has involved performing experiments at a constant cutting drum rotational speed of 90 rpm on at least four different types of bits. Three tip angles were used while two tip sizes were also included at one specific tip angle. The tip angles included were 60°, 75° and 90°, and the tip sizes, i.e., small and large, both have a 75° angle tip. Three different bit spacings, namely, 25.4, 38.1 and 5.08 mm (1, 1.5, and 2 in.), were considered. The confinement pressure, both vertical and horizontal, on the rock block was held constant for all the experiments. For each experiment, the amount of height and weight losses of the bits, the respirable dust concen-

Figure 2.—Typical experimental setup used in the study.

Figure 5.—Specific energy consumed at maximum depth of cut for different tip angles at 38.1 mm (1.5 in.) spacing.



dust during experimentation. The settled dust, consisting of major chips and rock fragments formed during the cutting process, was collected in an arrangement below the cutting head for further analysis. The results in the current study indicate that the airborne dust produced was affected by the bit tip size. Figure 7 shows the amount of dust produced for the two different types of bit sizes used in the study. The results shown were for 38.1 mm (1.5 in.) spacing and 75° tip angle. The cuts were made by using three bits until the maximum depth of cut was reached. It may be noted that the tip angle has not produced any significant trend on the airborne dust generated. This can be seen through the results interpreted in Fig. 8. As the bit tip angle increases, the amount of dust generated has a mixed effect. The larger the bit spacing, the lesser the amount of respirable dust generated. This can be explained as follows. The rock-ragmentation process was characterized by two stages of breakage. The rock material directly under the bit tip undergoes crushing before the fractures were magnified to inflict chip formation (Ready, 1988). Additionally, at smaller bit spacing, rock chips were formed, resulting in the removal of ridges/walls at an earlier stage with a least amount of energy invested. Whereas, if the spacing was increased, the rock-cutting process requires more energy to induce fractures across the ridges which were formed between adjacent cuts. The tests performed at spacings of 50.8 and 76.2 mm (2 and 3 in.) produced the least amount of airborne dust and only indicated increased energy demand. On the contrary, because the smaller bit spacing fragments the rock material during cutting, more respirable dust was the result.

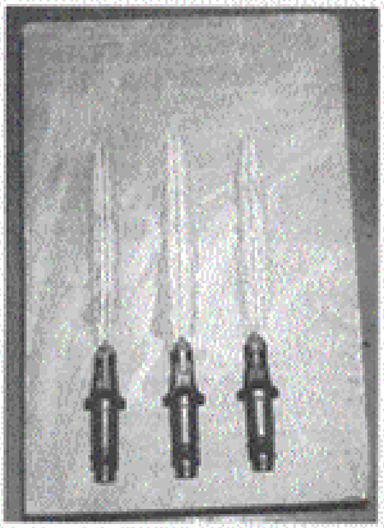


Figure 6.—Unfailed ridges/walls on a rock block after tests were performed at 50.8mm (2 in.) Spacing until the maximum cutting depth.

Figure 9 shows the respirable dust generated for the various cutting depths considered. Evidently, the smaller bit spacing resulted in more airborne dust generation. The anomaly in the results of the top cascade impactors could be attributed to the distance at which they were located from the cutting bit-rock interface.

Other data indicates the typical crushing that occurs at smaller bit spacing. As argued earlier, this aspect of cutting was the major concern for airborne dust generation. Further data shows the case of using a larger bit spacing and shows the remaining ridges after the cuts were made on the rock block. On the other hand, the bit tip angle has insignificant effect on the amount of airborne dust generated. However, these results cannot be used to initiate any recommendations to better cutting process until the complete tests were carried out and a thorough statistical analysis was conducted.

Summary and further research

The studies indicate that the specific energy and dust produced vary significantly for different parameters. At smaller bit spacing, the energy consumed was low, inducing a complete failure of ridges between two adjacent cuts. As the bit spacing increases, the demand on specific energy required to induce rock failure increases with increasing cutting depth. On the other hand, the smaller bit spacing results in higher respirable dust generation at the same time. The current results indicate that a spacing-to-depth ratio of 1.2 was a trade-off to these two aspects of the cutting process. The increase in bit tip angle requires more specific energy per unit volume of rock removed. A smooth cutting process that consumes low energy in order to break the rock under the cutting tool tip and generates low respirable dust with minimum wear on the bits was desirable for an efficient utilization of resources.

Future research includes completion of an orthogonal fractional factorial experimental plan to evaluate the effect of the above discussed parameters during the cutting process. The failure process of the rock ridges between the two adjacent cuts will be analyzed analytically as well. The failure angle results of these experiments will be correlated with the failure angles as obtained through standard triennial procedures.

Acknowledgments

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Figure 7.—Effect of bit tip size on respirable dust generated during cuts performed on three bits at 38.1 mm (1.5 in.) spacing and 75° tip angle (until the maximum depth).

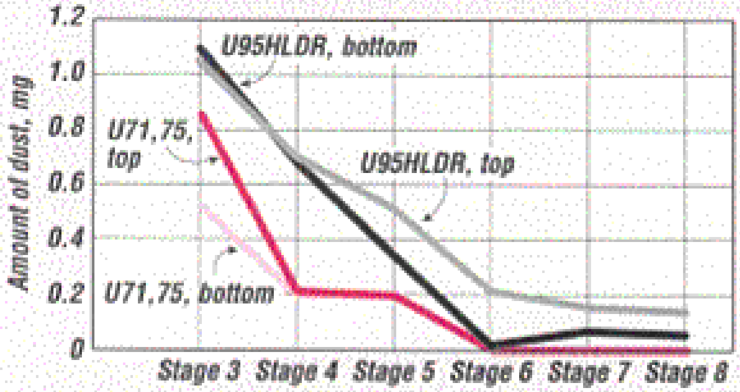


Figure 8.—Effect of bit spacing on respirable dust generated (three bits used, cuts were performed until the maximum depth at 38.1 mm (1.5 in.) spacing).

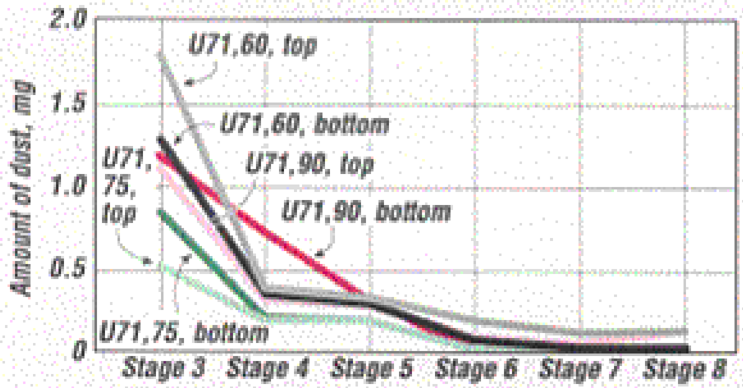
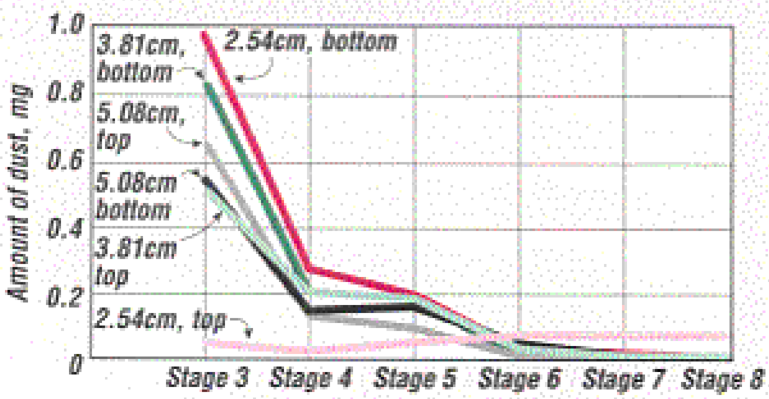


Figure 9.—Effect of bit spacing on respirable dust generated (three bits used, cuts performed on U71,75 until the maximum depth).



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Reprinted from the Society for Mining, Metallurgy, and Exploration's March 1998 issue of ***Mining Engineering.***

Residents pleased with CalMat attempts to reduce noise, dust

They will line the rock crushers with rubber, encase the rock separators with polyurethane vinyl, and expand the existing berms and add new ones.

These are the recommendations that CalMat of Mission Valley, Calif. will take on to try and reduce the noise of its sand and gravel operation.

When residents began complaining, the company argued that the noise was from the local interstate. But the company did take the extra step of hiring an acoustical engineer, who confirmed the neighbor's complaints that the rumbles and thuds were coming from the CalMat operation -- not the highway.

The engineer found that the operation creates at least a 50-decibel level of noise constantly, and during peak hours sounds reach as high as 80 decibels.

While the company is within local noise standards, it is taking the neighbors complaints seriously and correcting the problems.

The company has stated that not only will it follow the accoustial engineer's recommendations but it will increase water spraying to assuage concerns about dust.

The company expects to take care of the problems within two months.

*Reprinted from the February 19, 1999 edition of **Mine Safety and Health News** by Legal Publication Services.*

About the National Coal Museum

Written by: Leslie Stewart, Director, Public Relations

Well over thirty-six thousand visitors have already had the unique opportunity to experience The National Coal Museum...600 feet below ground at the only vertical shaft coal mine open to the public in the world (located in West Frankfort, Illinois). Since the grand opening, August 15, 1996, The National Coal Museum has attracted visitors from all fifty states as well as thirty-three foreign nations.

The National Coal Museum was founded by Dr. Christopher T. Ledvina, a former coal miner who was paralized in a roof fall accident while examining a mine. "It was an ironic twist of fait." Ledvina says. "The accident actually gave me the freedom to pursue my dream… founding The National Coal Museum. Dr. Ledvina was so intridued by the mining process and the rich history of mining, he began the tremendous journey of creating the only museum devoted to promoting and preserving the history and future of the entire coal industry. With the enormous efforts from a lot of devoted people, Ledvina's greatest endeavor opened one full year in advance.

The National Coal Museum was founded with the primary purpose of educating the public about the coal industry, while preserving our heritage. The museum will also serve as a training and research center, provide coal promotion and a forum for the entire coal industry. The museums proudest achievement is the ability to provide education and entertainment simultaneously.

The museums Mine 25 site, located just minutes from Interstate I-57, exists the only vertical shaft coal mine open to the public in the world! Experienced coal miners, serving as tour guides, take you 600 feet underground into the actual mine. While demonstrating the fascinating monster machinery, they will share with you their favorite anecdotes from their many years spent working as coal miners.

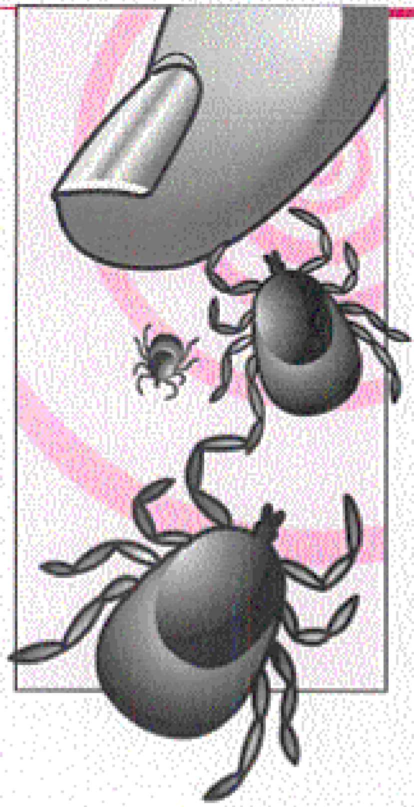
An enticing part of your visit will be The Company Store, featuring unique coal related gifts, books and fascinating souvenirs. The Company Store also provides softs drinks and snacks for your convenience. The National Coal Museum also provides meeting facilities for up to 40 people as well as catered lunches and dinners for groups of 20 or more.

At the Orient 2 site, located just a few miles from Mine 25, restoration is already underway on the only 1920s vintage coal mine left standing in the country. Orient 2 will house the above ground exhibits, demonstrations and artifacts telling the entire story of coal… past, present and future.

Spring of 1999, our newest addition to the Orient 2 site will hold its grand opening. The John L. Lewis Memorial Library will be open to the public, housing various historical artifacts and information related to the coal mining industry.

Nestled in the heart of southern Illinois, surrounded by numerous recreational and historical opportunities, The National Coal Museum is an international treasure that should not be missed.

Stewart, L. (1995). About The National Coal Museum. [Online] URL http://www.coalmuseum.com/about.htm [Accessed 17 February 1999]



REMINDER: BEWARE— It's Lyme time

Spring is tick season and ticks can cause Lyme disease, which can lead to chronic arthritis as well as problems with the heart, nervous system and joints. You may have Lyme disease if a tick bite becomes an expanding lesion, possibly accompanied by fever, headaches and muscle pain. To avoid this disease, it's a good idea to wear long pants and sleeves when walking in wooded areas and to check for ticks on your body and clothing afterward. There is also a vaccine on the market. For a free brochure on Lyme disease, write: Arthritis Foundation, P.O. Box 7669, Atlanta, GA 30357-0669.

Carrie Donovan
*Reprinted from the March 30, 1999 issue of the **Washington Post Health** magazine.*

Failure of truck driver to use parking brake contributed to miner's death

Failure to engage a parking brake on a dump truck caused the death of a truck driver, according to investigators researching a fatality at a gravel mine in Altair, Tex.

The victim, 60, died a few days after being struck by another truck. The man didn't have any mining experience but had been a truck driver for nine years.

On May 28, 1998, the victim and another man began their shift. The victim using a 1980 GMC end-dump 18-yard capacity truck and the co-worker driving a 1975 Peterbilt 16-yard capacity truck. The two worked as contractors on a pay-per-load basis.

On the day of the accident, the two men arrived at the gravel facility about 1:00 p.m. The owner was on-site when the accident occurred. The victim drove his truck into the load area and it was filled via a front-end loader. The victim then drove the fully loaded truck about 100 yards forward and stopped. He then got out and began cleaning loose sand and gravel from the top rails of the truck bed.

His co-worker then drove the other truck into the load area. The co-worker noticed tar and oil had built up on the truck's foot pedals. So, while the truck was being loaded, he went under the dash and began scraping the material from the pedals. While he cleaned, he didn't notice that his truck had begun rolling forward. The truck rolled until it struck the victim, who was standing behind his truck, pinning him between the two vehicles. The coworker immediately backed up his truck and the victim collapsed to the ground. He was transported to a hospital in Houston, but he died about a week later from his injuries.

It was noted that while the direct cause of the accident was the failure to set the parking brake on the truck, a contributing factor was the failure to use the designated area for tarping to clean spilled material from the victim's truck.

*Reprinted from the November 27, 1998 issue of **Mine Safety and Health News**.*

Timed spray reduces dust

A simple innovation is improving air quality, enhancing safety and cutting costs at Barrick's Holt-McDermott mine.

The operation recently started using a timed water spray .system to keep down dust at drawpoints where ore is stockpiled. The timed spray replaces an old system that used to spray the muckpile continuously during a shift.

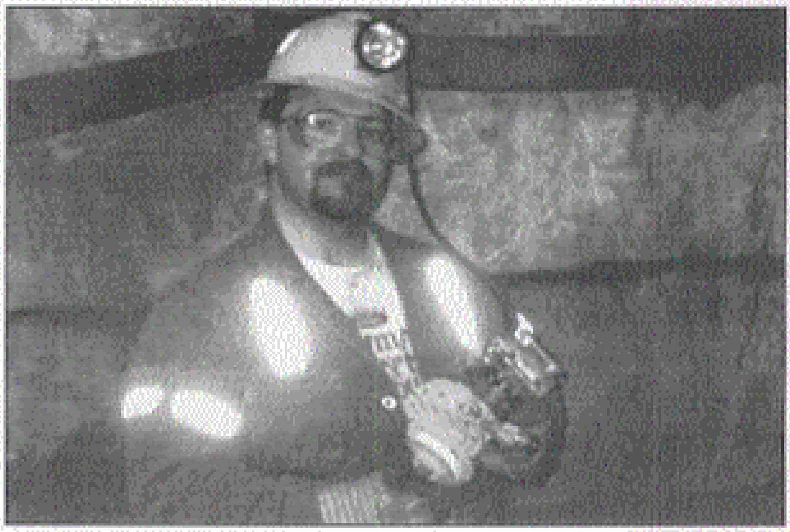
Operators actually spend only about 20 per cent of their time in the drawpoint. Although the muckpile must be wet to keep dust down and ensure good air quality, a constant spray meant water was wasted and excess water had to be pumped away. Road beds eroded more quickly, leading to more wear on equipment and tires, and greater chance of injury.

The new system uses a pull cord with a spring-loaded timing device. When the scoop operator enters the drawpoint, he pulls the cord and a spray of water wets down the muck pile. The water sprays for long enough to settle the dust and then shuts off automatically. The valve can be shut off completely if the drawpoint is not being used.

The system was invented by Michel Gervais, a production miner at Holt-McDermott who noticed the steady flow of water running down the ore pass. The mine worked with Sudbury Valve, Fitting and Control Limited to turn Gervais' idea into a product. Each unit costs about $800, and the mine has five operating so far.

MikeJohnson, Loss Control Coordinator for Holt-McDermott, said there has been a great deal of interest from other operations. He is preparing an information package.

*Reprinted from the Special April 1998 issue of MASHA's—Mines and Aggregates Safety and Health Association—**SAFETY FOCUS**.*



Michel Gervais, a production miner at Holt-McDermott demonstrates the timed spray system he developed.

Collapse thought to be part of thunderstorm

An abandoned coal mine in Tuscaloosa, Ala. collapsed on Jan. 19, sending shockwaves that registered 4.0 on the Richter scale, according to the National Earthquake Center.

The center, based in Colorado, detected the earthquake just after 2 am, and called officials in Alabama, according to Don Hartley, plans and warning officer for the Tuscaloosa County Emergency Management Agency.

"Ironically, the collapse happened at the same time we were experiencing severe thunderstorms," Hartley said. "The sound of the thunder apparently masked the fall of the longwall and no one reported it."

Hartley said a geologist from the National Earthquake Center called about 2:05 am to report an earthquake alarm and a 4.0 measurement. Because of the severe thunderstorm activity, Hartley and coworkers were in the emergency center at the time. After receiving the coordinates from the geologist, they dispatched Tuscaloosa Sheriff's deputies to check out the site and notified the area coal company command centers.

While a 4.0 earthquake isn't considered severe, people living nearby the epicenter usually feel the tremor. But in this case, people may have assumed the strong vibrations were caused by the thunderclaps.

The longwall collapsed in an inactive mine owned by Drummond Coal Co. about 15 miles northeast of Tuscaloosa, on the county line. It is one of dozens of old mines in a large coal field in the area, according to Hartley. It's also a sparsely populated region and state officials didn't discover any damage or injuries.

Another mine in the area suffered a partial collapse on Jan. 15, according to the Drummond Coal Co. An abandoned tunnel of the Shoal Creek facility in northwest Jefferson County crumbled down in the early morning hours but didn't cause any injuries.

*Reprinted from the February 19, 1999 edition of **Mine Safety and Health News** by Legal Publication Services.*

Coal fatal accident summary

General information

The coal mine is opened into the Pocahontas No. 3 Seam by eight shafts. Employment is provided for 345 persons. A total of 306 underground and 39 surface employees work on three production shifts per day, seven days per week. The surface area of the mine includes a large preparation plant which produces 10,000 tons of clean coal per day. Coal is cleaned, dried, stockpiled, and loaded into unit trains for transport or into trucks which deliver coal to the mine's impoundment area for storage when stockpiles are at or near capacity. The preparation plant area includes raw and clean coal silos, stockpile, and loadout facilities.

Description of accident

On Saturday, November 21, 1998, at 11:30 pm, the midnight shift crew comprised of twelve miners at the preparation plant began their shift under the supervision of plant foreman. The plant foreman's shift began at 7:30 pm. The plant was idle and repairs begun on the previous shift were continuing. The draw-off belt conveyor under the clean coal stockpile was operating to load coal into trucks for transportation to the impoundment area for storage. None of the draw-off belt conveyor feeders were operating as the stockpile was gravity feeding onto the belt conveyor. At approximately 1:00 am, the plant foreman traveled by pickup truck to the impoundment area to check a pump and later returned to the plant.

Repairs were completed in the plant and startup procedures began at 1:30 am. By 2:00 am the plant was operational. At 2:30 am the victim, a mobile equipment operator, returned to the plant office from the skip shaft area where he had been moving coal with a dozer since the start of the shift. At 3:00 am the plant foreman instructed the victim to assist with repairs on a floor brace in the plant. At 4:30 am The plant foreman instructed the victim to take a dozer to the clean coal stockpile and move coal away from the stacker.

The victim reported by radio to the control room operator, who logged the contact, that he was entering the stockpile area at 4:55 am. The victim called the dryer operator and told him that the No. 2 Feeder was feeding coal. At 5:25 am the control room operator called the victim on the radio and received no response. The control room operator contacted the dryer operator and asked him to go to the head house and see if he could locate the victim. The control room operator also notified the plant foreman of the situation. The plant foreman immediately obtained a vehicle and drove around the road beside the stockpile. Neither the plant foreman nor the dryer operator saw the victim or the dozer. The plant was then shut down completely including the draw-off belt conveyor. The plant electrician took another dozer onto the stockpile to look for the victim. He was unable to locate the victim and realized that the dozer must be in a void over a feeder. He located dozer tracks that ended at the edge of a void over the No. 1 Feeder. Within this approximate 15 minute time frame, personnel from both the plant and mine had begun to gather. The assistant mine foreman traveled up the overhead stacker belt line catwalk and reported seeing metal in the No. 1 Feeder. The plant electrician reported seeing two to three feet of the dozer blade at the same location.

The plant foreman contacted the plant superintendent, at home and asked him to begin emergency procedure contacts. The plant superintendent did this by cellular phone as he traveled to the mine site. The plant foreman brought in every available piece of earth moving equipment and immediately began moving coal away from the No. 1 Feeder area. Members of Consolidation Coal Company's mine rescue team arrived and assisted in the recovery. Personnel from the Mine Safety and Health Administration and the Virginia Department of Mines, Minerals, and Energy arrived at various times and assisted in and monitored the recovery operation.

The victim was extricated from the dozer at 1:12 pm and transported by ambulance to the hospital where he was pronounced dead by the county medical examiner.

Conclusion

The accident occurred when the dozer operated by the victim traveled into a hazardous area near the No. 1 Feeder containing a bridged over void in the stockpile. The bridged material collapsed causing the dozer to tumble into the underlying void where it was subsequently engulfed with loose coal. The layering effect of the fine coal and the fact that deenergized feeders gravity fed onto the draw-off belt conveyor without being positively identified led to a steep-sided void completely bridged over the No. 1 Feeder which was unobserved by the victim or any other personnel on the midnight or preceding shifts.

The Nos. 2 and 3 Feeders were blocked with steel plates. The Nos. 1 and 4 Feeders alone will be used until hydraulic doors are installed on all feeders to eliminate gravity flow.

The Nos. 1 and 4 Feeders will be energized before dozers enter the stockpile. Examinations will be made in the draw-off tunnel to verify that coal is feeding properly until the hydraulic doors are installed.

A visible void must be present above the Nos. 1 and 4 Feeders. If not, all employees will leave the stockpile and not return until the condition is corrected.

Edited from an MSHA accident investigation report by Fred Bigio.

Falling box hits ATRS lever, kills miner in freak accident

A box of resin grout tubes that fell off the top of a roof bolting machine caused the death of a 45-year old roof bolting machine operator in a freak accident at a coal mine in Buchanan County, Va., according to MSHA's final report on the accident.

The mine employs 13 people and produces 450 tons of coal per day, using room and pillar mining.

The victim died on Dec. 3, 1998 while running a Long Airdox single head roof bolting machine. He had reported to work the 7 am to 3 pm shift and was assigned to bolting duties by the No. 3 Entry. The victim worked alone on the single head machine.

At about 3 pm a co-worker passed by the victim's work area and noticed the bolting machine was still running. As he walked over to take a look, he saw that the victim was in a kneeling position at the front of the machine, with his head caught between the automated temporary roof support system and the frame of the machine.

Emergency treatment was immediately given but workers couldn't find a pulse.

An investigation revealed that a cardboard box of resin grout tubes was laying on the ATRS control levers when workers discovered the victim. The box had just two tubes of grout in it but tests showed that the box still had enough weight to depress the ATRS levers.

Apparently, the victim had placed the box on top of the bolting machine and during bolting operations, the box fell onto the ATRS control levers. The ATRS supports weren't set firmly against the mine roof, which allowed the tilt jack to rapidly fold the ATRS inward toward the front of the machine, crushing the victim.

If the machine was properly positioned and ATRS placed firmly against the mine roof, the shield would not fold back onto the machine. The victim's ATRS initially did set firmly against the roof but would lose pressure when he began using the bolting machine. The pressure loss came partially because of a leak in the hydraulic system but most of the separation between the shield and the mine roof occurred because the ATRS feet settled in loose coal and soft material on the tunnel floor.

*Reprinted from the February 19, 1999 edition of **Mine Safety and Health News** by Legal Publication Services.*

ATV rider killed near blast site

A man out for a ride on his four-wheeler died Feb. 15 after being struck by debris from a strip mining blast.

The 55 year-old victim, a resident of Phelps, Ky., died of massive injuries after the explosion near a surface mine in Pike County, Ky.

A spokesman for the Kentucky Dept. for Surface Mining said the victim was allowed to ride the vehicle on a logging road near the mine. The victim owned a double-wide trailer home on nearby Ash Lick Road and frequently rode his four-wheeler up and down the hill near the mine.

Officials did not say how close the victim came to the explosion site or even if he was on mine property when he was struck.

But the spokesman for the Kentucky Dept. for Surface Mining said they did determine that the miners gave a warning from two sets of air horns five minutes before the blast and sent a second signal one minute before the blast, as state law requires.

When the charges exploded at about 3 pm, apparently material flung into the air struck the victim. The county coroner pronounced him dead at the scene.

The victim was a retired Chicago plant worker who had relocated to the area.

*Reprinted from the February 19, 1999 edition of **Mine Safety and Health News** by Legal Publication Services.*

Metal and Nonmetal fatal accident summary

Fatal powered haulage accident (limestone)

General information

A 21 year-old utility person was fatally injured at about 9:15 am on December 23, 1998, when he was crushed between a rail car and a front-end loader bucket. The victim had 17 weeks and 2 days mining experience, all as a utility person at this operation. He had received training in accordance with 30 CFR, Part 48.

The mine is an underground crushed stone operation located about six miles south of Sherwood, Franklin County, Tennessee. The mine was normally operated two, ten-hour shifts a day, 5-1/2 days a week. A total of 46 persons were employed.

The operation consisted of an underground mine with a surface mill. The mine was opened to the surface by adits which also served as main haulage roads. Rooms and pillars in the mine were developed by conventional drilling and blasting. Broken limestone was loaded into trucks by front-end loaders and transported to the surface where it was crushed, sized, and stored in silos. The finished product was shipped by rail and truck to various customers, primarily for use in carpet manufacturing.

Description of accident

On the day of the accident the victim and the load-out operator reported for work at 5:00 am, their normal starting time. They went to the silos to load rail cars. Several loaded cars had been left from the previous shift, so they moved those cars down the second track. The victim operated the front-end loader while the load-out operator rigged the tow cable and worked the brakes on the rail cars. After moving the loaded cars, they began moving empty cars onto the second track, filling, weighing, and then towing them down the track.

At about 7:15 am, an additional utility person arrived and relieved the victim on the loader. The victim assisted him on the ground. Shortly after the additional utility person arrived, the load-out operator left to work elsewhere.

Work proceeded without incident until about 9:00 am when the victim and the additional utility person moved two loaded cars to the scale. The first car was weighed and towed past the scale. When the second car was weighed, it was determined that more product was needed to make the proper weight. Because the loader could get little traction with the no-lug tires and muddy ground, the additional utility person was unable to move both cars back to the silos. The cars were then separated and the victim attached the tow cable to the first car to move it down the track to join the other loaded cars. The additional utility person backed the loader, towing the car.

When the car began to roll freely, the tow cable became slack and the victim stepped between the slowly moving loader and rail car to unhook the cable. The car continued to roll approximately 100 feet while the additional utility person tried to maintain enough slack for the victim to unhook the cable. When the additional utility person realized he was about to back into the loaded rail cars parked on the third track, he stopped the loader. The rail car continued to roll past the loader. When the slack in the cable was taken up abruptly, the side of the loader bucket was jerked against the rail car, crushing the victim.

The accident occurred on the surface near the scales at the rail car load-out area. Three parallel sets of tracks served the load-out area. The first and second sets were joined by a switch near the scale. The scale and silos were adjacent to the second set of tracks. Empty cars were parked on the first track and towed to the silos, two at a time, by a front-end loader so both cars could be filled simultaneously. Loaded cars were towed over the scales, down the second track, then switched to the third track where they were parked.

The second track, where the accident occurred, sloped at a maximum of 1.56%. The first 24 feet of track dropped 3/4-inch per each 4 feet. The next 100 feet dropped 1/2-inch per each 4 feet. The track width was 60 inches. The distance between the first and second track varied but was 10-feet, 9-inches at the location of the accident. Cars were parked on the third track, approximately 100 feet from the scale.

The additional utility person summoned help and mine personnel administered CPR unsuccessfully. Emergency medical technicians transported the victim to a local hospital where he was pronounced dead on arrival. The immediate cause of death was respiratory arrest caused by a major chest crushing injury.

The rail car involved in the accident was a series 221 CSX hopper car with three compartments, each with a top hatch for bulk loading. It measured 50-feet, 9-inches long, and 10-feet, 8-inches wide and weighed 254,100 pounds when loaded. The rail car was loaded at the time of the accident and was on the second track.

Conclusion

The accident was caused by moving the rail cars with equipment not designed to be used for this purpose.

Edited from an MSHA accident investigation report by Fred Biglo.

When it comes to your skin, it's good to be in the dark...

Enlightening ways to avoid skin cancer

The two most common skin cancers are caused by cumulative ultraviolet exposure...not how much you had last summer, but how much over your lifetime. The lighter your skin, the less UV exposure it takes to cause a skin cancer. Whether you get your exposure from the sun or from a tanning salon, it's the same. It is recommended that SPF 15 to 30 be used—waterproof sunscreen which protects from both UVA and UVB rays. If you will be out for several hours, or in and out of water, re-apply the sunscreen often (see package instructions). Self-tanning lotions appear to be safe, but do not protect your skin from the sun. While a recent study questioned the utility of sun screens in preventing cancer, many others have shown its benefits. For now, both the American Academy of Dermatology and most dermatological practices strongly encourage its use.

And don't get burned! The most serious type of skin cancer, malignant melanoma, is thought to arise as a partial result of severe sun burns. The lighter your skin, the higher your risk. Other factors which increase your risk are a family history of melanoma or the presence of large numbers of moles. If you have a new or changing mole, or one which shows assymmetry, an irregular border, differences in color within the mole, or is larger than 6mm (the size of a pencil eraser), it should be checked by a dermatologist as soon as possible. If you have moles, you should perform a monthly self-examination to look for change.

If you already have had a skin cancer or pre-cancer, see the table above right for general guidelines for regular follow-up (individual follow-up may vary).

Basal cell
4 months after initial treatmert, then every 6 months
Squamous cell
4 months after initial treatment, then every 6 months
Melanoma
Every 4 months for 3 years, then every 6 months
Actinic keratoses (pre-cancer)
Every 6-12 months

Skin cancer facts and prevention

1. Half of all new cancers are skin cancers.

2. About one million new cases of skin cancer will be diagnosed in the United States each year.

3. 80% of the new skin cancers will be basal cell cancer, 16% squamous cell carcinoma, and 4% melanoma.

4. Both basal cell carcinoma and squamous cell carcinoma have a better than 95% cure rate if detected and treated early.

5. There will be 41,600 new cases of malignant melanoma in 1998, a 3% increase from 1997.

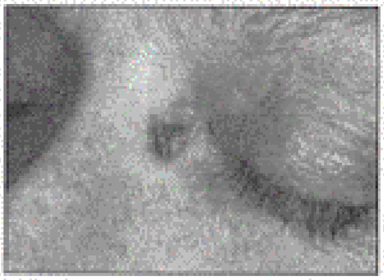
6. In 1998, 7,300 deaths will be attributed to malignant melanoma. Of these deaths, 4,600 will be men, 2,700 women. Older Caucasion males have the highest mortality rates

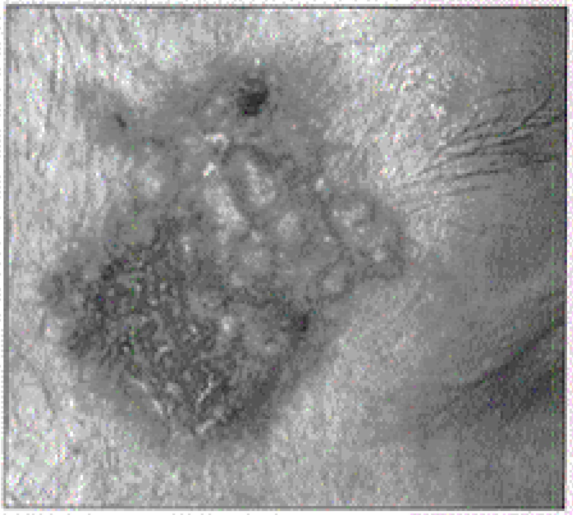
7. The incidence of malignant melanoma doubled among whites between 1973 and 1991.

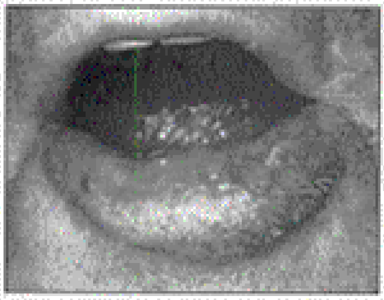
8. Six out of 7 skin cancer deaths are from malignant melanoma.

9. Melanoma is more common than any non-skin cancer among people between 25 and 29 years old.

Source: American Cancer Society—1998 Projections







The top three photos are good visual examples of basal cell carcinoma. The upper photo also portrays the large (greater than 6mm) irregular shape that is another of the signs that a physician should be seen as soon as possible. The bottom photo is an example of squamous cell carcinoma.

For some relatives and friends of missing miners, the grim vigil outside the Monongah mines would last for two weeks after the explosion. But for most, the wait ended in less than five days, and always with bad news. Snow, rain and sleet frequently fell on the waiting crowd.

America's worst mine disaster...

At 10:28 a.m., the earth shook and at least 362 men perished

By Sam Stafford, Editor, Mine Safety and Health magazine which ceased publishing in 1982

For Lester Trader, it had been an exhausting but routine night's work.

He had entered the Fairmont Coal Co.'s No. 6 mine near Monongah, W. Va., at 6 p.m. on Thursday, Dec. 5, 1907, and for much of the next 12 hours had walked and crawled through miles of underground passages checking for potentially dangerous accumulations of "marsh gas" or methane with a Wolfe flame safety lamp.

Although Trader, a 22-year-old fire boss, usually was alone in the mine at night, he was far from lonely. One of his duties was to sprinkle down excess coal dust in haulageways using a horse-drawn water cart. In the dark emptiness of the mine, the horse's presence was somehow comforting. Then, too, there were the rats. Hundreds of rats, some the size of cats, which functioned as efficient garbage collectors since they subsisted entirely on food discarded by the more than 360 miners on the day shift. Over the months, Trader had made pets of several rats that regularly hung around his shack waiting to be fed by hand when he returned after touring the mine.

On this night, as on most others, Trader had to crawl over big chunks of newly fallen slate to test for gas. He had long since come to terms with the hazards of the job, but the sight of a new slate fall in an area where he normally worked still sent a chill through him. Once in an abandoned working he had been appalled to find a newly fallen slab of slate nearly 50 feet long, 20 feet wide and three feet thick.

Using his flame safety lamp, Trader carefully tested for gas at each working area, leaving evidence of his visit at the face. On more than one occasion, he had found large accumulations of methane in areas of No. 6 which seldom showed more than traces of gas. But whether he found sizeable gas accumulations or the traces he routinely detected in corners of some headings, his findings were prominently marked on the board at the mine's mouth at the end of the shift. Day shift workmen were not allowed to enter areas containing gas until it had been removed by building canvas or wood brattices to divert the air flow.

Returning to the shanty after his next-to-last tour, Trader found his thoughts turning to the letter he was composing to his father who lived in McKeesport, Pa.

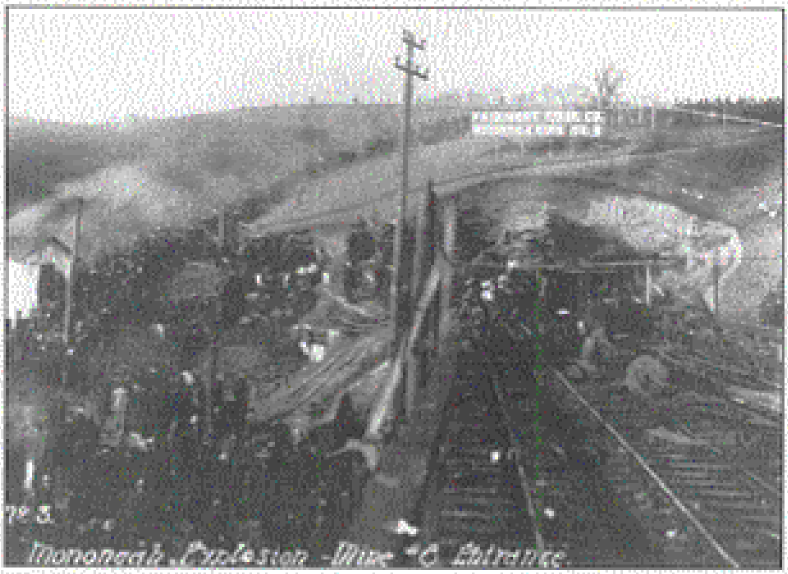
Less than a week before, 34 miners had been killed when the Naomi coal mine at Fayette City, Pa., "let go." The explosion was much on the minds of miners and their relatives in all coal regions. Trader and others could not help dwelling on similarities between the Naomi mine and Fairmont's Monongah Nos. 6 and 8 mines, which were connected. Mine layouts and working principles were the same at the three mines. Control of gas and coal dust were serious problems both at the Naomi and Monongah mines. And the expanding workforces in both areas included a high percentage of relatively inexperienced miners.

On Dec. 3, Trader had written what he conceived to be a reassuring letter to his father:

"It used to make the shivers run through me to read the news accounts of a mine horror," the letter read, "but since I have been in the mines and see into all the little details…, it has lost a great part of the horror for me, and the small, everyday accidents are more to be feared in my estimation than an extended explosion."

Now, a few hours before dawn on Dec. 6, 1907, in the wan shanty light, Trader again set forth his thoughts on the Naomi disaster and explosions in general for his father on a lined notepad. "The great damage in a mine is not done so much by the force of the explosion except where a dust explosion happens immediately after a gas explosion, but by the concussion . . . where a dust explosion takes place, there is a quick flash throughout the mine or a series of flashes . . ."

Finishing his shift at 6 a.m., Trader walked out of the mine and entered his findings on the board at the mouth. Traces of gas at several locations. An average night's report. At the same time, similar entries were being recorded for the No. 8



Onlookers examine wreckage at the entrance to Monongah mine No. 8. The two mines that blew up on Dec. 6, 1907 did not resume full operation until February 1908.

mine. During the next few hours, Trader cleaned up, mailed his letter, and had a leisurely breakfast. Then, suddenly weary, he climbed into bed.

By then, the men of the day shift were at work deep in Nos. 6 and 8 mines. They had trudged down the slopes wearing cloth caps with the attached open carbide burning lamps of the period, 366 of them, including many not yet old enough to shave, lunch pails swinging, shovels dangling from picks carried over their shoulders.

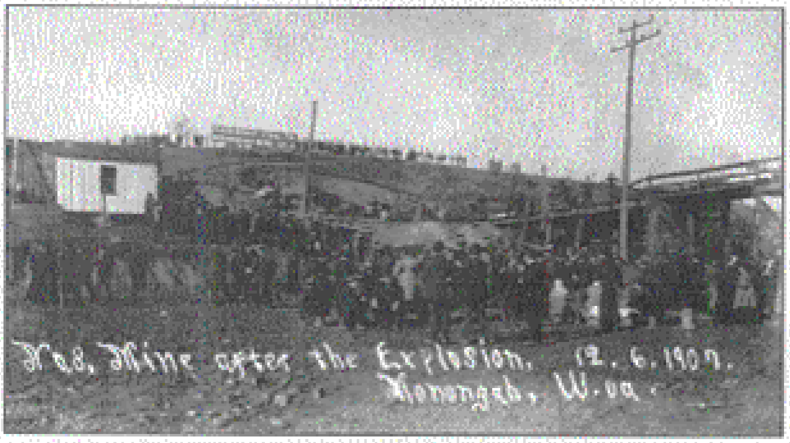
As they entered the mines, they conversed in Polish, Czech, Russian, Italian, Serbian, Croatian and other languages, and in the accents of West Virginia and western Pennsylvania. They were poorly paid even by standards of the region, and many nursed deep resentments that went beyond pay rates and working conditions. Before the most recent pay day, rumors had spread that foremen and fire bosses would be paid in cash but that miners would receive "paper"— promissory certificates which some shopkeepers in Monongah and nearby Fairmont previously had refused to honor. Many of the miners had tried to withdraw the small sums they had in a local bank only to be told they had to give three weeks' notice before making withdrawals. The rumors had proved unfounded.

The previous day, the mines had unaccountably been shut down. As had happened before, the company had not announced the closing until all men were in the mines. Most bitter were those men who had walked as far as three miles through the snow to get to work.

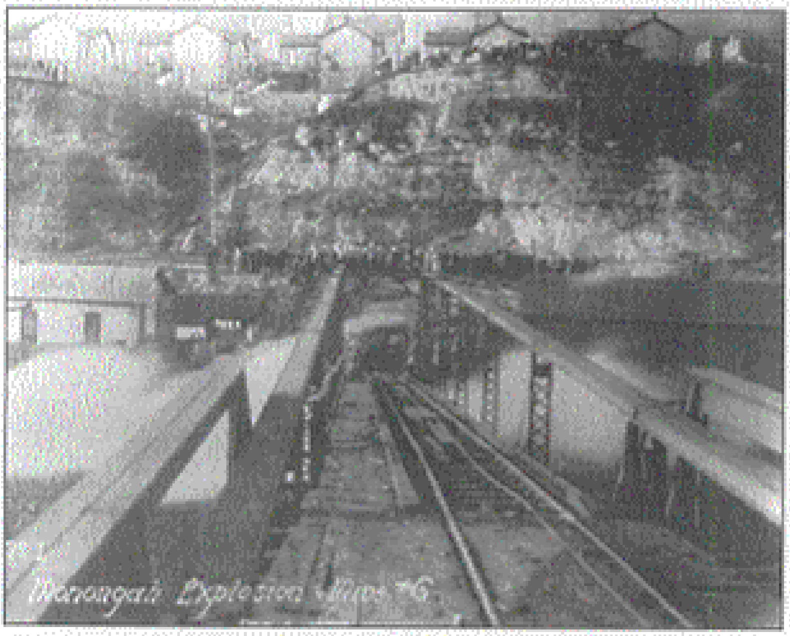
It was now 10 a.m. Above ground, wives made plans for Christmas, children recited school lessons, the B & O train rumbled through the West Fork River Valley. The sky was cloudless blue, the fitful breeze cold and dry. In the mines, two foremen, three fire bosses, 79 motormen, drivers, trackmen, timbermen, slatemen and other "day men" and 282 machinemen and loaders were at work. And there was one other— an outsider who had entered the mine to sell the men insurance. This was the official count of people in the mines at the time— 367; later, it would be claimed that the figure had been much higher.

Dec. 6, 1907, Doomsday, if they could have read the future.

The explosions ripped through the mines at 10:28 am, causing the earth to shake as far as eight miles



The somber still crowd quietly begins their agonizing vigil around Mine No. 8.



A second equally somber crowd gathered around Mine No. 6.

The wreckage of the fan and fan house around Mine No. 8.

away, shattering buildings and pavement, hurling people and horses violently to the ground and knocking streetcars off their rails.

Lester Trader, at the age of 93 and living in McKeesport, Pa., vividly recalled the awful moment.

"The first thump seemed to lift the whole house," he said. "It bounced the bed around, broke dishes, and we later found it had loosened bricks in the chimney. I jumped out of bed and before I could get out of the room there was another thump. I ran to the front door and looked toward the mine half a mile away. When I saw debris flying out of the fan house roof at No. 6, I knew what had happened..."

As a pall of soot descended on mines and town, horror-stricken relatives of miners and townspeople hurried toward the mine mouths. Soon afterward, their hopes were buoyed when four miners emerged through an outcrop opening—dazed, bleeding but with all limbs intact. But the stunned survivors could tell nothing of the fate of others still underground.

Trader was inside the mine less than 25 minutes after the explosion. He had been told that a trip of loaded coal cars had broken loose after reaching the knuckle of the No. 6 slope, then careened 1,200 feet to the bottom, where they piled up blocking the entry. Those who had heard the ominous rumble of the runaway cars said the wreck had occurred about the same time as the explosion,

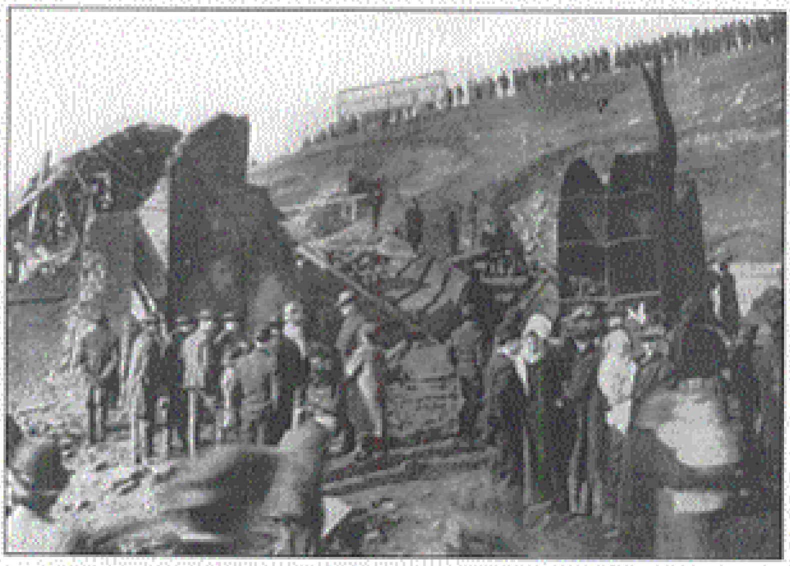
With Pete McGraw, another fire boss, he followed an air current down the No. 6 slope in an attempt to reach friends who worked at the bottom near the site of the wrecked coal cars. At the bottom, they found the bodies of motorman Fred Cooper, brakeman John Herman and a slope tender.

"Everything was coated with coal dust," Trader recalled. "It must have been the concussion because they had died instantly and hadn't been burned or even scratched.

"Fred Cooper laid on his back with his head to the door. Apparently, some time after he had died the muscles in his jaw relaxed and his mouth flew open. There was John Herman sitting on the bench on the other side of the shanty with his lunch bucket between his legs and his hands and head hanging down. I pushed his head back and coffee run off his lower lip. He had been drinking coffee when the thing hit . . ."

Choking coal dust, rubble and wrecked equipment impeded the progress of volunteer rescue teams. The No. 8 mine's huge ventilation fan had been destroyed, and a smaller fan was used to ventilate both mines. Brick brattices, the partitions used to direct air through the mines, had been blown out. As rescue parties slowly advanced, they built canvas curtains to restore ventilation, dilute gas and disperse dust.

Noon passed ... 2 p.m.... 3 ... still no news, good or bad, for wives, sweethearts, parents, children and other relatives of the missing men. But at 4 p.m., moaning was heard near a crop hole, and a rescuer was lowered through the hole on a rope. About 100 feet below, he found miner Peter Urban sitting on the shattered body of his brother, Stanislaus, staring glassy-eyed into space as he sobbed uncontrollably. Brought to the surface, Urban broke away from rescuers, bolted down a hill and crashed head-on into a fence. Though he later returned to work, the horror he had seen dominated Peter Urban's thoughts. He survived only to die in another mine accident.

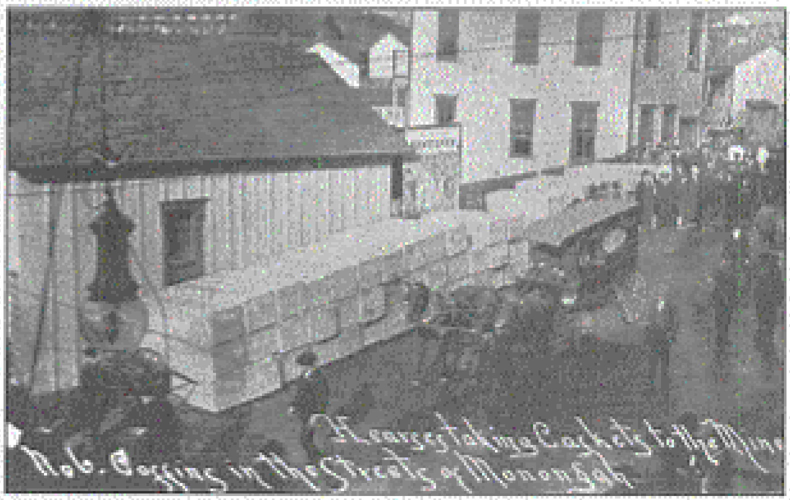


It was a night punctuated by tears and prayers, sudden shrieks, the wailing of women and children as shaken searchers brought canvas-shrouded bodies and fragments of bodies out of the mines. An icy, endless night, desolate beyond imagining.

Above: Volunteers worked under almost unbearable conditions in the mines during the search for victims and aided in recovery work above ground in any way they could following the explosion.
Far left, top: The remains of miners were wrapped in cloth and taken by wagon to a bank.
Center: Relatives were let into the bank (temporary morgue) a few at a time to identify victims.
Bottom: Coffins outside of bank

The remains and all personal effects found on bodies were tagged and numbered. Entry by entry, the list grew. Stanislaus Urban…, Carmen Zeoli… Michael Sabak…, Joseph Toth…, John Gomerczak…, Andy Stich…, J. A. Fluharty…, Luigi Feola …, John Ringer…, Mike Banyaezki…, Antonio Silleto… By noon the next day, 80 bodies, including some so badly mangled that they could not be positively identified, had been recovered.

Exhausted volunteers found conditions in the mines almost unbearable. Heat was intense. Eye-stinging afterdamp—the mix of gases left after the explosion—caused headaches and nausea. In some headings, ventilation materials and bodies had to be hauled 3,000 feet over massive roof falls and tangled machinery, mine cars, timbers and electrical wiring. In main haulways, bodies of men, horses and mules had been blown to pieces. The stench of death was barely tolerable



at the beginning, and became overpowering as the search dragged on.

A Pittsburgh newspaper reported that bodies and fragments of dozens of "strong-hearted breadwinners" had been found "in all conceivable shapes and positions" in one mine chamber.

"Hands and arms were lying around the chamber," the account continued."Bodies that had not been blown to bits were charred and burned beyond recognition."

Embalmers worked around the clock in shifts. Rough caskets lined both sides of Monongah's main street. A bank served as a morgue. Local churches conducted services several times a day as dozens of men dug long rows of graves in the nearby hills. Disputes flared over identification of victims. More than once, a body was claimed by two families.

For two days, a small, dark-haired woman waited near the mouth of No. 6 mine holding half a dozen carnations tied with a white ribbon. On Monday, she wordlessly handed the flowers to a searcher who had found her husband's body and went home.

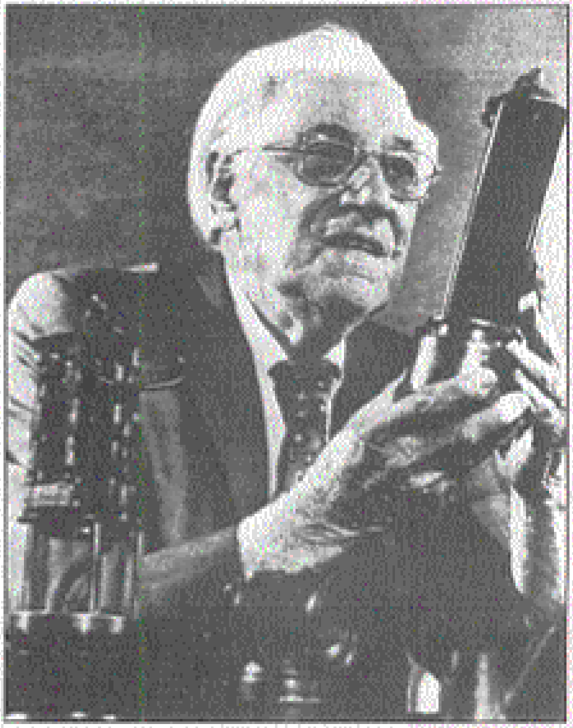
By Tuesday, the body count had passed 175, and it was obvious to most searchers—if not to relatives of men who were still missing—that Peter Urban would be the last man of the doomed shift to be brought out alive. By Thursday, Dec. 12, all workings had been ventilated and searched and 337 bodies recovered. One victim was Lester Trader's cousin, Harold Trader. Twenty five more victims were found during later cleanup operations.

The Monongah explosion was America's worst mining disaster in terms of lives lost, according to the Bureau of Mines' recorded toll—362. The second worst disaster took 263 lives in Dawson, N.M., in 1913. There is a strong possibility that the actual toll at Monongah was closer to 400 than to the 362 recorded. Miners listed as employees on Fairmont Coal Co. records were allowed to pay their own helpers without registering them with the company. Some miners did so and such helpers could have been in the mines on Dec. 6, though not listed as missing for the record. Difficulties in assembling parts of bodies for burial also could have lead to discrepancies. It is inconceivable, however, that a large number of men could have died in the mine without being reported missing by someone on the outside. For this reason, claims in some historical accounts that as many as 500 died in the tragedy have largely been discounted.

Groups of mine inspectors from West Virginia, Pennsylvania and Ohio made separate investigations, but failed to agree on either the point of origin or cause of the initial blast.

Ten out of 12 West Virginia state inspectors attributed the explosion to either ignition of methane gas by a machineman working in No. 8 or ignition of suspended coal dust in a different part of the same mine by a "blown-out shot" caused by a miner's careless use of black powder in "shooting out" coal. They concluded that the wreck of 15 loaded coal cars at the bottom of the No. 6 slope had nothing to do with the explosion.

Two other West Virginia inspectors, however, thought the first of a series of explosions that wracked the mines had occurred when a cloud of coal dust stirred up by the



Onetime Monongah mine fire boss Lester Trader examining an early flame safety lamp.

"Extreme peril..."

Use of early flame safety lamps like the one used by fire boss Lester Trader in the accompanying article represented a great advance in gas detection and dispersal in coal mines. Bureau of Mines files offer this chilling picture of the process in pre-safety-lamp times:

"...The presence of firedamp (methane) was ascertained by the miner creeping cautiously forward, holding a lamp or candle... and screening the flame with two forefingers, keeping his eye intently fixed on the top of the light. As he reaches the explosive compound, the flame begins to elongate and assume a color of greyish blue. He... slowly raises his light toward the roof where the firedamp floats. The flame now elongates into a sharp spire, changing to... a pure fine blue and giving off minute luminous sparks.

"This is the extreme point of danger—a sudden movement of the body or a quick lowering of the lamp would cause an explosion. The miner lowers the lamp with great caution, and extinguishes the flame."

Sometimes the gas was fired by means of a "firing line." A lamp or candle was attached to a cord, and the cord passed over a wheel at the face. The miner retreated a safe distance drawing on the cord to pull the light into the gas and explode it. A miner often would wrap himself in a wet jacket, and stretching flat on the floor would raise the light to explode the gas over his head. In France, this person sometimes was called the "penitent" because his head was covered by a mask that resembled a monk's cowl.

Coroner's inquest posing for time lapse photo, Jan. 11, 1908 (the white blobs are due to outside sun light through two windows).

Miner Peter Urban was brought out of a heading dazed but unharmed. Driven almost mad by the horror he had seen, he later died in another mine accident.

impact of the wreck in No. 6 was ignited by either an open burning cap lamp or short-circuited electrical wires ripped down by the runaway coal cars.

Ohio state inspectors decided that the explosion could have occurred in either mine and been set off by either a miner's lamp or a blown-out shot. They were critical of the company for its mining system ("Seven parallel main headings… acted as storage chambers for dust") and for connecting the two mines for ventilation reasons ("doubling the number of dead…").

The Pennsylvania inspectors attributed the explosion to ignition of dust during blasting of coal in No. 8. Their report, submitted to the Coroner's jury, but not made part of the record, also commented on the dangers of operating connecting mines, and was critical of coal blasting practices and dusty conditions at Fairmont's Nos. 6 and 8.

A Marion County Coroner's Jury heard numerous witnesses, including fire boss Lester Trader, then returned a finding that victims of the disaster "came to their deaths . . . by means of an explosion in Monongah mines Nos. 6 and 8 which was caused by either what is known as a blown-out shot or by ignition and explosion of powder in Mine No. 8.

We further find from the evidence that the traces of gas in these mines were slight and not considered dangerous, and that dust which was created was removed or kept watered down as far as was deemed practical, and that in operating these mines, the company complied with the mining laws of the state."

Lester Trader holds a distinctly different view of dust control practices in the Monongah mines in 1907.

"The fire boss was the sprinkler," he recalled, "and we wet down down the dust where we could, which wasn't much. Of all the damn crazy ideas. How much of a mine do you think one man with a horse and water cart can sprinkle in one night … You can only make about six trips a night…"

He added, "Another thing, we wet down the headings, but the heavy dust was in the rooms where the heat was, and they never got around to sprinkling the rooms.

Some of those mines was pure dust. They used those electric chain-driven mining machines. Here come a pick point this way and a pick point that way and a scraper here and a scraper there and you'd stand 10 feet away and you couldn't see a man's face for the dust, just a little yellow flame where his head was…, and he'd get down on his knees with a shovel and shove the dust away. Talk about black lung… I don't know how those fellows ever stood it…"

Trader strongly disagrees with findings of the Coroner's Jury, and believes that vital facts which were common knowledge in the mines were glossed over during the inquest.

He is convinced that the first explosion was the direct result of the coal car wreck in No. 6 mine, rather than of sloppy blasting of coal with black powder in No. 8. And he believes that sparks produced by grinding metal as the coal cars piled up—rather than shortcircuited electrical wires—caused a huge cloud of coal dust stirred up by the impact to ignite.

"It wasn't the first time there had been a wreck like this," Trader said."Pins on couplings were always breaking. Friday was always coupling day in the repair shop. Only three weeks before, a pin broke and four empty coal cars ran down the slope of No. 6 and smashed up in exactly the same place.

"They skidded along and kicked up an awful dust storm. Sparks from the ironwork set the thing on fire so that a great ball of fire rolled down the headings, but it burned itself out. I smelled smoke and went down there and I found pieces of wood and rags still smouldering."

He believes that much the same thing happened on Dec. 6.

"The wreck and the explosion were almost simultaneous," Trader said, "and that's too much of a coincidence for me. There was evidence that a burning ball of coal dust rolled from the switchback heading out into the main heading."

Why had the fireball in No. 6 flared through the mines setting off further explosions of dust, gas and blasting powder as it gained force? Why had it not burned itself out as the burning dust cloud had done after the wreck three weeks earlier?

The answer, he believes, may lie in a finding that never became part of the hearing record.

"Two nights before the (Dec. 6) explosion," Trader said, "I went up to a maintenance shack about 900 feet from the site of the wrecked cars to get some nails. On a shelf was a 50-pound box of dynamite, with the lid off. Several sticks had been capped and fused and laid on the box with the ends exposed.

"I told a supervisor about it later. I didn't go back there until after the explosion. I later found out that a crew had been ready to shoot down some overhanging slate, but nobody had brought around cars to load the slate in so they had put the dynamite back and left. After the explosion, I checked back and found the dynamite had gone off with terrific force tearing a big hole in the slate floor and demolishing everything nearby.

"They didn't even check on that until after the inquest. Maybe the fireball after the wreck would have continued through the mines on its own and not burned out. But many of us felt that when the dynamite went off, it made a general explosion certain."

For years, Trader has appealed to individuals and agencies to "set the record straight," but hardly anyone has shown interest in the long-ago event.

Between Dec. 1 and Dec. 19, 1907, four coal mine explosions killed 692 men. They were: Naomi mine, 34 dead; Monongah mines, 362 dead; Yolande mine, Yolande, Ala., 57 dead; and Darr mine, Jacobs Creek, Pa., 239 dead.

The shocking events of Bloody December 1907 focused national attention on the appalling hazards and working conditions in America's mines. In May 1910, the fi rst Federal mining safety laws were passed and the Bureau of Mines was created.

Under Dr. Joseph A. Holmes, its first director, the Bureau launched an intensive safety research program into explosives uses, particularly, into the advantages of using "permissible" flameless explosives in blasting, and worked to improve dust control methods and mine rescue devices and procedures.

On Halloween night in 1911, before 1,500 persons, Holmes personally set off an earth-shattering explosion at the Bureau's experimental mine in Bruceton, Pa., proving once and for all to remaining skeptics that ordinary coal dust by itself, virtually free of methane, has enormous explosive qualities.

Photos for this article were graciously supplied by Jane Demarchi at MSHA's National Mine Academy.

Although this year's WINTER ALERT campaign has ended... DON'T LET UP ON SAFETY!!!

THE LAST WORD...

I do not like work even when someone else does it.—Mark Twain

Better an ugly face than an ugly mind.—James Ellis

Tact: the ability to describe others as they see themselves.—Abraham Lincoln

Ye shall know the truth, and the truth shall make you mad.—Aldous Huxley

Without tact you can learn nothing.—Benjamin Disraeli

Human kindness has never weakened the stamina or softened the fiber of a free people. A nation does not have to be cruel in order to be tough.—Franklin Delano Roosevelt

Perplexity is the beginning of knowledge.—Kahlil Gibran

The lust of fame is the last that a wise man shakes off.—Tacitus

One meets his destiny often in the road he takes to avoid it.—French Proverb

Beauty is the first present nature gives to women and the first it takes away.—George Brossin Méré

NOTICE: We welcome any materials that you submit to the Holmes Safety Association Bulletin. For more information visit the MSHA Home Page at www.msha.gov. We **DESPERATELY** need color photographs suitable for use on the front cover of the ***Bulletin.*** We cannot guarantee that they will be published, but if they are, we will list the contributor(s). Please let us know what you would like to see more of, or less of, in the Bulletin.

REMINDER: The District Council Safety Competition for 1999 is underway—please remember that if you are participating this year, you need to mail your quarterly report to:

Mine Safety & Health Administration
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Holmes Safety Association Bulletin
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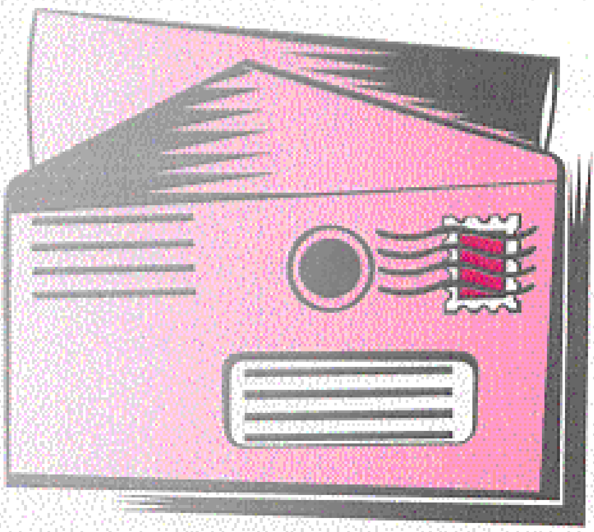

Please address any comments to the editor, Fred Bigio, at the above address or at: MSHA—US DOL, 5th floor—EPD #535A, 4015 Wilson Blvd., Arlington, VA 22203-1984.

Please phone us at (703-235-1400).

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We are short of articles on metal/quarry safety and welcome ***any*** *materials that you submit to the Holmes Safety Association Bulletin. We* ***DESPERATELY NEED*** *color photographs (8" x 10" glossy prints are preferred however, color negatives are acceptable—we will make the enlargements) for our covers. We* ***ALSO NEED*** *color or black and white photographs of general mining operations—underground or surface. We cannot guarantee that they will be published. If they are, we will credit the contributor(s) within the magazine. All submissions will be returned unless indicated.*

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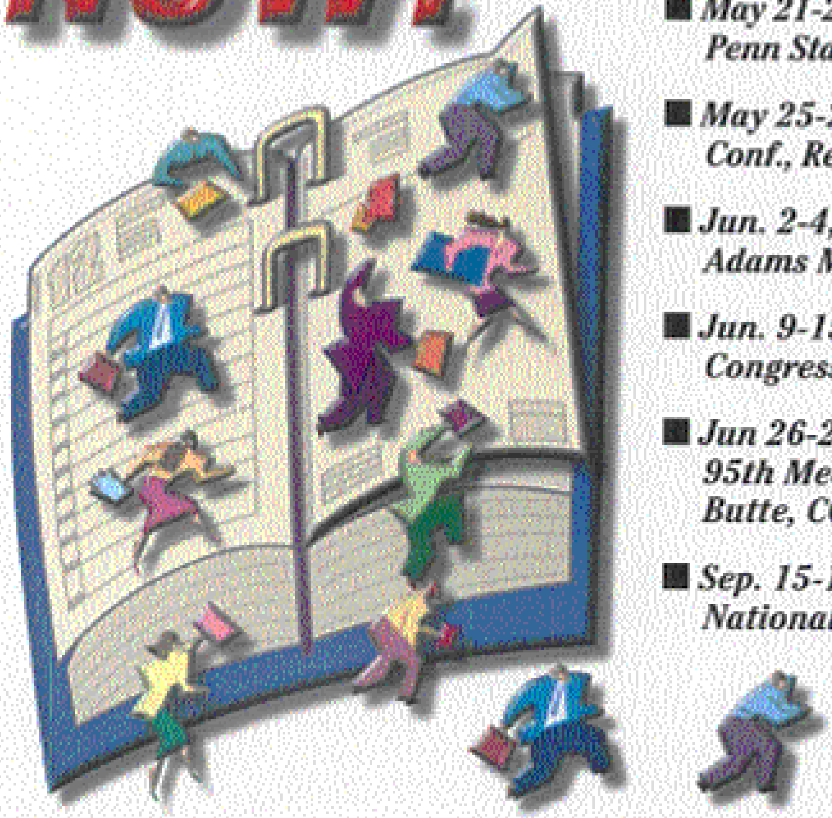

Upcoming events:

- *May 21-23, 4th Penn State Mineral Symp., Penn State Univ., State College, PA*
- *May 25-28, Calif. Mining Assoc.—'99 Annual Conf., Resort at Squaw Creek, Lake Tahoe, CA*
- *Jun. 2-4, JAHSA, HSA—Annual Meeting, Adams Mark Hotel, St. Louis, MO*
- *Jun. 9-15, MINETIME '99, 5th World Mining Congress, Dusseldorf, Germany*
- *Jun 26-29, Rocky Mtn. Coal Mining Inst—95th Meeting, Crested Butte Resort, Crested Butte, CO*
- *Sep. 15-17, Bluefield Coal Show, Brushfork National Guard Armory, Bluefield, WV*