Bureau of Mines

*A Bureau of Mines inspector investigating a mine blast with methane detector (right hand) and lamp.*

# Blast under Mannington

## Not enough law
## Not enough enforcement
## Not enough technology

For over 200 years, men have been going down into the coal mines of the land. Usually they come up.

When they don't, as 78 of 99 miners at Mannington, W. Va., didn't after a fire last month, the question is raised why such disasters continue to happen, and what is being done to prevent them.

**There may be** no final answer to the problem because of the nature of mining. But the evidence suggests that safety technology is antiquated and what measures have been developed aren't enforced by a Government hampered by inadequate funding and weak safety laws.

Every year the Bureau of Mines goes before Congress with a proposed budget, but between insufficient grants and bureau misjudgment of which areas are vital, the money has not gone around, and not enough safety equipment is on hand.

Senator Gaylord Nelson (D-Wis.), commenting on the disaster, complains that the bureau has not even enforced the laws it has. He points to the inspection record of the Mannington mine, which the Bureau of Mines inspected and passed in August after four violations were corrected. "I looked at all seven inspections since 1966," the Senator said. "The pattern runs the same: serious accumulations of coal dust and inadequate spraying of rock dust."

Rock dusting, a principal safety measure, is aimed at preventing a secondary coal dust explosion, which often follows the primary explosion of methane gas, the chief culprit in mine explosions. Coating the coal dust with a layer of rock dust, or ground limestone, acts to prevent the secondary explosion.

Nelson says the Mannington fire emphasizes the need of new coal mine safety legislation sent to Congress by President Johnson last September. The bill would increase penalties to mine owners who failed to observe the law, giving the bureau more power to enforce safety restrictions.

**The present** law provides for either minor fines or closing the mine, a drastic measure that is unpopular with miners as well as owners. Despite numerous safety violations at the Mannington mine, Sen. Nelson points out, "no mine closure penalties were ever invoked."

But legislation alone will not prevent mine disasters. It will take research into new methods and devices.

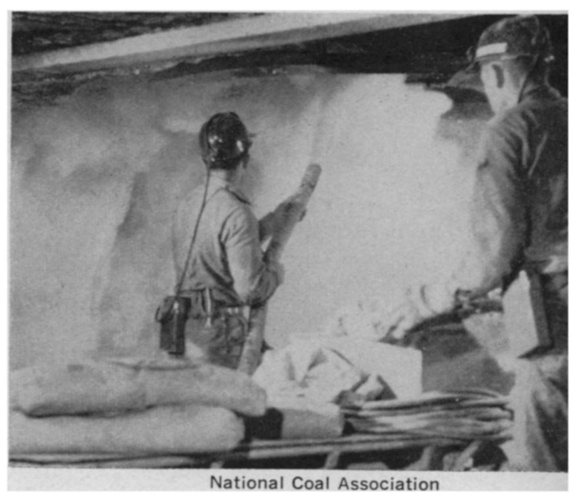
Besides rock dusting, one major preventive method is to avoid using flame-producing explosives. A flame explosion, such as from a black powder detonation, can rebound off the coal wall and ignite any methane present. Using dynamite is one way to eliminate this danger. The only legal method, and the most efficient, is to drill a hole in the rock for the charge and seal it with a clay plug. However, if this is not done correctly, the plug can be blasted out.

Most ignitions of methane at the drilling face are caused by sparks. Not all sparks will ignite a gas; those that can are called incendive. Incendive sparks can come from a drill striking iron, shale or sandstone in the coal wall.

The United States lags behind the British in research in this area. At the Health and Safety Research and Testing Center of the Bureau of Mines in Pittsburgh, however, research experiments are being conducted with water sprays, foams and lubrication of drilling tools to reduce spark intensity at the drilling face.

**It might** have been such a spark that triggered the Mannington explosion. The mine was gassy, meaning that substantial methane was present. Ten percent of the country's 5,400 underground mines are gassy. Secretary of the Interior Stewart L. Udall described working in the Mannington mine as "working in a low-grade gas field."

When a mine is classified as gassy, certain standard precautions automatically go into effect: electrical motors must be covered, only permissible or tested equipment can be used. Even



National Coal Association

*Miner uses rock dusting technique.*

so, an explosion could have been started by a drill creating a spark.

Another spark source is an electrical short circuit, which could come from a machine or a wheel cutting a wire. However, if voltage and current are kept low enough, sparks that start fires will not be produced. Although the Pittsburgh center is researching the design of such circuits and developing standards, applications are admittedly limited because most mining machines require high power.

Engineers in Pittsburgh are working to make an explosion quencher operational as soon as possible. It works by detecting the ultraviolet radiation in the first few milliseconds before the actual flame is seen and then explodes two metal troughs of potassium bicarbonate powder, which smothers the flame within 10 milliseconds. Moisture in the potassium carbonate and coal dust in the sensor are two potential trouble spots.

**Research at** the Pittsburgh center is also concerned with mine ventilation, one of the most critical safety areas.

Wind tunnel experiments are conducted to determine the effects of curves and obstructions, as well as the functioning of regulators, in preventing gas build-up and bringing in fresh air. A crucial research question is aimed at draining methane off in advance of mining to prevent an explosion.

At the Explosive Research Center, also in Pittsburgh, work is being done to determine the fundamental nature of explosions in general. Research there on flame propagation through methane layers, for example, may uncover a way to minimize future explosions.

As to what caused the Mannington explosion, safety engineers may never know. By the time investigators get down into the mine, fire will probably have wiped out all evidence.

**Although it is** the Manningtons that get the headlines, most of the 200 mining deaths each year are caused by scattered cave-ins. So far they are responsible for 85 deaths this year. Haulage, or machine deaths, was second with 31 deaths. Before Mannington, nine deaths had been caused by explosions. Since 1952, over 5,500 miners have been killed on the job and 250,000 seriously disabled. Latest figures show 109,709 underground coal miners in the country.

Research can provide some answers to the problem, but research depends on how much money Congress is willing to allot. Much will also depend on new legislation and its adequate application and enforcement. Unless action is immediate, the Mannington disaster—if it follows the usual pattern of previous mine disasters—will be buried and forgotten in the hills of West Virginia.

COSMIC RAYS

## New mysteries, not answers

Cosmic rays have been studied for fifty-odd years in the hope that they would reveal where in the universe they come from and what happens to them on the way. So far there is little certain information. And as new instruments, mainly on satellites, open up more areas to study, the result seems to be new mysteries instead of answers.

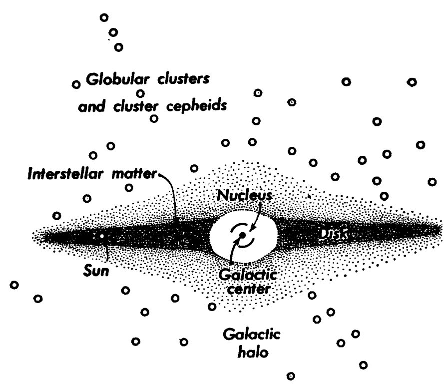
One new area, described at last week's American Physical Society meeting in Miami Beach by Prof. William L. Kraushaar of the University of Wisconsin, is that of high-energy gamma rays, in which each particle has an energy greater than 100 million electron volts.

**These rays,** as observations by a detector mounted on an orbiting solar observatory satellite show, are particularly bright in directions parallel to the plane of the galaxy, not only toward the center of the galaxy, but also in the opposite direction, the so-called anticenter. The question, according to Prof. Kraushaar, is why the galactic plane should be so hot in the production of these high-energy gammas. Tentative solutions try to explain this by finding something that could give rise to them and is already known to be heavily concentrated in the galactic plane.

One possibility is that the rays could be produced by collisions of other kinds of cosmic rays with the interstellar gas, known to be concentrated in clouds along the central plane of the galaxy. But the distribution of the gamma rays does not correlate very well with that of the gas. The discrepancy is about 10 percent.

**Another possible** source is interactions of electrons, also known to be there, either with light from the stars or the cosmic blackbody radio background. In either case collisions with electrons could raise these comparatively low energy photons to the high-energy gamma ray region. But there aren't enough electrons of the requisite energies—10 times too few for the blackbody radio, 100 times too few for the starlight.

Dr. Kraushaar's final suggestion, and one he rather favors, is that the gamma rays are produced by Bremsstrahlung, radiation emitted by the same electrons when they happen to be decelerated by the influence of other particles. But, objects Dr. Reuven Ramaty of the Goddard Space Flight Center, the Bremsstrahlung explanation requires many more electrons both toward the center of the galaxy and toward the anticenter than are known to be there.



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Dr. Ramaty's concern is where the electrons come from, and this too is a puzzle. He has studied them at all energies from one million electron volts to 300 billion electron volts. One can tell fairly well that they come from somewhere within the galaxy, he says. If they didn't—that is, if the whole universe were as full of electrons as we know the space near the earth is—then we would get far more cosmic X-rays.

Furthermore, the high-energy electrons must come from even closer, he says. The flux that should be arriving if the earth were seeing high-energy electrons from the whole galaxy does not appear, no matter which of the currently plausible models of the galaxy one uses. Dr. Ramaty concludes that the high-energy electrons cannot be produced all over the galactic disk. They must be local: less than half a million years old and from less than 1,500 light years away.

**Nearer sources** than had previously been supposed are also suggested for another cosmic ray component, atomic nuclei of low energy. These nuclei, with energy less than 200 million electron volts per particle, could not be studied until about two years ago, says Dr. John A. Simpson of the University of Chicago. In those two years, however, they have been looked at by satellites and probes going as far away as Mars.

The problem here is that the energies of these nuclei should fall off as one goes more and more toward elements whose neutrons greatly outnumber their protons. This decline had been calculated theoretically according to the amount of interstellar matter they should have passed through and other things that should have happened along the way. But observation does not show the energy falling off.

One way to get to what the observation shows, says Dr. Simpson, is to postulate two separate populations of cosmic ray nuclei—some that come from