A History of the U.S. Bureau of Mines, with Some Highlights of Its Involvement in Anthracite Mining

By L. Michael Kaas

The life span of the United States Bureau of Mines (USBM) was rather short. However, from 1910 to 1996, the bureau played an important role in the evolution of the U. S. mineral industry, and especially in the lives of its miners. This paper provides a concise look at the creation and ultimate demise of the bureau, discusses some of its many programs and contributions over the years, and mentions the bureau's involvement with Pennsylvania anthracite mining.

Mining Safety and the Creation of the USBM

Senator William Morris Stewart of Nevada first proposed creation of a bureau of mines in the Thirty-ninth Congress on 11 December 1865.[1] His idea was to foster the development of western mineral resources and to provide assistance to miners. However, eastern representatives were not sympathetic to the idea, and this and subsequent similar proposals went nowhere.

It took the deaths of 110 anthracite miners in the 6 September 1869 fire at the Avondale Colliery in Plymouth, Pennsylvania, to focus the public's attention on mining.[2] From 1839 to 1914, mining was indeed a very dangerous business. Over 53,000 coal miners were killed during that period of time.[3] In response to the deaths in the Avondale disaster, the Commonwealth of Pennsylvania created the first inspection law for anthracite mines in 1870. The law was extended to Pennsylvania's bituminous coal mines in 1878. Other states followed suit with their own laws and through the 1870s the horrific rate of fatalities in coal mines began to decline.

The USBM published the first comprehensive U.S. mine safety statistics in 1916 (Figure 1). From 1870, coal production climbed steadily, reaching 570 million tons in 1913. Anthracite accounted for 92 million of that total tonnage. As production increased, so did the number of fatalities. Unfortunately, after the initial reduction of the fatality rate from 1870 to 1880, little additional improvement occurred. In 1907, the number of coal mining fatalities spiked upward to 3,242, including 918 miners killed in eighteen major disasters. Once again, the carnage in the mines caught the public's attention.

In 1907, the secretary of the interior established the U.S. Geological Survey (USGS), Technologic Branch to improve mine safety, reduce fatalities, and test coal purchased by the government. In 1910, the Sixty-first Congress passed the Organic Act creating the USBM.[4] With a budget of $502,000 and a staff of 298, the bureau went into action. The USGS Technologic Branch was incorporated into the bureau in 1910. In 1913, amendments to the Organic Act expanded USBM's functions to include scientific investigations related to mineral processing, utilization, conservation, and economic development.[5] These two laws became the foundation of the bureau for the rest of its existence.

Dr. Joseph A. Holmes became the first director of the bureau. He had been the state geologist for North Carolina and the head of the USGS Technologic Branch. He would become recognized as one of the foremost champions of industrial safety, and his first job was to attack the

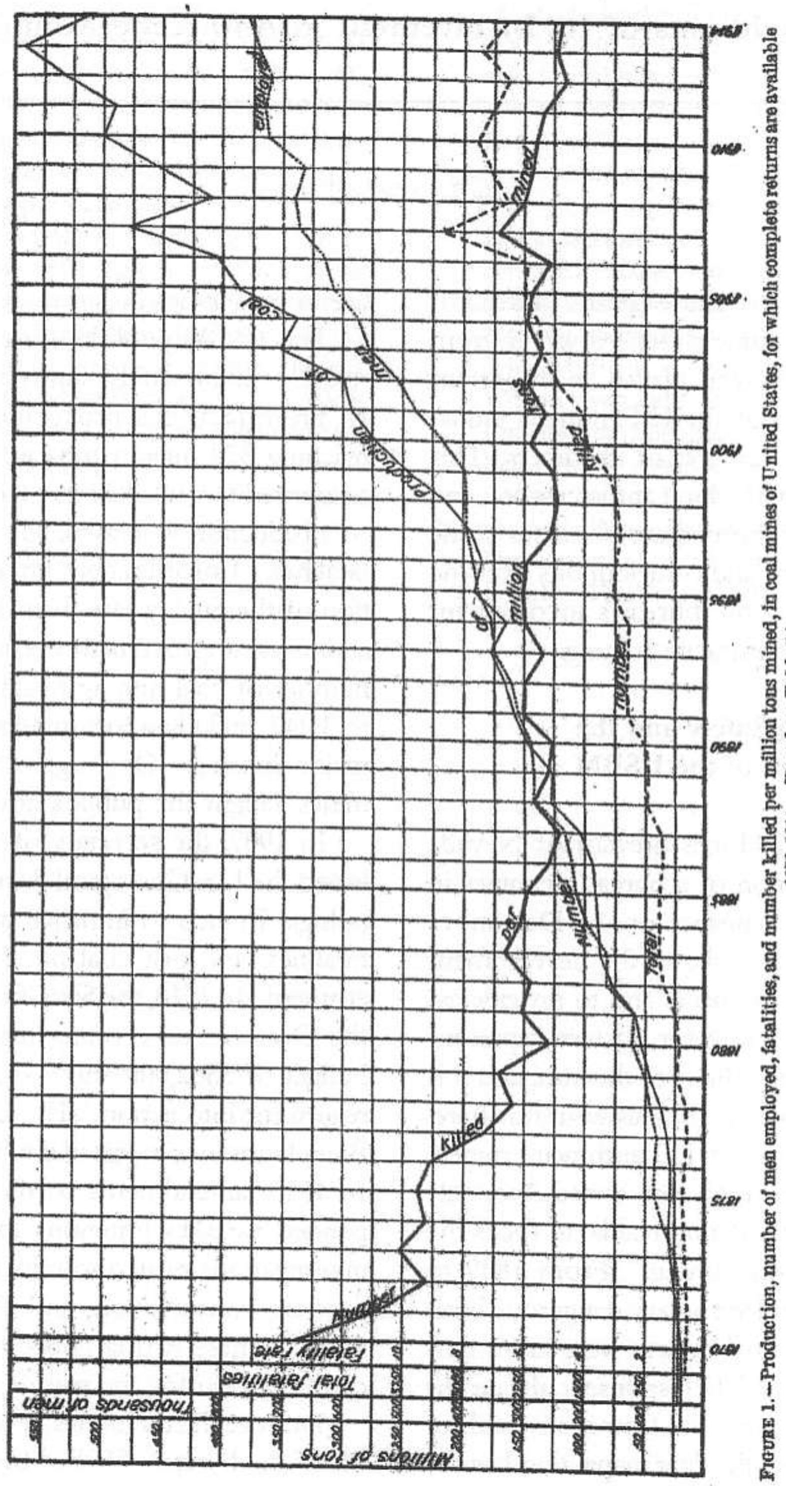


Figure 1. Coal Production, Employment, and Safety Statistics, 1870-1914 (Albert Fay, "Coal-Mine Fatalities in the United States, 1870-1914," USBM Bulletin 115, 21.)

mine safety problem. Historical statistics on mining accidents and fatalities collected by the bureau would help provide the support he needed for reforms.

From 1870 to 1913, over forty-nine thousand miners were killed, more than six thousand in mine disasters.[6] Although the deaths of miners in multi-fatality disasters caught the public's interest, most miners were killed one or two at a time, falling victim to a number of mining hazards and unsafe practices. Holmes' safety strategies included developing the ability to respond quickly to major disasters with mine rescue equipment and expertise, establishing safer mining methods, and training miners in mine rescue, first aid, and safe mining practices developed or endorsed by the bureau. The bureau conducted laboratory research on prevention of fires and explosions, improved mine rescue apparatus, safer permissible explosives, more effective roof support, and less hazardous mining lamps and electrical equipment.

The bureau operated six Mine Rescue Stations in important mining areas; however, many mines were located in remote areas. One of Holmes' most innovative ideas was to convert a fleet of wooden Pullman railroad cars into mine safety cars equipped with mine rescue equipment and a small technical staff (Figure 2). In the event of a disaster at a remote mine, a rescue car would be dispatched to the scene quickly. The railroads gave these cars top priority and transported them free of charge. Upon arriving at a disaster, bureau experts assisted in rescue efforts and examined evidence to determine the cause of the disaster. Their findings helped to guide research and training programs. Car No. 1 was initially located at Wilkes-Barre, Pennsylvania, in the anthracite region.[7]

When not involved in a disaster response, each mine safety car became a mobile classroom that offered demonstrations, lectures, and mine-

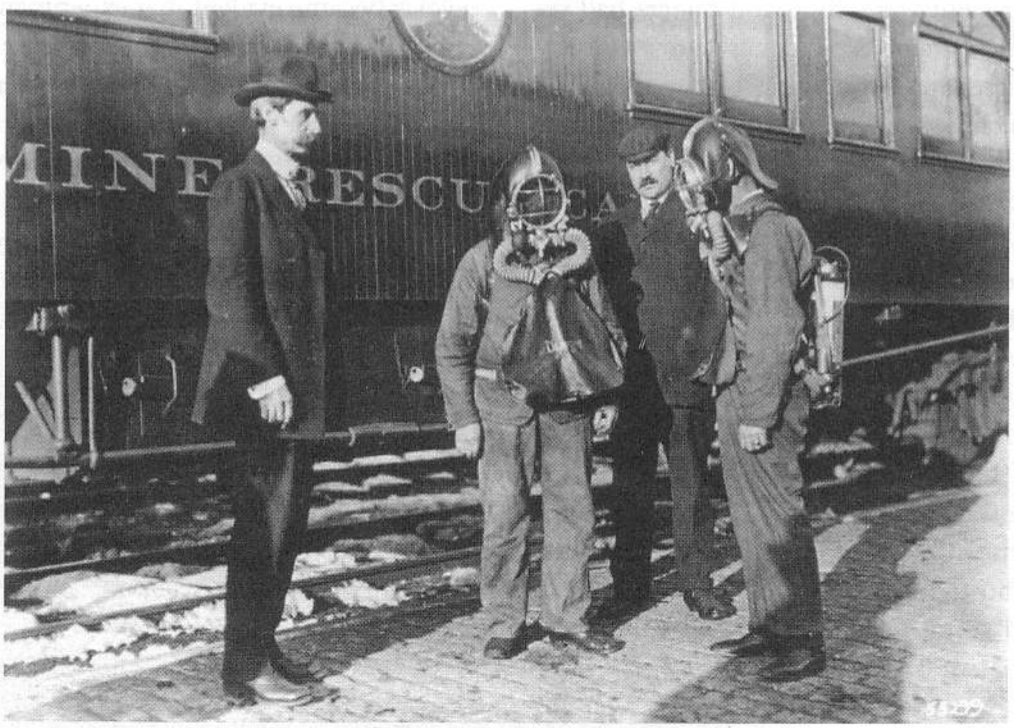


Figure 2. U.S. Bureau of Mines Director Joseph A. Holmes (left), mine rescuers, and a mine safety car. (USBM photo.)

Figure 3. President William Howard Taft and Bureau of Mines Director Joseph A. Holmes at the first mine rescue and safety contest, Forbes Field, Pittsburgh, Pennsylvania, 1911. (USBM photo.)

rescue and first-aid training classes. By June 1920, over eighty-nine thousand miners had received USBM training.[8] Holmes' safety strategy included creating local mine rescue corps or teams which could provide immediate disaster response. Contests were held to encourage the proficiency of the rescue teams. President William Howard Taft presented the awards at the first contest, held at Forbes Field in Pittsburgh in 1911 (Figure 3).[9]

Not every miner could attend bureau-conducted safety lectures or classes. To spread the message of "Safety First," the USBM developed scores of bulletins, miners' circulars, technical papers, and other publications on safety. Because of the influx of thousands of foreign coal miners who did not speak English, the bureau published some popular titles in several languages.[10] Most of these publications used photographs extensively to illustrate both safe mining techniques and how *not* to get the job done (Figure 4).

The bureau first conducted research at the Pittsburgh Arsenal site near downtown.[11] It quickly became evident that experiments involving large-scale dust and gas explosions were not suited for this urban laboratory. The bureau leased and later purchased a small tract of bituminous coal in rural Bruceton, Pennsylvania, and constructed the USBM Experimental Mine at the site (Figure 5). Early tests in the mine demonstrated the explosive hazards presented by coal dust as well as by methane gas. The bureau also did rescue training and explosives testing at the mine. Bruceton would eventually become the bureau's Pittsburgh Mining Research Center.

In 1915, Congress authorized the creation of several new Mines Experiment Stations and Mine Rescue Stations, greatly expanding the bureau's presence throughout the nation.[12] The first of the new experiment stations opened in 1919 in Pittsburgh, adjacent to what is now Carnegie Mellon University. By 1920, eleven Mines Experiment Stations, seven Mine Rescue Stations, and ten Mine Safety Cars were in operation.[13] By then, the bureau's budget had in-

Figure 4. A photograph from a USBM safety publication illustrating unsafe mining practices. (USBM photo.)

Figure 5. A test explosion at the USBM Experimental Mine, Bruceton, Pennsylvania. (USBM photo.)

creased to $1.3 million and its staff to 738. Joseph Holmes did not live to see these fruits of his labors, having died in 1915, but his "Safety First" slogan is still in common use, and the Joseph A. Holmes Safety Association was established in his honor and remains active today.

Early Anthracite Subsidence Study

One of the earliest USBM publications dealing specifically with anthracite mining was Bulletin 25, "Mining Conditions under the City of Scranton, Pa."[14] In its preface, Joseph Holmes noted that by early 1911, mining in the eleven anthracite beds beneath the city had removed 177 million tons of coal and 44 million tons of waste rock. But even this staggering amount represented only 30 percent of Scranton's coal reserves, and it was in both the local and national interest that as much of the remaining coal as possible be recovered without dangerous subsidence or excessive cost.

In 1909, mine subsidence had severely damaged a school, fortunately unoccupied at the time. This event raised concern for public safety and for the future of the anthracite mining industry. An advisory board was formed to recommend solutions to subsidence problems to local governmental bodies. Members of the board were well-known engineers: John Hayes Hammond, D. W. Brunton, R. A. F. Penrose, Lewis B. Stillwell, and W. A. Lathrop. The board suggested that William Griffith and Eli T. Conner conduct a consulting study. Both were considered well-qualified engineers with knowledge of mining and geology in the anthracite area.

The consultants made an extensive review of mining and geologic maps and other records, and inspected the underground mines. Their report estimated that 10 percent of the city was threatened by subsidence, including three additional schools. They included in their report detailed maps and geologic cross-sections showing the mines and coal seams under the city.

Griffith and Conner recommended that mine voids be filled by flushing with a mixture of water and sand or other solid materials such as culm (coal waste) or crushed rock, beginning with the most endangered areas. They also recommended that a general policy be adopted to support all mined areas under the city, and included bureau tests of fill materials in their report.

Between the Wars

While mining safety always remained a major thrust of the bureau, its programs also included research projects on extraction, conservation, and use of a host of energy, metallic, and non-metallic minerals. The results of these studies appear in countless bureau publications. The bureau began publishing mineral production statistics in the 1920s. Starting publication in 1932, the bureau's "Minerals Yearbook" became recognized worldwide as the authoritative source for minerals information.[15]

Its position as a major government scientific and research organization caused the bureau to become involved in some rather unusual endeavors. USBM extraction technology made lower-cost radium available to the medical community.[16] Experience with mine rescue equipment led to the development of gas masks for U.S. soldiers in World War I.[17] The bureau conducted investigations on explosives and minerals important to the war effort, including potash, graphite, manganese, aluminum, sulfur, petroleum, and helium. It investigated the amount and composition of motor vehicle exhaust gases expected to be present in the Holland Tunnel by conducting over a hundred road tests in a special circular tunnel at the Experimental Mine.[18] The bureau also evaluated the hazards of combustible anesthetic gases to prevent hospital operating room explosions or fires.[19] Continuing metallurgical research on recovery of precious metals by the bureau and other organizations laid the foundation for the rebirth of the U.S. gold industry in

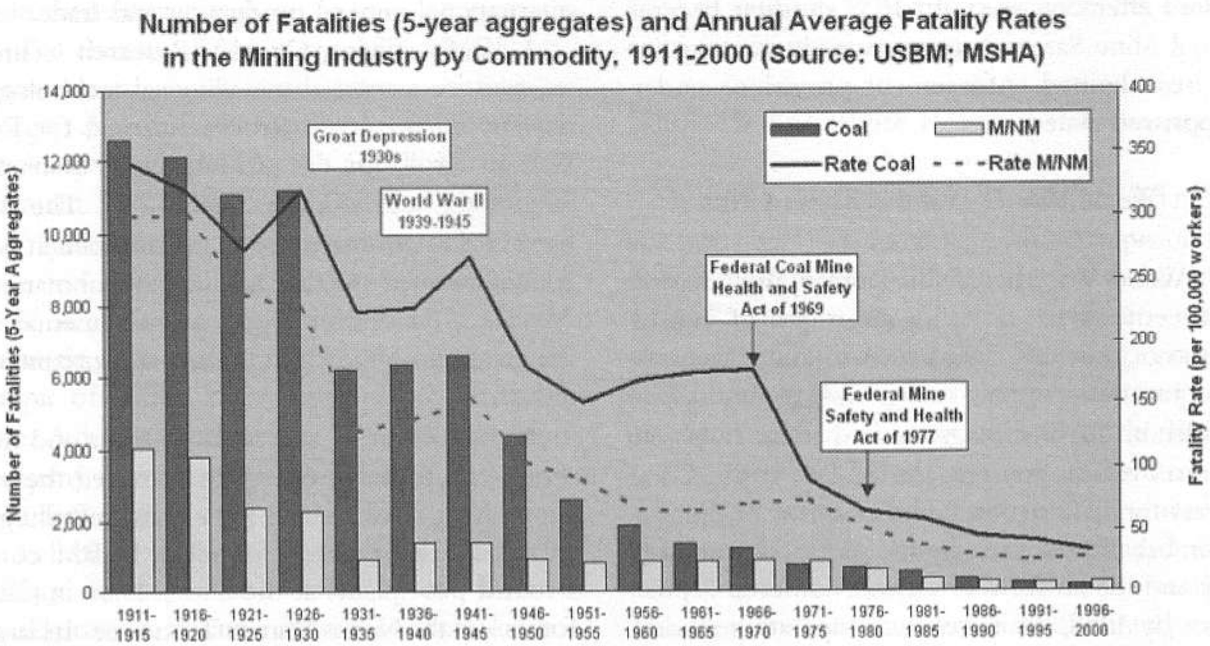


Figure 6. Number of Fatalities (in five-year aggregates) and Annual Average Fatality Rates in the Mining Industry by Commodity (National Institute of Occupational Safety and Health, www.cdc.gov)

the 1980s.[20]

With a new World War brewing in Europe, the 1939 Strategic Minerals Act directed the bureau to explore and develop strategic mineral resources on both public and privately-owned lands. The act stipulated that research be conducted on mining, preparation, treatment, and the utilization of ores essential to national defense and industrial needs. USBM engineers and geologists began a nationwide search for critical and strategic minerals.[21] Hundreds of deposits were evaluated. Many low-grade deposits were discovered, which posed challenges for engineers and metallurgists in the laboratories working on economic extraction methods. The assessment of mineral resources on public lands would continue to be an important function of the bureau until it closed.

With some exceptions during the Great Depression and World War II, fatality rates for coal and hard rock miners continued to improve throughout the 1920s, '30s, and '40s (Figure 6).[22] The contribution of USBM programs to saving the lives of thousands of miners is considered by many to be its greatest achievement. Other contributing factors included enforcement of state mine safety laws, pressure from organized labor for safer working conditions, and a growing awareness by management that "Safety First" was a good business practice.

In 1941, the Federal Coal Mine Inspection Act gave the USBM authority to enter coal mines, conduct periodic inspections, and gather data on safety and health conditions and on the causes of injuries, fatalities, and occupational diseases. In 1947, bituminous coal mine safety standards were adopted, and bureau inspectors were required to notify mine operators and state agencies about safety problems and to make recommendations for their remediation. But the bureau had no power to enforce correction of hazards and unsafe practices, and this law expired after one year. In 1952 the first Federal Coal Mine Safety Act was passed, granting the bureau limited enforcement provisions under approved state plans.

World War II and the Korean War

World War II and the Korean War created concerns about potential shortages of critical strategic minerals. Many essential minerals, such as chromium, cobalt, manganese, platinum, petroleum, tin, and tungsten, had to be obtained from overseas sources. In the late 1940s, Congress funded the development and scale-up of a number of processes designed to recover minerals and metals from low-grade domestic deposits. By 1950, the bureau was operating several demonstration projects and production-scale plants. It had also established a new Foreign Regional Office in Washington, D.C., to track international mineral production and trade.

USBM's Albany, Oregon, Research Center focused on advanced metallurgical technology, developing the Kroll Process, named for Dr. William Kroll, for the production of titanium, zirconium, and hafnium (Figure 7).[23] The Albany facility produced the zirconium used in the construction of the first U.S. nuclear submarine, *Nautilus*. This technology was instrumental in the creation of the U.S. titanium and zirconium industries.

Construction of several large dams and hydroelectric plants in the 1930s provided the inexpensive power needed for electro-metallurgical recovery of scarce metals. USBM constructed pilot plants at the Shasta Dam in California and the Norris Dam in Tennessee. Its largest installation was at Boulder City, Nevada, near Hoover Dam (Figure 8).[24] The Boulder City plants recovered chromium, manganese, tita-

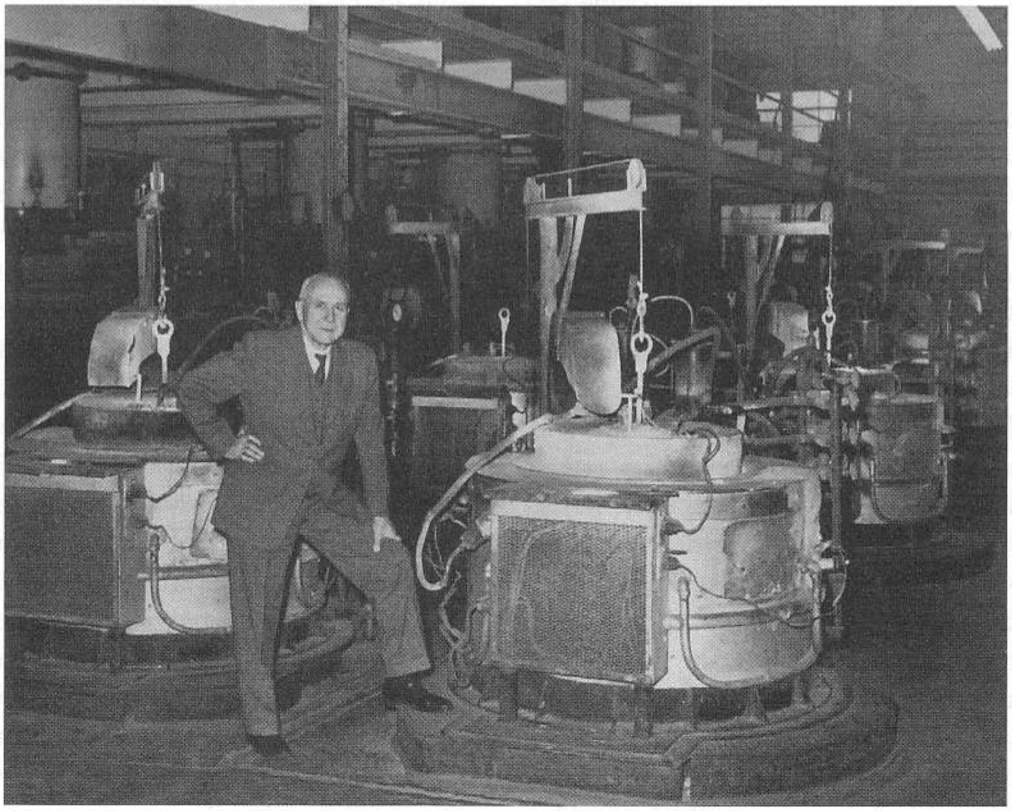


Figure 7. Dr. William J. Kroll in the USBM zirconium plant, Albany, Oregon. (USBM photo.)

nium, and other metals.

The Bureau of Mines conducted an underground coal gasification demonstration at Gorgas, Alabama. Production of gas from lignite coal was studied at the Grand Forks Experiment Station in North Dakota. Hydrogen and synthetic gas plants were operated at Bruceton, Pennsylvania.[25] Colorado's vast deposits of oil shale were recognized as an important domestic petroleum resource, and oil shale was a topic of bureau laboratory research for some time. A demonstration mine, retort, refinery, and company town were operated in Rifle, Colorado (Figure 9).[26]

Following the war years, most of the technology developed and tested by the bureau would prove to be uneconomic as soon as lower-cost minerals and materials from higher-grade foreign deposits became available on the world market. The bureau's advancements in the science of resource recovery remain on the shelf for future national emergencies.

USBM's Anthracite Research Laboratory

From a peak production of one hundred million tons in 1917, national anthracite production declined to forty-six million tons by the late 1930s.[27] The primary cause of this decline was competition from oil and gas. The energy needs of World War II caused a brief but only temporary increase in production. In 1942, the Federal Anthracite Commission recommended a number of steps to revitalize the Pennsylvania industry. These recommendations included establishing an Anthracite Research Laboratory. This agency would study methods of mining and processing designed to lower production costs and reduce the hazards of mine flooding. It would also develop technology to increase the

Figure 8. The USBM chromium (left, front), titanium (right, rear), and manganese (left, rear) electro-metallurgical plants at Boulder City, Nevada. (USBM photo.)

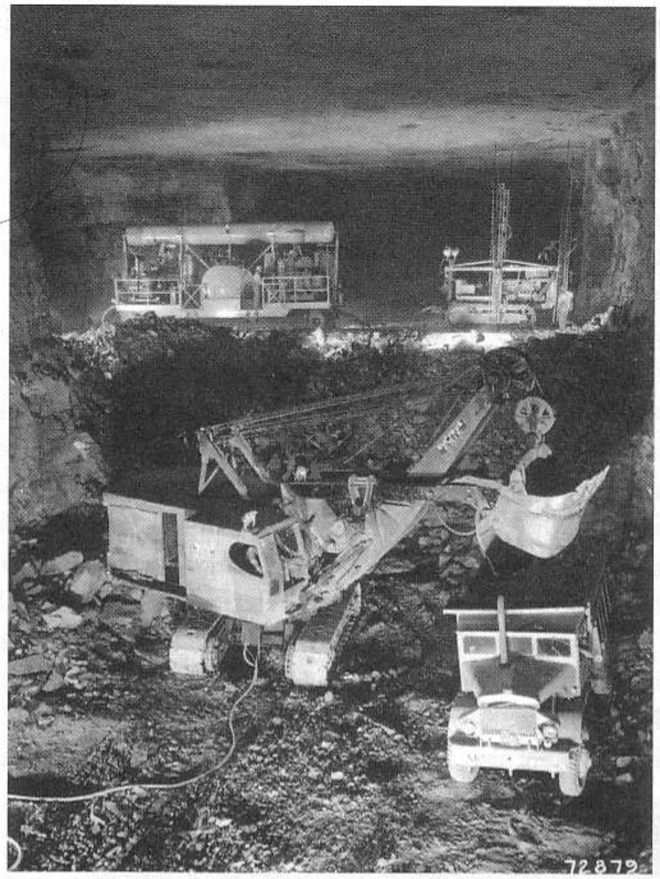
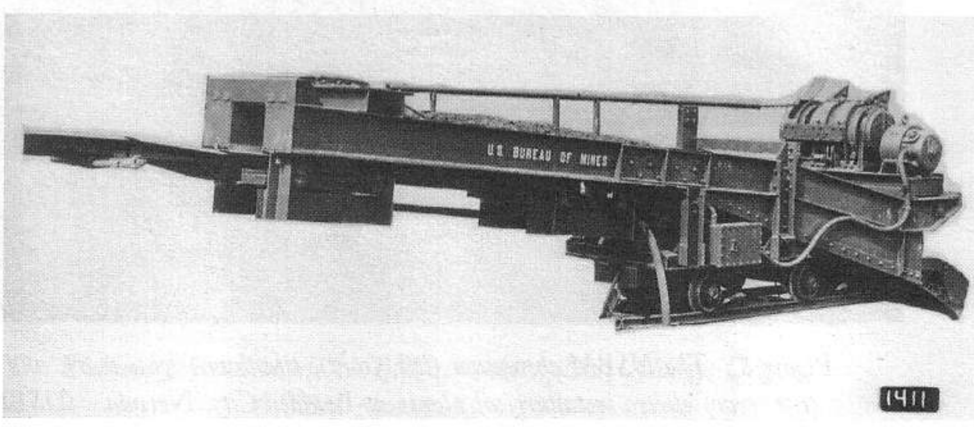


Figure 9. The USBM oil-shale mine at Rifle, Colorado. (USBM photo.)

Figure 10. A USBM-developed mechanical loading machine for anthracite mines. (USBM photo.)



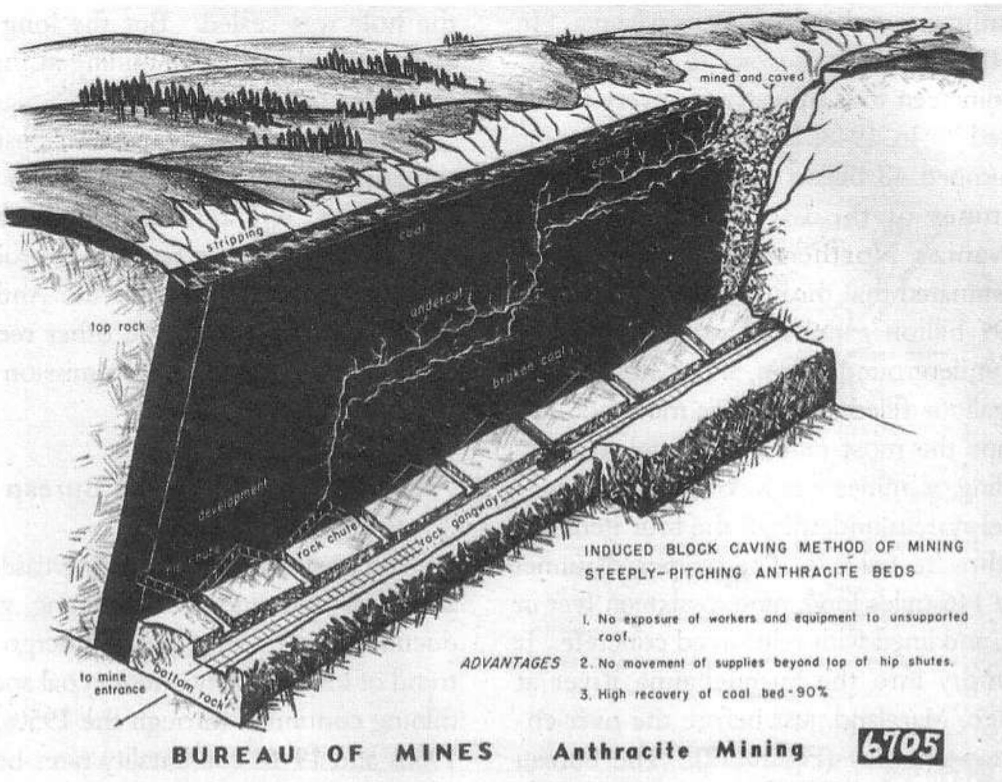


Figure 11. A USBM block-caving system for anthracite mining. (USBM illustration.)

use of anthracite.

World War II delayed the construction of the Anthracite Research Laboratory until 1950, when it opened in Schuylkill Haven, Pennsylvania. Research focused on developing new mining machines that would reduce the cost and increase the productivity of underground mining. This was a continuation of mechanical mining research that had been conducted at a leased facility in Wilkes-Barre, Pennsylvania, since 1944. The bureau developed a loading machine designed for conditions in Pennsylvania anthracite mines (Figure 10).[28] Various types of European mining equipment were also tested and adapted for U.S. mines.

The bureau developed designs for new mining systems. An example is an induced block-caving system intended to replace the traditional breast-and-pillar mining system previously used in steeply dipping seams (Figure 11).[29] In this method, a long block of coal is undercut and allowed to cave from the pressure of the overlying rock strata, eliminating much costly drilling and blasting. The miners loading the coal can work safely under supported ground. This new method was successfully demonstrated at several mines.

Anthracite coal preparation and utilization research included studies of its performance in boilers and stokers, its use as a feed for the production of producer gas, and its metallurgical uses.[30] The bureau conducted other research on methods to extinguish underground mine fires. USBM developed methods for containing fires by drilling holes ahead of the advancing fire and flushing sand and silt into the mine voids.

Following the recommendations of the Anthracite Commission, the bureau conducted extensive studies on the problem of mine flooding, which posed a serious threat to the future of the anthracite industry of Pennsylvania. In the mid-1940s, it was necessary to pump an average of nineteen tons of water for every ton of coal mined.[31] In 1948, twenty-seven pumping plants pumped 48 billion gallons of water out of the mines of the Lackawanna Basin of Pennsylvania's Northern Anthracite Field. USBM estimated that throughout the anthracite region, 91 billion gallons of water lay in 159 pools in underground mines, and 2.3 billion additional gallons filled 141 surface mine pools.

Perhaps the most radical proposal to solve the flooding of mines was to construct a drainage-tunnel system underneath the four Pennsylvania anthracite fields.[32] The proposed tunnel would be 146 miles long, nine to sixteen feet in diameter, and lined with reinforced concrete. It would empty into the Susquehanna River at Conowingo, Maryland, just before the river enters Chesapeake Bay (Figure 12). The bureau developed the preliminary design for the tunnel and estimated its cost at over $350 million. The Pennsylvania Anthracite Mine Drainage Study Commission, established by the state's governor, opposed the tunnel's construction and the proposal was never funded. While such a project would be almost inconceivable with today's environmental standards and concern for the health of the Chesapeake Bay, it was considered a viable concept in the 1940s and 1950s. At the time, the bureau had just finished another smaller mine drainage tunnel in Leadville, Colorado.[33]

Ultimately, it was water that put an end to underground anthracite mining in Pennsylvania's Northern Field.[34] On 22 January 1959, miners at the Knox Mine, north of Wilkes-Barre, broke through less than two feet of rock separating the mine from the bed of the Susquehanna River. The mine was quickly inundated and twelve of the eighty-two miners working that day lost their lives. Immediate response actions failed to plug the hole and the water level in the valley's mines continued to rise. Eventually, a cofferdam was constructed around the hole in the riverbed and the hole was sealed. But the long history of underground anthracite mining in the Northern Field was over.

The competition from lower-cost fuels continued, and so did the decline in anthracite production. Within a few years the industry was finished, except for a few mines producing coal for local markets. Neither the Anthracite Research Laboratory nor the other recommendations of the Anthracite Commission could save it.

Waves of Change for the Bureau of Mines

The post-war period saw increased mechanization of bituminous coal mining, greater production, and fewer miners underground. The trend of lower fatality rates in coal and hard rock mining continued through the 1950s, but in the 1960s and 1970s coal fatality rates began to rise again (Figure 6, page 77). Once more came calls to strengthen mine safety laws. The proposed changes would significantly impact the bureau.

Although the previous mine safety laws had required mine inspections by the bureau, it had had no direct authority to force coal mine operators to comply with safety standards or implement safety improvements. Amendments to the Federal Coal Mine Safety Act in 1966 gave the bureau limited enforcement authority, but stipulated no monetary penalties for violations. The Federal Metal and Non-Metal Mine Safety Act, also passed in 1966, also had minimal enforcement authority.

Major changes finally came in the 1969 Federal Coal Mine Safety Act. This law strengthened safety and health standards, required more frequent inspections, covered both surface and underground mines, had monetary penalties for all violations and criminal penalties for knowing and willful violations, and included compensation for miners with black lung disease. In 1974, the interior secretary created the Mine Enforcement and Safety Administration (MESA) to

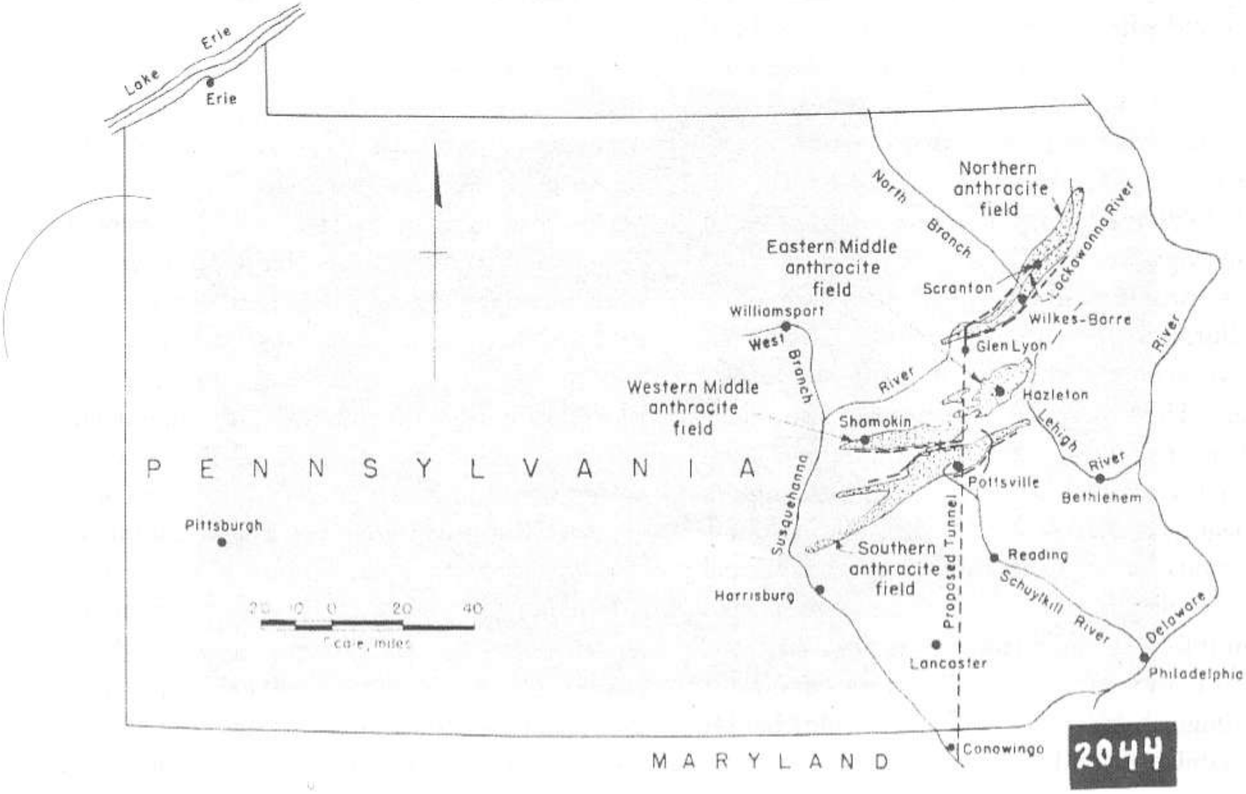


Figure 12. The USBM-designed anthracite drainage tunnel. (USBM illustration.)

implement the act, and three thousand USBM mine inspectors were transferred to MESA. Health and safety research functions remained at the bureau. In 1977, the Federal Mine Health and Safety Amendments Act consolidated federal mine health and safety regulations for both coal and non-coal mining. MESA was transferred to the Department of Labor, where it was renamed the Mine Safety and Health Administration (MSHA).

The energy crises of 1973 and 1979 resulted in more changes to the bureau. In 1974, oil and gas research programs and centers in Bartlesville, Oklahoma, Laramie, Wyoming, Grand Forks, North Dakota, and Morgantown, West Virginia, were transferred to the new Energy Research and Development Administration (ERDA). The bureau expanded its coal and oil shale research in response to the fuels shortages. A contract study of the potential for revitalizing the anthracite industry was included in this effort.[35] In 1979, President Jimmy Carter created the Department of Energy. USBM coal productivity research, oil shale research, energy minerals information functions—along with nearly $60 million from its budget—were transferred to Energy.[36] Mine safety and health research and nonfuel minerals programs stayed with the Bureau of Mines.

The 1960s and 1970s was a period of growing environmental awareness. Congress passed new laws to control and clean up pollution of air, land, and water. Decades of unregulated mining had caused extensive environmental damage, and the mining industry was blamed as a major polluter. In 1977, the interior secretary established the Office of Surface Mining, Reclamation, and Enforcement (OSM) to provide environmental regulation of the coal mining industry under the new Surface Mining Control and Reclamation Act (SMCRA). This followed the MESA-MSHA model, in which the bureau's mining research was separated from regulatory enforcement.

In 1979, the USBM Minerals Environmental Technology Research Program was created to address problems in coal and hard rock mining, metallurgical operations, mined-land reclamation, recycling, and even municipal waste disposal.[37] The program had many successes, ranging from technology used in hundreds of constructed wetlands to control metals in acid mine drainage (Figure 13), to a vitrification process for locking hazardous components of municipal refuse in glass beads that could be safety placed in landfills. In the anthracite region, environmental demonstration projects were conducted to extinguish mine fires, eliminate culm banks, and stabilize subsidence-prone areas.

Changes in Public Land Management

The nation's increased environmental awareness also signaled a dramatic change in its management of public lands. In 1964, the Wilderness Act created the National Wilderness Preservation System. USBM and USGS were directed to conduct joint surveys to assess the mineral values of areas proposed for inclusion in the system. Once areas were included in the system, they would be off-limits for future exploration and development. Subsequent laws continued to require mineral land assessments to support land management decision making.[38]

A USBM policy analysis of eight continental western states and Alaska showed that, by 1990, 2.1 million of a total land area of 3.5 million square kilometers, or 60 percent, was federally controlled. Of that federally controlled land, 20 percent—439 thousand square kilometers—contained favorable mineral terranes or known

Figure 13. A USBM-constructed wetland for control of metals from acid mine drainage. (USBM photo.)

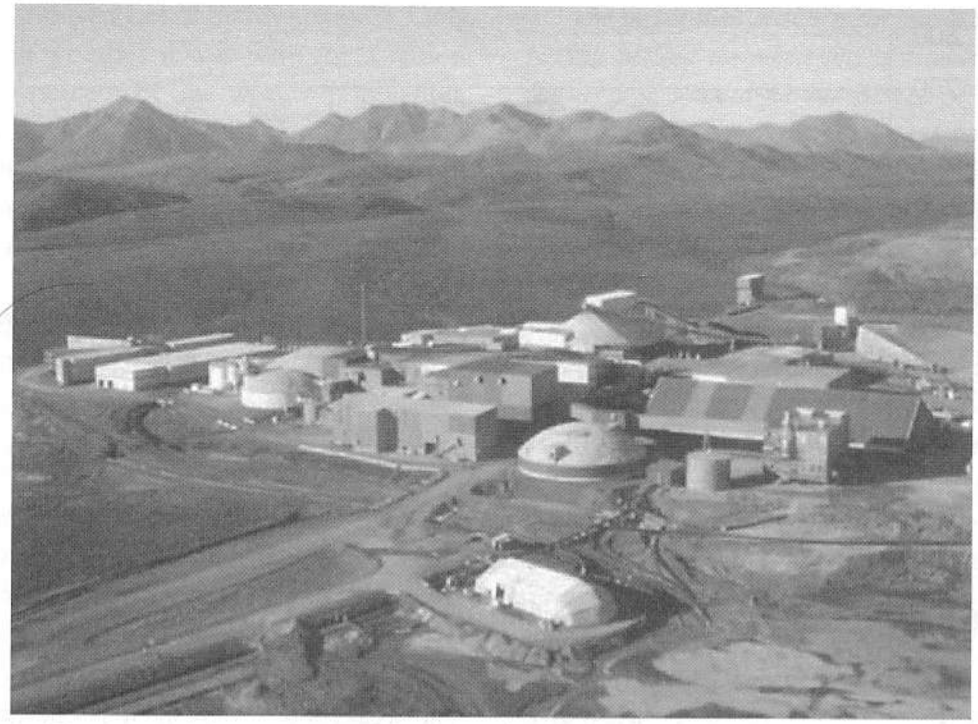


Figure 14. The Red Dog Mine in Alaska. (Courtesy of Teck Cominco, Ltd.)

mineral deposit areas. Because of land withdrawals and restrictions, only 20 percent—151 thousand square kilometers—of the favorable mineral terranes and known mineral deposit areas on federal lands were actually available for unrestricted exploration and development.[39]

Land management issues were particularly complex in Alaska. Statehood in 1959 permitted the State of Alaska to select 104 million acres of Bureau of Land Management (BLM) land. The Alaska Native Claims Settlement Act (ANCSA) of 1971 allocated 44 million acres from unreserved federal land to the Alaska Native corporations. It also allowed the secretary of the interior to withdraw 80 million acres for national parks, wildlife refuges, forests, and wild and scenic rivers. Conflicts arose between the secretary's selections and those of the state and the native corporations. This led to the passage of the Alaska National Interest Lands Conservation Act (ANILCA) in 1980. It added 104 million acres to conservation units, with 56 million acres designated as wilderness and withdrawn from mineral development.

Miners have frequently referred to Alaska as "elephant country," where huge mineral deposits just wait to be found. USBM's Alaska engineers and geologists shared that dream. In 1975, while the bureau was conducting a mineral assessment of lands proposed for the Noatak National Arctic Range, it made a major mineral discovery called the Red Dog prospect.[40] When this news hit the street, there was a claim-staking rush to the area. The Canadian mining company Cominco was able to establish a major land position on the deposit. But it took fourteen more years before the mine opened.

In 1980, under ANCSA, the Northwest Alaska Native Association (NANA) Regional Corporation selected a 120-square-mile block of land that included the Red Dog deposit. After a lengthy process of negotiations, NANA and Cominco reached an agreement on how to develop the mine (Figure 14). Cominco (now Teck Cominco, Ltd.) has invested $550 million in the mine, now the world's largest producer of zinc

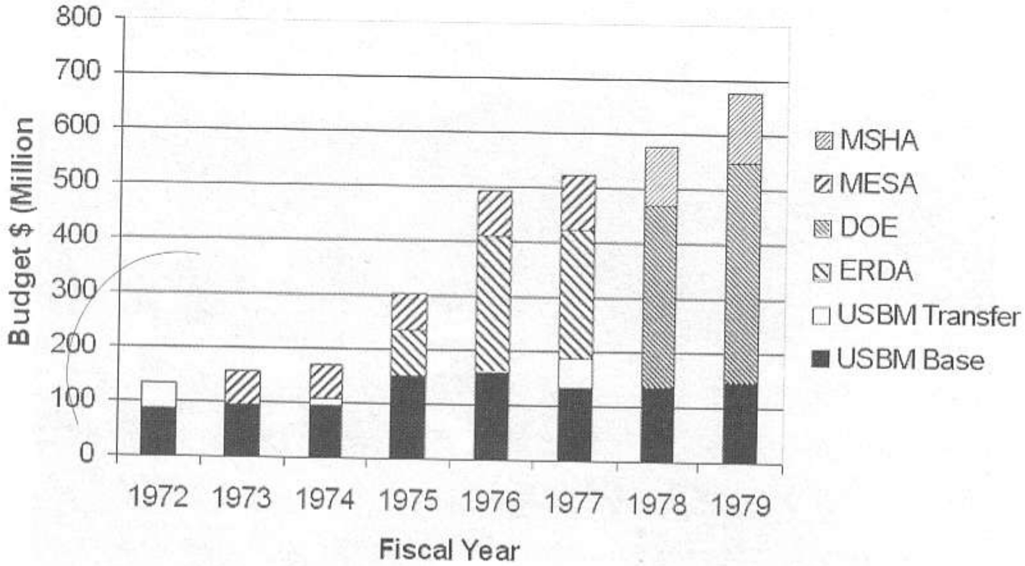


Figure 15. The erosion of the Bureau of Mines' functions and funding in the 1970s. Derived by author from annual bureau budgets.

concentrate. Its workforce numbers nearly five hundred, of which about half are Alaska Natives. From its first production in 1989 through the end of 2004, the mine produced 6.5 million tons of zinc, 1.2 million tons of lead, and byproduct silver. The total value of the lead and zinc produced is $6.7 billion.[41] Based on published ore reserves and additional discoveries in the area, the total value of mineral production from the Red Dog area will surely surpass the total cumulative funding of the USBM from 1910 to 1996!

The End of an Era

In the 1980s and early 1990s, the remaining bureau programs continued to produce award-winning research, operate internationally-respected minerals-information systems, and produce sound policy analyses. However, the transfer of bureau functions to other government organizations in the 1970s should have signaled that there would be more trouble ahead (Figure 15). USBM had lost its dominant role in government minerals research and information. Industrial and congressional support for the bureau weakened as new agencies became actively engaged in mining matters. Although the bureau's annual budget in the early 1990s exceeded $100 million, that figure was dwarfed by the resources available to the Energy and Labor departments and the Environmental Protection Agency.

In 1995, Congress was seeking to reduce government spending and the Clinton administration wished to redeploy resources to many unfunded priorities. In the Fiscal Year 1996 appropriations process, the unthinkable happened: The secretary of the interior and Congress agreed to abolish the United States Bureau of Mines. Traditional USBM supporters did little to stop the process, and closure of the ninety-six-year-old bureau took place in a mere ninety days. A few programs were transferred to other agencies, but in the end, most of the USBM's laboratories and offices were closed, its projects were scrapped, and twelve hundred bureau employees were terminated.[42]

It is ironic that the decision to close the bureau came just five years after the National Research Council had warned the nation that "the 'technology pipeline' for the domestic [minerals and metals] industry has all but dried up."[43] Only time will tell whether it was wise for a nation with only 5 percent of the world's population, but with an appetite for 25 percent of the world's annual mineral production, to terminate much of its capability to develop the technologies needed to meet future minerals needs.

L. Michael Kaas is a retired mining engineer whose career included employment with the U.S. Bureau of Mines, the Office of the Secretary of Interior, the IBM Corporation, and several mining companies. He received a B.S. degree in mining engineering from the Pennsylvania State University and a M.S. degree in mineral engineering from the University of Minnesota. His current mining history research concerns the mines and mineral processing plants that supported the Confederacy during the Civil War.

The preparation of this paper would not have been possible without the advice and assistance of many colleagues who worked for the Bureau of Mines. The staff of the Department of the Interior Library in Washington was particularly helpful. The library has an excellent collection of Bureau of Mines publications and reports. Michael Brnich of the National Institute of Occupational Safety and Health's Pittsburgh Laboratory, Cathy Wright of the Department of Energy's Albany Research Center, and Becky Farley of the Mine Safety and Health Administration's National Mine Health and Safety Academy Library were invaluable in locating old Bureau of Mines photos and other media. Mr. Kaas extends special thanks to his wife and faithful editor, Patricia, and their family members, who have tolerated his love affair with mining and the Bureau of Mines for the last forty years.

Notes:

1 D. A. Lyon, "Fifteenth Annual Report of the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ended June 30, 1925" (Washington, D.C.: U.S.G.P.O., 1925), 2.

2 James J. Corrigary, "The Great Disaster at Avondale Colliery, September 6, 1869," MSHA, www.msha.gov/District/Dist_01/History/history.htm (accessed 28 Sep. 2005). Early reports of the disaster claimed 179 fatalities, but subsequent research has determined that the actual number was 110, including two rescuers. Illustrations of the disaster from *Harper's Weekly* (25 Sep. 1869), can be found on-line at www.thomasgenweb.com/avondale_report6.html (accessed 28 Sep. 2005).

3 Albert H. Fay, "Coal-Mine Fatalities in the United States 1870-1914," USBM *Bulletin 115* (Washington, D.C.:U.S.G.P.O., 1916), 8-11, 21, 67, 290-1. This bulletin significantly expanded the historical statistics presented in *Bulletin 69* in 1913. In mine safety statistics, disasters are classified as incidents with five or more fatalities.

4 Joseph A. Holmes, "First Annual Report of the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ending June 30, 1911" (Washington, D.C.: U.S.G.P.O., 1912), 3-12, 50-7.

5 Joseph A. Holmes, "Third Annual Report of the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ending June 30, 1913," (Washington, D.C.: U.S.G.P.O., 1914), 6-8.

6 Fay, "Coal-Mine Fatalities," 8-9, 21, 67.

7 Holmes, "First Annual Report, 1911," 20-1.

8 Each of the early directors' annual reports provides statistics on miner training. The staff of the mine safety cars conducted most of the formal classes. Tens of thousands of other miners attended safety lectures and visited mine safety cars to see the safety and rescue equipment that they carried.

9 Herbert M. Wilson and Albert H. Fay, "First National Mine Safety Demonstration," USBM *Bulletin 44* (Washington, D.C.: U.S.G.P.O., 1912), 49-53. This bulletin includes a chapter by George S. Rice on the first public demonstration of a coal-dust explosion, conducted at the Experimental Mine.

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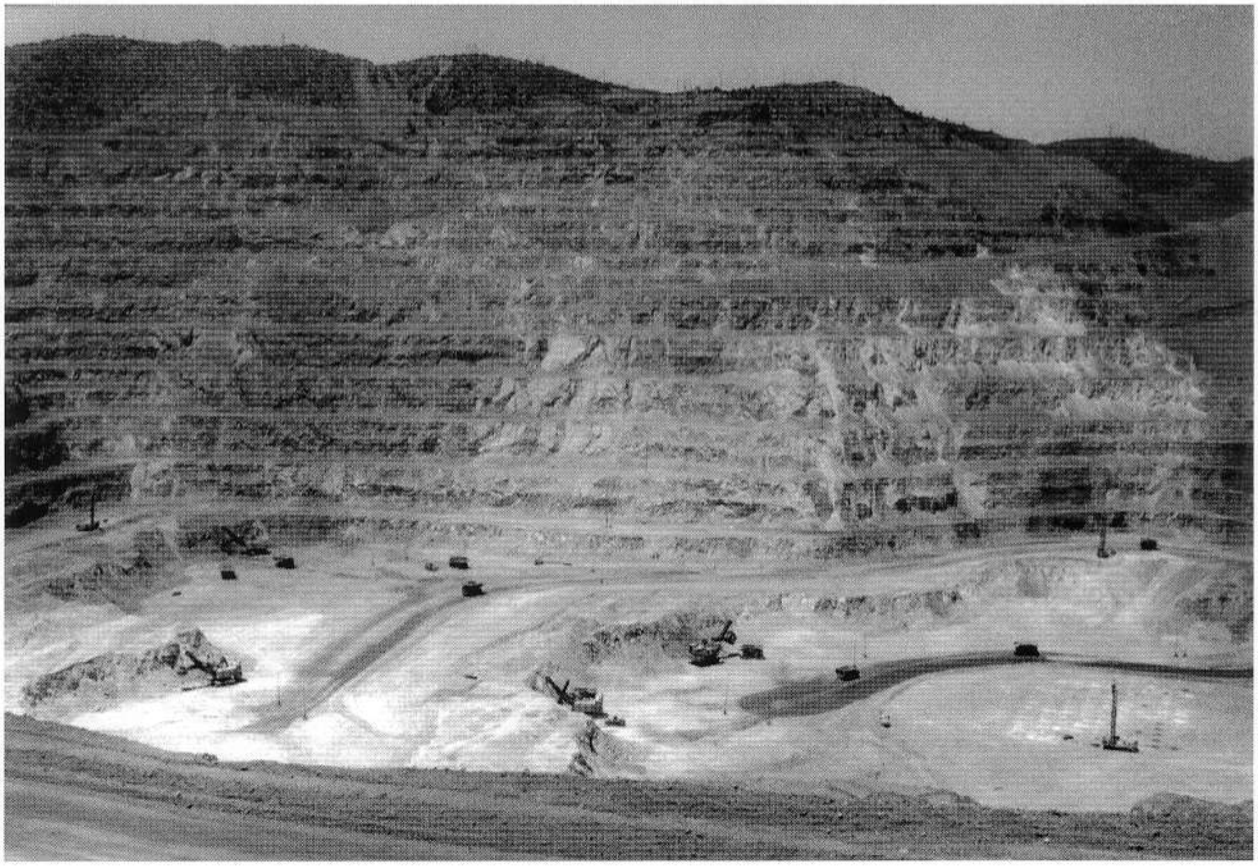

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