COAL MINING

Coal Investigations

Alaska

The results of an investigation of coal mining in the Matanuska and the Nenana fields of Alaska were reported.18/ Alaska requires an adequate fuel supply for its development and has large potential coal reserves ranging from lignite to bituminous with a little anthracite, but coal production in the Territory is now less than requirements. In 1947 production was 361,000 tons, divided about equally between bituminous coal from the Matanuska field and subbituminous coal from the Nenana field.

The coal exposures in the Matanuska field occur in an area approximately 25 miles long by 7 miles wide and parallel the general syncline of the Matanuska Valley. The coal beds, which are predominantly bituminous in rank, occur in the Chickaloon formation of Tertiary age. At present the Evan Jones mine is the only mine in operation in this field. Other mines have been worked in the past, but physical conditions in and surrounding the beds have been a factor in closing the mines. Beds of low-rank subbituminous coal and lignite occur in the Nenana field, which is characterized by the absence of extreme structural disturbances and igneous intrusions. Coal has been produced from one underground mine, the Suntrana mine of the Healy River Coal Corp., and from the Usibelli and the Diamond strip mines.

Greek Lignite

Following investigation of Greek lignite deposits by a Bureau of Mines engineer, recommendations were made and plans were submitted to the Economic Cooperation Administration for a diamond-drilling program at Kimi and Aliveri on the Island of Euboea. The objective of this program was to determine the minable reserves of lignite in these areas that could be developed to provide fuel for power generation and for chemical uses. The two areas were diamond-drilled under the supervision of a Bureau of Mines engineer. From September 1949 to March 8, 1950, 1,980 feet in two diamond-drill holes were drilled at Aliveri, and seven holes, totaling 5,035 feet, were drilled at Kimi.

Georges Creek, Md.

The results of an investigation of the lower coal beds in Georges Creek and north part of the Upper Potomac Basins, Allegany and Garrett Counties, Md., were published.18a/

The annual production of coal from mines in the Georges Creek field in Allegany and Garrett Counties, Md., has declined from 2,250,000 tons before 1931 to about 1,800,000 tons in the past few years. The greater part of this production was from mines being worked in the upper coal beds - Pittsburgh [Big Vein and Sewickley (Tyson)] - which are approaching depletion after many years of mining. Because of this depletion, the annual production of the field is certain to decline further, with an accompanying loss of employment for miners, unless production from the lower, thinner beds can be increased.

18/ Toenges, A. L., Coal-Mine Development in Alaska: Am. Inst. Min. and Met. Eng. Tech. Pub. 2686F, Min. Trans., vol. 184, 1949, pp. 361-364; Min. Eng., vol. 1, October 1949, pp. 361-364.

18a/ See footnote 14.

The coals of the lower beds are low-volatile, strongly coking coals, some of which are suitable for blending in the manufacture of metallurgical coke. Another important use for this semismokeless coal is for domestic and industrial use in the nearby Washington, Baltimore, and Pittsburgh areas. Little was known of the continuity and thickness of these lower beds; the purpose of this investigation was to determine the reserves, thickness, physical characteristics, and chemical properties of these coals, with the objective of obtaining necessary data for developing mines in the lower beds.

The area was investigated by diamond drilling, engineering examination, and geologic study. Operating and abandoned mines, where accessible, were examined, and all available maps and information regarding mined-out areas were obtained. Thirteen beds of coal were penetrated in drilling. These beds, from the top downward are: Barton, Federal Hill, Harlem, Upper Bakerstown, Lower Bakerstown, Brush Creek, Mahoning, Upper Freeport, Lower Freeport, Upper Kittanning, Middle Kittanning, Lower Kittanning, and Mount Savage. The total estimated reserves of coal (including measured, indicated, and inferred reserves), 18 inches or more thick in 10 beds, are as follows:

Coal bed:	Estimated reserves, tons
Barton	63,318,000
Harlem	16,651,000
Upper Bakerstown	79,435,000
Lower Bakerstown	131,393,000
Mahoning	18,432,000
Upper Freeport	146,926,000
Lower Freeport	3,042,000
Upper Kittanning	94,902,000
Middle Kittanning	61,907,000
Lower Kittanning	10,723,000
Total	626,729,000

Possible reserves in the Federal Hill, Brush Creek, and Mount Savage beds were not estimated, because these beds are either too thin or not extensive enough to be important at present.

The minimum thickness of bed used in estimating reserves is 18 inches, but it may not be economical to mine a bed of this thickness in this field at present. The minimum thickness that can be mined depends upon many economic factors.

The bed moisture ranges from 1.5 to 3.0 percent, and the dry, ash-free volatile matter for all of the coals averages 21 percent. The ash and sulfur contents of the coals is relatively high and varies considerably among the different beds and within the same bed in the same area. The weighted average ash analysis of all samples analyzed on the moisture-free basis (excluding samples of the Mount Savage coal) ranges from 12.8 percent for the Federal Hill bed to 21.2 percent for the Upper Bakerstown bed; the weighted average sulfur, on the same basis (excluding the Mount Savage coal), ranges from 1.8 percent for the Mahoning bed to 4.5 percent for the Lower Kittanning bed. However, the ash and sulfur contents of these coals can be improved by washing.

The correlation of the coal beds penetrated in drilling was made possible by a study of the stratigraphy of the Georges Creek and the north part of the Upper Potomac Basins. The principal control in hole-to-hole correlation was the persistent sequence of key beds in the lower part of the Conemaugh formation between the Barton and the Brush Creek coals. Below the Brush Creek coal, the intervals between coal beds were the only possible control because key beds, other than coals, were not present. The names used for coal beds, other than the Mount Savage coal, follow Pennsylvania terminology, which is standard for the Northern Appalachian coal field.

Study of Coking-Coal Reserves

In the study of coking-coal reserves, field investigations in areas in central and southern Pennsylvania, southern West Virginia, and eastern Kentucky were completed. Estimates of reserves in these areas are in preparation. A report of the estimated known recoverable reserves of coking coal in Cambria County, Pa., the first in a series of reports by counties, was completed, and a report on Indiana County, Pa., reserves is almost complete.

Mining Methods and Practices

Bull Mountain, Mont.

In the course of studies of coal-mining methods and practices, electrical power requirements at coal mines, and coal resources in the Missouri River Basin, the results of an investigation in the Bull Mountain coal field of Montana were published.19/ This report contains a short summary of the geology and geography of the field and discusses the following information obtained during the field study by Bureau of Mines engineers: Method of mining practiced at each mine, including a description of each phase of the mining cycle; coal produced and its distribution at each mine; power requirements and the consumption of electricity per ton of coal produced by mines; number of men employed by mines, the production per man per shift underground, and the over-all production per man employed; and estimates of future production and power requirements for the field as a whole.

Iowa

A description of methods of mining in Iowa coal mines was published.19a/ Iowa ranks eighteenth in the United States in the production of bituminous coal and lignite, with output of 1,670,156 tons in 1948. The greater part of this production was from mines in the central and south central parts of the State. Physical conditions vary in these areas, and mining methods and practices necessarily conform to these conditions. The general topography of the coal fields of Iowa is flat to rolling. Many of the coal beds are lenticular and are not continuous. These beds occur under heavy deposits of glacial drift, which usually obscure the outcrop of the beds. However, one bed, the Mystic, is fairly consistent in thickness and extent. The dip of the coal beds ranges from slightly inclining to steeply dipping in some areas. Mines are developed by shafts, drifts, slopes, and stripping, depending upon physical conditions. Usually the room-and-pillar system of mining is used in most areas of the State. However, in Appanoose County, where the Mystic bed is mined extensively, the longwall system of mining is followed. (See fig. 4.) Coal beds, lying at shallow depths of 65 feet or less, are being mined successfully by stripping. In 1948, 788,126 tons of coal were produced from strip mines. This represents 47.2 percent of the total production of the State. The output of coal loaded mechanically underground increased from 13.4 percent in 1943 to 22.2 percent in 1948. Mobile loading machines and conveyors comprise the loading equipment.

19/ Travis, Raymond G., and Turnbull, Louis A., Coal-Mining Methods and Practices and Electric Power Requirements in the Bull Mountain Coal Field, Montana: Bureau of Mines Rept. of Investigations 4684, 1950, 27 pp.
19a/ See footnote 10.

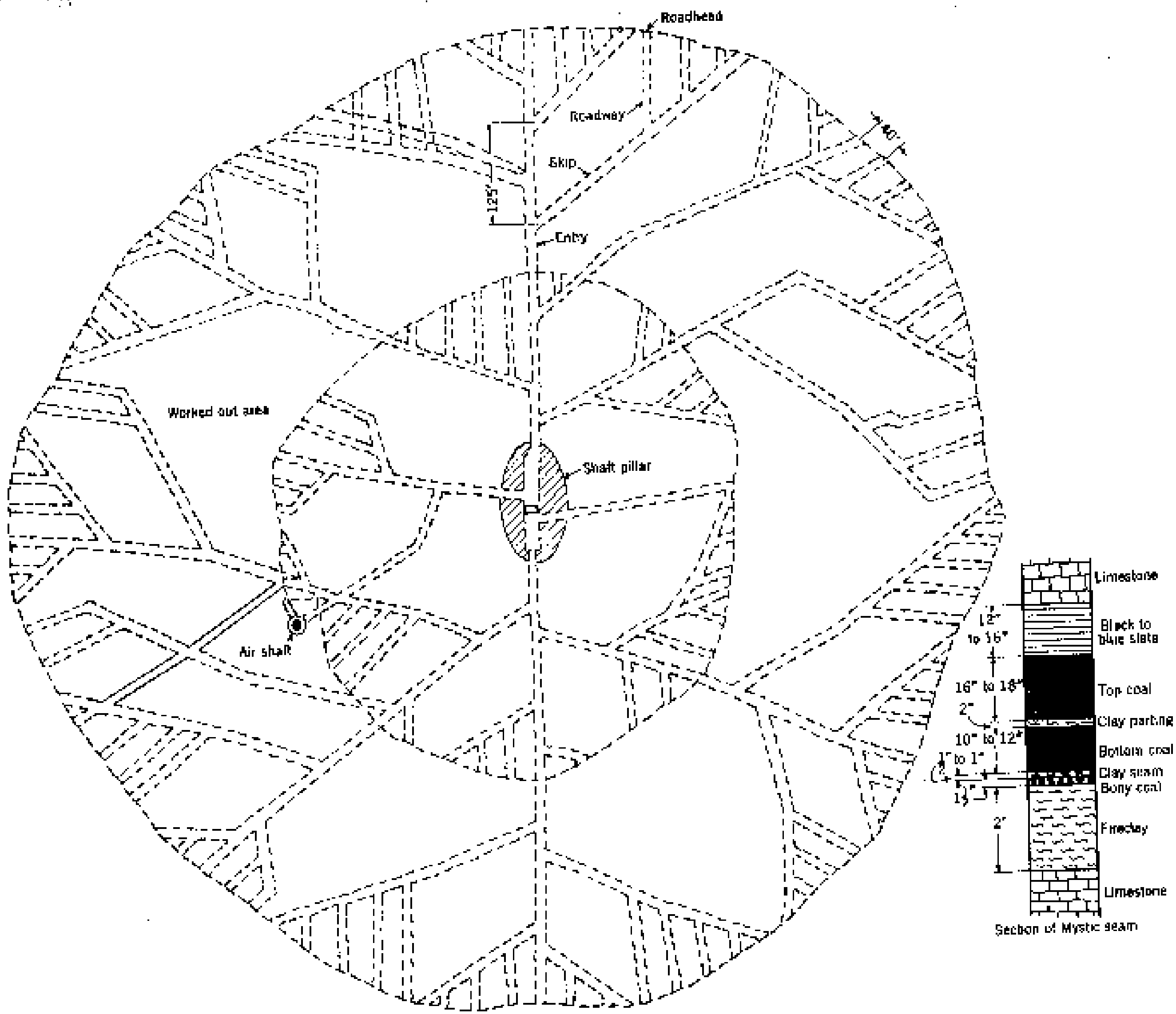

Figure 4. - Map of an Iowa longwall mine, Centerville district.

Mechanical Mining Studies

The methods and practices followed in extracting pillars with mechanized equipment at 55 coal mines in all of the important coal fields of the United States were studied, and those used in 10 of the mines were described.[20] This study clearly indicates that the most difficult problem in extracting pillars with mechanized equipment is the effective control of the immediate roof and the entire overlying strata. In mines practicing pillar extraction, production per mobile loading machine is 6 to 10 percent less than in mines not practicing such extraction. Such extraction increases the percentage of recovery of coal in a given area.

Anthracite Mechanical Mining Research

Activities for the Bureau's anthracite mechanical mining studies are now headquartered in the new Anthracite Research Laboratory at Schuylkill Haven, Pa. The Bureau's participation in these studies has consisted of design, manufacture, and testing of new and untried mining machinery and engineering services. Cooperating companies have provided underground test sections, labor, power, and supplies. Projects are active in the Northern, Western Middle, and Southern fields of the anthracite region of Pennsylvania.

Preliminary underground tests have been completed on a scraper-shaker loading machine for eliminating transportation delays in developing thin, steeply pitching anthracite beds.[21] Tests on the machine in a rock gangway demonstrated a maximum capacity of 150 tons per hour. Average rated capacity is 70 tons per hour. The machine has been redesigned, reconstructed, and electrified, and further tests in a coal gangway are planned.

Further tests have been made on air-powered German lightweight shearing machines. In the Southern field of Pennsylvania anthracite tests have been completed that show power requirements for cutting of less than 2 horsepower when making shear cuts at a satisfactory rate.[22] In the Northern field tests have been completed for driving a pillar road 420 feet long in a coal bed 28 feet thick, without shattering the pillar. The best test runs demonstrated that, by cutting both horizontals and shears with the machine, explosive requirements were reduced by some 900 percent, as compared to requirements for mining off the solid. The average reduction in explosive requirements for the entire series of tests was 237 percent.

Underground tests are being made with a pneumatic packing machine of German origin for filling between pillars to permit recovery of the pillar coal. To date, over 100,000 cubic feet of packing material has been placed.

20/ Turnbull, Louis A., and Toenges, Albert L., Mechanical Mining in Some Bituminous-Coal Mines. Progress Report 5. Extraction of Pillars with Mechanized Equipment: Bureau of Mines Inf. Circ. 7527, 1949 59 pp.

21/ Buch, John W., and Allan, Andrew, Jr., Anthracite Mechanical Mining Investigations. Progress Report 1. Preliminary Underground Tests of the Bureau of Mines Scraper-Shaker Loading Machine for Driving Gangways: Bureau of Mines Rept. of Investigations 4500, 1949, 9 pp.

22/ Buch, John W., and Allan, Andrew, Jr., Anthracite Mechanical Mining Investigations. Progress Report 2. Preliminary Testing of Eickhoff Shearing Machine, Model DEK: Bureau of Mines Rept. of Investigations 4501, 1949, 14 pp.

Measurements of loads borne by roadway supports were made as a basis for the design of a telescopic working-face shield for more efficient and safer roof support. Underground mine timbers were removed, and their physical properties were determined. Plans are under way and instruments are being built to measure electrically the actual underground roof loads in gangways.

Experimental work is being conducted in the design of precast, reinforced concrete timber sets for use in permanent-type roof supports in gangways. These sets are less affected by underground elements and are made with a slate aggregate, thereby utilizing an anthracite byproduct which formerly was discarded.

Compressed-Air Receivers

The important advantages of large-capacity compressed-air receivers over standard receivers in underground mining operations were summarized.23/ These advantages include: (1) Elimination or reduction of underground work stoppages due to compressor breakdowns; (2) increased efficiency due to constant, full air pressure at the machines using the air; (3) possible elimination of some existing compressor capacity with a better load factor for that remaining; and (4) cooling of the compressed air by storage for a period of time in the receiver.

Studies on the Use of Diesel Engines Underground

In connection with the evaluation of liquid fuels and their behavior in Diesel engines, a study of the composition of Diesel exhaust gas was carried out in detail. Such knowledge is essential when Diesel engines are used underground and is helpful in the solution of many combustion and operation problems.24/

The exhaust gases from a Diesel engine consist chiefly of carbon dioxide, water vapor, nitrogen, and excess oxygen. The constituents of Diesel exhaust gas that are harmful to health at certain concentrations are carbon dioxide, carbon monoxide, oxides of nitrogen, and oxides of sulfur (if the fuel contains sulfur); aldehydes are objectionable because of their odor and smoke and of their contaminating effect in the atmosphere and in the engine. When Diesel engines are operated underground or in a confined space, ventilation should be provided to maintain the concentration of any constituent at the allowable values.

The composition of Diesel exhaust gas depends chiefly on the fuel-to-air ratio. However, the relation between fuel:air ratio and the constituents present in low concentrations (carbon monoxide, aldehydes, and oxides of nitrogen) is affected to some extent by type of engine, composition of the ambient atmosphere in which the engine operates, barometric pressure, and cetane number of the fuel. This relation is affected only slightly over wide ranges of pressures in the intake and exhaust manifolds.

Carefully controlled operation of a Diesel engine showed that at fuel:air ratios greater than the stoichiometrical or chemically correct value (that is, operation in a deficiency of air) the concentration of products of incomplete combustion (carbon monoxide, hydrogen, methane, and unburned carbon) increased rapidly with an increase in fuel:air ratio. Operation of a Diesel engine under such conditions is not normal and is always accompanied by the production of excessive quantities of smoke.

23/ Allen, Andrew, Jr., Summary of Published Information on Large-Capacity Compressed-Air Receivers for Underground Mines: Bureau of Mines Inf. Circ. 7541, 1950, 7 pp.

24/ Elliott, M. A., Combustion of Diesel Fuel: Quarterly Trans. Soc. Auto. Eng., vol. 3, July 1949, pp. 490-515.

Attempts to remove aldehydes from Diesel exhaust gas by scrubbing with water were not completely successful. However, aqueous sodium sulfite solution, inhibited by the addition of hydroquinone to prevent oxidation of the sulfite, removed substantially all of the aldehydes and effected a significant reduction in odor and irritation for extended periods of time.

The Bureau of Mines work on the use of Diesel engines for underground haulage was reviewed before the Fifth International Conference of Directors of Mine Safety Research.25/

Coal-Mining Practices in Germany and Japan

Coal mines in the Ruhr district of Germany were opened decades ago, but progress in developing modern haulage systems has been handicapped by the cost of the changes needed to accommodate more modern equipment. Some changes that have been made are the use of larger locomotives and the adoption of skip hoisting, but notable advances have been made only at newer plants.26/

The Bureau of Mines furnished safety engineers to the UK/US Coal Control Group supervising postwar production from the Ruhr district of western Germany. In connection with their investigation of safety conditions, some of the operating conditions and practices also were studied. Coal beds in the active field of operations are far from exhausted, and preparation plants are generally efficient.27/ Virtually all coal in Germany is mined by the longwall system, but only a small amount of the total production is mined mechanically. Not more than 6 percent is blasted. Ventilation systems are efficient in removing methane, but temperatures were high in many mines.

Safety practices, mining conditions, and methods of mining were studied for the purpose of making recommendations for the revision of the Coal-Mine Safety Standards for Japanese mines. Geological conditions, mining and safety practices, and accident rates of the principal coal fields in Japan are described separately.28/

Control of Coal-Mine Fires

The control and extinguishment of mine fires is under investigation by the Bureau, both in actual occurrences and in test procedure at the Experimental Mine. Through trials and tests, attempts are made to find effective methods and equipment, particularly for use against coal-mine fires. Sealing, flooding, and use of carbon dioxide have been the methods applied in fighting recent mine fires; in some instances, the three methods were used in combination. Carbon dioxide was effective in an instance where fire seals would not hold the pressure of water to flood the

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25/ Elliott, Martin A., Review of Bureau of Mines Work on Use of Diesel Engines Underground: Bureau of Mines Bull. 489, 1950, pp. 140-167.

26/ Stahl, R. W., Sanford, H. E., and Benson, J. B., Underground Transportation in the Ruhr Coal-Mining District of Germany: Bureau of Mines Inf. Circ. 7547, 1950, 9 pp.

27/ Benson, J. B., Sanford, H. E., and Stahl, R. W., Conditions and Practices at Coal Mines in the Ruhr District of Western Germany: Bureau of Mines Inf. Circ. 7549, 1950, 48 pp.

28/ Warncke, Russell G., Observations of Safety Practices and Conditions in Japanese Coal Mines: Bureau of Mines Inf. Circ. 7542, 1949, 38 pp.

enclosed area but could hold the gas.29/ In another instance, carbon dioxide introduced into a sealed area cooled the area sufficiently to permit prompt reopening without immediate rekindling of the fire, although the gas leaked through the seals into abandoned areas and did not extinguish the fire. The hot material was loaded out with a loading machine, rock dust being applied to shield men and equipment from the extremely hot rock and slag.30/

Decreasing Explosive Hazards Underground

Since its introduction into coal mines, the use of Airdox has grown in popularity, especially in the Indiana and Illinois coal fields. Many of the hazards connected with the use of explosives are eliminated, but when Airdox lines are electrically grounded as specified by the Federal Mine Safety Code, there is danger of arcing through contact with mine tracks or other mine equipment. To eliminate such arcing, the use of reinforced rubber-jacketed tubing and insulating air-line couplings has been introduced in coal mines where Airdox is used for breaking coal.31/ Premature blasts of charges of explosives have caused many deaths in anthracite mines, and the causes of many of the blasts were not determined satisfactorily. Investigation often has found fairly high potential differences between rails, pipes, conveyor lines, or sheet-iron chutes in working places where these accidents occurred, and it is considered probable that these potential differences have caused premature firing of the electric detonators. A survey of a large number of such incidents indicated that this hazard could be reduced by proper bonding of metallic installations.32/

Toxic Mine Atmospheres

Conditioning air is one of the most essential factors to be considered in underground workings, not only from the standpoint of health and safety, but also with regard to efficiency and productivity. As an instance, mechanical refrigeration cooled off new lower levels in copper mines in a month where 3 years would have been required for cooling by ventilation with the normal mine air. To survey the theoretical and practical methods of conditioning air in mines and the results obtained by some of the systems now in use, a review of published information has been made.33/

Although dust control is practiced in many bituminous-coal and lignite mines, the extent and effectiveness of control over the entire industry is not generally known. Factual data on dust-allaying practices at working faces in a large number of the bituminous coal and lignite mines in the United States were compiled from reports on Federal inspections of these mines.34/ Although dust produced at faces

29/ Westfield, James, Brumbaugh, H. C., and Whittaker, R. W., Extinguishing Fire with Carbon Dioxide in the Valier Mine, Valier Coal Co., Valier, Franklin County, Ill.: Bureau of Mines Inf. Circ. 7563, 1950, 10 pp.

30/ O'Connor, J. A., Malesky, J. S., and Higgins, T. C., Fighting a Fire in No. 59 Mine, Peabody Coal Co., Springfield, Sangamon County, Ill.: Bureau of Mines Inf. Circ. 7564, 1950, 19 pp.

31/ Gallagher, P. J., Two Devices to Prevent Electric Arcs with Airdox Operations in Coal Mines: Bureau of Mines Inf. Circ. 7515, 1949, 5 pp.

32/ Weber, Charles F., A Study of Stray Currents in Pennsylvania Anthracite Mines: Bureau of Mines Rept. of Investigations 4637, 1950, 8 pp.

33/ Forbes, J. J., Davenport, Sara J., and Morgis, Genevieve, Review of Literature on Conditioning Air for Advancement of Health and Safety in Mines. Part III. Methods of Controlling the Chemical and Physical Qualities of Underground Air: Bureau of Mines Inf. Circ. 7526, 1949, 57 pp.

34/ Forbes, J. J., Franklin, R. K., and Reese, S. T., Review of Dust-Allaying Practices at Working Faces in Some Bituminous-Coal and Lignite Mines: Bureau of Mines Inf. Circ. 7566, 1950, 29 pp.

was allayed effectively in about one-third of the mines requiring dust allaying, no effort was made to control such dust in more than half of these mines. The allaying of dust at the source in bituminous-coal mines will reduce the dust-explosion hazard and protect men from respiratory infection from inhaling coal dust.

In connection with the work carried out under the provisions of the Federal Coal-Mine Inspection Act, more than 16,000 samples of mine air were analyzed to determine the adequacy of ventilation in coal mines, to detect and aid in the elimination of hazards from flammable and toxic gases, and to aid in the control and extinguishment of mine fires.

Surveys were conducted in coal mines to determine the concentrations of air-borne dust produced by various mining operations, thus to provide information for the formulation of recommendations for control measures leading to the reduction of exposure of coal-mine workers to harmful dusts.

The production of dust by roof-drilling for roof bolting in coal mines was studied. As the roof strata usually contain a much higher percentage of free silica than the coal measures, the problem of control of the dust produced by roof-drilling is a serious one for those engaged in such drilling operations. A test program was initiated to study the efficacy of various devices that have been developed commercially to control or trap the dust produced by such operations.

More than 1,000 examinations were conducted to determine the concentration and particle size of air-borne dusts and the composition of such dusts and dust-source materials to evaluate their hygienic significance in the working environment of coal and other types of mines. These examinations were conducted by microscopic, petrographic, X-ray diffraction, and spectrographic methods. Examinations were also made of various materials to determine their suitability for use in rock-dusting coal mines to reduce the possibilities of coal-dust explosions.

Studies relating to the determination of air-borne dust were described in two publications issued during the year.35/36/ Studies were also conducted of dust dissemination by the use of different-type treads on tires of coal-mine shuttle cars, and the attendant compacting of the mine roadways was observed.37/

Approval testing was conducted on respiratory protective devices, including gas masks and dust respirators applicable to use for personal protection in the mining and mineral industries. Eight new approvals and 25 extensions of approval of such devices were granted, representing modifications and improvements in design. In many instances such modifications were developed in a form suitable for Bureau of Mines approval only after extended tests and consultations between Bureau personnel and the manufacturers of the respiratory protective devices. To aid industry in the selection of respiratory protective devices and to present up-to-date information on the subject, a listing was prepared of all such devices approved by the Bureau of Mines.38/ Because of increasing interest in the control of and protection against

35/ Foster, Wilder D., Petrographic Determination of Quartz in the Presence of Clay-like Minerals: Bureau of Mines Rept. of Investigations 4573, 1949 13 pp.

36/ Brown, Carlton E., and Schrenk, H. H., Relation Between and Precision of Dust Counts (Light- and Dark-Field) from Simultaneous Impinger, Midget-Impinger, Electric-Precipitator, and Filter-Paper Samples: Bureau of Mines Rept. of Investigations 4568, 1949, 33 pp.

37/ Nicholas, F. H., Whittaker, J. S., Dornenburg, D. D., Harmon, John P., and Bank, Walter, Shuttle-Car Tire and Roadbed Study: Bureau of Mines Rept. of Investigations 4624, 1949, 22 pp.

38/ Pearce, S. J., and Berger, L. B., List of Respiratory Protective Devices Approved by the Bureau of Mines: Bureau of Mines Inf. Circ. 7570, 1950, 16 pp.

dust produced in coal-mining operations, the use of dust respirators in this application was discussed in a publication which includes instructions on the selection, care, and maintenance of these devices.39/

Mine ventilation studies conducted by the Bureau were coordinated with new developments in this field as applied by the coal-mining industry. A historical résumé was prepared, outlining studies conducted by the Bureau of Mines on mine and tunnel ventilation during the period 1910 to 1949.40/

The ventilation-survey practice of a large anthracite producing company in South Wales in Great Britain was reviewed41/ to provide background material for American colliery managers who are planning to make ventilation surveys as a step toward improving environmental conditions in their mines. This British company is staffed to make such surveys as a routine operation. Rates of air flow in underground air current are measured on a circuit basis with rotating vane anemometers, and pressure changes are measured on inclined U-tube manometers. Results are plotted on the mine map so that zones of excessive loss are revealed instantly.

A two-color psychrometric chart, especially adapted to solving mine air-conditioning problems at all barometric pressures, was published.42/

Roof Control

Early in 1947 the Bureau of Mines became interested in adapting suspension roof support to coal mining as a possible means of reducing the high rate of accidents from falls of roof. For a time the program made little progress because of the shortage of steel products after the end of World War II, but with the easing of the shortage and as of May 1, 1949, experimental work had either been started or materials and equipment in anticipation of trial installations had been ordered at 114 mines. It is estimated that 30 linear miles of roof in underground passageways have been secured by this method in recent months, and no lost-time roof-fall accident has been reported in these areas up to that date.

The Bureau of Mines, in cooperation with several mining companies and State agencies, is carrying on a program of research and investigation not only on problems involving suspension roof supports, but also on the broader subject of roof control in general.43/

Anthracite Flood Prevention

The Bureau of Mines continued its work in obtaining and evaluating information on the underground mine-water problem in the anthracite region of Pennsylvania and

39/ Pearce, S. J., The Use of Dust Respirators in Coal Mines: Bureau of Mines Inf. Circ. 7561, 1950, 6 pp.

40/ McElroy, G. E., Historical Résumé of Mine and Tunnel Ventilation Studies, Bureau of Mines, 1910-49: Bureau of Mines Inf. Circ. 7556, 1950, 16 pp.

41/ Smith, Cloyd M., Routine Ventilation Surveying in South Wales Anthracite Mines: Bureau of Mines Inf. Circ. 7530, 1949, 11 pp.

42/ McElroy, G. E., A Mine Air-Conditioning Chart: Bureau of Mines Rept. of Investigations 4165, 1947, 23 pp. (Chart reproduced on larger scale in 1949.)

43/ Thomas, Edward, Barry, A. J., and Metcalf, Arthur, Suspension Roof Support. Progress Report 1: Bureau of Mines Inf. Circ. 7533, 1949, 13 pp.

in preparing plans that would aid in solving this problem. In the course of this work the application, design, and performance of deep-well and shaft pumps were studied for possible use in a project to pump underground waters.44/

An engineering study of the inundated anthracite reserves of the Eastern Middle field of Pennsylvania and of the various methods that can be used to unwater these reserves was made.45/ One of the major methods of handling mine water at the anthracite mines is by pumping. Data on the types of pumps and their performance in the Pennsylvania anthracite region were presented, with the relationship between precipitation, anthracite production, and the amount of water pumped to the surface.46/

Other investigations that are being conducted on the problem of underground water in the anthracite region of Pennsylvania include studies of centrifugal-pump installations in the anthracite mines of Pennsylvania, the buried valley of the Susquehanna Valley in the region, a plan for dewatering the mines by driving a drainage tunnel, the strength of barrier pillars underground, and estimation of the tonnage of anthracite that would be affected by any drainage method.

PREPARATION OF COAL

Coal Washing

Cyclone Thickener Performance Tests

Under a cooperative agreement with the Truax-Traer Coal Co., Chicago, Ill., the Bureau of Mines installed and operated a 14-inch-diameter cyclone thickener at the preparation plant of the Shamrock mine, Kayford, W. Va.47/ The unit was placed in the fine-coal washery circuit and used as a water-clarification device. Test data indicate the recovery of substantially all coal particles 100-mesh and larger in size. Less efficient recovery is experienced as the particle size decreases, with but a one-third recovery of those solids finer than 325-mesh.

This one cyclone recovered 5 to 6 tons per hour of marketable coal, which was previously lost. The demonstration of the usefulness of this device in the preparation plant influenced the cooperating company to install three additional cyclones to handle the entire water volume of the fine-coal washery circuit.

Coal-Preparation Bibliography

To meet the many requests for information on the preparation of coal, a bibliography of Bureau of Mines publications on the subject was compiled.48/

44/ Lesser, William H., Deep-well Pumps and Shaft Pumps in Anthracite Mines of Pennsylvania: Bureau of Mines Rept. of Investigations 4656, 1950, 52 pp.

45/ Ash, S. H., Kynor, H. D., Fatzinger, R. W., Davies, B. S., and Gilbert, J. C., Inundated Anthracite Reserves: Eastern Middle Field of Pennsylvania: Bureau of Mines Bull. 491, 1950, 28 pp.

46/ Ash, S. H., Eaton, W. L., Gilbert, Joseph C., James, U. M., Jenkins, Hayden E., Kennedy, D. O., Kynor, H. D., Link, Howard B., and Romischer, W. M., Data on Pumping at the Anthracite Mines of Pennsylvania: Bureau of Mines Rept. of Investigations 4700, 1950, 264 pp.

47/ Fraser, T., Sutherland, R. L., and Giese, F. F., Performance Tests of an Experimental Installation of Cyclone Thickeners at the Shamrock Mine: Am. Inst. Min. and Met. Eng. Tech. Pub. 2615F, Min. Trans., vol. 184, 1949, pp. 436-446; Min. Eng., vol. 1, December 1949, pp. 439-446.

48/ Crentz, William L., Publications of the Bureau of Mines on Coal Washing: Bureau of Mines Inf. Circ. 7531, 1949, 7 pp.

Preparation Characteristics of Illinois Coals

As part of the Bureau's survey of preparation characteristics of American coals, an examination was made of the coals of Illinois.49/ Float-and-sink tests and screen analyses of representative samples from the important mining districts and beds indicated the comparative responsiveness of these coals to mechanical preparation.

The recoverable clean coal readily obtained by conventional coal-washing practices operating at a separation gravity of about 1.60 contained 6.0 to 13.0 percent ash. Test separations at 1.30 specific gravity showed many coals had fractions with as low as 4.0 percent ash, but the quantity of this low-ash coal is generally less than half the original raw coal.

Much of the Illinois coal is high in sulfur, some exceeding 5 percent, but there are areas which are singularly low in sulfur content in both the raw and washed coal. The low sulfur and ash contents of the No. 6 coal bed in the Franklin-Williamson mining district is well-known and frequently has been examined as a possible source of metallurgical fuel. Tipple samples of nut and egg sizes from the No. 5 bed in Saline County and the No. 6 bed in Jefferson County showed substantial yields of low-sulfur float coal, and face samples taken in these mines corroborate the feasibility of recovering float coal containing a sulfur content within the present tolerances for metallurgical use. Face samples from the No. 2 bed in northern Illinois showed some coal of this category in the finer sizes.

With regard to the size consist of screenings, a factor of major importance in appraising an industrial fuel, a substantial increase in fines occurred during the period 1914 to 1935, with only a very small change since.

The finer sizes of Illinois coals are more responsive to ash reduction by specific-gravity separation. On the other hand, even fine crushing of high-sulfur raw coal does not materially effect the release of sulfur so as to permit the recovery of a low-sulfur coal by mechanical cleaning.

Preparation Characteristics of Cumberland Plateau, Tenn. Coal

A washability study was completed on one of the coal beds in the Cumberland Plateau of Tennessee.50/ Data were compiled from laboratory tests on the coal, and a discussion of the results to be expected from the treatment of this coal by conventional coal-preparation methods. It was found that if this coal was washed by conventional methods, such as jigging and tabling, a product could be obtained containing approximately 12.3 percent ash and 2.07 percent sulfur; however, if by the use of heavy-medium methods separations between washed coal and refuse could be made at specific gravities as low as 1.40 on the sizes above three-sixteenths inch, a washed coal of about 10.1 percent ash and 1.57 percent sulfur would be obtained.

Upgrading Marginal Coking Coals by Coal-Preparation Methods

In a Nation-wide appraisal of coking-coal reserves and of the feasibility of expanding them by upgrading marginal coals, an investigation was made of the washing

49/ Crentz, William L., Preparation Characteristics of Illinois Coals: Bureau of Mines Tech. Paper 724, 1949, 112 pp.

50/ Gandrud, B. W., and Riley, H. L., Washability Study of Coal from a Strip Pit Bed on the Cumberland Plateau, Near Chalybeate, Van Buren County, Tenn.: Bureau of Mines Rept. of Investigations 4596, 1949, 10 pp.