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ANNUAL REPORT OF RESEARCH AND TECHNOLOGIC WORK ON COAL

FISCAL YEAR 1947<sup>1/</sup>

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## INTRODUCTION

This, the twelfth annual report of research and technologic work conducted by the Bureau of Mines on coal and coal products, summarizes the

research and tests conducted from July 1, 1946, to July 1, 1947. The organic act of Congress establishing the Bureau of Mines authorized technologic investigations of all phases of mining, preparation, treatment, and utilization. These investigations<sup>4/</sup> cover eight main fields of activity. The emphasis on individual projects varies from time to time. The United States possesses about one-half of the coal reserves of the world. These reserves are not always of the quality desired or in the place where they could best be used. It is necessary to continue research in order that increased output, greater recovery, and better quality can be maintained under safe mining conditions. Coal comprises 98 percent of the known fuel reserves of the United States and eventually must take over much of the requirements now supplied by petroleum and natural gas.<sup>5/</sup>

The purpose of this report is to bring to the reader a resume of the work of the fiscal year. The material presented herein is based largely upon publications. In a few instances the results of research that would not otherwise be available in the immediate future are presented. For details concerning the research, it is suggested that the readers consult the publications given in the footnote references.

Collected references to all Bureau of Mines publications on coal are published in a series of bibliographies. Technical Paper 576 covers 1910 to 1935; Technical Paper 639 covers 1935 to 1940; and Technical Paper 698,<sup>6/</sup> issued in 1947, covers 1940 to 1945.

#### SUMMARY

Following the unprecedented demand for coal during the war, the Bureau of Mines completed all war research on coal and directed its efforts toward improvements in mining, preparation, and utilization of coal for national security and peacetime economy. Special emphasis was given to conservation and safety research.

Service to Federal agencies was continued on fuel-utilization problems, including the sampling and analysis of coal, consulting on the purchase of fuel and fuel-burning equipment, tests of fuels and boiler-room equipment, instructions on the storage of coal, analyses of boiler water, recommendations as to boiler-water chemical treatment, and the supplying of boiler-water test kits. Such services, including those within the Bureau of Mines, required the analysis of 18,045 samples of coal, coke, char, tar, pitch, hydrogenated residues, heavy oils, pasting oils, organic compounds, distillation fractions, and coal-mine dusts. Government purchases and tippie

- <sup>4/</sup> Fieldner, Arno C., Coal-Research Activities of the Bureau of Mines: Bureau of Mines Inf. Circ. 7367, August 1946, 14 pp.  
<sup>5/</sup> Fieldner, Arno C., The National Fuel Reserves. Relation to the Future Supply of Liquid Fuels: Mech. Eng., March 1947, pp. 221-226 and 228.  
<sup>6/</sup> Fieldner, Arno C., Fischer, P. L., and Pollock, Marjorie B., Bibliography of Bureau of Mines Investigations of Coal and Its Products 1940 to 1945: Bureau of Mines Tech. Paper 698, 1947, 53 pp.



inspections accounted for 3,666 samples; Bureau of Mines research on composition, preparation, combustion, carbonization, and liquefaction, including work for the Federal Geological Survey, accounted for another 7,713 samples. The coal-mine inspectors and engineers of the Health and Safety Branch submitted 6,623 samples of coal-mine dusts from the Nation's larger producing coal mines.

Increasing concern over depletion of high-grade coking-coal deposits led to the development of additional reserves of coal for making metallurgical coke. Two investigations to determine minable reserves of coking coals were completed, one in Maryland, where about 500,000,000 tons of coal that by suitable preparation methods could be used for making metallurgical coke were indicated, and one in Alabama, where a 14,000,000-ton reserve in thin beds was indicated. Another investigation was continued to determine the amount and coking quality of coal in Gunnison County, western Colorado, that could supply needed coking coal for the western steel industry. In Alaska, an investigation of bituminous-coal reserves was started in the Matanuska field.

The practicability of using scrapers and other light earth-moving equipment for strip-mining areas of limited extent and with moderate overburden was shown in a study completed this year. The efficacy of a scraper-shaker-loader designed by the Bureau was demonstrated, and minor improvements in design are being made before the machine is again placed in test operation. A special type of shearing machine was proved by underground tests to be particularly suited for cutting steeply pitching anthracite beds. Designs were completed and construction was started on a coal planer with vibrating blades to simultaneously shear off and load coal in longwall mining.

Factory tests and examination of tunnel air during construction of the Delaware aqueduct showed that the carbon dioxide, carbon monoxide, and oxides of nitrogen content of the air in Diesel exhausts did not increase to a prohibitive amount; also, the oxygen content of the air was not depleted to any significant extent.

Continuing its program to eliminate the hazards to life and property in the manufacture, storage, and use of explosives, the Bureau conducted over 2,300 tests on permissible explosives and blasting devices, new types of industrial explosives seeking to utilize surplus military stores, and hazardous chemical materials. Six new explosives were added to the permissible list, raising the total number approved to 186. To meet the requirements of increased mechanization in coal mines, a reevaluation of the Bureau's permissibility tests has been undertaken; and, after 650 large-scale tests in the Experimental mine, permanent approval was given for an increase in the maximum charge weight of permissible explosives from 1.5 to 3 pounds per shot.

Another approach to the problem of providing critically needed coking coal was followed in the Bureau's studies of upgrading high-sulfur or high-ash coals to make them suitable for metallurgical use. Such preparation studies

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were made in connection with the coal-investigation project in Maryland, where several hundred million tons of additional coking coal reserves are indicated, provided that the sulfur and ash can be reduced to a suitable figure. Limitations of present preparation methods to reduce sulfur content to meet metallurgical standards was shown in a study of coal from an area in western Pennsylvania estimated to contain half the recoverable coal in the Pittsburgh bed in this State. A systematic study of typical commercial preparation plants was initiated to appraise the factors that limit and influence the beneficiation of lower-grade coals, and field work at two plants has been completed. A method for recovering fine-size coking coal formerly wasted has been developed by the Bureau and is now in commercial use. Analysis of data obtained in a survey of coal-preparation practices in western Europe disclosed new ash-removal methods and technological developments that will be of value to the American coal industry. These included methods of preparing very low ash coals for the synthetic liquid-fuel industry and use of a cyclone coal washer for cleaning fine coal and clarifying washery water. Construction of the building to house the coal-preparation pilot plant at Bruceton, Pa., was completed, and equipment is being installed.

Research in subbituminous coal and lignite on a pilot scale indicated the efficacy of a steam-drying process that would expand the market area for these coals and permit their storage for long periods.

Types of fuel and fuel-burning equipment were determined for 38 new hospital projects of the Veterans Administration. At the request of the Navy, a program giving special instructions to Navy personnel on inspecting and sampling coal at Navy land stations was well-started, many stations being visited. Improvements were made in boiler-water conditioning for Federal boiler plants, and improved test procedures were devised for control of chemical treatment. Research was started on a new chemical for preventing corrosion in condensate return lines that gives promise of being much cheaper.

Research work was continued on corrosive external deposits on boiler equipment that cause excessive boiler outage and maintenance expense. One phase of this work has resulted to date in substantial improvement in the maintenance and operation of air preheaters throughout the United States.

Basic factors have been evaluated in the Bureau of Mines study of corrosion of boiler tubes. Field and laboratory studies of protective coatings to provide corrosion resistance are showing very promising results. Investigations of heat absorption and effect of coal-ash slag on operation of large central-station boiler furnaces was continued in laboratory and field studies. Eight tests of a gas producer designed to make rock wool and gas from Rhode Island anthracite have indicated the desirability of using preheated air for the blast. The volume of smoke produced by packaged fuels of various types was investigated in tests simulating domestic furnace conditions.

Aiding in the search for new coking coals to replace depleted reserves, the Bureau of Mines continued its investigation of the carbonizing properties



of American coals, with tests on one coal each from Kentucky and Virginia, four from Pennsylvania, and five from Alabama. Similar tests were made on one coal from Venezuela and on three samples of asphaltic material from Argentina. Study of effect of coal size upon carbonizing properties indicated improvement of coking properties for the smaller sizes of some coals. Complete gasification of lignite was obtained by using an externally heated alloy retort for production of gas and char and fluidized-bed producer for gasification of the char.

The possibilities of efficiently using some of our coal resources without extensive underground work and of utilizing beds that cannot be mined economically has aroused Nation-wide interest in the underground gasification of coal. In January the Alabama Power Co. and the Bureau of Mines began an experiment with this method at Gorgas, Ala., where an isolated block of coal was ignited and gasified with various combinations of air, oxygen, and steam. The results of this exploratory test were favorable in that the coal was fully consumed in the gasified area and the roof rock expanded to occupy the space left as the coal was used up. However, the heating value of the gas was low. Further tests should be made.

Construction of the facilities required to carry on the Bureau's program of synthetic liquid-fuel research and demonstration has been hampered by wartime and postwar shortages of men and materials ever since the work was authorized in 1944. Nevertheless, three of the four major installations were completed or approaching completion at the end of the 1947 fiscal year.

Several new and improved methods that promise lower costs for gasoline and oil from coal are under development at Pittsburgh and at Bruceton, Pa., where new pilot plants are nearing completion.

A coal-hydrogenation demonstration plant to produce 200 barrels of gasoline a day is under construction at Louisiana, Mo. The site of this plant is the Missouri Ordnance Works, which was made available to the Bureau by the War Department.

Much information, unavailable during the war, on the mining, preparation, and utilization of coal in Germany and other European countries was widely disseminated to industry through distribution of published and microfilmed reports containing data gathered by Bureau of Mines personnel and other investigators while on foreign assignment.