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INTRODUCTION

This report summarizes the research and technologic work of the Bureau of Mines on coal and coal products from July 1, 1947, to July 1, 1948. It is the thirteenth of a series presenting résumés based largely upon publications issued during the year. In some instances, research and testing results, not otherwise available in published form, are presented. The individual publications given as footnote references herein will provide further detail to the interested reader.

The period covered by this report was marked by an ever-mounting concern for the adequacy of the Nation's fuel resources and for fuel shortages arising from an increasing demand for fuels at home and abroad. Several reports appeared which delineated the place of synthetic liquid fuels in the future fuel technology and economy of the Nation, emphasized the fact that eventually the principal raw material for the production of such fuels will be ⁴, ², ⁶ coal, and described the

⁴ Fieldner, A. C., Synthetic Liquid Fuels from Coal and Oil-Shale: Ohio State University Engineering Experiment Station News, vol. 20, No. 1, 1948, pp. 22-28.

² Schroeder, W. C., Synthetic Liquid Fuels in the United States: Mech. Eng., vol. 69, No. 2, December 1947, pp. 989-995.

⁶ Schroeder, W. C., Comparison of Major Processes for Synthetic Liquid Fuels: Chem. Ind., vol. 62, No. 4, 1948, pp.

progress made by the Bureau of Mines in developing processes for the production of synthetic liquid fuels. Congressional committees 7, 8, 9 heard testimony along similar lines.

Increased awareness of the fuels problems confronting the Nation led to an authorization by the 80th Congress for the erection of an anthracite research laboratory at Schuylkill Haven, Pa., to house expanded Bureau of Mines research on anthracite. Design of the structure was well under way by the end of the fiscal year. (See fig. 1.) Looking forward to expansion of Bureau research on lignite, the 80th Congress heard testimony on the problems and programs of lignite research 10, 11 as a prelude to authorizing the construction of a lignite research laboratory in North Dakota.

SUMMARY

As peacetime demands for coal continued at peak levels and the coal industry successfully increased production to meet that demand, additional emphasis was placed on the Bureau of Mines research program of increased efficiency, conservation, and safety in the mining, preparation, and utilization of coal.

Implementing the conservation in utilization of coal phase of this program, the Bureau rendered service to Federal agencies that involved consultations on the purchase of fuel and fuel-burning equipment, testing fuels and boiler-room equipment, analyzing boiler water, recommendations on boiler-water chemical treatment, supplying boiler-water test kits, and sampling and analyzing coal. These services

- 7/ Schroeder, W. C., Statement on Synthetic Liquid Fuels, Hearing before the House of Representatives Committee on Interstate and Foreign Commerce: 80th Cong., 2d Sess., Mar. 4 and 5, 1948, U. S. Govt. Printing Office, Washington, D. C., 1948, pp. 8-36.
- 8/ Schroeder, W. C., Statement on Synthetic Liquid Fuels, Hearings before the House of Representatives Special Subcommittee on Petroleum of the Committee on Armed Services: 80th Cong., 2d Sess., Feb. 23, 1948, U. S. Govt. Printing Office, Washington, D. C., 1948, pp. 616-637.
- 9/ Schroeder, W. C., Statement on Synthetic Liquid Fuels published in Hearings before the Subcommittee on Mines and Mining of the Committee on Public Lands, House of Representatives: 80th Cong., 1st Sess., on H. R. 2161. Demonstration Plants to Produce Synthetic Liquid Fuels: Committee Print 14, U. S. Govt. Printing Office, Washington, D. C., June 9, 1947, pp. 2-4.
- 10/ Fieldner, A. C., Statement on the Establishment of a Research Laboratory in the North Dakota Lignite-Consuming Region: Hearing before a Subcommittee of Senate Committee on Interior and Insular Affairs, 80th Cong., 2d Sess., Feb. 19, 1948, U. S. Govt. Printing Office, Washington, D. C., 1948, pp. 16-18. Statement on same subject, Hearings before Subcommittee on Mines and Mining of the Committee on Public Lands: House of Representatives, 80th Cong., 1st Sess., Committee Print 14, U. S. Govt. Printing Office, Washington, D. C., June 7, 1947, pp. 24-26.
- 11/ McCabe, L. C., Statement on the Establishment of a Research Laboratory in the North Dakota Lignite-Consuming Region: Hearings before Subcommittee on Mines and Mining of the Committee on Public Lands, House of Representatives, 80th Cong., 1st Sess., June 27, 1947, Committee Print 14, U. S. Govt. Printing Office, Washington, D. C., pp. 32-33.

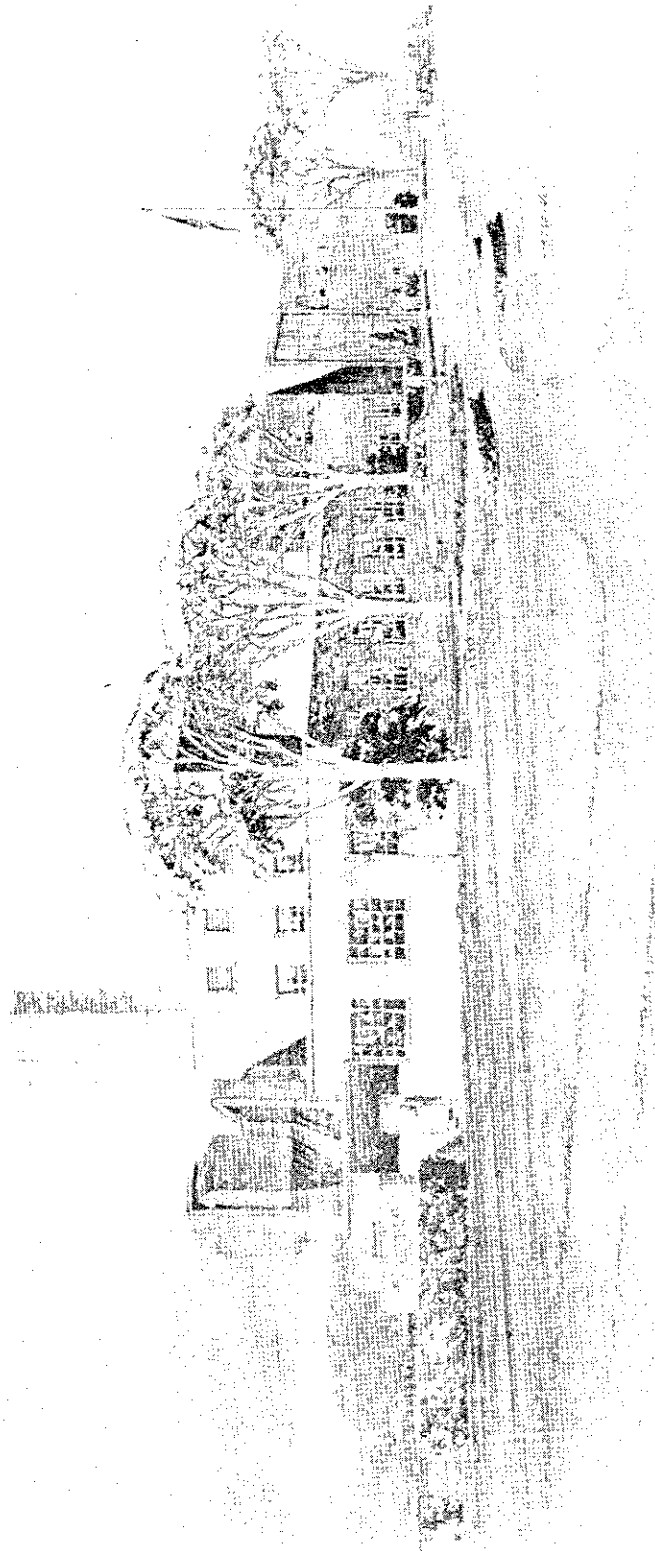


Figure 1. - Anthracite Research Laboratory, Schuylkill Haven, Pa.

required the analysis of 6,841 coal samples. In addition, 6,334 samples of coal and coal products were analyzed in the course of Bureau of Mines research and test work on mining, preparation, and utilization of coal. To assist Federal coal-mine inspectors in making safety recommendations at the larger coal mines, 9,485 coal-dust samples were analyzed.

Various investigations of coal deposits by core drilling to provide supplies of coal in fuel-short areas and to augment our depleted deposits of coking coal were continued. In Washington, a reserve of over 8 million tons of lignite was proved of which 5,300,000 are considered minable by stripping methods. In Oregon, drilling proved 13,600,000 tons of minable reserves of coal. In Rhode Island drilling demonstrated the lack of continuity of the meta-anthracite deposits. Investigations of deposits in Colorado, Maryland, North Carolina, and Alaska were continued.

The Bureau-designed scraper-shaker loader for mechanical mining of anthracite was improved by further modification. As the effectiveness of special shearing machines had been proved, plans were made to use these machines in establishing mechanical mining systems for removing thick bed pillars in anthracite, a project that may permit recovery of millions of tons of coal now lost underground.

The possibility of removing noxious aldehydes from the exhaust of Diesel engines underground by scrubbing was demonstrated, and 55 approvals for various items of electrical equipment for use underground in coal mines were given. Two-way radio communication was shown to be satisfactory for use underground, and various safety practices in coal mines were investigated and either recommended or disapproved. It was shown that rock dusting would prevent dust explosions in underground workings when carried to within 40 feet of the working face and that a minimum of 65 percent incombustible matter must be maintained in the dust. The Bureau carried out over 1,600 tests on permissible explosives and blasting devices, types of explosives, detonators, and hazardous explosives, and the list of permissible explosives was increased to 191. A satisfactory permissible multiple-shot blasting unit was developed.

Increasing mechanization of coal mining and the necessity of substituting lower-grade coals have placed added emphasis on preparation as a means of providing suitable coal supplies. Research in this field resulted in the development of a new cleaning and dewatering process for fine-size coal and in further refinement of the cyclone washer for cleaning fine coal and clarifying washery water. The efficacy of washing in beneficiating coking coals as a means of offsetting depletion of these valuable coals was demonstrated on Maryland coal beds, and a fundamental study of the forms of sulfur in bituminous coal promises aid in solving the problem of providing adequate supplies of metallurgical coal so essential to our national security and peacetime economy. Conservation of our dwindling supplies of high-rank coal requires that means be devised to utilize our low-rank coals. To this end, Bureau research went forward on the development of a flash-drying process for subbituminous coal which has considerable promise for the efficient removal of moisture. The study of storage of low-rank coals provided valuable data that will be used in studying the storage of millions of tons of lignite being excavated from a dam site in North Dakota.

Fuel-engineering service to Government establishments by the Bureau of Mines resulted in marked operational savings, particularly at Army and veterans' hospital installations. Valuable information obtained in the course of experience with

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Government plants was disseminated to industry as an aid toward increasing the efficiency of fuel utilization throughout the country.

During the fiscal year, analyses and recommendations were made on 8,180 samples of boiler water from various Government boiler plants. Research on the treatment of boiler water has resulted in developments that will reduce the cost of treatment. Chemicals and methods for controlling intracrystalline cracking in boilers were developed.

Techniques were developed for determining the temperature and composition of gases in pulverized-coal-fired furnaces, an important contribution to conservation, since it improves the thermal efficiency of coal combustion and increases our ability to burn a wide range of grades of coal.

As part of its program of augmenting our depleted reserves of coking coal, the Bureau of Mines obtained complete data on the carbonizing properties of two West Virginia coals and one each from Kentucky and Mexico. Additional tests were made on 47 other coking coals or blends of coking and noncoking coals. Particular attention was paid to the swelling properties of coal during the coking process, and the plasticity of coals and oxidation of coal were shown to have a deleterious effect upon carbonizing properties of many coals. Investigation of the production of gas and char by gasification of lignite in an externally heated alloy retort was continued, and it was demonstrated that such methods can operate at high thermal efficiencies.

Several publications on coal mining and technology in Europe and particularly in Germany have provided data heretofore unavailable.

Continuing its investigation of the feasibility of exploiting coal deposits through gasification underground, Bureau of Mines investigators devised a laboratory-scale retort that has provided experimental data on the factors involved. Preparations were made to conduct a second field-scale gasification experiment at Gorgas, Ala., in cooperation with the Alabama Power Co.

The Bureau of Mines program on the production of synthetic liquid fuels from coal continued during the year with marked success. Laboratory research and pilot-plant experimentation on the production of synthesis gas and on the synthesis of liquid fuels from such gas progressed sufficiently to permit design of an 80- to 100-barrel-per-day Demonstration Plant at Louisiana, Mo., and construction of the plant was in its initial stages at the end of the fiscal year. With the construction of the 200- to 300-barrel-per-day Coal-Hydrogenation Demonstration Plant at Louisiana, Mo., over 80 percent complete, laboratory research designed to meet problems which may be encountered during operation of the plant was continued. New laboratories to house synthetic liquid fuels research were completed at Bruceton, Pa. (See fig. 2.)

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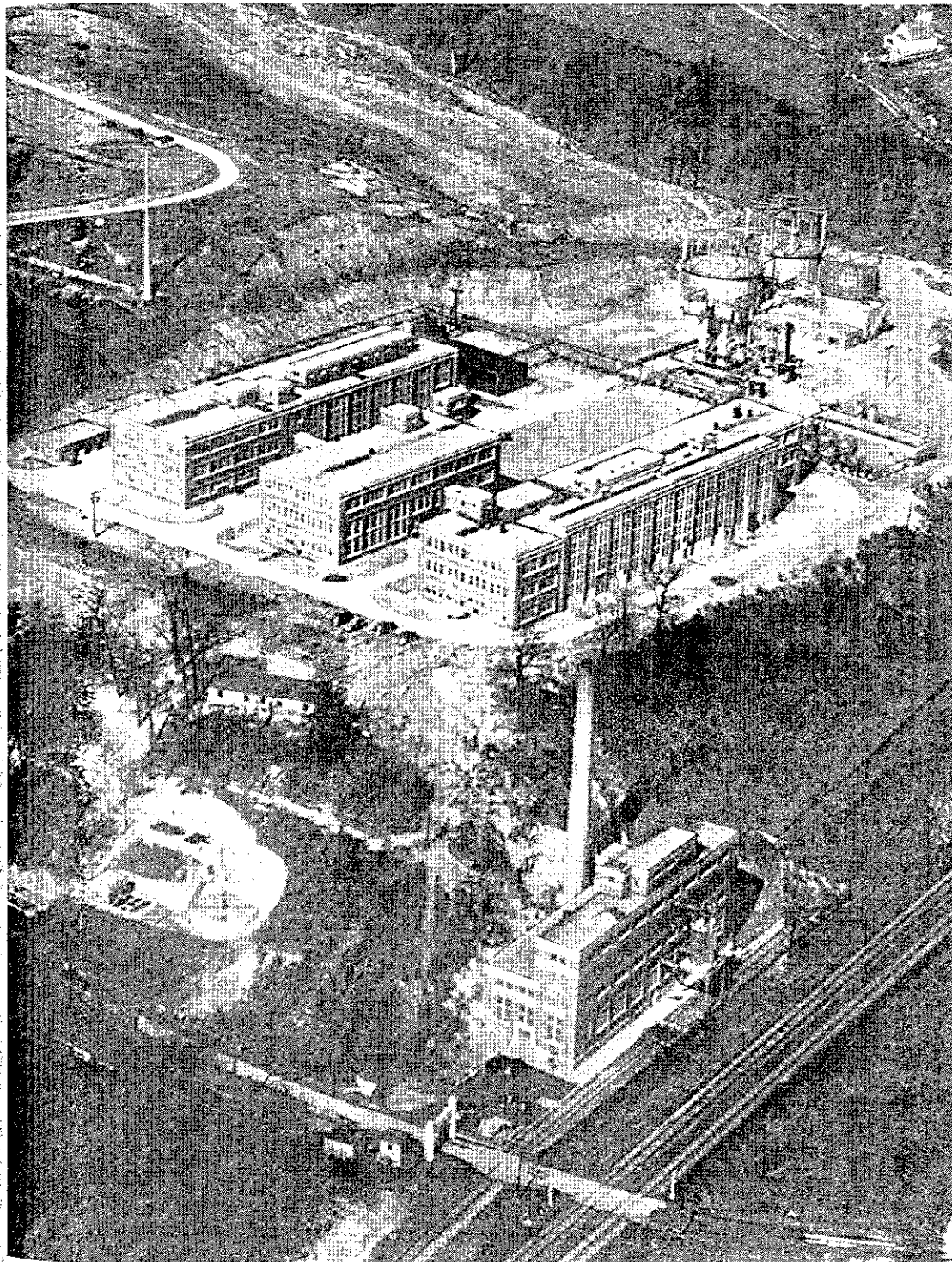


Figure 2. - Air view of synthetic liquid fuels laboratories and pilot plants at Bruceton, Pa.

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ORIGIN, COMPOSITION, AND PROPERTIES OF COAL

Inspection, Sampling, and Analysis

Demand for coal for domestic use and export exceeded supply during the year, and the better grades were difficult to obtain. With some exceptions, Government agencies were able to obtain bids on their coal requirements, although in many instances coal of the desired quality was not offered. Coal was purchased on a guaranteed analysis basis, including penalties for delivery of substandard coal, by the Bureau of Prisons, U. S. Department of Justice, Office of Indian Affairs, U. S. Department of the Interior, War Department in scattered areas, and for export. Some purchases were made at a fixed price, subject to adjustment by negotiation for delivery of substandard coal, and other purchases were made at a fixed price not subject to adjustment for quality. Coal requirements of Federal agencies for the fiscal year were estimated at approximately 5,145,000 tons. The Navy Department purchased coal for both the Army and Navy and was by far the largest Federal purchasing agency for coal. Recommendations were made for awards of contracts for some agencies, and other agencies were furnished analyses to evaluate coal bids and substitute coals offered.

Upon the request of the War and Navy Departments, a program for the inspection and sampling of coal exported to the occupied countries was begun in April. The coal was purchased on a guaranteed analysis basis with penalties for delivery of substandard coal. To the end of the fiscal year about 120,000 tons had been inspected and sampled.

For the use of various Government agencies in making coal purchases and for public information, 424 tipple and face samples were collected at 154 mines in 8

States. For research on carbonization, grindability, free swelling, and other properties of coal, 262 samples were collected in 185 mines.

Proximate or ultimate analyses were made of 4,298 samples, and fusing-temperature determinations were made on 2,119 samples in connection with Government purchases, tippie and breaker inspections, and coal exported to Japan and Europe. Two-thirds of the samples were analyzed for the War and Navy Departments and the remainder for other Government departments and agencies.

Research and test work by the Bureau of Mines relating to mining, preparation, and utilization of coal and coal products required analyses of 5,739 samples. Analyses were made of 605 samples of marine sediments submitted by the Geological Survey which were obtained from drill cores taken from the floor of the Gulf of Mexico.

Analyses were made of 9,485 samples of road, roof, rib, and gob dusts from approximately 1,500 coal mines in 18 States. These analyses were made to assist Federal coal-mine inspectors in determining whether corrective recommendations were necessary at specific mines and in formulating the recommendations where required.

Analyses of Michigan, North Dakota, South Dakota, and Texas Coals

The analyses of coals from four States - Michigan, North Dakota, South Dakota, and Texas - have been published in a technical paper^{12/} as another in a series describing coals of various States. The geology of the coal fields, methods of mining, production, distribution, uses, and the relationship of mine samples to commercial shipments were discussed. Descriptions of tippie, face, and delivered samples included chemical analyses, calorific values, classification by rank, agglomerating index, and fusibility of ash temperatures. Descriptions were given of the location, thickness of bed, nature of floor and roof, and partings. Maps showing the areas known to contain coal were included.

Analyses of Miscellaneous Materials

Chemical analyses to aid in various investigations of the Bureau concerning coal utilization and safety in mines required tests of 123 samples of miscellaneous materials.

These included complete analyses of 20 boiler scales or water-formed deposits and of 7 boiler compounds to assist in formulating recommendations for feed-water treatments at various Government-agency steam plants. Two external deposits from boiler tubes were examined and the presence of boron as the equivalent of 11.8 percent B_2O_3 , in one of the deposits was confirmed.

As part of an investigation of materials, available in coal fields, that are suitable for rock-dusting coal mines, 30 samples submitted by rock-dust producers and mine operators were examined. Tests of limestones from five deposits in four coal-mining States proved them to be suitable for use as rock dust in preventing coal-dust explosions. Thirteen samples of various substitutes for limestone dust

^{12/} Fieldner, A. C., Huddle, J. W., Andrews, D. A., Toenges, A. L., Bell, C. H., Anderson, R. L., Snyder, N. H., Cooper, H. M., Abernethy, R. F., and Tarpley, E. C., Analyses of Michigan, North Dakota, South Dakota, and Texas Coals: Bureau of Mines Tech. Paper 700, 1948, 106 pp.