dolomite, kaolinite, melanterite, and pyrite.[13] A discussion on the occurrence and formation of analcite is included. The presence of analcite indicates that waters penetrating the joint cracks of the juvenile coal bed were alkaline in their reaction.

COAL MINING

Experimental Mine and Dust Explosions

Demonstrations

Educational demonstrations of the hazards of mine explosions and of means for their prevention were continued during the year for the benefit of workers and officials of the coal-mining industry, and for mining students. Two large public demonstrations, attended by 1,500 people, and many smaller ones were given at the Experimental coal mine. The second large demonstration, which was held a few weeks after the Centralia coal-mine explosion, aroused Nation-wide interest. A new feature that was demonstrated was the violent character of the explosion of a natural gas-air mixture in a mine entry with the mixture containing only 90 cubic feet of natural gas.

In connection with two large safety meets held by mining groups in Kentucky, a member of the staff gave several coal dust explosion demonstrations and exhibited the inhibiting effect of rock dust.

A color motion picture of one of the large Bruceton demonstrations was shown at the annual exhibit of the American Mining Congress in Cleveland, Ohio. Motion pictures of the demonstrations were also shown in newsreels throughout the country.

Technical Assistance and Services to Others

Continued assistance was given in the preparation of safety codes on dusting explosion prevention and on explosion pressure release by committees of the National Fire Protection Association, and in the preparation of safety digests by the National Safety Council. Technical consulting advice was also rendered on dust-explosion prevention and other miscellaneous safety problems to the War Department, the Department of Agriculture, the National Advisory Committee for Aeronautics, State labor departments, insurance associations, and numerous manufacturers.

Coal was mined from the Experimental mine and prepared for studies on hydrogenation, carbonization, and combustion by the Coal and Synthetic Liquid Fuels Divisions. The mine was made available to the Safety Division for investigating underground communication systems and for studies of trip lights on mine cars. During the year about 100 technical men, including foreign guests from many countries, visited the laboratories and the mine to become acquainted with the research facilities and test procedures.

13/ Foster, Wilder D., and Feicht, Florence L., Mineralogy of Concretions from Pittsburgh Coal Seam, with Special Reference to Analcite: Am. Mineral., vol. 31, Nos. 7 and 8, July-August 1946, pp. 357-364, incl.

Coal Investigations

Coal Creek, Gunnison County, Colo.

Additional sources of coking coal west of the Continental Divide are needed for western steel plants; and as the analyses of coal obtained in diamond-drill cores in a hole drilled in Gunnison County, Colo., at the confluence of Anthracite Creek and the North Fork of Gunnison River indicated that these coals had coking qualities, a reconnaissance was made of the area adjacent to Anthracite, Muddy, Snowshoe, and Coal Creeks. This area is being investigated by diamond drilling.

The interest shown by coal-mine operators in the West in additional reserves of coking coal has made it advisable to publish the preliminary results of the investigation.14/

The area investigated comprises secs. 4, 7, 8, 9, 10, 11, 15, 16, 21, 22, 23, and 28, T. 13 S., R. 89 W., Gunnison County, Colo. The coal and mining rights in most of the land in the area are owned by the Government. The center of the area is approximately 6 miles east of the end of the Denver & Rio Grande Western standard-gage line to Somerset and the Oliver mine.

The topography of the area is mountainous and is traversed by several streams, which unite to form the North Fork of the Gunnison River. Altitudes range from 6,200 feet in the valleys to 8,000 feet on the plateaus. Marcelina and West Beckwith Mountains, east of the area, rise to altitudes over 12,000 feet.

The coal beds occur in the Mesaverde formation of upper Cretaceous age. The coal-bearing members comprise sandstone, shale, and coal beds. The coals, which are bituminous in rank, occur in the strata above the Rollins sandstone. The prevailing dip is approximately 5 percent or 3° northeast.

To date, 18 diamond-drill holes to obtain minimum 2-1/8-inch cores have been drilled to determine the thickness, physical characteristics, and extent of the coal beds and the character of the overlying and underlying strata. One hole to recover 8-inch cores of the coal beds was drilled to obtain enough coal for carbonization tests. The locations of the holes are shown in figure 15, and a condensed log of hole 8-9 follows:

14/ Toenges, Albert L., Turnbull, Louis A., Davis, J. D., and Reynolds, D. A., Investigation of Coal Deposits in the Coal Creek District, Gunnison County, Colo. - Progress Report 1: Bureau of Mines Rept. of Investigations 4104, 1947, 20 pp.

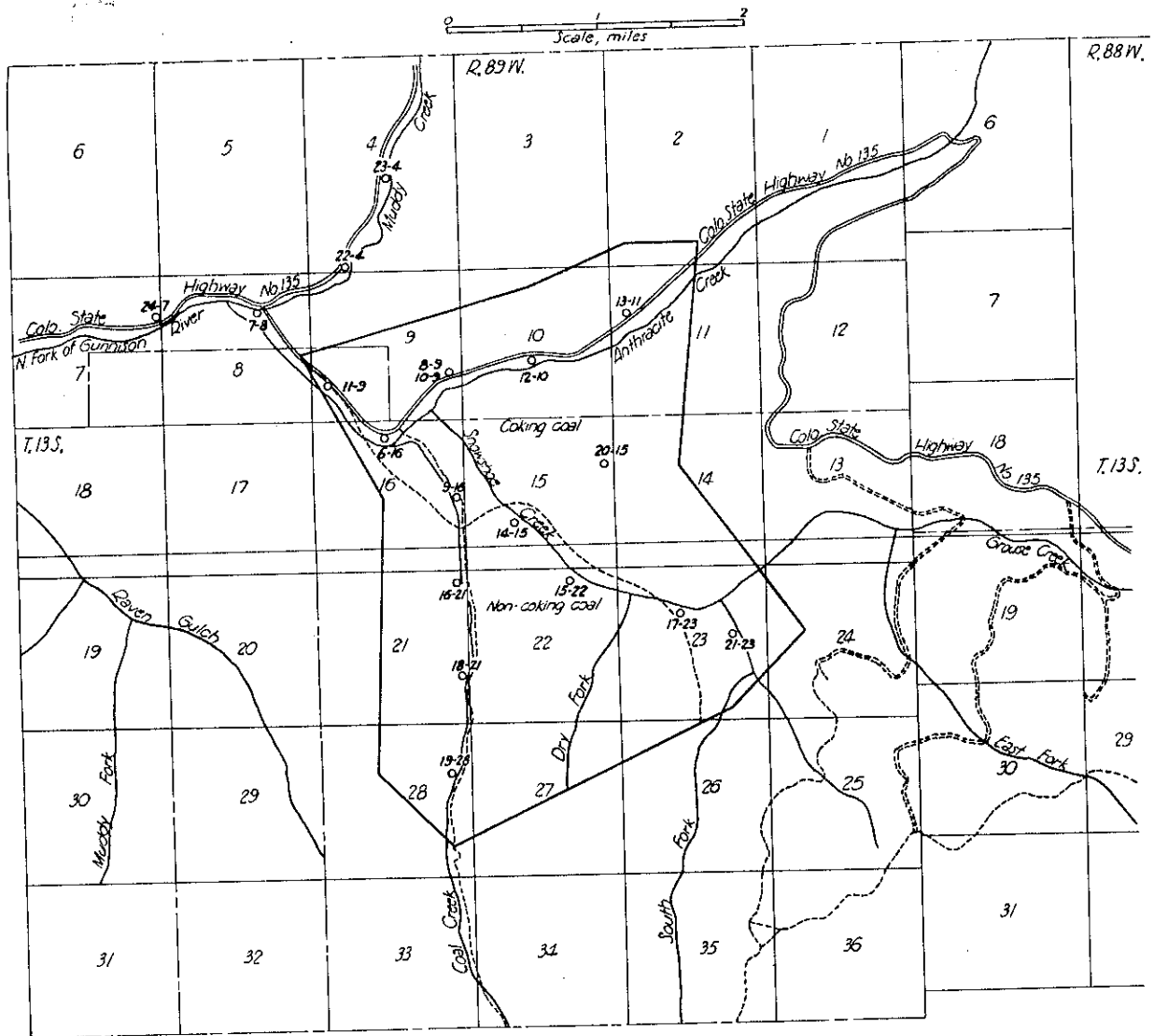

Figure 15. - Diamond drilling in Coal Creek area, Gunnison County, Colo.

Hole 8-9

Location: 1,500 feet N. and 600 feet W. of SE. corner, sec. 9, T. 13 S., R. 89 W.
Surface elevation: 6,447 feet.

Depth From Feet	Depth From Inches	Depth To Feet	Depth To Inches	Material	Thickness Feet	Thickness Inches	Remarks
0	0	908	0	Shale, sandstone, and thin coal beds.	908	0	
908	0	929	3	Medium sandstone containing carbonaceous material.	21	3	
929	3	933	9	COAL.	4	6	
933	9	934	8-1/2	Carbonaceous shale.		11-1/2	
934	8-1/2	934	9-1/2	Bony coal.		1	
934	9-1/2	942	6	Carbonaceous, sandy shale.	7	8-1/2	
942	6	943	0	Bone.		6	
943	0	950	0	COAL.	7	0	
950	0	952	7-1/4	Mottled, gray, silty shale and carbonaceous shale.	2	7-1/4	
952	7-1/4	953	8-3/4	Carbonaceous shale.	1	1-1/2	
953	8-3/4	954	2-1/4	COAL.		5-1/2	
954	2-1/4	955	11-1/4	Carbonaceous shale.	1	9	
955	11-1/4	962	6	COAL.	6	6-3/4	
962	6	963	2	Sandy bone.		8	Top of Rollins sandstone 963 feet.
963	2	972	9	Medium to coarse sandstone with plant casts and scattered streaks of carbonaceous material.	9	7	
972	9	1003	0	Medium sandstone with abundant halymenites.	30	3	

The chemical analyses of the coal beds penetrated in hole 8-9 are given in table 4.

TABLE 4. - Analyses of coal cores, Coal Creek, Gunnison County, Colo.

Lab. No.	Drill hole	Conditions[1]	Proximate, percent: Moisture	Volatile matter	Fixed carbon	Ultimate, percent: Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Calorific value, B.t.u.	Ash-fusion temperatures, °F.[2]	Agglutinating index[3]
C-50797	8-9	1	2.7	40.0	53.8	3.5	.8	5.8	78.0	1.7	10.2	14,030	2,180 IDT	5.2
929' 3"-933' 9"		2	-	41.1	55.3	3.6	.8	5.6	80.1	1.8	8.1	14,420	2,420 ST	
		3	-	42.6	57.4	-	.9	5.8	83.1	1.8	8.4	14,960	2,620 FT	
C-50757	8-9	1	2.3	39.7	52.0	6.0	.5	5.6	76.4	1.7	9.8	13,690	2,210 IDT	5.8
943' 0"-950' 0"		2	-	40.7	53.2	6.1	.5	5.5	78.2	1.7	8.0	14,020	2,310 ST	
		3	-	43.3	56.7	-	.6	5.8	83.3	1.9	8.4	14,930	2,600 FT	
C-50758	8-9	1	2.3	38.3	51.4	8.0	.6	5.5	74.6	1.6	9.7	13,350	2,800 IDT	5.2
955' 11-1/4 - 962' 6"		2	-	39.2	52.7	8.1	.6	5.4	76.4	1.7	7.8	13,670	2,850 ST	
		3	-	42.7	57.3	-	.7	5.8	83.1	1.8	8.6	14,880	2,910+ FT	

1/ 1. Sample as-received; 2. Dried at 105° C.; 3. Moisture- and ash-free.
2/ IDT - Initial deformation temperature; ST - Softening temperature; FT - Fluid temperature.
3/ Ratio silicon carbide:coal, 15:1, crushing strength in kilograms.

The results obtained in diamond drilling show that the minable coal beds exist near the base of the coal-bearing formations immediately above the Rollins sandstone. Three coal beds were found to be reasonably persistent at this horizon. The Upper bed, in secs. 9, 10, and 11 and the north half of secs. 15 and 16, ranges from 3 feet 9 inches to 5 feet 3 inches in thickness. In other parts of the area, this bed apparently is not minable. The Middle bed is fairly persistent at minable thickness throughout the area. It ranges in thickness from 4 feet to 10 feet 3 inches, except in hole 9-16, where it is only 1 foot 10 inches thick. However, drilling indicated that this bed is part of the Lower bed in some places, as shown in the logs of holes 14-15, 15-22, 17-23, and 21-23. The Lower bed is the most persistent in thickness and extent throughout the area. The thickness of this bed ranges from 6 feet 4 inches to 14 feet 10 inches, except in holes 16-21, 18-21, and 19-28, where the bed is very thin. These three holes are on Coal Creek, at the southern end of the area drilled, and it is evident that the Lower bed is not present at minable thickness in this particular area.

The additional work to be done in the Coal Creek district will furnish more data regarding the thickness and continuity of these three beds.

Preliminary estimates of measured reserves of coal in the area tested by drilling to date, are as follows:

	Tons
Coking coal	65,000,000
Noncoking coal	35,000,000
	100,000,000

The recovery in mining should range from 70 to 80 percent of the total reserves.

The first hole drilled at this project (6-16) encountered a small amount of oil and a strong flow of gas at a depth of 400 feet, about 250 feet above the upper minable coal bed. Samples of the oil were analyzed at the Bureau of Mines Petroleum and Oil-Shale Experiment Station, Laramie, Wyo. The results of those analyses show the oil to be a low-gravity, naphthenic oil, which contains no gasoline or kerosine and has no lubricating qualities. Evidently, the oil has little commercial value except as cracking stock in a refinery.

Gas was found in most of the holes, and the quantities and pressures were especially large in hole 19-28 and other holes on Coal Creek. The gas apparently is present in several hundred feet of strata above the coal beds, as well as at the horizon of the coals, and must be considered in planning mining operations.

A strong flow of water also was found in hole 19-28 at about the horizon of the coal beds. No doubt, the intensity of this flow was increased by the pressure of the gas in the hole. Water was found in other holes, but not in amounts that would affect mining operations adversely.

The cores from hole 10-9 were large enough to be carbonized by the Bureau of Mines-American Gas Association (BM-AGA) method, using 13-inch-diameter cylindrical retorts of about 85 pounds capacity. Table 5 gives the yields of carbonization products at 900° C., and table 6 gives the physical properties of the cokes. Corresponding results for Sunnyside coal, Sunnyside mine, Carbon County, Utah, are included in both tables for comparison.

The drilled samples yielded more coke, gas, and tar and less liquor than the Sunnyside coal, although the differences were small. The Lower bed (286) gave the highest yield of coke (65.2 percent); the Middle bed (285) yielded the most gas (18.1 percent); and the Upper bed (284) gave the highest yield of tar (7.5 percent). Differences in the yields of liquor, ammonium sulfate, and light oil probably are not significant.

The quality of the cokes obtained from the drilled samples may be judged by comparing their strength-test indexes with those of the coke obtained from Sunnyside coal under identical test conditions. The coking properties of Sunnyside coal are well-known, and the sample used in this study was representative of the bed. These data indicate that the Upper and Lower beds coke more strongly than the Sunnyside bed. The Middle bed yielded weaker coke than the Upper and Lower beds; it was slightly inferior to Sunnyside coke. Technologists of the Columbia Steel Co. judge their coke largely by the proportion that remains on the 1/2-inch screen in the tumbler test, which, in their opinion, should be 80 percent or more. By that standard the cokes from the Upper and Lower beds would qualify as metallurgical grade.

The chemical composition of the cokes from all three beds was satisfactory. The cokes from the Upper, Middle, and Lower beds contained 6.3, 8.3, and 10.9 percent ash and 0.9, 0.5, and 0.4 percent sulfur, respectively.

Additional diamond drilling will be done and carbonization tests made on coal in another part of the area. Final estimates of reserves and conclusions as to the coking quality of the coals cannot be made until the investigation is completed.

Coking-Coal Deposits on Lookout Mountain, DeKalb and Cherokee Counties, Ala.

An area comprising about 140 square miles on southern Lookout Mountain in DeKalb and Cherokee Counties, Ala., was investigated for coking coal.15/ Six coal beds 18 inches or more in thickness are represented in this area, but this project was confined principally to the third bed, correlated as the Upper Cliff No. 1 seam, and indicated by preliminary investigation as being a low-volatile, high-grade coking coal. In all, 95 holes were drilled. The very friable nature of the coal made it difficult to recover complete cores; but the coal was found to have good coking qualities, making it suitable for blending with high-volatile coking coal for the production of metallurgical coke.

15/ Coulter, Don M., Coking-Coal Deposits on Lookout Mountain, DeKalb and Cherokee Counties, Ala.: Bureau of Mines Rept. of Investigations 4030, 1947, 89 pp.

TABLE 5. - Yields of carbonization products, as-carbonized basis

Coal no.	Description	Yields, percent by weight of coal							Yields per ton of coal			
		Coke	Gas	Tar	Light oil	Free ammonia	Liquor	Total	Gas, cubic feet	Tar, gallons	Light oil, gallons in gas	$(NH_4)_2SO_4$, pounds
284	Upper core	64.2	17.4	7.5	0.85	0.124	7.7	97.8	10,800	15.7	2.35	21.7
285	Middle core	64.5	18.1	6.7	.95	.128	7.0	97.4	11,100	13.8	2.62	20.4
286	Lower core	65.2	17.3	7.2	.87	.120	7.3	98.0	10,500	15.0	2.43	20.9
276	Sunnyside	64.1	17.0	6.4	.93	.101	8.6	97.1	10,550	13.2	2.54	16.4

TABLE 6. - Physical properties of coke, determined by Columbia Steel Co. methods

Coal no.	Description	Shatter test, cumulative percent, upon -				Tumbler test, cumulative percent, upon -			
		1-1/2-inch screen	1-inch screen	3/4-inch screen	1/2-inch screen	1-1/2-inch screen	1-inch screen	3/4-inch screen	1/2-inch screen
284	Upper core	51	81	88	94	22	62	71	80
285	Middle core	28	70	80	91	19	53	64	76
286	Lower core	37	80	89	96	25	65	76	84
276	Sunnyside	43	75	84	92	20	55	65	76

Georges Creek Basin, Md.

The annual production of coal from mines in the Georges Creek field in Allegany and Garrett Counties, Md., has declined from 2,250,000 before 1931 to about 1,800,000 tons in the past few years. The greater part of this production was from mines working in the upper coal beds /Pittsburgh (Big Vein) and Sewickley (Tyson)/, which are approaching depletion after many years of mining. 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.

The coals of the lower beds are low-volatile 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 beds, and the purpose of this investigation was to determine the minable reserves, thickness, physical characteristics, and chemical properties of these coals with the objective of obtaining necessary data for the development of mines in these lower beds. The field investigation has been completed, and data are being assembled and will be published.

Coosa Coal Field, Alabama

Coal mining in the Coosa Coal field, Alabama, has been conducted intermittently for many years. This field, which is east of the Warrior and Cahaba coal fields, is traversed by the main line of the Seaboard Airline Railway and adjacent to the proposed Coosa River development.

Reserves of coking coal in the Warrior field have been seriously depleted, and coals from the Coosa field might prove to be an additional source of metallurgical coke for southern steel plants. Information regarding the continuity and character of the coal beds in the Coosa field was too meager to encourage the development of modern mechanized mines, and this investigation was undertaken to determine the thickness and extent of the coal beds, physical conditions in and surrounding the beds that would influence mining, and the chemical and washability characteristics of the coals.

A reconnaissance of the area was made in the summer of 1945 by Bureau of Mines engineers and geologists of the Federal Geological Survey. Following this reconnaissance, the investigation of the field was undertaken. Operating and abandoned mines in the field, where accessible, were examined, and all maps and other available information regarding abandoned mines were secured. Sections of the Hammond, Brewer, Coal City, and Fairview beds were measured in abandoned and operating mines and in test pits, which were excavated at the outcrop of the Fairview bed. Face samples for petrographic study and chemical analysis were secured at mines in the Hammond, Brewer, Coal City, and Fairview beds. A 1-1/2-ton sample was obtained from the abandoned Soot Creek mine (Fairview bed) for washability tests at the Southern Experiment Station, Bureau of Mines, Tuscaloosa, Ala. The thickness of the