GEOLOGICAL SURVEY CIRCULAR 228

A THICK COAL BED NEAR LAKE DE SMET JOHNSON COUNTY WYOMING

UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

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By William J. Mapel, James M. Schopf, and James R. Gill

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By William J. Mapel

INTRODUCTION

A concealed coal bed that averages more than 100 feet in thickness and locally may be as much as 220 feet thick underlies an area at least 2 1/2 square miles west of a normal fault at the north end of Lake De Smet, Johnson County, Wyo. The coal was found in holes drilled from 1944-51 by the U. S. Bureau of Reclamation, the U. S. Geological Survey, and private individuals. Reserves of coal in this bed and in a thinner bed beneath an area of about 3 square miles east of the fault are estimated to be 528.56 million tons of which 35.40 million tons are measured and the rest indicated and inferred. The coal cannot be classified precisely as to rank but available analytic data indicates that it probably is low within the range of subbituminous C, according to specifications of rank given by the American Society for Testing materials. [1] The top of the coal is less than 100 feet below the surface in much of the area tested by drilling and thus the coal is minable by stripping methods.

Information on the coal deposits of Lake De Smet was obtained during an investigation of the geology and coal resources of a larger area in Johnson and Sheridan Counties, Wyo. as part of the Interior Department's program for the development of the Missouri River Basin. Field work was begun in 1949 and completed in 1951 and a report now is being prepared for publication. Investigation of a possible dam and reservoir site at Lake De Smet was begun by the U. S. Bureau of Reclamation in 1944 and finished in 1951. During this work, a core hole near the north end of the lake penetrated 128 feet of coal, including shale partings, beneath 97 feet of clinker. In order to identify this unusually thick coal bed and to explore its extent and character, the U. S. Geological Survey drilled four core holes near the lake in 1950. Mapel planned and conducted the drilling program with the assistance of C. A. Sandberg, under the general supervision of L. S. Gardner. Schopf and Gill studied the coal cores at the Coal Geology laboratory of the Geological Survey, Columbus, Ohio, and prepared the samples for transmittal to the U. S. Bureau of Mines for chemical analysis. Their report on descriptive and analytic characteristics of this coal is given as part 2 of this publication.

The Yellowstone District Office of the U. S. Bureau of Reclamation kindly furnished the logs of 25 holes drilled for the proposed Lake De Smet reservoir and dam site, and provided topographic maps of the area. Through its cooperation, a truck-mounted core drill was made available for use by the U. S. Geological Survey. D. H. Jepsen and W. J. Witherspoon, Jr., geologists for the U. S. Bureau of Reclamation, made available the results of their geologic investigations of the reservoir site. J. E. Rice of Sheridan, Wyo., furnished the logs of four holes drilled by him on the northwest side of Lake De Smet in August and September, 1950, and Carl Hepp contributed the log of a well drilled in 1944 on his land 3 miles northwest of the lake. R. F. Abernethy, chief, Coal Analysis Section, U. S. Bureau of Mines, supervised coal analytic work and offered valued suggestions with regard to interpretation of some of the analytic results.

LOCATION AND PHYSIOGRAPHY

Lake De Smet and the surrounding area described in this report includes about 40 square miles in the western part of the Powder River basin, northern Johnson County, Wyo. The lake is roughly oval in outline 3 1/2 miles long and 1 1/4 miles wide with its long axis trending northwestward. It occupies a natural undrained basin at the mouth of Shell Creek. Low saddles separate the lake from Piney Creek, about 2 miles to the north, and from Boxelder Creek, about 1 mile to the south. A system of canals was dug in 1923 connecting the lake with Piney Creek. Through these canals, water is diverted from Piney Creek into the lake to be stored and later returned to Piney Creek as needed for irrigation downstream. The surface of the water in the lake can be raised as much as 10 feet above its former high-water level by this means, thus giving the lake a potential storage capacity of about 32,500 acre-feet, and a maximum depth of about 60 feet.

The region is semiarid with mean annual precipitation of about 16 inches. The land surface has moderate relief. Steep-sided divides and buttes capped by resistant clinker east of Lake De Smet appear in marked contrast to the rounded hills west of the lake where clinker is not so abundant. Cottonwood and willow trees grow along the main stream valleys, and a few small patches of juniper are found along the outcrops of clinker and sandstone in the hills.

U. S. Highway 87, a hard-surfaced road that connects the towns of Buffalo and Sheridan, is a half mile west of Lake De Smet. A hard-surfaced road

[1] American Society for Testing Materials, 1949, A.S.T.M. standards on coal and coke: 1949 book of A.S.T.M. standards 5, pp. 575-729, Philadelphia, Pa.

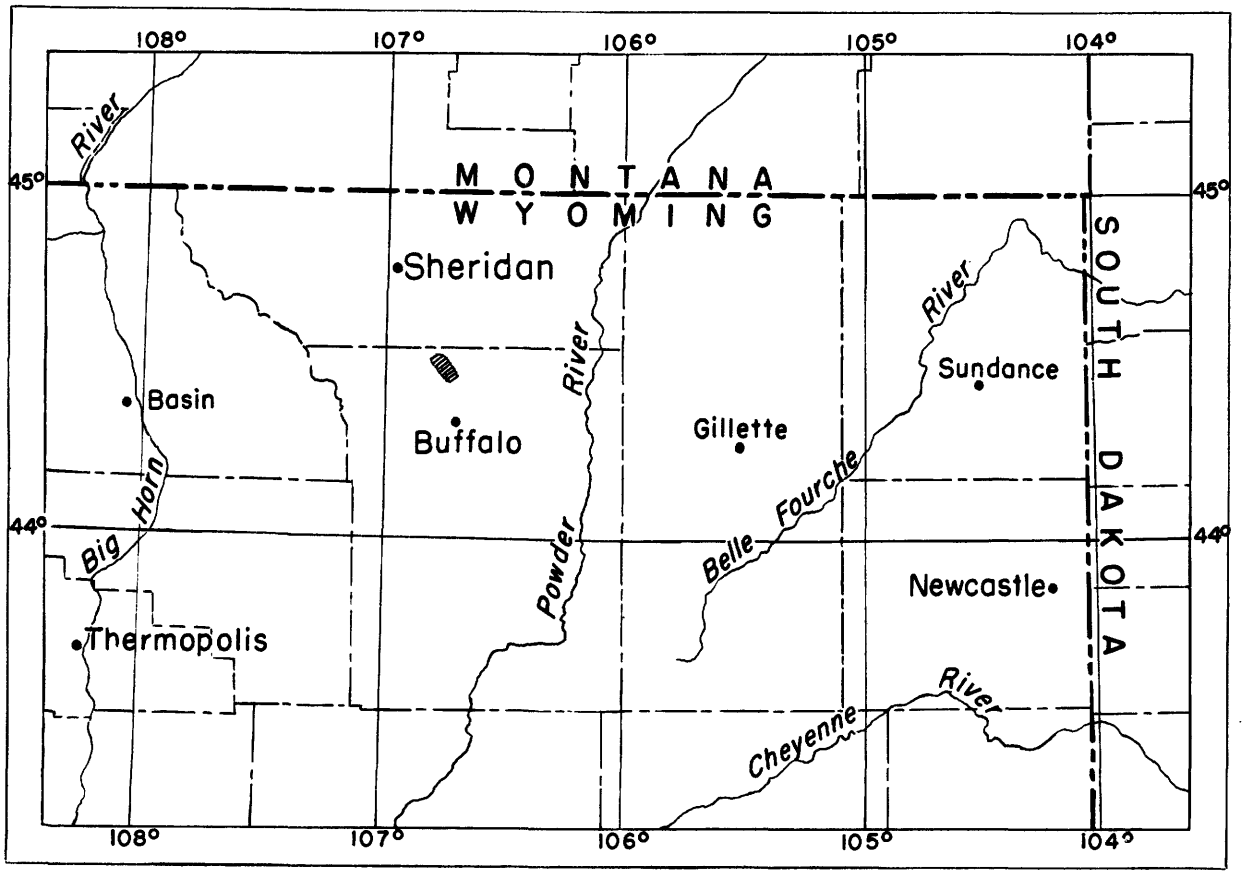

Figure 1. --Index map showing location of mapped area.

from Storey, joins Highway 87 in the northern part of the area near the settlement of Kearney. Other graded and ungraded roads give access to most of the area in dry weather. The Chicago, Burlington & Quincy Railroad provides shipping facilities at Sheridan, 24 miles north of Lake De Smet, and Clearmont, 26 miles northeast of the lake.

A 12 3/4-inch pipeline between the Billy Creek gas field and Sheridan, owned and operated by the Montana-Dakota Utilities Co., crosses the area closely paralleling U. S. Highway 87.

GEOLOGY

The region near Lake De Smet has long been known to contain workable deposits of coal. Darton[2] briefly mentioned the coal beds and clinker exposed near Lake De Smet in reports on the geology of the Bighorn Mountains and adjacent parts of the Powder River basin. Gale and Wegemann[3] in a report on the Buffalo coal field, described these coal beds in more detail and correlated them throughout a large region in Johnson and Sheridan Counties. They noted that a well in the valley of Little Piney Creek about 3 miles northwest of the lake was drilled to a depth of 200 feet, encountering much coal through a 100 foot interval.

[2]Darton, N. H., 1906a, Geology of the Bighorn Mountains: U. S. Geol. Survey Prof. Paper 51.
Darton, N. H., 1906b, U. S. Geol. Survey Geol. Atlas, Cloud Peak-Fort McKinney Folio no. 142.
[3]Gale, H. S., and Wegemann, C. H., 1910, The Buffalo coal field, Wyoming: U. S. Geol. Survey Bull. 381-B, pp. 137-169.

Stratigraphy

Rocks exposed in the vicinity of Lake De Smet are of Eocene age and belong to the upper part of the Wasatch formation. Surficial deposits of Quaternary age consist of alluvium along the stream courses and gravel on terraces above the valley floors.

The Wasatch formation comprises alternating beds of light colored cross-bedded sandstone, gray shale, brown carbonaceous shale, and low-rank subbituminous coal. At many places the coal beds are burned and the heat has converted the overlying rocks into deposits of massive red clinker as much as 200 feet thick. With the exception of some of the coal beds, individual lithologic units have little continuity or extent. The sandstones are light-gray to light yellowish-gray, friable, fine- to medium-grained, and fairly well sorted east of Lake De Smet where they make up about 50 percent of the formation, but westward they become increasing arkosic, coarse-grained, and poorly sorted. Thin lenses of greenish-gray and brown carbonaceous shale grade laterally within a few feet into these coarse-grained sandstones.

Coal beds occur at various levels in the Wasatch formation. The beds that crop out near Lake De Smet are shown on the accompanying geologic map (pl. 1) and are described on pages 2-9.

Quaternary deposits of silt, sand, and gravel occur on several terrace levels near Piney and Shell Creeks. The deposits consist largely of subrounded pebbles and cobbles of granitic rocks, and some scattered pebbles and cobbles of limestone. The lowest

and youngest terrace, 5 to 25 feet above the present streams, forms the surface of large areas on the valley bottoms of Piney and Shell Creeks, and floors the narrow valley through which the Lake De Smet outlet canal is dug. Remnants of higher and older terraces are preserved near the North Fork Shell Creek and north of Piney Creek.

Quaternary alluvium, consisting mainly of silt and sand with lesser amounts of gravel, is present along Piney and Little Piney Creeks, and covers the floor of the shallow valley that extends southeastward from the south end of Lake De Smet.

Structure

The Lake De Smet area is on the western flank of the Powder River basin. The rocks dip as much as 7° NE along the southwestern side of the lake, but the regional northeast dip decreases to less than 1° E of the lake. Local dips as high as 9° along the inlet canal near the north end of Lake De Smet may be the result of slumping towards the lake as coal beds penetrated by shallow drill holes in that area are almost horizontal.

A northwest-trending normal fault cuts the clinker of the Walters and Healy coal beds near the junction of Piney Creek and the Lake De Smet outlet canal, and is also indicated by the tentative correlation of coal beds found in holes drilled near the north end of the lake (pl. 2). The fault extends northwest for an unknown distance under the terrace gravels of Piney Creek and probably dies out to the southeast under the lake. Data from drill holes indicate that strata on the west side of the fault probably are dropped 50 to 150 feet relative to those on the east.

A second normal fault, also trending northwestward, was found by drilling at the south end of Lake De Smet (pl. 3). The displacement along this fault appears to be opposite that at the north end of the lake, the rocks on the east side of the fault being dropped about 100 feet below those of the west side.

Coal

The Healy and overlying Walters beds are the two main coal beds exposed near Lake De Smet. Both can be traced for many miles east of the lake. Other coal beds crop out at various places in the area, but for the most part these beds are thin and lenticular, grading laterally into shale and sandstone within a short distance. The relative stratigraphic positions of the coal beds, and their thicknesses where measured at the surface, are shown on figure 2.

The Walters bed consists of 25 to 35 feet of coal, including many shale partings, at the few localities within the Lake De Smet-Buffalo region where the bed crops out and has not burned. Immediately east of Lake De Smet, the Walters coal bed is almost completely burned except perhaps beneath the highest part of the Piney Creek-Boxelder Creek divide. The resulting clinker is widespread and conspicuous on buttes and high divides throughout the region. At least 62 feet of interbedded carbonaceous shale and coal, tentatively correlated with the Walters bed, crops out along the sides of the Lake De Smet inlet canal in the SE¼ sec. 36, T. 53 N., R. 83 W. and also crops out in cuts along nearby U. S. Highway 87. The lower part of this carbonaceous zone was found in the top 22 feet of core hole GS-6.

The Healy coal bed crops out 200 to 225 feet below the Walters bed in the valleys of Piney and Boxelder Creeks. It ranges in thickness from 12 to 25 feet under much of the area east of Lake De Smet. It thickens westward, however, at about the position of the lake. The bed is 27 feet thick in seismographic shot hole 65 drilled in the SE¼ sec. 23, T. 52 N., R. 82 W. but increases in thickness to 112 feet including shale partings, 1 mile west in U. S. Bureau of Reclamation hole 305 drilled in the SE¼ sec. 22 of the same township (see pl. 3 and fig. 3). The Healy bed is 52 feet thick, including thin partings of shale, in core hole GS-2A drilled in the SE¼ sec. 8, T. 52 N., R. 82 W., a few hundred feet east of the lake. It is about 40 feet thick in U. S. Bureau of Reclamation core hole A-5 drilled west of the Lake De Smet outlet canal. Clinker formed by burning of the Healy bed borders the lake on the east.

The thick coal found in core holes drilled northwest of Lake De Smet is correlated tentatively with the Healy coal bed and is referred to as the Healy(?) bed. It underlies an area 1 mile wide and 2 1/2 miles long and has an average thickness of more than 100 feet. It is bounded on the east by the fault that passes under the north end of the lake, but the extent of the coal along the fault is unknown, and the data from drill hole D are not conclusive in establishing the southwestern margin of the bed. The fence diagram (fig. 5) shows the thickness and extent of the deposit in the area explored by drilling. Graphic logs of some of the holes that encountered the thick coal are shown on figure 2.

The correlation of this bed with the Healy coal bed is based on two lines of evidence, neither of which is conclusive. First, the Healy bed thickens westward at an average rate of 85 feet per mile, between drill holes 65 and 305 so a thick accumulation of Healy coal west of the fault at the north end of Lake De Smet is not in opposition to the known trends of thickness changes in the Healy bed. Second, the stratigraphic interval between the base of the thick coal bed and the base of the prominent zone of coal and carbonaceous shale considered to be the Walters bed is fairly close to the interval between the Healy bed and the overlying Walters bed where they are exposed east of Lake De Smet. Thus, the interval is 265 feet in hole GS-6, and about 225 feet in outcrops along the east shore of the lake.

An alternative theory is that neither the thick coal seam west of Lake De Smet nor the overlying zone of coal and carbonaceous shale correlates with either the Healy bed or the Walters bed, both of the beds west of the lake being stratigraphically higher in the Wasatch formation than the Healy and Walters beds. No direct evidence is known to refute this possibility. However, such a correlation requires a displacement of more than 400 feet along the fault beneath Lake De Smet. It seems probable that if the fault had such a large displacement, it would also have a more pronounced topographic expression, and the beds along both sides of the fault would be more disturbed. In the absence of such data, the correlation of the exceptionally thick coal bed with the Healy bed is accepted, and the bed is called the Healy(?) bed in this report.

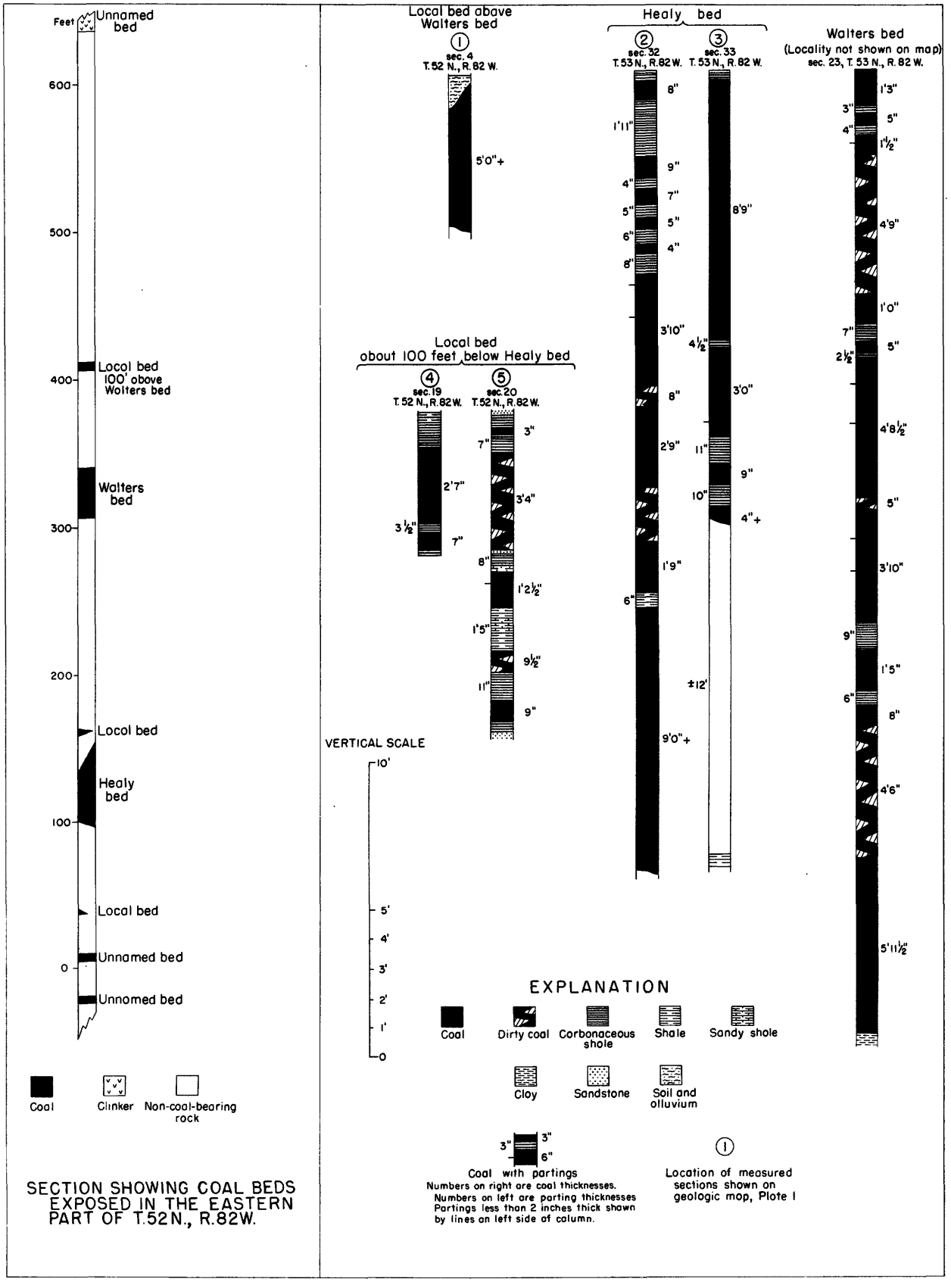

Figure 2. --Graphic sections of a part of the Wasatch formation showing coal beds exposed near Lake De Smet, Johnson County, Wyo.

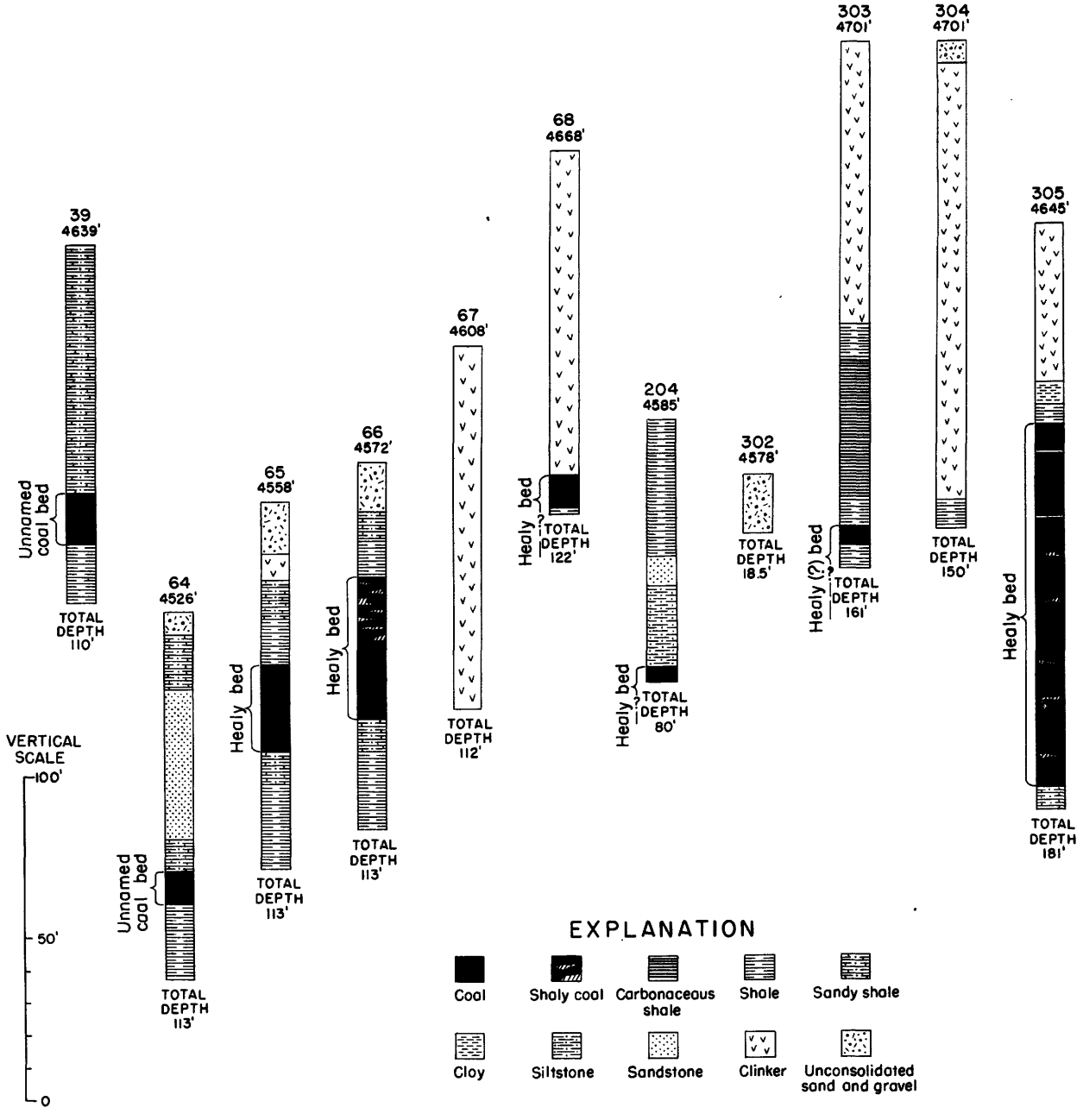

Figure 3. —Graphic logs of selected holes drilled near the north end of Lake De Smet, Johnson County, Wyo.

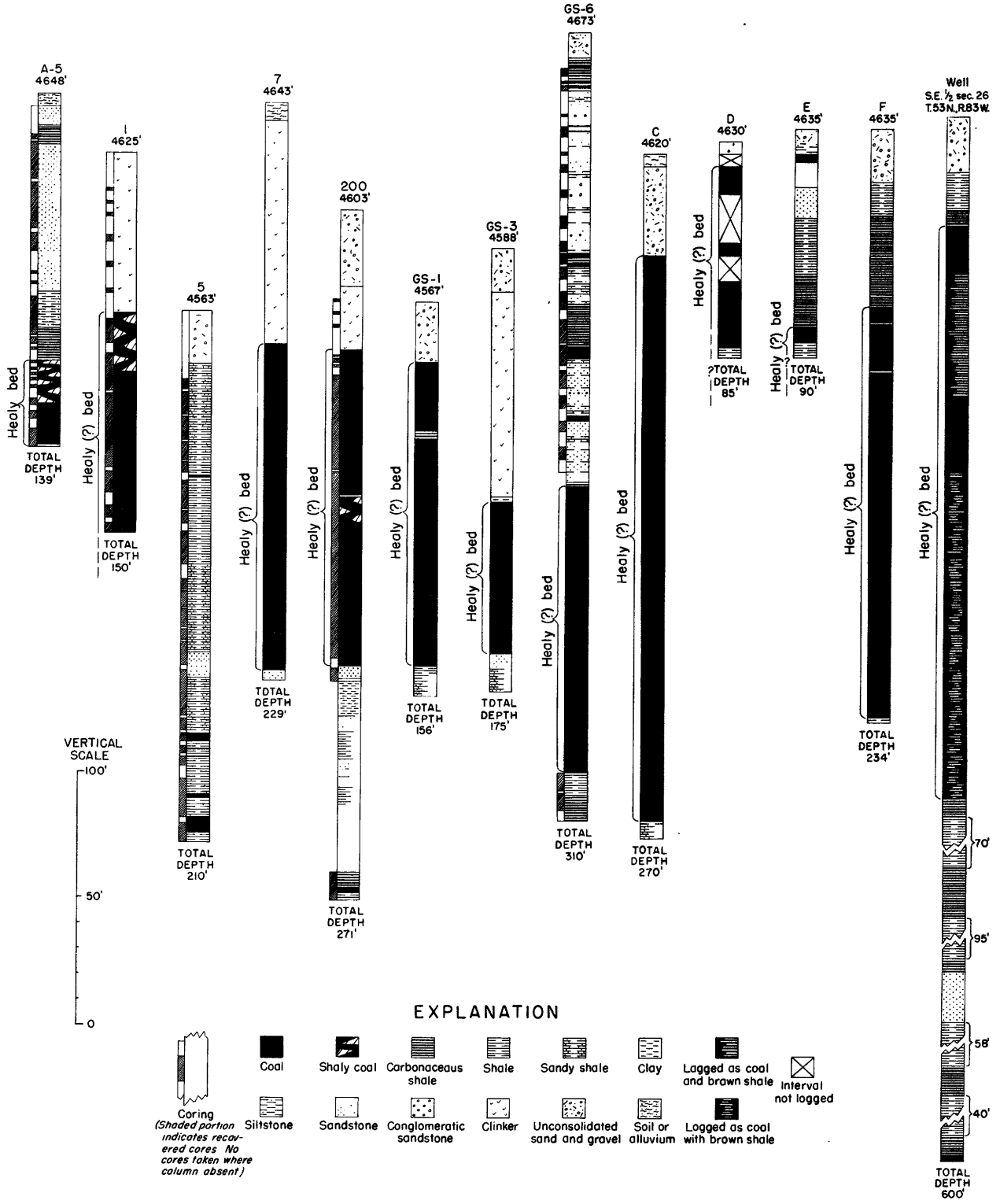

Figure 4. —Graphic logs of holes drilled near the south end of Lake De Smet, Johnson County, Wyo.

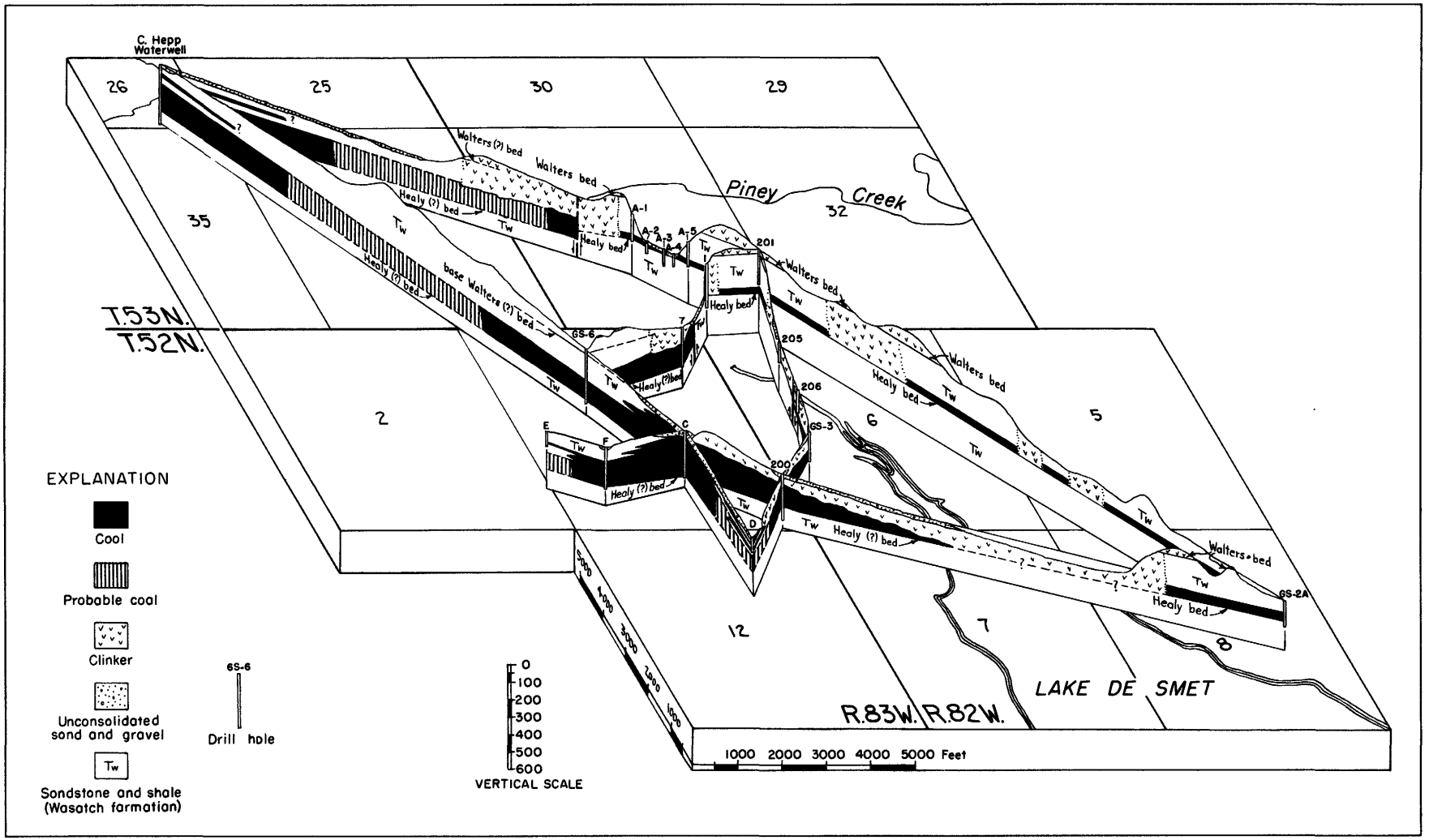

Figure 5.—Fence diagram showing the thickness and extent of the Healy(?) coal bed near the north end of Lake De Smet, Johnson County, Wyo.

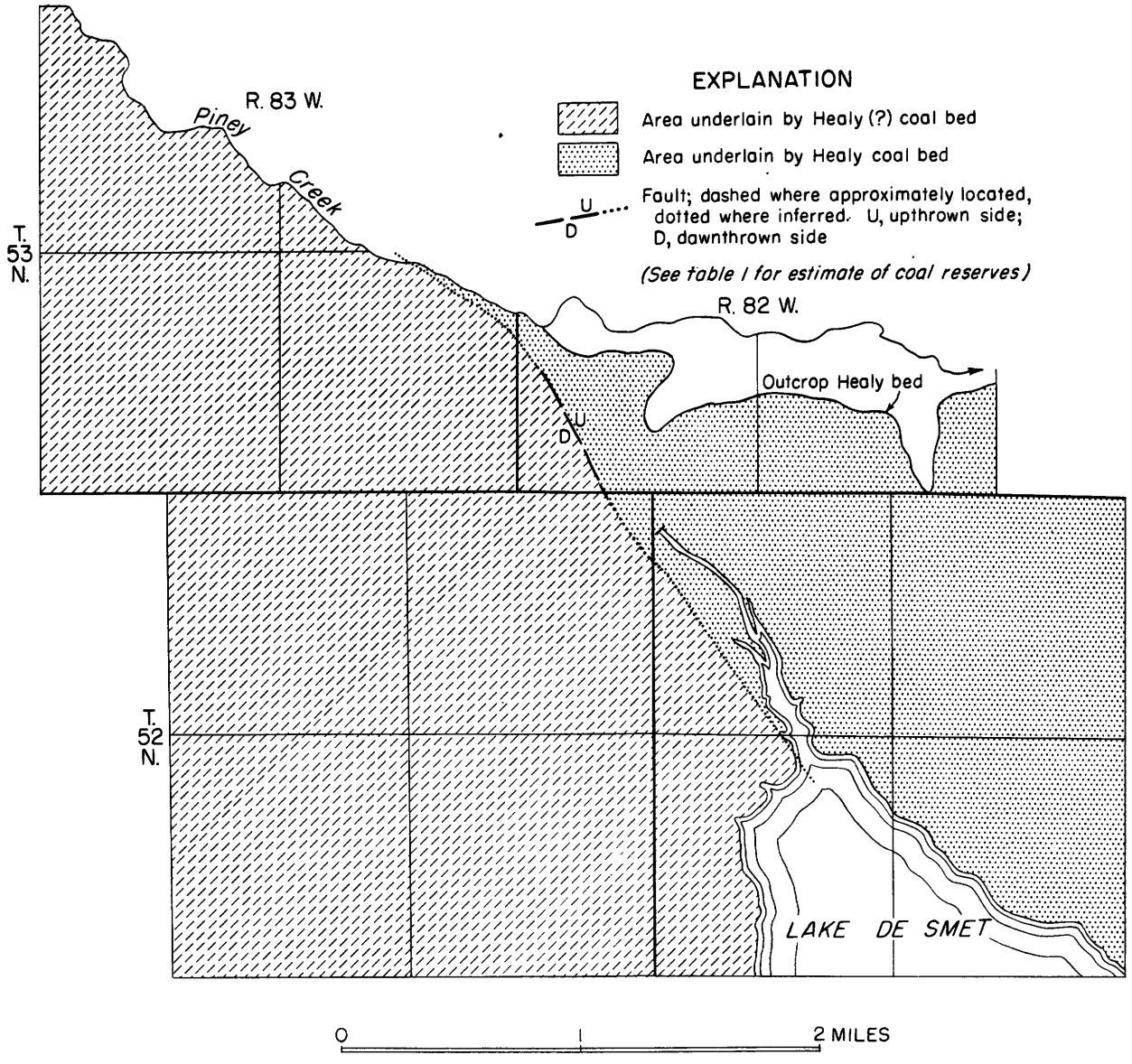

Figure 6. --Map showing areas for which coal-reserve estimates are presented in table 1.

Four core holes, GS-1, 7, 200, and GS-3 located between U. S. Highway 87 and Lake De Smet, penetrated 56 to 128 feet of coal, including thin partings of shale. Clinker or terrace gravel overlies the Healy(?) coal bed at all four locations, thus an unknown thickness of coal at the top of the bed has been destroyed by burning or erosion, and the coal and partings found in the holes represent only some fraction of the coal originally deposited. The total thickness of the Healy(?) bed is 115 feet in hole GS-6 (NW¼ sec. 1, T. 52 N., R. 83 W.) where both the top and bottom of the bed were drilled. Shale and sandstone above the top of the Healy(?) bed may be represented by coal near hole 7, half a mile to the east. However, it is also possible that the Healy(?) bed near hole GS-6 has been thinned by normal faulting that was not detected on the surface. This possibility is suggested by the erratic steep dips in the coal cores from hole GS-6.

J. E. Rice drilled four holes west of U. S. Highway 87 near Shell Creek in 1950, the logs of which are shown graphically on figure 2. Hole C penetrated 223 feet of coal and hole F, 162 feet. The remaining two holes penetrated coal, but probably neither reached the base of the Healy(?) coal bed. As no cores were taken from these holes and the logs were made by observation of cuttings and drilling characteristics, partings of shale, if present, may not have been noticed.

The base of the burned coal bed mapped along the west side of Lake De Smet as the Healy(?) bed appears to be stratigraphically much higher than the base of the thick coal found in drill holes C, 200, and D. This apparent discrepancy in the position of the Healy(?) bed probably is due to gradation of coal in the lower part of the Healy(?) into sandstone and

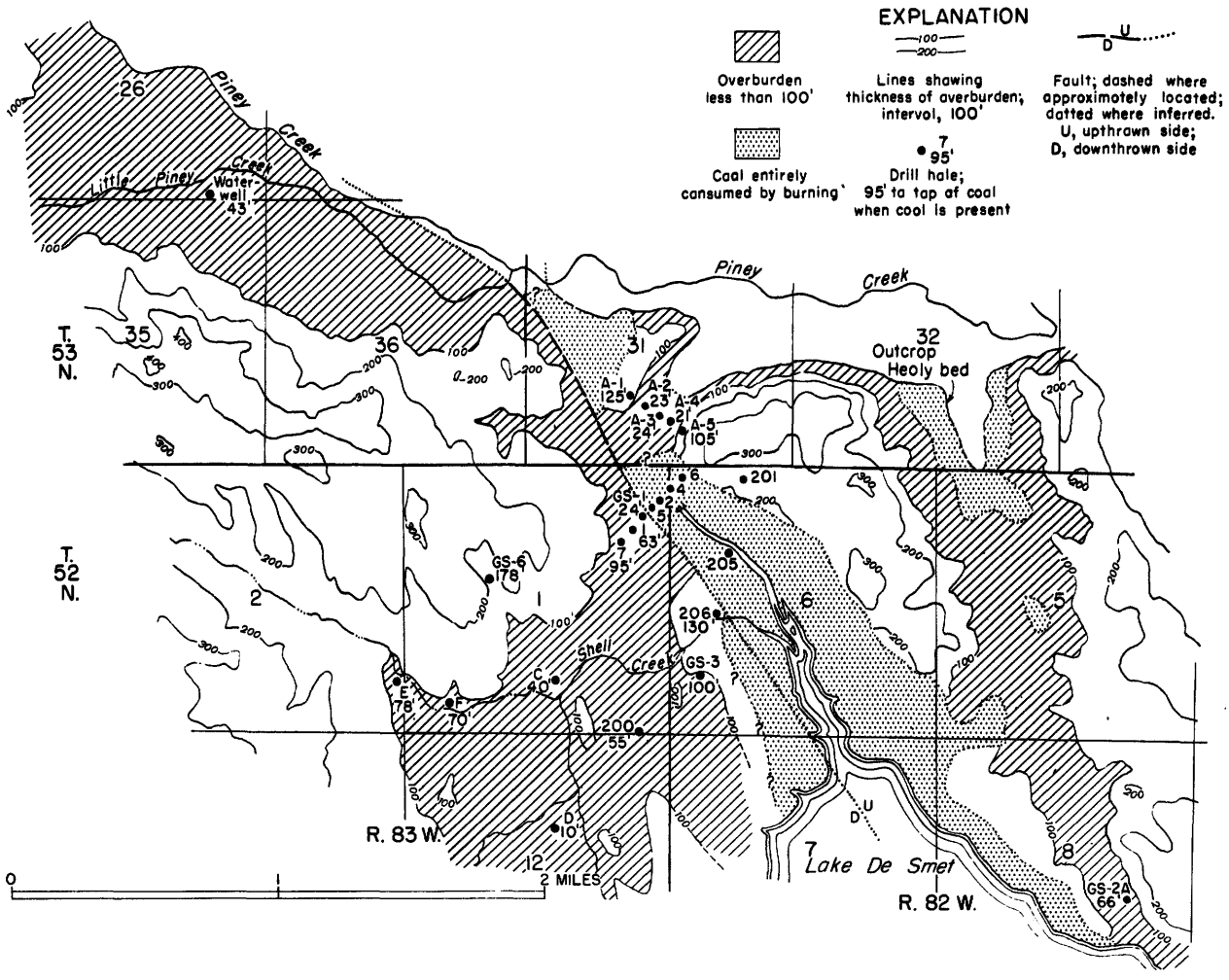

Figure 7.--Map showing thickness of overburden above the Healy and Healy(?) coal beds near Lake De Smet.

shale within a short distance southeast of hole D. The clinker along the west side of the lake probably was produced by a tongue of coal equivalent to only the uppermost part of the thick Healy(?) bed.

A water well drilled in 1944 on the Carl Hepp property about 3 miles northwest of Lake De Smet is reported to have penetrated 224 feet of coal and brown shale beneath 43 feet of overburden. The altitude of the top of this coaly sequence corresponds closely to that of the thick coal found in holes to the south.

PREVIOUS MINING

Coal in the Lake De Smet-Buffalo region has been mined intermittently for domestic use for many years. There are four abandoned adits in the Healy bed in secs. 31 and 32., T. 53 N., R. 83 W. along the side of Piney Creek near Lake De Smet. No data are available on the tonnage that was mined. Gale and Wegemann (1910, p. 50) report that some coal was mined from the local bed in secs. 19, 20, and 29, T. 52 N., R. 82 W.

COAL RESERVES

Reserves of coal in the Healy(?) and Healy beds near the north end of Lake De Smet are shown in table 1. The reserves are estimated to be 35,404,000 tons of measured coal, 255,970,000 tons of indicated coal, and 237,189,000 tons of inferred coal. Measured reserves consist of coal lying within a quarter of a mile from a core-drill hole or from a section measured at the outcrop of the coal bed. Indicated reserves consist of coal extending a quarter of a mile beyond the limits assumed for measured coal, or coal that lies within half a mile from a point where coal is known to

Table 1.—Estimated original coal reserves in Healy(?) and Healy coal beds near Lake De Smet, Johnson County, Wyo.
(In thousands of short tons)

[All coal is of subbituminous rank and under less than 500 feet of overburden]

Weighted average thickness	Measured reserves					Indicated reserves					Inferred reserves		Total all classes
	Area (acres)	Thickness of benches (feet) 2 1/2-5	5-10	More than 10	Total	Area (acres)	Thickness of benches (feet) 2 1/2-5	5-10	More than 10	Total	Area (inches)	Benches more than 10 feet thick	
Area 1 (reserves in Healy(?) bed)[1]													
3.1	1,904	10,447	---	---	10,447	---	---	---	---	---	---	---	10,447
3.2	---	---	---	---	---	3,420	19,371	---	---	19,371	---	---	19,371
6.5	---	---	---	---	---	1,710	---	19,674	---	19,674	---	---	19,674
7.0	770	---	9,540	---	9,540	---	---	---	---	---	---	---	9,540
11.5	360	---	---	7,328	7,328	---	---	---	---	---	---	---	7,328
11.5	---	---	---	---	---	570	---	---	11,602	11,602	---	---	11,602
110.0	---	---	---	---	---	---	---	---	---	---	908	[3] 176,788	176,788
125.0	---	---	---	---	---	849	---	---	---	[3] 187,841	---	---	187,841
Total	3,034	10,447	9,540	7,328	27,315	6,549	19,371	19,674	11,602	238,488	908	176,788	442,591
Area 2 (reserves in Healy bed)[2]													
2.8	48	238	---	---	238	---	---	---	---	---	---	---	238
4.9	91	789	---	---	789	135	1,171	---	---	1,171	---	---	1,960
8.8	48	---	748	---	748	184	---	2,866	---	2,866	---	---	3,614
9.6	91	---	1,546	---	1,546	135	---	2,294	---	2,294	---	---	3,840
14.8	182	---	---	4,768	4,768	270	---	---	7,073	7,073	---	---	11,841
16.0	---	---	---	---	---	144	---	---	4,078	4,078	---	---	4,078
39.0	---	---	---	---	---	---	---	---	---	---	875	[3] 60,401	60,401
Total	460	1,027	2,294	4,768	8,089	868	1,171	5,160	11,151	17,482	875	60,401	85,972
Grand total	3,494	11,474	11,834	12,096	35,404	7,235	20,542	24,834	22,753	255,970	1,783	237,189	528,563

[1] Weight of coal per acre-foot assumed to be 1,770 tons in all calculations.
[2] See figure 6.
[3] Total thickness of coal in bed, undifferentiated according to bench thickness.

occur but where its thickness and quality have not been reliably defined. Inferred reserves lie beyond the limits assigned to indicated reserves and consist of coal for which quantitative estimates are based largely on broad knowledge of the geologic character of the bed.

The reserves in each category are further subdivided according to the thickness data for coal and partings. Reserves are listed for individual layers of coal within the coal-bearing sequence that are 2 1/2 to 5 feet thick, 5 to 10 feet thick, and more than 10 feet thick between shale partings. Where coal was drilled but not cored, the ratio of coal to partings in the nearest cored hole is assumed to apply in calculating the reserves, and no subdivision is made according to the thickness of individual layers of coal.

Figure 6 shows two areas for which reserve estimates were made separately. Area 1 includes the thick coal of the Healy(?) bed found by drilling west of the normal fault at the north end of Lake De Smet. Area 2 includes reserves of the Healy bed found by drilling and by examining the outcrop east of the normal fault. Reserves that may be present in the Walters coal bed and in local coal beds are not included.

MINING POSSIBILITIES

The Healy(?) bed is covered by less than 100 feet of overburden in a large part of the area and much of the coal thus may be reached by strip-mining methods. The overburden ranges in thickness from 40 feet to more than 400 feet and consists, from place to place, of unconsolidated sand and gravel, clinker, and relatively soft Eocene sandstone and shale. Figure 6 shows the thickness of overburden covering the thick Healy(?) coal and the thinner Healy coal in the area tested by drilling.

Three general areas appear most favorable for further exploration by core drilling and for possible development:

1. In secs. 1 and 12, T. 52 N., R. 83 W., northwest of Lake De Smet, areas of low relief adjacent to Shell Creek are underlain by 10 to 100 feet of overburden consisting mainly of clinker and unconsolidated gravel. The coal ranges in thickness from 50 to more than 120 feet and locally may be more than 200 feet thick. The variation in thickness is chiefly the result of burning and local erosion of the upper part of the deposit.

2. In the SE¼ sec. 26, T. 53 N., R. 83 W., and parts of adjacent sections, the lower valley of Little Piney Creek may be underlain by as much as 224 feet of coal and interbedded carbonaceous shale beneath less than 50 feet of unconsolidated gravel and soft Eocene sandstone and shale. Eocene sandstone and shale less than 100 feet thick lie above the coal along the sides of the valley.

3. In the valley nearly bisecting secs. 8 and 5, T. 52 N., R. 82 W., the Healy bed probably ranges from 30 to 50 feet in thickness and is overlain by Eocene sandstone and shale ranging from 50 to 100 feet in thickness.

FIELD LOGS OF CORE HOLES DRILLED NEAR LAKE DE SMET, JOHNSON COUNTY, WYO.

Hole GS-1

Cores coated with paraffin and submitted to the Coal Geology laboratory of the Geological Survey, Columbus, Ohio, for description and sampling.

Location: Near center of S½NE¼NE¼, sec. 1, T. 52 N., R. 83 W.
Ground elevation: 4,567 feet
Total depth: 156.0 feet
Depth to water table: 12 feet

Driller: H. Koplin
Logged by: W. J. Mapel
Begun: November 1, 1950
Completed: November 8, 1950

Description	Depth (feet)	Length of core recovered
Gravel, sand and silt, unconsolidated	0.0-24.0	--
Coal	24.0-25.0	(1)
Do	25.0-27.0	(1)
Coal (continuous drive samples taken)	27.0-46.7	--
Probably coal	46.7-48.5	--
Coal	48.5-51.0	(1)
Shale, brown, carbonaceous, a few fragments of coal	51.0-52.0	--
Shale, brown, carbonaceous (drive sample)	52.0-54.0	--
Probably coal	54.0-59.0	--
Coal (shale partings not logged)	59.0-61.0	1.0
Do	61.0-66.0	1.5
Do	66.0-71.0	3.6
Do	71.0-76.0	4.0
Do	76.0-81.0	5.0
Do	81.0-86.0	2.5
Do	86.0-91.0	3.5
Do	91.0-92.0	.7

Hole GS-1--Continued

Description	Depth (feet)	Length of core recovered
Gray clay on core barrel and in cuttings	92.0- 93.0	--
Coal (shale partings not logged)	93.0- 99.0	4.6
Do.	99.0-101.0	2.0
Do.	101.0-106.0	3.0
Do.	106.0-111.0	3.5
Do.	111.0-116.0	4.0
Do.	116.0-121.0	5.0
Do.	121.0-126.0	4.8
Do.	126.0-131.0	3.1
Do.	131.0-139.0	8.2
Coal to 142. Black carbonaceous shale 142 to 144	139.0-144.0	5.0
Probably gray shale	144.0-151.0	.0
Shale, gray, sandy.	151.0-156.0	--
Bottom of hole at 156.0 feet	---	--

Hole GS-2A

Cores submitted to the Coal Geology laboratory of the Geological Survey, Columbus, Ohio, for description and sampling. Cores of coal above 97 feet were coated with paraffin; cores of coal below 97 feet were wrapped in waxed butcher paper.

Location: Near center of N½NE¼NW¼SE¼, sec. 8, T. 52 N., R. 82 W.
Ground elevation: 4,585 feet
Total depth: 146.5 feet
Depth to water table: 12 feet

Driller: H. Koplin
Logged by: W. J. Mapel
Begun: November 17, 1950
Completed: November 21, 1950

Description	Depth (feet)	Length of core recovered
Clinker, sand, and some silt	0.0- 23.0	--
Sandstone, light-gray, fine-grained, poorly consolidated	23.0- 52.0	--
Shale, light-gray	52.0- 63.0	--
Shale, light-gray becoming brown below about 65.0 feet. A few chips of coal in the cuttings	63.0- 66.0	--
Coal (shale partings not logged)	66.0- 68.0	1.3
Do.	68.0- 71.0	2.6
Do.	71.0- 76.0	4.0
Do.	76.0- 82.0	4.6
Do.	82.0- 87.0	5.0
Do.	87.0- 92.0	3.7
Do.	92.0- 97.0	4.7
Do.	97.0-102.0	3.7
Do.	102.0-107.0	5.0
Do.	107.0-117.0	9.8
Coal, 2 inches of light-gray shale at bottom of core	117.0-119.0	1.4
Shale, light-gray, in cuttings and on drill stem	119.0-127.0	.0
Shale, light-gray, and light-gray fine-grained sandstone	127.0-146.0	--
Bottom of hole at 146.0 feet	---	--

Hole GS-3

Cores coated with paraffin and submitted to the Coal Geology laboratory of the Geological Survey, Columbus, Ohio, for description and sampling.

Location: Near center of W½SW¼, sec. 6 T. 52 N., R. 82 W.
Ground elevation: 4,588 feet
Depth: 175.0 feet
Depth to water table: 30 feet

Driller: H. Koplin
Logged by: W. J. Mapel
Begun: November 10, 1950
Completed: November 16, 1950

Hole GS-3--Continued

Description	Depth (feet)	Length of core recovered
Gravel and sand, unconsolidated	0.0- 17.0	--
Clinker	17.0- 98.0	--
Clay (ash?), light-gray and light-brown, a few fragments of coal	98.0-101.0	--
Coal, hard and brittle	101.0-106.0	0.5
Probably coal	106.0-112.0	--
Coal, hard and brittle	112.0-115.0	--
Coal	115.0-117.5	1.0
Do.	117.5-118.7	.4
Coal (shale partings not logged)	118.7-123.7	5.0
Do.	123.7-128.7	5.0
Do.	128.7-133.4	4.7
Do.	133.4-136.0	2.4
Do.	136.0-141.0	5.0
Do.	141.0-144.5	2.8
Do.	144.5-149.3	4.8
Do.	149.3-154.2	4.5
Do.	154.2-158.2	3.8
Coal to 159.5. Dark-brown carbonaceous shale and firmly cemented fine-grained light-gray sandstone 159.5 to 160.7	158.2-160.7	2.5
Probably fine-grained sandstone	160.7-166.0	--
Shale, light-gray, sandy	166.0-175.0	--
Bottom of hole at 175.0 feet	---	--

Hole GS-6

Entries marked with asterisk (*) indicate cores submitted to the Coal Geology laboratory of the Geological Survey, Columbus, Ohio, for description and sampling. Moisture content preserved by wrapping in waxed butcher paper.

Location: Near center of SW¼NW¼, sec. 1 T. 52 N., R. 83 W.
Ground elevation: 4,673 feet
Total depth: 310.3 feet
Depth to water table: 18 feet

Driller: H. Koplin
Logged by: W. J. Mapel
Begun: November 22, 1950
Completed: December 8, 1950

Description	Depth (feet)	Length of core recovered
Silt, unconsolidated	0.0- 10.0	--
Shale, brown, carbonaceous	10.0- 14.0	--
Shale, brown, carbonaceous, a few thin lenses of coal	14.0- 19.0	3.0
Coal, shaly	19.0- 20.9	.6
Coal, shaly, to 22.1. 22.1 to 32.0 probably interbedded light-gray siltstone and coarse-grained arkosic sandstone	20.9- 32.0	1.5
Sandstone, greenish-gray, shaly	32.0- 37.0	.3
Sandstone, light-greenish-gray, coarse-grained and fine-grained in alternating beds, poorly sorted, a few thin beds of light-gray silty clay	37.0- 47.0	2.0
Do.	47.0- 52.0	.8
Same as above. A few thin layers of brown carbonaceous shale	52.0- 62.0	3.1
Do.	62.0- 72.0	3.7
Do.	72.0- 82.0	4.5
Same as above. Shaly coal from 85.0 to 86.5	82.0- 87.0	4.0
Coal and black carbonaceous shale to 90.5 underlain by light-gray coarse-grained sandstone	87.0- 92.0	4.4
Shale, light greenish gray, silty and sandy; many thin beds of poorly consolidated coarse-grained sandstone and a few thin layers of brown carbonaceous shale	92.0-102.0	7.1
Shale, light-greenish-gray and light-gray, interbedded light-gray sandstone, 102 to 105.5. Black carbonaceous shale with thin seams of coal 105.5 to 112	102.0-112.0	8.4
Coal with partings of black carbonaceous shale	112.0-122.0	9.0
Coal 122 to 126.5. Light-greenish-gray shale and fine-grained to coarse-grained sandstone 126.5 to 132	122.0-132.0	7.3

Hole GS-6--Continued

Description	Depth (feet)	Length of core recovered
Sandstone, light-gray, fine- to very coarse grained, a few thin layers of brown carbonaceous shale and carbonaceous siltstone	132.0-142.0	6.5
Same as above. Coal from 149.5 to 151.5	142.0-152.0	5.1
Sandstone, light-gray, fine- to very coarse grained, a few thin layers of brown carbonaceous shale and carbonaceous siltstone	152.0-162.0	3.7
Same as above	162.0-172.0	5.2
Same as above to 176.5. Coal 176.5 to 182.0	172.0-182.0	*6.1
Coal (shale partings not logged)	182.0-192.0	*8.7
Do	192.0-200.5	*8.5
Do	200.5-210.0	*9.3
Do	210.0-220.0	*8.6
Do	220.0-230.1	*9.6
Do	230.1-238.7	*7.2
Do	238.7-242.7	*2.1
Do	242.7-247.2	*4.3
Do	247.2-254.3	*6.5
Do	254.3-262.0	*7.0
Do	262.0-272.0	*9.0
Do	272.0-279.3	*7.0
Do	279.3-282.3	*3.1
Do	282.3-285.0	*2.0
Coal and brown carbonaceous shale to 291. Light-gray shale, very firm, 291-292	285.0-292.0	*2.7
Shale, dark-brown to black, carbonaceous, numerous fossil mollusks	292.0-300.0	6.6
Bottom of hole at 310.3 feet	---	--

The following description of the drill cuttings and cores from hole 7, drilled by the U. S. Bureau of Reclamation, was made by personnel of the Bureau of Reclamation.

Hole 7

Cores of coal coated with paraffin and submitted to the U. S. Bureau of Mines, Pittsburgh, Pa., for description and analysis.

Location: Near center of SW¼NE¼ sec. 1, T. 52 N., R. 82 W.
Ground elevation: 4,643 feet
Total depth: 231.0 feet
Depth to water table: 82 feet

Driller: Blades and Pompeo
Logged by: Blades and Pompeo
Begun: May 19, 1948
Completed: June 11, 1948

Description	Depth (feet)	Length of core recovered
Sandy clay	0.0- 7.0	--
Clinker	7.0- 32.0	2.0
Do	32.0- 37.4	.6
Do	37.4- 40.0	--
Do	40.0- 47.0	--
Do	47.0- 60.0	--
Do	60.0- 71.0	.9
Do	71.0- 90.0	2.2
Coaly shale	90.0- 95.0	3.6
Medium hard coal	95.0-100.0	4.0
Do	100.0-101.0	1.0
Do	101.0-102.0	--
Do	102.0-107.0	4.5
Do	107.0-112.0	5.0
Coal, layer of shale at 115.6	112.0-117.0	5.0
Coal	117.0-122.0	5.0

Hole 7--Continued

Description	Depth (feet)	Length of core recovered
Coal, shale parting at 123.6 feet	122.0-127.0	5.0
Coal	127.0-132.0	5.0
Coal, shale parting at 132.6 feet	132.0-137.0	5.0
Coal	137.0-142.0	5.0
Do.	142.0-147.0	5.0
Do.	147.0-152.0	5.0
Coal, shale parting at 156.9 feet	152.0-157.0	5.0
Coal	157.0-162.0	5.0
Do.	162.0-166.0	3.6
Do.	166.0-171.0	5.0
Do.	171.0-176.0	5.0
Do.	176.0-181.0	5.0
Do.	181.0-186.0	4.6
Coal, shaly	186.0-191.0	5.0
Coal	191.0-196.0	5.0
Coal, shaly below 197 feet	196.0-201.0	5.0
Coal, shaly	201.0-206.0	5.0
Coal	206.0-211.0	5.0
Do.	211.0-216.0	5.0
Do.	216.0-221.0	5.0
Coal to 224.9. Sandstone, medium hard 224.9 to 226.0	221.0-226.0	4.2
Sandstone, medium hard, to 227.0. Gray shale 227.0 to 228.6. Hard gray sandstone to bottom of hole	226.0-231.0	4.6
Bottom of hole at 231 feet	---	--

PART 2.--DESCRIPTIVE AND ANALYTIC CHARACTERISTICS OF COAL IN DE SMET DRILL CORES

By James M. Schopf and James R. Gill

METHODS OF HANDLING COAL CORES

Methods used in handling the thick coal cores from the Lake De Smet area are described below because the significance and reliability of the analyses depend on how closely the coal reflects bed conditions by the time it reaches the analytical laboratory. Cores of the thick coal from the Lake De Smet area presented some unusual problems simply because of its extraordinary thickness.

Coal cores should be pushed directly from the core barrel into wax paper-lined core boxes. A heavy waxed-paper liner can then be immediately wrapped tightly in double or triple thicknesses around the core, care being taken to avoid displacing any cored material. Driller's depths may be marked on the paper core wrapper, on the core box, or on blocks of wood inserted before wrapping between segments of the core. Cleats, nailed inside the core box, hold the core securely in position during shipment. After the core-box lid is fastened securely with screws, the core boxes are shipped promptly by express to the Coal Geology laboratory of the U. S. Geological Survey, Columbus, Ohio. Coal cores handled in this way show no effects of exposure and retain an excess film of moisture, derived mostly from the water circulated in drilling, when they are unwrapped in the laboratory. In the early stages of the drilling, coherent sections of the De Smet Cores were dipped wet into melted paraffin wax, as a means of conserving bed moisture, before being packed in sawdust in the core boxes. This practice was discontinued because of difficulty in uniform handling and because of possible error in subsequent determination of calorific values. On all subsequent cores approved practices were followed, essentially as indicated above, with good results.

In the laboratory, the wrapped cores were removed from the core boxes to a core trough on which a parallel shelf was arranged to hold a standard paper log strip. The waxed-paper core wrapping was split and laid open so that the position of drillers measurements and banding planes or other lithologic features of the core could be drawn on the parallel log strip at full scale. After this initial inspection and recording, the core was kept covered with moistened towels until it could be sawed longitudinally, one part to be used for an analytic sample and the other to be retained as a reserve for petrographic study. A dry cut-off saw was used to split core segments uniformly, a little to one side of the midline of the core. The saw consists of a motor driven 10-inch blade, one-sixteenth inch thick, of plastic-bonded silicon carbide. Sawing action is extremely rapid and very little heat is generated. Dust is removed and ventilation provided by a suction-type dust collector attached to the saw slot beneath the saw table.

The saw-cut surfaces are smoother and show lithologic features and impurities of the coal to better advantage. These characteristics were also entered on the log strip, and impurities, rejectable for analytic purposes, were removed from the coal sample at this time. Other lithologic features of the coal were sketched or noted in proper position on the log strip after breaking the sample half of the core longitudinally with a chisel point hammer. This work must be carried out rapidly on the Lake De Smet coal to avoid undue loss of moisture. Coal of bituminous or higher rank is not as susceptible to alteration and would not require as extensive precautions.

The segments of coal core between any two rejectable partings, intervals of lithologic change, or loss in drilling, were placed in separate humidified glass containers. After a considerable thickness of core had been studied, it was then possible to decide how successive coal layers should be combined for analysis. Samples were constituted, insofar as possible, from coal of similar lighologic characteristics representing intervals that showed about the same extent of loss in drilling. Boundaries between successive samples from single drill hole were generally determined by the presence of partings or intervals of loss in drilling. As the exact amount and depth of losses cannot often be determined, the total loss for any section of core was accumulated at the bottom of the intervals bounded by accurate depth measurements supplied by the driller. Within the limits indicated, the source and relationship of materials in the samples is accurately established. Usually coal from 5 to 15 feet of drilled interval was combined in an individual sample. The actual thickness of coal core included in each analytic

sample has been indicated in each instance (see descriptions of coal cores). The sample intervals were marked in relation to other information on the log strip and the samples transferred to standard moisture-proof containers. Analytic requests were made out and mailed at the same time samples were sent to Pittsburgh, Pa., for analytic determinations by the U. S. Bureau of Mines, Coal Analysis Section.

Blocks also were trimmed from the reserve section of the core, chiefly from the attrital coal layers, to provide material for petrographic study The blocks, 1 to 2 inches long and half an inch wide, were numbered, their position and number recorded on the log strip, and then stored under water in quart jars, as moist coal is most amenable to microscopical preparation. The remainder of the reserve half of the core was stored for future reference as required for other studies now in progress.

THE COAL

Coal in cores from holes GS-1, GS-2A, GS-3, and GS-6 drilled by the Geological Survey were studied in the Coal Geology laboratory. The analytic characteristics of coal from hole 7, drilled by the Bureau of Reclamation,are discussed but this core was not examined in the laboratory. The core from hole A-6, drilled by the Bureau of Reclamation, was described after the completion of this report. Laboratory descriptions of the core are included on p. 32-34, but none of the conclusions in the report are based upon information obtained from hole A-6.

Physical characteristics

The coal from the cores obtained in the Lake De Smet area is dull black when moist, somewhat brownish when dry, with only slight differentiation of constituents according to luster. The coal is close to the borderline between subbituminous coal and lignite and not sufficiently metamorphosed for vitrain to assume its characteristic brilliance and conchoidal fracture. The coal contains about 30 percent moisture, and checks and breaks down readily on exposure to air. Checking is usually deeper in attrital layers but more closely spaced in woody bands. Surface textures on fresh fractures distinguish fairly well between constituents.

Most of the partings are black carbonaceous shale that does not contrast strongly in appearance with the moist coal. Woody lenses are almost as abundant in many of the partings as they are in the coal. In these woody lenses a carbonaceous matrix rich in detrital mineral matter is present instead of a normal matrix of attrital plant debris. More easily recognized shale partings are gray. None of the dark shale is very tough but some of it is platy. Slickensides are common along sloping contacts between shale and woody lenses.

A few layers of light-colored siltstone include some woody fragments similar to the woody inclusions in the shale. The contrast in compaction between siltstone and its coaly inclusions is more prominent than in the shale and, when present, the coaly pieces in siltstone show extreme contortion like the specimen shown in figure 8, a tracing of a core section from hole GS-6 at a depth of 182 feet 6 7/8 inches.

The sandstone at the bottom of some holes is barely cemented and much more friable than the siltstone interbedded with the coal. A few bands of white clay that disintegrate in water also were observed.

The bone and claystone logged in hole 7 by geologists of the Bureau of Reclamation presumably are similar to the partings described

Figure 8.--Contorted siltstone and woody material from GS-6; depth 182 feet, 6 7/8 inches.

above rather than to the much denser, tough carbonaceous shale and siltstone identified as bone in the coal fields of the central and eastern United States.

None of the partings in the coal cores from the Lake De Smet area show any distinctive characteristics that would identify individual partings from hole to hole within the area. All indications suggest that local tonguing relationships exist between the partings and the coal. This is consistent with the general expectation for a local coal deposit of such unusual thickness where lithologic units within the deposit are likely to be highly lenticular.

Coal ingredients

Woody material in bands makes up about 34 to 39 percent of the coal studied in cores from the Lake De Smet area. Most of the woody bands appear lenticular; some are as much as 7 inches thick but the average thickness is less than 3 1/2 inches. Annual rings are discernible in some of the woody material. These occurrences suggest that medium-sized trees grew in the swamp that was transformed later into this coal deposit.

Much of the attrital coal, in which woody fragments are dispersed, probably was derived from material supplied by the larger plants. Microscope studies, which can be mentioned only incidentally now, are required for accurate description of the microscopic fragments. The attrital matrix is mostly translucent, only a small amount consisting of opaque organic matter. Both megascopic and microscopic resinous bodies are common; direct evidence of fungal decay can be seen by microscopic examination.

Fusain occurs at some levels in the deposit but is not an important constituent. A band three-quarters of an inch thick occurred in hole GS-6 at a depth of 238 feet and a band half an inch thick in hole GS-1 at 117 feet 11 1/2 inches depth. Most of the fusain occurs as partings less than 2 millimeters thick, and probably represents less than 1 percent of the deposit.

Blebs of yellow resins are fairly common in the attrital coal and in shaly partings. Some blebs are more than half an inch in diameter and have a distinctly resinous luster and appearance. Probably the resin was derived from coniferous plants but it usually is not directly associated with woody remains. Occurrences of resin blebs are noted in descriptions of coal cores but no resinous concentrations appear prominent enough to be of interest for commercial separation.

Structure in drill cores

The coal beds and associated Eocene rocks drilled near Lake De Smet dip northeast from 3° to 6° and this slight dip should hardly be perceptible in cores. However, the only core showing this amount of dip consistently is from hole GS-2A. The cores from the other holes show variable dips that range from the regional dip to as much as 30° within each core. The coal in hole GS-6 dips about 40° at a depth of about 173 feet. Intervals of steeply dipping coal in each core are separated by intervals of essentially horizontal coal. Dips are indicated in the heading of the descriptions of coal cores and some of the prominent occurrences are tabulated at the bottom of the page. The large core loss in some parts of the holes suggests that even higher dips may have been present because steeply dipping coal is more likely to be lost in coring. In some cores, the intervals having only a slight dip grade gradually into the intervals having a high dip. At other places in the same core, the dip of the bedding appeared to change abruptly at a normal break in the core.

The cause of the variation in dip cannot be determined from the data now available. Probably the cause will not become evident until cores from many closely spaced holes are available or the deposit is exposed through mining. Some deflection of bedding planes might be explained by differential compaction within the coal deposit, but it is not easy to see how dips exceeding 10° to 15° could be formed in this manner. Local lenses of sandstone are known to give rise to compaction features of this sort in some coal fields but sandstone is not abundant in this thick coal deposit. Slumping, incident to minor block faulting within the deposit, seems a more likely explanation. Probably steeply dipping beds were responsible for some of the losses in coring as there was evidently much better recovery in the area of horizontal or only slightly dipping coal.

Hole GS-1			Hole GS-3			Hole GS-6		
Depth		Dip	Depth		Dip	Depth		Dip
(feet)	(inches)	(degrees)	(feet)	(inches)	(degrees)	(feet)	(inches)	(degrees)
59	4	20	120	2-1/2	30	173	3-1/2	40
106	2	23	128	0	30	208	11	22
108	0	23	130	8	22	218	5	25
126	5	23	134	2	22	230	1-3/8	32
			136	9	22	248	2-3/4	30
						279	7-1/2	30

Analytical data

Proximate and ultimate analyses are used for the classification of coal as to rank and to indicate commercial possibilities. Analyses indicate the degree of local metamorphism of coal in a more sensitive fashion than is possible for most other kinds of rock. Under favorable conditions, distinctive analyses may be used to support geologic correlations. Analyses also provide a carefully standardized basis for comparison of coal of unknown utilization character with other coals that are well known.

Coal analyses also provide data on the average properties of the coal constituents combined in the particular sample. Individual lithologic entities of the coal grouped together in a sample would, if separately analyzed, yield results different from the analysis of the sample as a whole. Divergences from standard methods of obtaining and handling coal samples can result in errors in the analyses much greater than the tolerance of error of the laboratory procedures. Thus if sampling procedures other than regular mine-sampling procedures are followed, the resulting analyses do not serve as a proper basis for the identification of rank. Analyses of core samples are not strictly comparable to analyses of samples from mines. Excess moisture to a greater or lesser extent is added to the coal from the fluid used in drilling. Also, losses of core, to some extent indeterminable in character, always occur in core drilling. Losses are probably mostly coal because it is usually more friable than the rocks with which it is associated. If coal deposits are closely drilled, inequalities from coring losses can be evaluated, but the five core records on which the present report is based are too widely spread to minimize this source of uncertainty.

Weighted averages of analyses of the cores from each of the holes drilled in the Lake De Smet area by the Geological Survey and from one hole drilled by the Bureau of Reclamation are shown in table 2. The analysis included in the table for hole 7 drilled by the Bureau of Reclamation represents 101 feet 7 inches of coal analyzed as a single sample. The analysis of this sample differs somewhat from the analytic averages of the other four holes. Some of the difference may be the result of less detailed examination of this core for rejectable impurities than was given the other cores. The greater difference in moisture content probably can be accounted for through different procedures in handling and shipping.

The thick coal in the Lake De Smet area will generally average slightly less than 9 percent ash and less than 1 percent sulfur. The coal probably contains a little less than 30 percent moisture, on a mineral-free basis, and 1 or 2 percent less than this on an as-received basis. Moderate drying would remove 5 or 6 percent additional moisture with a consequent enhancement of apparent heating values. The lowest average Btu content is 8,380 in coal from hole GS-6 and the highest (owing to less moisture, as received) is 9,240 in Bureau of Reclamation hole 7, as calculated on the moist, mineral-free-basis. Volatile matter averages about 30 percent and fixed carbon averages 34 percent on an as-received basis.

According to the standards of the American Society for Testing Materials, coal having heating values of 8,300 to 9,500 Btu on a moist, mineral-matter free basis, is classified as subbituminous C. Consolidated coals of lower heating value are classed as lignite. Values determined for individual samples of the thick coal in the Lake De Smet area appear to cluster around the boundary between lignite and subbituminous C. Because true bed-moisture values are lacking, the present data do not indicate precisely in which rank some of the samples should be placed. However, the averaged heating values of the coal suggest that it should be classed as low in the range of subbituminous C.

Tables 3-7 show the proximate analyses of each sample from the holes drilled by the Geological Survey and from hole 7 drilled by the Bureau of Reclamation. The apparent rank and parenthetic number as determined by analysis for each sample (according to ASTM procedure) is shown in the tables. These should be construed as "rank equivalent" indications; that is, these parenthetic numbers are the ones that would indicate the rank if the samples were standard mine-face samples. No better basis for classification exists at the present time.

Ultimate analyses of selected samples from the drill holes are shown in table 8. Because ultimate analyses are less useful for relative comparison of coal characteristics and apply chiefly to utilization aspects, ultimate analyses were requested only for selected samples free of obvious impurities containing no significant core loses.

Table 9 shows analyses of mine-face samples of five coals from well-known producing mines in the Powder River basin for comparison with values presented for the coal from near Lake De Smet.

Table 2.—Weighted average analyses of coal near Lake De Smet, Johnson County, Wyo.

Core-hole designation	Total coal thickness (inches)	Percent									Btu		
		Mineral (1.08 ash plus 0.55 S)	Ash (as-received)	Sulfur (as-received)	Moisture		Volatile matter		Fixed carbon		Mineral and moisture free	Moist mineral-matter free	As-received
					Mineral-matter-free	As-received	Mineral and moisture free	As-received	Mineral and moisture free	As-received			
GS-1--------	545.7	7.0	5.1	0.6	31.3	29.1	45.8	29.0	54.2	34.5	12,440	8,550	7,970
GS-2A-------	489.8	6.9	6.1	.5	32.8	30.5	47.4	30.3	52.6	33.0	12,540	8,410	7,845
GS-3--------	446.7	8.6	7.7	.6	27.9	28.3	45.3	29.4	54.7	34.6	12,470	8,690	7,890
GS-6--------	817.5	10.3	9.2	.6	32.7	29.3	45.8	28.6	54.2	32.8	12,470	8,380	7,515
7(Recl.)----	1,219.0	11.0	9.7	1.0	26.1	23.6	45.0	31.9	53.0	34.8	12,570	9,240	8,270
Total or average values----	3,518.7	9.3	8.1	.7	29.6	27.0	46.4	30.1	53.6	34.0	12,510	8,750	7,940

Table 3.—Proximate analyses of subbituminous coal from hole GS-1,[1] Lake De Smet area, Johnson County, Wyo.

[Core hole located in center of S 1/2, NE 1/4, sec. 1, T. 52 N., R. 83 W., plate 1]

Laboratory no.[2]	Sample no.	Thickness[3] of coal analyzed (inches)	Depth interval[3]				Rank[4] indication	Sample[5] condition	Air-dry loss	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Heat value (Btu)
			From		To										
			Feet	Inches	Feet	Inches									
D-56797----	GS-1-1	63 3/8	59	0	73	4 1/2	(54 to 85.4)	A	17.6	29.4	30.4	35.1	5.1	0.4	8,070
								B	---	14.3	36.9	42.7	6.1	.4	9,790
								C	---	---	43.1	49.7	7.2	.5	11,430
								D	---	---	46.4	53.6	---	.5	12,310
								E	---	31.2	31.6	37.2	---	---	8,540
								F	---	---	46.0	54.0	---	---	12,410
D-56798----	GS-1-2	80 7/8	73	4 1/2	86	0	(54 to 86.3)	A	20.0	28.5	30.7	35.5	5.3	.5	8,140
								B	---	10.5	38.4	44.5	6.6	.6	10,180
								C	---	---	42.9	49.7	7.4	.7	11,380
								D	---	---	46.3	53.7	---	.8	12,290
								E	---	30.3	32.0	37.7	---	---	8,630
								F	---	---	45.9	54.1	---	---	12,390
D-56799----	GS-1-3	47 3/4	86	0	92	11 1/2	(53 to 86.3)	A	18.0	28.1	30.2	33.6	8.1	.4	7,880
								B	---	12.3	36.9	40.9	9.9	.5	9,620
								C	---	---	42.1	46.6	11.3	.6	10,970
								D	---	---	47.4	52.6	---	.6	12,360
								E	---	30.9	32.3	36.8	---	---	8,630
								F	---	---	46.7	53.3	---	---	12,490

D-56800---	GS-1-4	68 1/2	92	11 1/2	106	0	(53 to 86.0)	A	19.1	28.3	29.9	33.3	8.5	0.9	7,780
								B	---	11.4	36.9	41.2	10.5	1.1	9,620
								C	---	---	41.7	46.4	11.9	1.2	10,850
								D	---	---	47.3	52.7	---	1.4	12,320
								E	---	31.4	31.9	36.7	---	---	8,560
								F	---	---	46.5	53.5	---	---	12,470
D-56801---	GS-1-5	49 1/4	106	0	113	9	(54 to 87.0)	A	18.7	28.1	30.2	33.9	7.8	2.4	7,970
								B	---	11.5	37.2	41.7	9.6	3.0	9,800
								C	---	---	42.0	47.2	10.8	3.4	11,080
								D	---	---	47.1	52.9	---	3.8	12,430
								E	---	31.1	31.7	37.2	---	---	8,700
								F	---	---	46.0	54.0	---	---	12,630
D-56802---	GS-1-6	127 1/2	113	9	127	7 1/4	(54 to 85.1)	A	18.1	29.4	29.8	35.0	5.8	.4	7,980
								B	---	13.8	36.4	42.7	7.1	.5	9,740
								C	---	---	42.2	49.6	8.2	.6	11,290
								D	---	---	46.0	54.0	---	.7	12,300
								E	---	31.4	31.2	37.4	---	---	8,510
								F	---	---	45.6	54.4	---	---	12,410
D-56803---	GS-1-7	32 3/4	127	7 1/4	133	1/4	(55 to 85.8)	A	15.7	29.2	29.6	35.4	5.8	.3	8,040
								B	---	16.0	35.1	42.0	6.9	.4	9,530
								C	---	---	41.8	50.0	8.2	.5	11,350
								D	---	---	45.5	54.5	---	.5	12,370
								E	---	31.2	31.0	37.8	---	---	8,580
								F	---	---	45.1	54.9	---	---	12,470
D-56804---	GS-1-8	95 3/4	133	1/4	141	6 1/2	(55 to 84.1)	A	18.9	30.4	29.2	35.4	5.0	.4	7,960
								B	---	14.1	36.1	43.6	6.2	.5	9,820
								C	---	---	42.0	50.8	7.2	.6	11,430
								D	---	---	45.2	54.8	---	.7	12,320
								E	---	32.3	30.3	37.4	---	---	8,410
								F	---	---	44.8	55.2	---	---	12,410

[1] Core paraffin-dipped in the field to prevent moisture loss; paraffin removed mechanically before analysis.

[2] Laboratory number refers to those given on U. S. Bureau of Mines analytic reports and included in their records of analyses.

[3] Difference between coal thickness analyzed and intervals of depth is accounted for by losses in coring and partings rejected from analytical samples. See detailed core descriptions, p. 31-33, for details.

[4] Rank indication is given by a parenthetic hyphenated number, according to the method suggested in ASTM Standards on coal and coke, in which percent fixed carbon is represented by numerals before the hyphen and hundreds of Btu by numerals following the hyphen. All rank indications are based on core samples that do not correspond exactly with those taken under standard conditions.

[5] Sample condition: A, as received; B, air dried; C, moisture-free; D, moisture and ash-free; E, moist, mineral-matter-free; F, dry, mineral-matter-free.

Table 4.—Proximate analyses of subbituminous coal from hole GS-2A,[1] Lake De Smet area, Johnson County, Wyo.

[Core hole located in center of N 1/2, NE 1/4, NW 1/4, SE 1/4, sec 8, T. 52 N., R. 82 W., see map, plate 1]

Laboratory no.[2]	Sample no.	Thickness[3] of coal analyzed (inches)	Depth interval[3] From Feet	From Inches	To Feet	To Inches	Rank[4] indication	Sample[5] condition	Air dry loss	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Heat value (Btu)
D-55877 ---	GS-2A-1	47 1/2	66	0	71	0	(52 to 83.4)	A	17.8	30.9	30.0	32.0	7.1	0.5	7,700
								B	---	15.9	36.6	38.9	8.6	.7	9,360
								C	---	---	43.5	46.2	10.3	.8	11,130
								D	---	---	48.4	51.6	---	.9	12,410
								E	---	33.5	31.8	34.7	---	---	8,340
								F	---	---	47.8	52.2	---	---	12,550
D-55876 ---	GS-2A-2	49	71	0	76	0	(52 to 83.8)	A	17.3	30.6	30.5	32.4	6.5	.3	7,790
								B	---	16.1	36.8	39.3	7.8	.4	9,420
								C	---	---	43.9	46.8	9.3	.5	11,230
								D	---	---	48.4	51.6	---	.5	12,380
								E	---	32.9	32.2	34.9	---	---	8,380
								F	---	---	48.0	52.0	---	---	12,500
D-55875 ---	GS-2A-3	56 1/2	76	0	82	0	(52 to 84.1)	A	15.1	30.4	30.6	32.5	6.5	.4	7,820
								B	---	18.1	36.1	38.2	7.6	.4	9,210
								C	---	---	44.0	46.7	9.3	.5	11,240
								D	---	---	48.5	51.5	---	.6	12,400
								E	---	32.7	32.3	35.0	---	---	8,410
								F	---	---	48.0	52.0	---	---	12,510
D-55874 ---	GS-2A-4	24 3/4	82	0	84	3/4	(50 to 84.8)	A	21.3	29.1	31.0	30.3	9.6	.5	7,600
								B	---	9.9	39.4	38.5	12.2	.7	9,660
								C	---	---	43.7	42.7	13.6	.7	10,720
								D	---	---	50.5	49.5	---	.8	12,410
								E	---	32.6	33.6	33.8	---	---	8,480
								F	---	---	49.8	50.2	---	---	12,570
D-55873 ---	GS-2A-5	31 1/4	84	3/4	87	1/2	(53 to 84.6)	A	19.8	30.9	30.5	33.7	4.9	.5	8,010
								B	---	13.9	38.0	42.0	6.1	.6	9,980
								C	---	---	44.1	48.8	7.1	.7	11,590
								D	---	---	47.5	52.5	---	.8	12,470
								E	---	32.7	31.7	35.6	---	---	8,460
								F	---	---	47.1	52.9	---	---	12,570
D-55872 ---	GS-2A-6	42 1/2	87	1/2	92	0	(53 to 83.1)	A	20.8	31.6	30.2	33.7	4.5	.3	7,910
								B	---	13.6	38.1	42.6	5.7	.4	9,990
								C	---	---	44.1	49.3	6.6	.5	11,570
								D	---	---	47.2	52.8	---	.5	12,380
								E	---	33.3	31.3	35.4	---	---	8,310
								F	---	---	46.9	53.1	---	---	12,460

D-55871 ---	GS-2A-7	54 1/4	92	0	97	0	(54 to 84.9)	A	14.8	30.0	30.1	34.2	5.7	0.5	7,970
								B	---	17.8	35.4	40.1	6.7	.6	9,360
								C	---	---	43.0	48.9	8.1	.7	11,390
								D	---	---	46.8	53.2	---	.7	12,400
								E	---	32.0	31.5	36.5	---	---	8,490
								F	---	---	46.3	53.7	---	---	12,500
D-55616 *---	GS-2A-8	38 1/2	97	0	100	2 1/2	(53 to 85.3)	A	19.8	29.1	30.7	34.1	6.1	.5	7,970
								B	---	11.6	38.3	42.5	7.6	.6	9,940
								C	---	---	43.3	48.1	8.6	.7	11,240
								D	---	---	47.3	52.7	---	.7	12,290
								E	---	32.3	32.2	35.5	---	---	8,530
								F	---	---	46.9	53.1	---	---	12,410
D-55618 *---	GS-2A-10	55 1/2	102	0	107	0	(52 to 83.8)	A	15.6	31.2	30.6	32.8	5.4	.6	7,890
								B	---	18.5	36.3	38.8	6.4	.7	9,350
								C	---	---	44.5	47.7	7.8	.8	11,460
								D	---	---	48.3	51.7	---	.9	12,430
								E	---	33.2	31.9	34.9	---	---	8,380
								F	---	---	47.8	52.2	---	---	12,710
D-55619 *---	GS-2A-11	28	107	0	109	4	(53 to 82.9)	A	22.9	31.3	30.2	32.8	5.7	.4	7,780
								B	---	11.0	39.1	42.5	7.4	.5	10,090
								C	---	---	44.0	47.7	8.3	.5	11,330
								D	---	---	47.9	52.1	---	.6	12,350
								E	---	33.4	31.6	35.0	---	---	8,290
								F	---	---	47.5	52.5	---	---	12,450
D-55621 *---	GS-2A-13	62	111	10 1/2	119	0	(54 to 84.4)	A	16.6	30.7	29.7	33.7	5.9	1.3	7,910
								B	---	16.8	35.7	40.4	7.1	1.5	9,480
								C	---	---	42.9	48.6	8.5	1.8	11,400
								D	---	---	46.9	53.1	---	2.0	12,460
								E	---	33.0	30.9	36.1	---	---	8,440
								F	---	---	46.2	53.8	---	---	12,610

[1] Core paraffin-dipped in the field to prevent moisture loss; paraffin removed mechanically before analysis.

[2] Laboratory number refers to those given on U. S. Bureau of Mines analytic reports and included in their records of analyses.

[3] Difference between coal thickness analyzed and intervals of depth is accounted for by losses in coring and partings rejected from analytical samples. See detailed core descriptions, p. 33-36, for details.

[4] Rank indication is given by a parenthetic hyphenated number, according to the method suggested in ASTM Standards on coal and coke, in which percent fixed carbon is represented by numerals before the hyphen and hundreds of Btu by numerals following the hyphen. All rank indications are based on core samples that do not correspond exactly with those taken under standard conditions.

[5] Sample condition: A, as received; B, air dried; C, moisture-free; D, moisture and ash-free; E, moist, mineral-matter-free. F, dry, mineral-matter-free.

* Core not paraffin-dipped.

Table 5.—Proximate analyses of subbituminous coal from hole GS-3,[1] Lake De Smet area, Johnson County, Wyo.

[Core hole located in center of W 1/2, SW 1/4, sec. 6, T, 52 N., R. 82 W., see map, plate 1]

Laboratory no.[2]	Sample no.	Thickness[3] of coal analyzed (inches)	Depth interval[3] From Feet	From Inches	To Feet	To Inches	Rank[4] indication	Sample[5] condition	Air dry loss	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Heat value (Btu)
D-56436----	GS-3-1	54 5/8	118	8 3/8	123	8 3/8	(54 to 85.3)	A	19.0	29.5	29.6	33.4	7.5	0.4	7,840
								B	---	13.0	36.6	41.2	9.2	.5	9,670
								C	---	---	42.0	47.4	10.6	.5	11,110
								D	---	---	47.0	53.0	---	.6	12,430
								E	---	32.1	31.5	36.4	---	---	8,530
								F	---	---	46.4	53.6	---	---	12,580
D-56437----	GS-3-2	39 5/8	123	8 3/8	127	2 3/4	(53 to 85.6)	A	19.8	27.8	29.0	32.0	11.2	.9	7,530
								B	---	10.1	36.2	39.7	14.0	1.1	9,390
								C	---	---	40.2	44.2	15.6	1.2	10,440
								D	---	---	47.6	52.4	---	1.4	12,360
								E	---	31.8	31.7	36.5	---	---	8,560
								F	---	---	46.5	53.5	---	---	12,560
D-56438----	GS-3-3	101 1/2	127	2 3/4	136	9 1/2	(55 to 85.0)	A	17.6	28.5	28.8	33.9	8.8	.6	7,690
								B	---	13.1	35.0	41.2	10.7	.7	9,340
								C	---	---	40.3	47.4	12.3	.8	10,750
								D	---	---	45.9	54.1	---	.9	12,250
								E	---	31.6	30.9	37.5	---	---	8,500
								F	---	---	45.2	54.8	---	---	12,420
D-56439----	GS-3-4	137 3/4	136	9 1/4	149	3 5/8	(55 to 86.5)	A	15.5	28.4	29.9	35.5	6.2	.5	8,070
								B	---	15.3	35.4	41.9	7.4	.6	9,550
								C	---	---	41.8	49.5	8.7	.7	11,260
								D	---	---	45.8	54.2	---	.7	12,340
								E	---	31.6	30.2	38.1	---	---	8,650
								F	---	---	45.2	54.8	---	---	12,450
D-56440----	GS-3-5	20 1/8	149	3 5/8	151	5 1/2	(55 to 85.7)	A	22.5	28.1	28.7	33.8	9.4	.4	7,700
								B	---	7.1	37.0	43.7	12.2	.6	9,940
								C	---	---	39.9	47.0	13.1	.6	10,700
								D	---	---	45.9	54.1	---	.7	12,320
								E	---	31.3	31.0	37.7	---	---	8,570
								F	---	---	45.2	54.8	---	---	12,480
D-56441----	GS-3-6	94 7/8	151	5 1/2	159	8 1/2	(55 to 87.0)	A	18.1	27.8	29.5	35.8	6.9	.7	8,050
								B	---	11.9	36.0	43.7	8.4	.9	9,820
								C	---	---	40.8	49.7	9.5	1.0	11,140
								D	---	---	45.1	54.9	---	1.1	12,310
								E	---	30.2	31.1	38.7	---	---	8,700
								F	---	---	44.5	55.5	---	---	12,450

[1] Core paraffin-dipped in the field to prevent moisture loss; paraffin removed mechanically before analysis.

[2] Laboratory number refers to those given on U. S. Bureau of Mines analytic reports and included in their records of analyses.

[3] Difference between coal thickness analyzed and intervals of depth is accounted for by losses in coring and partings rejected from analytical samples. See detailed core descriptions, p. 36-37, for details.

[4] Rank indication is given by a parenthetic hyphenated number, according to the method suggested in ASTM Standards on coal and coke, in which percent fixed carbon is represented by numerals before the hyphen and hundreds of Btu by numerals following the hyphen. All rank indications are based on core samples that do not correspond exactly with those taken under standard conditions.

[5] Sample condition: A, as received; B, air dried; C, moisture-free; D, moisture and ash-free; E, moist, mineral-matter-free; F, dry, mineral-matter-free.

Table 6.—Proximate analyses of subbituminous coal from hole GS-6, Lake De Smet area, Johnson County, Wyo.

[Core hole located SW 1/4, SE 1/4, NW 1/4, sec. 1, T. 52 N., R. 83 W., see map, plate 1]

Laboratory no.[1]	Sample no.	Thickness[2] of coal analyzed (inches)	Depth interval[2] From Feet	From Inches	To Feet	To Inches	Rank[3] indication	Sample[4] condition	Air dry loss	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Heat value (Btu)
D-55870---	GS-6-1	103 1/2	172	0	191	7 1/8	(53 to 83.2)	A	14.2	29.3	28.5	31.0	11.2	1.1	7,320
								B	---	17.5	33.3	36.2	13.0	1.2	8,530
								C	---	---	40.3	43.9	15.8	1.5	10,350
								D	---	---	47.9	52.1	---	1.8	12,290
								E	---	33.6	31.1	35.3	---	---	8,320
								F	---	---	46.8	53.2	---	---	12,530
D-55867---	GS-6-2	80 3/4	191	7 1/8	201	7	(54 to 82.3)	A	15.7	31.4	28.9	33.8	5.9	.3	7,710
								B	---	18.7	34.3	40.0	7.0	.3	9,140
								C	---	---	42.2	49.2	8.6	.4	11,240
								D	---	---	46.2	53.8	---	.5	12,300
								E	---	33.6	30.3	36.1	---	---	8,230
								F	---	---	45.6	54.4	---	---	12,400
D-55868---	GS-6-3	41 1/4	201	7	205	1/4	(53 to 87.1)	A	15.5	28.5	30.9	34.6	6.0	.7	8,150
								B	---	15.4	36.6	40.9	7.1	.9	9,640
								C	---	---	43.3	48.4	8.3	1.0	11,390
								D	---	---	47.2	52.8	---	1.1	12,430
								E	---	30.6	32.4	37.0	---	---	8,710
								F	---	---	46.6	53.4	---	---	12,560
D-55869---	GS-6-4	22 5/8	205	1/4	210	0	(52 to 84.4)	A	20.0	28.2	29.7	31.8	10.3	.3	7,500
								B	---	10.3	37.2	39.6	12.9	.4	9,380
								C	---	---	41.4	44.2	14.4	.4	10,450
								D	---	---	48.4	51.6	---	.5	12,200
								E	---	31.8	32.4	35.8	---	---	8,440
								F	---	---	47.5	52.5	---	---	12,370
D-56375---	GS-6-5	53 1/2	210	0	222	3/4	(54 to 84.2)	A	17.6	29.7	28.7	32.8	8.8	.7	7,620
								B	---	14.7	34.9	39.7	10.7	.9	9,250
								C	---	---	40.9	46.6	12.5	1.0	10,850
								D	---	---	46.7	53.3	---	1.2	12,400
								E	---	32.9	30.8	36.3	---	---	8,420
								F	---	---	45.9	54.1	---	---	12,560
D-56376---	GS-6-6	21 1/4	222	3/4	223	10	(54 to 86.3)	A	22.6	28.8	30.1	35.2	5.9	.4	8,080
								B	---	8.0	38.9	45.4	7.7	.5	10,430
								C	---	---	42.2	49.5	8.3	.6	11,340
								D	---	---	46.1	53.9	---	.6	12,370
								E	---	30.9	31.5	37.6	---	---	8,630
								F	---	---	45.6	54.4	---	---	12,480

See footnotes at the end of the table.

Table 6.—Proximate analyses of subbituminous coal from hole GS-6, Lake De Smet area, Johnson County, Wyo.—Continued

Laboratory no.[1]	Sample no.	Thickness[2] of coal analyzed (inches)	Depth interval[2] From Feet	From Inches	To Feet	To Inches	Rank[3] indication	Sample[4] condition	Air dry loss	Moisture	Volatile matter	Fixed carbon matter	Ash	Sulfur	Heat value (Btu)
D-56377---	GS-6-7	45 3/4	223	10	228	11 3/4	(55 to 81.6)	A	25.9	31.7	28.4	33.7	6.2	.4	7,620
								B	---	7.8	38.3	45.6	8.3	.5	10,280
								C	---	---	41.5	49.5	9.0	.6	11,160
								D	---	---	45.6	54.4	---	.6	12,260
								E	---	34.1	29.8	36.1	---	---	8,160
								F	---	---	45.2	54.8	---	---	12,380
D-56379---	GS-6-9	64 7/8	230	1 3/8	239	7 3/4	(53 to 84)	A	17.4	28.7	28.6	30.8	11.9	.5	7,340
								B	---	13.6	34.7	37.3	14.4	.6	8,890
								C	---	---	40.1	43.3	16.6	.7	10,290
								D	---	---	48.2	51.8	---	.8	12,340
								E	---	33.0	31.6	35.4	---	---	8,420
								F	---	---	47.1	52.9	---	---	12,570
D-56380---	GS-6-10	55 1/4	239	7 3/4	247	2 3/8	(53 to 86)	A	17.7	28.4	29.4	32.1	10.1	.6	7,650
								B	---	13.0	35.8	39.0	12.2	.8	9,290
								C	---	---	41.1	44.8	14.1	.9	10,690
								D	---	---	47.9	52.1	---	1.0	12,440
								E	---	32.0	31.9	36.1	---	---	8,580
								F	---	---	47.0	53.0	---	---	12,620
D-56381---	GS-6-11	119 1/2	247	2 3/8	262	0	(55 to 84)	A	17.9	29.2	28.0	33.0	9.8	.6	7,520
								B	---	13.8	34.1	40.2	11.9	.8	9,150
								C	---	---	39.6	46.6	13.8	.9	10,620
								D	---	---	45.9	54.1	---	1.0	12,320
								E	---	32.8	30.3	36.9	---	---	8,410
								F	---	---	45.0	55.0	---	---	12,510
D-56382---	GS-6-12	43 3/4	262	0	265	7 3/4	(54 to 82.9)	A	19.1	28.8	28.2	31.8	11.2	.4	7,290
								B	---	12.0	34.8	39.3	13.9	.4	9,020
								C	---	---	39.6	44.6	15.8	.5	10,240
								D	---	---	47.0	53.0	---	.6	12,160
								E	---	32.8	31.0	36.2	---	---	8,290
								F	---	---	46.1	53.9	---	---	12,350
D-56383---	GS-6-13	40 1/4	265	7 3/4	272	0	(55 to 85.5)	A	20.3	28.8	29.5	34.7	7.0	.6	7,910
								B	---	10.6	37.0	43.7	8.7	.8	9,920
								C	---	---	41.4	48.8	9.8	.9	11,100
								D	---	---	45.8	54.2	---	1.0	12,300
								E	---	30.7	31.7	37.6	---	---	8,550
								F	---	---	45.4	54.6	---	---	12,450

D-56384---	GS-6-14	66 1/2	272	0	279	3 5/8	(56 to 82.8)	A	15.4	27.8	26.6	32.4	13.2	.6	7,130
								B	---	14.7	31.5	38.2	15.6	.8	8,430
								C	---	---	36.9	44.8	18.3	.9	9,890
								D	---	---	45.1	54.9	---	1.1	12,100
								E	---	32.8	29.5	37.7	---	---	8,280
								F	---	---	44.2	55.8	---	---	12,260
D-56385---	GS-6-15	34 1/2	279	3 5/8	282	3 5/8	(57 to 84.1)	A	21.9	30.2	28.2	36.0	5.6	.6	7,900
								B	---	10.6	36.1	46.2	7.1	.8	10,110
								C	---	---	40.4	51.6	8.0	.9	11,310
								D	---	---	43.9	56.1	---	1.0	12,290
								E	---	32.2	29.4	38.4	---	---	8,410
								F	---	---	43.4	56.6	---	---	12,410
D-56386---	GS-6-16	24 3/8	282	3 5/8	292	0	(55 to 81.8)	A	25.3	31.0	28.0	32.8	8.2	1.3	7,460
								B	---	7.8	37.5	43.8	10.9	1.7	9,980
								C	---	---	40.7	47.5	11.8	1.8	10,820
								D	---	---	46.1	53.9	---	2.1	12,270
								E	---	34.2	29.7	36.1	---	---	8,180
								F	---	---	45.1	54.9	---	---	12,440

[1]Laboratory number refers to those given on U. S. Bureau of Mines analytic reports and included in their records of analyses.

[2]Difference between coal thickness analyzed and intervals of depth is accounted for by losses in coring and partings rejected from analytical samples. See detailed core descriptions, p. 38-43, for details.

[3]Rank indication is given by a parenthetic hyphenated number, according to the method suggested in ASTM Standards on coal and coke, in which percent fixed carbon is represented by numerals before the hyphen and hundreds of Btu by numerals following the hyphen. All rank indications are based on core samples that do not correspond exactly with those taken under standard conditions.

[4]Sample condition: A, as received; B, air dried; C, moisture-free; D, moisture and ash-free; E, moist, mineral-matter-free; F, dry, mineral-matter-free.

Table 7.—Proximate analyses of subbituminous coal from Bureau of Reclamation hole 7,[1] Lake De Smet area, Johnson County, Wyo.

Laboratory no.[2]	Sample no.	Thickness[3] of coal analyzed (inches)	Depth interval[3] From		To		Rank[4] indication	Sample[5] condition	Air dry loss	Moisture	Voal-tile matter	Fixed carbon	Ash	Sulfur	Heat value (Btu)
			Feet	Inches	Feet	Inches									
C-97450---	---	1,219	95	0	224	11	(53 to 92.4)	A	6.7	23.6	31.9	34.8	9.7	1.0	8,270
								B	---	18.2	34.2	37.2	10.4	1.1	8,860
								C	---	---	41.7	45.6	12.7	1.3	10,830
								D	---	---	47.8	52.2	---	1.5	12,400
								E	---	26.1	35.0	38.9	---	---	9,240
								F	---	---	47.0	53.0	---	---	12,570

[1]Core paraffin-dipped in the field to prevent moisture loss; paraffin probably was removed mechanically before analysis.

[2]Laboratory number refers to those given on U. S. Bureau of Mines analytic reports and included in their records of analyses.

[3]Difference between coal thickness analyzed and intervals of depth is accounted for by losses in coring and partings rejected from analytical samples. See detailed core descriptions, p. 45-47, for details.

[4]Rank indication is given by a parenthetic hyphenated number, according to the method suggested in ASTM Standards on coal and coke, in which percent fixed carbon is represented by numerals before the hyphen and hundreds of Btu. by numerals following the hyphen. All rank indications are based on core samples that do not correspond exactly with those taken under standard conditions.

[5]Sample condition: A, as received; B, air dried; C, moisture-free; D, moisture and ash-free; E, moist, mineral-matter-free; F, dry, mineral-matter-free.

Table 8.—Ultimate analyses of selected coal samples[1] from the Lake De Smet area, Johnson County, Wyo.

[For locations of holes see tables 3-7 and map, plate 1]

Laboratory no.[2]	Drill hole and sample no.	Thickness[3] of coal analyzed (inches)	Depth interval[3] From Feet	From Inches	To Feet	To Inches	Rank[4] indication	Sample[5] condition	Air dry loss	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Ash
D-56804 --	GS-1 Sample 8	95 3/4	133	1/4	141	6 1/2	(55 to 84.1)	A	18.9	6.6	46.5	0.9	40.6	0.4	5.0
								B	---	5.5	57.3	1.1	29.4	.5	6.2
								C	---	4.6	66.7	1.2	19.7	.6	7.2
								D	---	5.0	71.9	1.3	21.1	.7	---
D-55877 --	GS-2A Sample 1	47 1/2	66	0	71	0	(52 to 83.4)	A	17.8	6.7	44.3	.8	40.6	.5	7.1
								B	---	5.7	53.9	.9	30.2	.7	8.6
								C	---	4.7	64.1	1.1	19.0	.8	10.3
								D	---	5.2	71.4	1.2	21.3	.9	---
D-55873 --	GS-2A Sample 5	31 1/4	84	3/4	87	1/2	(53 to 84.6)	A	19.8	6.7	46.5	.7	40.7	.5	4.9
								B	---	5.7	57.9	.9	28.8	.6	6.1
								C	---	4.8	67.3	1.0	19.1	.7	7.1
								D	---	5.2	72.4	1.1	20.5	.8	---
D-55618*--	GS-2A Sample 10	55 1/2	102	0	107	0	(52 to 83.8)	A	15.6	6.6	46.3	.8	40.3	.6	5.4
								B	---	5.8	54.8	1.0	31.3	.7	6.4
								C	---	4.6	67.2	1.2	18.4	.8	7.8
								D	---	5.0	72.9	1.3	19.9	.9	---
D-56438 --	GS-3 Sample 3	101 1/4	127	2 3/4	136	9 1/2	(55 to 85.0)	A	17.6	6.3	45.4	.7	38.2	.6	8.8
								B	---	5.3	55.1	.8	27.4	.7	10.7
								C	---	4.4	63.4	.9	18.2	.8	12.3
								D	---	5.0	72.3	1.1	20.7	.9	---
D-56439 --	GS-3 Sample 4	137 3/4	136	9 1/2	149	3 5/8	(55 to 86.5)	A	15.5	6.4	47.4	.8	38.7	.5	6.2
								B	---	5.5	56.1	.9	29.5	.6	7.4
								C	---	4.5	66.2	1.1	18.8	.7	8.7
								D	---	4.9	72.5	1.2	20.7	.7	---
D-56441 --	GS-3 Sample 6	94 7/8	151	5 1/2	159	8 1/2	(55 to 87.0)	A	18.1	6.3	47.2	.9	38.0	.7	6.9
								B	---	5.2	57.6	1.0	26.9	.9	8.4
								C	---	4.4	65.4	1.2	18.5	1.0	9.5
								D	---	4.9	72.2	1.3	20.5	1.1	---
D-55868*--	GS-6 Sample 3	41 1/4	201	7	205	1/4	(53 to 87.1)	A	15.5	6.5	47.5	.8	38.5	.7	6.0
								B	---	5.6	56.2	.9	29.3	.9	7.1
								C	---	4.6	66.4	1.1	18.6	1.0	8.3
								D	---	5.0	72.4	1.1	20.4	1.1	---

D-56382*--	GS-6 Sample 12	43 3/4	262	0	265	7 3/4	(54 to 82.9)	A	19.1	6.2	42.7	0.7	38.8	0.4	11.2
								B	---	5.1	52.8	.9	26.9	.4	13.9
								C	---	4.3	60.0	1.0	18.4	.5	15.8
								D	---	5.1	71.2	1.2	21.9	.6	---
C-97450[1]--	Recl. 7	101 ft, 7 in.	95	0	224	11	(53 to 92.4)	A	6.7	6.1	48.3	.7	34.2	1.0	9.7
								B	---	5.8	51.8	.8	30.1	1.1	10.4
								C	---	4.6	63.2	1.0	17.2	1.3	12.7
								D	---	5.2	72.4	1.1	19.8	1.5	---

[1] Core paraffin-dipped in the field to prevent moisture loss; paraffin removed mechanically before analysis.

[2] Laboratory number refers to those given on U. S. Bureau of Mines analytic reports and included in their records of analyses.

[3] Difference between coal thickness analyzed and intervals of depth is accounted for by losses in coring and partings rejected from analytical samples. See detailed core descriptions, p. 33-47, for details.

[4] Rank indication is given by a parenthetic hyphenated number, according to the method suggested in ASTM Standards on coal and coke, in which percent fixed carbon is represented by numerals before the hyphen and hundreds of Btu by numerals following the hyphen. All rank indications are based on core samples that do not correspond exactly with those taken under standard conditions.

[5] Sample condition: A, as received; B, air dried; C, moisture-free; D, moisture and ash-free.

* Core not paraffin-dipped.

Table 9.—Proximate analyses of standard face samples of coal mined in Johnson, Sheridan, and Campbell Counties, Wyo., and Rosebud County, Mont.

Laboratory no.[1]	Location	Bed	Mine	Rank designation	Sample[2] condition	Air Dry loss	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Heat value (Btu)
D-50515-----	SW 1/4, sec. 1, T. 53 N., R. 82 W., Johnson County, Wyo.	Healy-----	Krezelok--	Subbituminous (54 to 83.6).	A	12.1	30.7	29.8	34.4	5.1	0.4	7,900
					B	---	21.2	33.9	39.1	5.8	.4	8,990
					C	---	---	43.0	49.7	7.3	.5	11,400
					D	---	---	46.0	53.6	---	.5	12,300
					E	---	31.6	32.0	36.4	---	---	8,360
					F	---	---	46.0	54.0	---	---	12,400
D-25128------	SE 1/4, sec. 20, T. 51 N., R. 81 W., Johnson County, Wyo.	120 feet below Healy bed.	Clear Creek Coal Co.	Lignite (54 to 80.6).	A	17.6	31.1	28.7	31.4	8.8	1.4	7,350
					B	---	16.4	34.9	38.0	10.7	1.7	8,920
					C	---	---	41.7	45.5	12.8	2.1	10,670
					D	---	---	47.8	52.2	---	2.4	12,240
					E	---	35.1	30.4	34.5	---	---	8,060
					F	---	---	47.2	52.8	---	---	12,320
D-12685[3]-----	Sheridan coal field, Sheridan County, Wyo.	Monarch--	Monarch--	Subbituminous (53 to 97.0).	A	8.1	23.9	34.3	38.4	3.4	.4	9,340
					B	---	17.2	37.3	41.8	3.7	.4	10,160
					C	---	---	45.1	50.5	4.4	.5	12,260
					D	---	---	47.2	52.8	---	.5	12,830
					E	---	24.9	35.2	39.9	---	---	9,700
					F	---	---	46.9	53.1	---	---	12,910

See footnotes at the end of the table.

Table 9.—Proximate analyses of standard face samples of coal mined in Johnson, Sheridan, and Campbell Counties, Wyo., and Rosebud County, Mont.—Continued

Laboratory no.[1]	Location	Bed	Mine	Rank designation	Sample condition[2]	Air dry loss	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Heat value (Btu)
A-2640[3]	Gillette coal field, Campbell County, Wyo.	Roland	Peerless	Subbituminous (53 to 83.0).	A	18.0	33.3	29.0	31.8	5.9	0.5	7,770
					B	---	18.6	35.4	38.8	7.2	.6	9,480
					C	---	---	43.4	47.7	8.9	.8	11,650
					D	---	---	47.7	52.3	---	.8	12,780
					E	---	35.7	30.3	34.0	---	---	8,300
					F	---	---	47.2	52.8	---	---	12,900
A-10685[4]	Secs. 3, 6, 7, 18, T. 1 N., R. 42 E., and secs. 1, 2, 3, 4, 11, 12, 13, T. 1 N., R. 41 E., Rosebud County, Mont.	Rosebud	Colstrip	Subbituminous (59 to 101.3).	A	5.4	22.3	28.9	41.2	7.6	.8	9,290
					B	---	17.9	30.5	41.6	8.6	.8	9,820
					C	---	---	37.2	53.0	9.8	1.1	11,290
					D	---	---	41.2	58.8	---	1.2	13,240
					E	---	24.4	30.6	45.0	---	---	10,130
					F	---	---	40.5	59.5	---	---	13,400

[1] Laboratory number refers to those given on U. S. Bureau of Mines analytic reports and included in their records of analyses.

[2] Sample condition: A, as received; B, air dried; C, moisture-free; D, moisture and ash-free; E, moist, mineral-matter-free; F, dry, mineral-matter-free.

[3] Analyses from Analyses of Wyoming Coals, U. S. Bureau of Mines Tech. Paper 484, 1931.

[4] Analyses from Analyses of Montana Coals, U. S. Bureau of Mines Tech. Paper 529, 1932.

LABORATORY DESCRIPTIONS OF COAL CORES

HOLE GS-1

Location: Near center of S½NE¼NE¼, sec. 1, T. 52 N., R. 83 W., Johnson County, Wyo.
Remarks: Apparent dip of bedding in core ranges from approximately horizontal to as much as 33°. A dip up to 20° was noted in the first coal recovered from this hole at 59 feet, 4 inches; 23° at a depth of 106 feet, 2 inches; 33° at 108 feet; and a dip of about 23° extended for an interval of only a few inches below the depth of 126 feet, 5 inches.

Thickness (feet)		Depth (feet)
24	Overburden, silt, sand and gravel	0-24
27	Coal reported in drilling; no cores submitted for laboratory study or sampling	24-51
3	Shale with some coal reported in drilling; no cores submitted for laboratory study	51-54
5	Coal probable, but no core recovered	54-59

Sample GS-1-1

Thickness (inches)		Depth (feet)	(inches)
10 5/8	Coal, moderately medium banded, about 29 percent woody; top 2 inches includes coal crushed in drilling. Top of sample at	59	
13 3/8	Loss in coring above 61 feet.		
1 3/4	Coal, like that below.		
2 1/2	Shale, black excluded from sample.		
14 3/4	Coal, abundantly medium and thick banded, about 39 percent woody.		
41	Loss in coring above 66 feet.		
2 1/2	Coal, broken in drilling.		
7 1/2	Shale, black, excluded from sample.		
18 3/4	Coal, moderately thick banded, about 24 percent woody.		
31 1/4	Loss in coring above 71 feet.		
15	Coal, moderately thick banded, about 28 percent woody.		
13 1/2	Shale, black, excluded from sample, down to 73 feet and 4 1/2 inches. Bottom of sample at	73	4 1/2

Sample GS-1-2

Thickness (inches)		Depth (feet)	(inches)
16 1/4	Coal, abundantly thick banded, about 51 percent woody. Top of sample at	73	4 1/2
15 1/4	Loss in coring above 76 feet.		
47 5/8	Coal, moderately medium and thick banded, about 27 percent woody. Dip on base of bed, 12°.		
12 3/8	Loss in coring above 81 feet.		
10 3/4	Coal, abundantly medium and thick banded, about 45 percent woody, with megascopic resin blebs at 81 feet, 5 inches. Bedding at top of bed nearly horizontal.		
7 1/4	Loss in coring above 82 feet, 6 inches.		
4	Coal, sparsely thin banded, about 10 percent woody. Dip on base of bed, 10°.		
5 3/4	Shale, black, excluded from sample.		
2 1/4	Coal, about 38 percent woody.		
30	Loss in coring above 86 feet. Bottom of sample at	86	

Sample GS-1-3

Thickness (inches)		Depth (feet)	(inches)
1 1/2	Coal, dominantly thick and very thick banded, about 60 percent woody. Top of sample at	86	
5 1/2	Shale, black with woody fragments, excluded from sample.		

HOLE GS-1—Continued

Sample GS-1-3—Continued

Thickness (inches)		Depth (feet)	(inches)
30	Coal, dominantly thick and very thick banded, about 61 percent woody, resin blebs 1/8 to 1/4-inch diameter scattered between 86 feet, 8 1/2 inches to 87 feet, 10 inches. Dip on base of bed, 11°.		
23	Loss in coring above 91 feet.		
7 1/4	Coal, abundantly medium and thick banded, about 34 percent woody.		
4 3/4	Loss in coring above 92 feet.		
1 1/2	Shale and coal crushed in drilling, excluded from sample.		
9	Coal, sparsely thin banded, about 8 percent woody, resin blebs 1/4-inch diameter at 92 feet, 4 inches and 92 feet, 8 inches.		
1	Shale, black, excluded from sample, above 92 feet, 11 1/2 inches. Bottom of sample at.....	92	11 1/2

Sample GS-1-4

Thickness (inches)		Depth (feet)	(inches)
2 3/4	Coal, about 21 percent woody. Top of sample at	92	11 1/2
1	Shale, black, excluded from sample.		
1 3/4	Coal, as above.		
1/2	Shale, black, excluded from sample.		
17	Coal, dominantly thick and very thick banded, about 68 percent woody. Dip on base of bed, 11°.		
3 1/2	Shale, black, excluded from sample.		
9 1/4	Coal, moderately thin and medium banded, about 27 percent woody. Bedding at top of bed nearly horizontal.		
36 3/4	Loss in coring above 99 feet.		
18 1/4	Coal, abundantly medium and thick banded, about 39 percent woody.		
11 3/4	Loss in coring above 101 feet, 6 inches.		
2	Shale, black, excluded from sample.		
19 1/2	Coal, abundantly medium and thick banded, about 33 percent woody.		
5 1/2	Shale, black, excluded from sample. Bedding at base of bed nearly horizontal.		
27	Loss in coring above 106 feet. Bottom of sample at	106	

Sample GS-1-5

Thickness (inches)		Depth (feet)	(inches)
28 3/4	Coal, abundantly medium and thick banded, about 38 percent woody, with pyritic lenses 1/8 to 1/4 inch thick at 106 feet, 5 inches; 106 feet, 7 inches; 107 feet, 1 inch; 108 feet, 1 inch; 108 feet, 4 inches; megascopic resin blebs at 108 feet, 1 inch. Top of sample at.....	106	
1 1/4	Loss in coring above 108 feet, 6 inches.		
8 1/2	Coal, dominantly thick and very thick banded, about 62 percent woody.		
21 1/2	Loss in coring, above 111 feet.		
1 1/2	Shale, black, excluded from sample.		
9 1/4	Coal moderately thick banded, about 18 percent woody. Bedding at top of bed nearly horizontal.		
3 1/4	Shale, black coaly, excluded from sample.		
2 3/4	Coal, 95 percent woody derived from a large tree trunk.		
16 1/4	Shale, black, coaly, with large woody fragments excluded from sample, above 113 feet, 9 inches. Bottom of sample at.....	113	9

Sample GS-1-6

Thickness (inches)		Depth (feet)	(inches)
55	Coal, abundantly medium and thick banded, about 37 percent woody, with thin fusain streak at 116 feet, 3 inches and fusain 1/2 inch thick at 117 feet, 11 1/2 inches (the thickest occurrence of fusain in this core). Dip on base of bed, 8°. Top of sample at.....	113	9

HOLE GS-1—Continued

Sample GS-1-6—Continued

Thickness (inches)		Depth (feet)	(inches)
4 3/4	Shale, black, coaly, excluded from sample.		
6 1/4	Coal, derived entirely from a large tree trunk.		
21	Loss in coring above 121 feet.		
14 1/4	Coal, abundantly medium and thick banded, about 51 percent woody.		
4 3/4	Shale, black, excluded from sample. Bedding at base of bed nearly horizontal.		
32 3/4	Coal, abundantly medium and thick banded, about 31 percent woody, with 1/8-inch to 1/4-inch diameter resin blebs scattered at 124 feet, 8 inches.		
8 1/4	Loss in coring above 126 feet.		
19 1/4	Coal abundantly medium and thick banded, about 33 percent woody, above 127 feet, 7 1/4 inches. Bottom of sample at	127	7 1/4

Sample GS-1-7

Thickness (inches)		Depth (feet)	(inches)
16 3/4	Coal, moderately medium and thick banded, about 25 percent woody. Top of sample at	127	7 1/4
24	Loss in coring, above 131 feet.		
16	Coal, moderately medium banded, about 20 percent woody, with thin fusain streak at 131 feet, 1 inch and a few 1/4-inch resin blebs at 131 feet, 4 inches. Bedding at top of bed nearly horizontal.		
8 1/4	Shale, black, excluded from sample, above 133 feet, 1/4 inch. Bottom of sample at	133	1/4

Sample GS-1-8

Thickness (inches)		Depth (feet)	(inches)
65 1/4	Coal, abundantly medium and thick banded, about 40 percent woody, with 1/4-inch resin blebs at 136 feet, 3 1/2-inches. Bedding at base of bed nearly horizontal. Top of sample at	133	1/4
6 1/2	Loss in coring above 139 feet.		
30 1/2	Coal, moderately medium banded, about 22 percent woody, above 141 feet, 6 1/2 inches. Bottom of sample at	141	6 1/2
	141 feet, 6 1/2 inches depth to 144 feet excluded from analytic samples.		
7 1/2	Shale, black, with large woody fragments.		
5 1/2	Shale, black, pyritic.		
16 1/2	Loss in coring above 144 feet.		

Gray shale reported on drill stem below 144 feet; gray sandy shale recovered from 151 feet to final depth of 156 feet; no laboratory study of material below 144 feet.

HOLE GS-2A

Location: Near center of N½NE¼NW¼SE¼, sec. 8, T. 52 N., R. 82 W., Johnson County, Wyo.
Remarks: The bedding as observed in this core is essentially horizontal.

Thickness (feet)		Depth (feet)
66	Shale, gray and brown with thin coaly streaks overlying coal	0-66

Sample GS-2A-1

Thickness (inches)		Depth (feet)	(inches)
15 1/2	Coal, abundantly thick banded, about 40 percent woody; thin fusain at 67 feet, 1 inch. Top of sample at	66	
8 1/4	Loss in coring at about 68 feet.		

HOLE GS-2A—Continued

Sample GS-2A-1—Continued

Thickness (inches)		Depth (feet) (inches)
32	Coal, abundantly thick banded, about 33 percent woody, with scattered resin blebs in coal at 70 feet.	
4 1/4	Loss in coring above 71 feet. Bottom of sample at	71

Sample GS-2A-2

Thickness (inches)		Depth (feet) (inches)
49	Coal, abundantly thick banded, about 36 percent woody, with scattered resin blebs in upper part; thin fusain streaks at 71 feet, 3 1/2 inches, 72 feet, 2 inches, and 72 feet, 6 inches. Top of sample at	71
11	Loss in coring above 76 feet. Bottom of sample at	76

Sample GS-2A-3

Thickness (inches)		Depth (feet) (inches)
56 1/2	Coal, abundantly thick and very thick banded, about 56 percent woody, with 1/4-inch shale streaks at 77 feet, 6 1/2 inches and 78 feet, 2 inches; thin fusain at 77 feet, 6 inches and 79 feet, 1 inch. Top of sample at	76
15 1/2	Loss in coring above 82 feet. Bottom of sample at	82

Sample GS-2A-4

Thickness (inches)		Depth (feet) (inches)
24 3/4	Coal, moderately medium and thick banded, over 15 percent woody, with a thin white clay streak at 82 feet, 6 inches and thin fusain partings at 82 feet, 3/4 inch and 83 feet; scattered resin blebs in lower part of coal. Top of sample at	82
	Bottom of sample at	84 3/4

Sample GS-2A-5

Thickness (inches)		Depth (feet) (inches)
4 1/2	Shale, black clayey below 84 feet, 3/4 inch, excluded from sample. Top of sample at	84 3/4
31 1/4	Coal, abundantly medium and thick banded, about 35 percent woody, with thin 1/4-inch shaly streaks at 85 feet, 1 1/4 inches, 86 feet, 3/4 inch, and 86 feet, 5 3/4 inches. Bottom of sample at	87 1/2

Sample GS-2A-6

Thickness (inches)		Depth (feet) (inches)
42 1/2	Coal, moderately medium and thick banded, about 28 percent woody, with thin fusain streaks at 88 feet, 9 inches and 89 feet, 10 1/2 inches. Top of sample at	87 1/2
17	Loss in coring above 92 feet. Bottom of sample at	92

Sample GS-2A-7

Thickness (inches)		Depth (feet) (inches)
54 1/4	Coal, abundantly thick banded, about 55 percent woody, with 1/8-inch to 3/8-inch diameter, resin blebs at 92 feet, 7 inches and 94 feet, 8 inches. Top of sample at	92
3/4	Shale band, black, at 92 feet, 9 inches, rejected from sample.	
5	Loss in coring above 97 feet. Bottom of sample at	97

HOLE GS-2A—Continued

Sample GS-2A-8

Thickness (inches)		Depth (feet)	(inches)
38 1/2	Coal, moderately medium banded, about 25 percent woody, with scattered resin blebs between 98 feet, 8 inches, to 100 feet. Top of sample at	97	
	Bottom of sample at	100	2 1/2

Sample GS-2A-9

Thickness (inches)		Depth (feet)	(inches)
	About 8 1/2 inches broken coal core recovered. Top of sample at	100	2 1/2
	About 13 inches loss in coring above 102 feet. Bottom of sample at	102	

Sample GS-2A-10

Thickness (inches)		Depth (feet)	(inches)
24	Coal above 104 feet, sparsely thin and medium banded, about 4 percent woody, with thin fusain streaks at 103 feet, 7 1/2 inches and scattered resin blebs at 103 feet, 9 1/2 inches and 104 feet, 3 inches. Top of sample at	102	
31 1/2	Coal below 104 feet, abundantly medium and thick banded, about 40 percent woody; small pyritic spherulites noted at 106 feet, 2 inches.		
2 1/2	Shale, crushed and with some coal, occurs below 104 feet, 9 7/8 inches and was excluded from sample.		
2	Loss in coring above 107 feet. Bottom of sample at	107	

Sample GS-2A-11

Thickness (inches)		Depth (feet)	(inches)
28	Coal, moderately medium and thick banded, about 30 percent woody, with some resin blebs at 108 feet, 6 inches. Top of sample at	107	
	Bottom of sample at	109	4

Sample GS-2A-12

Thickness (inches)		Depth (feet)	(inches)
30 1/2	Coal and shaly coal, moderately thin and medium banded, about 17 percent woody, with thin fusain streak at 110 feet, 8 inches; core is cut by a number of glossy slip planes and slickensides. Top of sample at	109	4
	Bottom of sample at	111	10 1/2

Sample GS-2A-13

Thickness (inches)		Depth (feet)	(inches)
12 1/4	Coal, moderately medium and thick banded, about 25 percent woody; probably high ash content. Top of sample at	111	10 1/2
1	Shale, dark; rejected from sample.		
3 5/8	Coal, as noted above.		
2 1/2	Shale dark, rejected from sample.		
26 1/2	Coal as noted above.		
2 5/8	Shale, dark; rejected from sample.		
8 1/4	Coal as noted above.		
2	Impure shaly coal; rejected from sample.		
9 3/8	Loss in coring; condition of core suggests most of loss occurred at this position.		
1	Shale, clayey, white; rejected from sample.		
2 1/4	Impure coal, pyritic; rejected from sample.		
4 1/8	Coal, as noted above.		

HOLE GS-2A--Continued

Sample GS-2A-13--Continued

Thickness (inches)		Depth (feet) (inches)
3/4	Coaly shale, brown; rejected from sample.	
7 1/4	Coal, as noted above.	
2	Shale, dark clayey, above soft friable sandstone; rejected from sample. Bottom of sample at	119

Soft gray shale and sandstone reported below coal to final depth of 146 feet, 6 inches; no laboratory study.

HOLE GS-3

Location: Near center of W½SW¼, sec. 6, T. 52 N., R. 82 W., Johnson County, Wyo.
Remarks: Apparent dip of bedding in core ranges from approximately normal to as much as 30° at 120 feet, 2 1/2 inches; 30° at 128 feet; 22° at 130 feet, 8 inches; 22° at 134 feet, 2 inches; and 22° at 136 feet, 9 inches. Dips of lesser magnitude, approaching horizontal, are found in intervals between the more extreme dips indicated.

Thickness (feet)		Depth (feet)
17	Overburden of unconsolidated gravel and sand above 17 feet	0-17
71	Clinker reported in drilling; no cores submitted for laboratory study	17-98
3	Gray clay and coal; no laboratory study	98-101
5 1/2	Coal, scant recovery; no laboratory study	101-106 1/2
12 1/4	Coal, little or no recovery; no cores submitted for laboratory study or sampling to 118 feet, 8 3/8 inches. Drill connections at 112 feet, 115 feet, and 117 feet, 6 inches	106 1/2-118 3/4

Sample GS-3-1

Thickness (inches)		Depth (feet) (inches)	
54 5/8	Coal, abundantly medium and thick banded, about 36 percent woody; resin blebs, 1/8 inch to 1/4 inch, scattered, at 118 feet, 8 inches, 119 feet, 1 inch, 119 feet, 7 inches; thin fusain streak at 119 feet, 10 inches and 122 feet, 7 1/2 inches. Bedding at base of bed nearly horizontal. Top of sample at	118	8 3/8
5 3/8	Loss in coring above 123 feet, 8 3/8 inches. Bottom of sample at	123	8 3/8

Sample GS-3-2

Thickness (inches)		Depth (feet) (inches)	
1 1/4	Siltstone, light gray, excluded from sample. Top of sample at	123	8 3/8
33 5/8	Coal, moderately medium and thick banded, about 25 percent woody; resin blebs scattered at 125 feet, 8 inches and 126 feet, 5 inches. Dip on top of bed, 9°. Dip on base of bed, 6°.		
1	Shale, black, excluded from sample.		
6	Coal, moderately thin and medium banded, about 18 percent woody; resin blebs at 127 feet. Dip on base of bed, 4°.		
1/2	Shale, black, excluded from sample. Bottom of sample at	127	2 3/4

Sample GS-3-3

Thickness (inches)		Depth (feet) (inches)	
12 1/2	Coal, abundantly medium and thick banded, about 40 percent woody; thin fusain bands at 127 feet, 9 1/2 inches and 128 feet, 10 1/2 inches. Bedding at top of bed nearly horizontal. Dip on base of bed, 30°. Top of sample at	127	2 3/4
5 1/8	Loss in coring above 128 feet, 8 3/8 inches.		

HOLE GS-2A—Continued

Sample GS-3-3—Continued

Thickness (inches)		Depth (feet)	(inches)
45 1/8	Coal, abundantly medium and thick banded; about 38 percent woody; resin blebs scattered between 129 feet, 7 inches and 130 feet, 2 inches and at 131 feet, and 131 feet, 8 inches; thin fusain streak at 132 feet. Dip on top of bed, 9°.		
1 1/2	Shale, dark gray, excluded from sample.		
8	Coal, moderately medium and thick banded; about 21 percent woody; thin fusain streak at 133 feet, 2 inches. Bedding at base of bed nearly horizontal.		
1 5/8	Loss in coring above 133 feet, 4 5/8 inches.		
27 7/8	Coal, abundantly thick and very thick banded; about 55 percent woody. Dip on top of bed, 7°. Dip on base of bed, 18°.		
3 1/2	Loss in coring, above 136 feet.		
7 3/4	Coal, like that above. Dip on base of bed, 22°.		
1 1/2	Shale, black, with thin woody streaks, above 136 feet, 9 1/2 inches; excluded from sample. Bottom of sample at.....	136	9 1/2

Sample GS-3-4

Thickness (inches)		Depth (feet)	(inches)
50 1/4	Coal, abundantly medium and thick banded; about 40 percent woody; resin blebs, 1/4 inch, at 137 feet, 1 inch, 139 feet, 2 inches and 140 feet, 4 inches; thin fusain streaks at 136 feet, 10 1/2 inches, 138 feet, 7 inches; pyritic band, 1/8 inch thick, at 138 feet, 2 1/2 inches. Dip on top of bed, 22°. Dip on base of bed, 6°. Top of sample at.....	136	9 1/2
1/2	Loss in coring, above 141 feet.		
32 1/2	Coal, abundantly thick and very thick banded; about 41 percent woody; thin fusain streak at 141 feet, 1 inch.		
10 3/4	Loss in coring above 144 feet, 7 1/4 inches.		
55	Coal, abundantly medium and thick banded; about 33 percent woody. Dip on base, 10°.		
1 3/8	Loss in coring above 149 feet, 3 5/8 inches. Bottom of sample at.....	149	3 5/8

Sample GS-3-5

Thickness (inches)		Depth (feet)	(inches)
3/4	Shale, black, excluded from sample. Top of sample at.....	149	3 5/8
20 1/8	Coal, abundantly medium banded; about 33 percent woody; thin fusain streak at 150 feet, 3 inches.		
5	Loss in coring above 151 feet, 5 1/2 inches (shale interpreted by driller). Bottom of sample at.....	151	5 1/2

Sample GS-3-6

Thickness (inches)		Depth (feet)	(inches)
28 3/4	Coal, moderately thin and medium banded; about 28 percent woody; thin fusain streak at 152 feet, 3 inches; resin blebs, yellow, 1/4-inch diameter, at 153 feet, 2 inches. Dip on top of bed, 9°. Top of sample at.....	151	5 1/2
4 1/8	Loss in coring above 154 feet, 2 3/8 inches.		
66 1/8	Coal, moderately medium banded; about 23 percent woody; thin fusain streaks at 158 feet, 3 1/2 inches and 158 feet, 8 inches; resin blebs at 158 feet, 8 1/2 inches; 1/8-inch pyritic lens at 158 feet, 11 1/2 inches. Dip on top of bed, 8°. Bedding at base of bed nearly horizontal. Bottom of sample at.....	159	8 1/2
	159 feet, 8 1/2 inches depth to 160 feet, 8 3/8 inches excluded from analytic samples.		
3 1/2	Shale, black, pyritic.		
6	Sandstone, light-gray, pyritic.		
2 3/8	Loss in coring above 160 feet, 8 3/8 inches.		

Core lost, friable sandstone interpreted by driller from 160 feet, 8 3/8 inches to 166 feet; gray sandy shale recovered from 166 feet to 175 feet; no laboratory study below 160 feet, 8 3/8 inches.

HOLE GS-6

Location: Near center of SW¼NW¼, sec. 1, T. 52 N., R. 83 W., Johnson County, Wyo.
Remarks: Apparent dip of bedding in core ranges from approximately horizontal to as much as 40° at a depth of 173 feet, 3 1/2 inches, 22° at 208 feet, 11 inches, 25° at 218 feet, 5 inches, 32° at 230 feet, 1 3/8 inches and 30° at 248 feet, 2 3/4 inches and 279 feet, 7 1/2 inches. (Dips of lesser magnitude, approaching horizontal, intervene between all the more extreme dips cited.)

Thickness (feet)		Depth (feet)
172	Sandstone, light gray, coarse to fine grained with thin streaks of brown carbonaceous siltstone overlying coal at depth of 172 feet	0-172

Sample GS-6-1

Thickness (inches)		Depth (feet)	(inches)
6 1/2	Clay shale, black, with a few woody fragments, excluded from sample. Top of sample at	172	
13 7/8	Coal, moderately medium banded, about 25 percent woody with pyritic lenses 1/4 inch to 3/8 inch thick at 172 feet, 10 inches and 173 feet, 1 inch. Dip on top of bed, 13°.		
2 5/8	Shale, black, excluded from sample.		
7/8	Coal consisting of one woody trunk. Dip on base of bed, 10°.		
2 1/4	Shale, black, excluded from sample.		
6 1/2	Coal abundantly medium and thick banded, about 45 percent woody. Dip on base of bed, 22°.		
3/8	Shale, excluded from sample.		
22 3/4	Coal, abundantly medium banded, with one very thick band, probably from a large tree trunk; coal about 41 percent woody. Resin blebs about 1/4-inch diameter occur at 175 feet, 2 1/2 inches and 175 feet, 5 inches.		
1 3/8	Shale, black, excluded from sample.		
4 1/2	Coal, about 50 percent woody with scattered resin blebs. Dip on top of bed, 24°.		
10	Shale, black, coaly near the top with scattered woody fragments, excluded from sample.		
48 1/2	Loss in coring above 182 feet.		
3 3/4	Shale, black, with woody fragments, excluded from sample.		
3 1/8	Coal, moderately medium banded, about 25 percent woody. Dip on top of bed, 27°.		
9 1/2	Siltstone, light gray to buff, with contorted woody fragments (photograph), excluded from sample.		
22	Coal, abundantly medium and thick banded, about 48 percent woody, with 1/8-inch white clay streak at 184 feet, 5 inches. Dip on top of bed, 14°. Dip on base of bed, 15°.		
9 1/2	Loss in coring above 186 feet.		
18 7/8	Shale, light gray, with a few woody fragments, excluded from sample.		
16 1/8	Coal, abundantly medium and thick banded, about 50 percent woody, with resin blebs at 188 feet, 2 inches. Bedding at top of bed nearly horizontal.		
3 5/8	Shale, black with woody fragments, excluded from sample.		
8 5/8	Coal, moderately medium banded, about 15 percent woody.		
6 1/2	Shale, gray, coaly in part, excluded from sample.		
4	Coal, derived from a single woody trunk.		
8 1/4	Shale, dark gray, excluded from sample.		
1 1/8	Coal, completely woody, above 191 feet, 7 1/8 inches. Bedding at top of bed nearly horizontal. Bottom of sample at	191	7 1/8

Sample GS-6-2

Thickness (inches)		Depth (feet)	(inches)
4 5/8	Coal, moderately medium banded, about 16 percent woody. Top of sample at	191	7 1/8
2 1/4	Clay shale, gray, excluded from sample.		
3 1/2	Coal derived from a single woody trunk.		
1	Shale, dark, excluded from sample.		
3	Coal, woody with pyritic lens 1/4 inch thick.		
3 1/2	Shale, dark, with woody fragments, excluded from sample.		

HOLE GS-6—Continued

Sample GS-6-2—Continued

Thickness (inches)		Depth (feet)	(inches)
8 3/4	Coal, sparsely medium banded, about 10 percent woody, with pyritic lens 1/8 inch thick at 192 feet, 4 inches.		
1 1/2	Pyritic band, excluded from sample.		
11 5/8	Coal, abundantly medium and thick banded, about 35 percent woody, with frequent resin blebs 1/4-inch diameter from 194 feet, 2 inches to 1 194 feet, 10 inches.		
1 1/8	Loss in coring above 195 feet.		
28 3/4	Coal, moderately medium and thick banded, about 26 percent woody, with a thin fusain streak at 195 feet, 1 inch.		
3 5/8	Shale, black, coaly, excluded from sample.		
2	Coal, about 50 percent woody.		
9 5/8	Shale, black, coaly, with large woody fragment at 198 feet, 3 1/2 inches, excluded from sample.		
14 3/4	Coal, dominantly very thick banded, about 70 percent woody, derived from a few large tree trunks; resin blebs 1/4-inch diameter at 199 feet, 6 inches and 199 feet, 10 inches.		
7 1/4	Shale, black, and siltstone gray, with woody fragments in the darker matrix.		
1 1/2	Shale and coal crushed in drilling, excluded from sample.		
3 3/4	Coal, about 24 percent woody.		
1 1/4	Pyritic band excluded from sample.		
6 1/2	Shale, black, in part coaly, with woody bands, excluded from sample, above 201 feet, 7 inches depth. Bottom of sample at.....	201	7

Sample GS-6-3

Thickness (inches)		Depth (feet)	(inches)
41 1/4	Coal, moderately medium and thick banded, about 26 percent woody, with yellow resin blebs 1/4 inch in diameter at 201 feet, 8 inches and 202 feet, 1/4 inch. Top of sample at.....	201	7
	Bottom of sample at.....	205	1/4

Sample GS-6-4

Thickness (inches)		Depth (feet)	(inches)
16 1/4	Partially mineralized (siliceous?) wood, grain badly distorted, excluded from sample. Dip on top of bed, 12°. Top of sample at.....	205	1/4
8	Coal, abundantly medium and thick banded, about 37 percent woody, with thin fusain streaks at 206 feet, 10 inches and 207 feet.		
2	Shale, black, excluded from sample.		
11	Coal, moderately thin and medium banded, about 20 percent woody, resin blebs 1/4-inch diameter scattered from 207 feet, 5 inches to 207 feet, 9 inches, and shale streak 1/8 inch thick at 207 feet, 10 inches. Dip on top of bed, 13°. Dip on base of bed, 15°.		
7 1/2	Clay shale, black, with numerous woody fragments, excluded from sample.		
3 5/8	Coal, abundantly medium and thick banded, about 50 percent woody. Dip on top of bed, 22°.		
7 1/2	Shale, black and gray with thick woody fragments, excluded from sample.		
3 7/8	Loss in coring above 210 feet. Bottom of sample at.....	210	

Sample GS-6-5

Thickness (inches)		Depth (feet)	(inches)
1	Shale, dark, with resin blebs. Top of sample at.....	210	
6 1/4	Coal, moderately thin and medium banded, about 16 percent woody.		
8 3/4	Shale, brown with small vitrain streaks.		
9 1/8	Coal, moderately medium banded, about 20 percent woody, with 1/4 inch gray shale streak at 211 feet, 8 inches and thin fusain lenticle at 212 feet, 1/2 inch. Dip on top of bed, 18°. Dip on base of bed, 12°.		

Sample GS-6-5—Continued

Thickness (inches)		Depth (feet)	(inches)
10 1/2	Shale, black, woody fragments in top 3 inches, blebs of resin at 212 feet, 2 inches and 212 feet, 4 inches, excluded from sample.		
24 1/2	Coal, dominantly thick and very thick banded, with resin blebs 1/8-inch to 1/4-inch diameter at 213 feet, 7 inches and 214 feet; a coaly tree trunk 7 1/2 inches thick occurs below 212 feet, 11 1/2 inches. Dip on base of bed, 22°.		
2 7/8	Shale, black, excluded from sample.		
1 1/2	Coal, attrital, about 10 percent woody.		
3 3/4	Shale, black, coaly, excluded from sample.		
6 1/8	Coal, moderately medium banded, about 18 percent woody. Dip on base of bed, 25°.		
17 5/8	Shale, black, coaly towards top, excluded from sample.		
6	Coal, moderately medium banded, about 20 percent woody, with fusain band 3/8 inch thick below 217 feet, 9 inches. Dip on top of bed, 10°.		
7 1/4	Shale, black, excluded from sample.		
14 3/4	Loss in drilling above 220 feet.		
24 3/4	Shale, black, with a few woody fragments above 222 feet, 3/4 inch. Bottom of sample at	222	3/4

Sample GS-6-6

Thickness (inches)		Depth (feet)	(inches)
21 1/4	Coal, abundantly medium and thick banded, about 57 percent woody, shale lenticles at 222 feet, 3 3/4 inches and 222 feet, 11 1/2 inches. Top of sample at	222	3/4
	Bottom of sample at	223	10

Sample GS-6-7

Thickness (inches)		Depth (feet)	(inches)
30 3/4	Shale, black, with numerous woody fragments in upper and lower parts, resin blebs at 224 feet, 7 inches, excluded from sample. Top of sample at	223	10
16	Coal, moderately medium banded, about 25 percent woody, 1/4-inch fusain lenticle at 226 feet, 7 1/4 inches. Dip on base of bed, 23°.		
15	Shale, black, with frequent woody fragments, excluded from sample. Bottom of sample at	228	11 3/4

Sample GS-6-8

Thickness (inches)		Depth (feet)	(inches)
3 1/2	Coal, dull luster, with frequent woody fragments. (Prepared for photograph.) Dip on base of bed, 20°. Top of sample at	228	11 3/4
3 3/4	Shale, black, excluded from sample.		
6 3/8	Loss in drilling above 230 feet, 1 3/8 inches. Bottom of sample at	230	1 3/8

Sample GS-6-9

Thickness (inches)		Depth (feet)	(inches)
9 1/8	Coal, abundantly medium banded, about 40 percent woody. Dip on top of bed, 32°. Dip on base of bed, 36°. Top of sample at	230	1 3/8
4	Shale, black with woody fragments, excluded from sample.		
27 1/2	Coal, abundantly medium banded, about 36 percent woody, with 1/8-inch shale streak at 231 feet, 5 inches and 1/4-inch resin blebs at 232 feet to 232 feet, 2 inches; 3/4-inch fusain band at 233 feet. Dip on top of bed, 18°. Dip on base of bed, 21°.		

Sample GS-6-9—Continued

Thickness (inches)		Depth (feet)	(inches)
3 1/2	Siltstone, light gray, carbonaceous with small woody fragments, excluded from sample.		
28 1/4	Coal, moderately medium banded, about 29 percent woody, with thin fusain streaks at 233 feet, 10 inches; 234 feet, 2 inches; 234 feet, 11 inches; 235 feet, 9 inches; resin blebs 1/4-inch diameter at 235 feet, 11 inches. Dip on base of bed, 30°.		
10	Shale, black, with scattered woody fragments, excluded from sample.		
20 3/4	Loss in coring above 238 feet, 8 3/4 inches.		
11 1/4	Shale, dark, with occasional woody fragments, excluded from sample above 239 feet, 7 3/4 inches. Bottom of sample at.....	239	7 3/4

Sample GS-6-10

Thickness (inches)		Depth (feet)	(inches)
13 1/4	Coal, abundantly medium and thick banded about 43 percent woody, with resin blebs at 240 feet, 1 inch. Top of sample at.....	239	7 3/4
23 3/8	Loss in drilling above 242 feet, 8 3/8 inches.		
11 1/4	Coal, moderately medium banded, about 16 percent woody, with thin fusain lenticle at 242 feet, 11 inches. Scattered resin blebs 1/8 inch to 1/4 inch in diameter from 242 feet, 9 inches to 243 feet, 5 inches. Bedding at top of bed nearly horizontal. Dip at base of bed, 5°.		
4 3/4	Shale, black, with fragments of fusain and woody debris, excluded from sample.		
30 3/4	Coal, abundantly medium and thick banded, about 31 percent woody, thin fusain lenticles at 244 feet, 1 inch and 244 feet, 7 inches; resin blebs 1/4-inch to 1/8-inch diameter scattered from 245 feet to 245 feet, 6 inches. Bedding at top of bed nearly horizontal. Dip on base of bed, 23°.		
7 1/4	Loss in drilling above 247 feet, 2 3/8 inches. Bottom of sample at.....	247	2 3/8

Sample GS-6-11

Thickness (inches)		Depth (feet)	(inches)
4 1/2	Shale, dark, with numerous small woody fragments, excluded from sample. Top of sample at.....	247	2 3/8
8	Coal, dominantly medium and thick banded, about 86 percent woody. Dip on top of bed, 10°.		
5	Shale, black, with woody fragments, excluded from sample.		
12 1/4	Coal, moderately medium banded, about 20 percent woody. Dip on top of bed, 30°. Dip on base of bed, 26°.		
5	Shale, black, with numerous woody fragments, excluded from sample.		
4 1/2	Coal, sparsely thin banded, about 4 percent woody. Dip on top of bed, 20°. Dip on base of bed, 37°.		
4	Shale, soft, black, excluded from sample.		
16 1/4	Coal, dominantly thick and very thick banded, about 82 percent woody, thin fusain streak at 252 feet, 1 inch. Dip on top of bed, 26°. Dip on base of bed, 18°.		
2 5/8	Shale, black, with woody fragments, excluded from sample.		
14	Coal, moderately medium banded, about 35 percent woody, with resin blebs 1/8-inch to 1/4-inch diameter at 252 feet, 7 inches. Dip on top of bed, 26°.		
9	Loss in drilling above 254 feet 3 5/8 inches.		
2 1/4	Coal, derived from a single woody stem. Dip on base of bed, 16°.		
4 1/4	Shale, dark, abundant woody fragments, excluded from sample.		
7 5/8	Coal, abundantly medium banded, about 34 percent woody with thin fusain lenticle at 255 feet, 4 inches. Dip on top of bed, 20°.		
3/8	Shale parting excluded from sample.		
26 3/4	Coal, abundantly medium and thick banded, about 31 percent woody, thin fusain band at 255 feet, 6 1/2 inches, resin blebs 1/4-inch to 1/8-inch diameter at 255 feet, 9 inches and 256 feet, 1 inch. Dip on top of bed, 22°. Dip on base of bed, 30°.		
5 3/8	Shale, black, few woody fragments, excluded from sample.		

Sample GS-6-11—Continued

Thickness (inches)		Depth (feet)	(inches)
14 1/8	Coal, dominantly thick and very thick banded, about 80 percent woody. Dip on base of bed, 25°.		
2 1/4	Shale, black, few woody fragments, excluded from sample.		
13 3/4	Coal, dominantly thick and very thick banded, about 84 percent woody. Dip on base of coal, 28°.		
4 1/4	Shale, black, many woody fragments, excluded from sample.		
11 1/2	Loss in drilling above 262 feet. Bottom of sample at	262	

Sample GS-6-12

Thickness (inches)		Depth (feet)	(inches)
43 3/4	Coal, moderately medium and thick banded, about 28 percent woody, 1/4-inch resin bleb at 264 feet, 10 inches. Top of sample at	262	
	Bottom of sample at	265	7 3/4

Sample GS-6-13

Thickness (inches)		Depth (feet)	(inches)
7 3/4	Shale, black, few woody fragments, excluded from sample. Top of sample at	265	7 3/4
8	Coal, moderately medium banded, about 25 percent woody, resin bleb at 266 feet, 10 inches. Dip on base of bed, 24°.		
9 1/2	Clay shale, gray, with moderate number of woody fragments, excluded from sample.		
32 1/4	Coal, moderately medium and thick banded, about 28 percent woody, with thin fusain streaks at 268 feet, 2 1/4 inches; 269 feet, 4 inches and 269 feet, 6 inches; resin blebs 1/4-inch diameter at 270 feet, 2 inches. Bedding at top of bed nearly horizontal. Bedding at base of bed, 12°.		
5 1/4	Clay shale, with woody fragments, excluded from sample. Dip at base of bed, 12°.		
13 1/2	Loss in drilling above 272 feet. Bottom of sample at	272	

Sample GS-6-14

Thickness (inches)		Depth (feet)	(inches)
14 1/2	Coal, abundantly medium and thick banded, about 46 percent woody. Top of sample at	272	
8 1/4	Clay shale, black, excluded from sample.		
29	Coal, moderately medium and thick banded, about 28 percent woody, 1/8-inch resin blebs at 276 feet, thin fusain lenticle at 276 feet, 3 inches. Dip on top of bed, 15°.		
4 3/4	Shale, black, with few woody fragments and resin blebs, excluded from sample.		
21 1/4	Coal, abundantly medium and thick banded, about 33 percent woody. Dip on base of bed, 20°.		
4 1/4	Siltstone, light gray, with large woody fragments.		
1 3/4	Coal, with 1/2-inch band of fusain at 178 feet, 11 1/2 inches.		
3 7/8	Loss in drilling above 279 feet, 3 5/8 inches. Bottom of sample at	279	3 5/8

Sample GS-6-15

Thickness (inches)		Depth (feet)	(inches)
2 3/8	Coal, broken. Top of sample at	279	3 5/8
1 1/2	Band of pyritic wood, excluded from sample.		
32 1/8	Coal, abundantly thick and very thick banded, about 50 percent woody, above 282 feet, 3 5/8 inches. Bottom of sample at	282	3 5/8

Sample GS-6-16

Thickness (inches)			Depth (feet)	(inches)
2	1/2	Shale and coal crushed in drilling, excluded from sample. Top of sample at.....	282	3 5/8
17		Coal, moderately medium banded, about 27 percent woody. Dip on top of bed, 13°.		
13		Loss in drilling above 285 feet.		
11	1/2	Shale, black, with small bones of vertebrate fossils at 285 feet, 8 1/2 inches.		
7	3/8	Coal, sparsely medium banded, about 5 percent woody.		
11	1/2	Clay shale, gray, excluded from sample.		
53	1/2	Loss in drilling, above 292 feet. Bottom of sample at.....	292	

Clay, light gray, very firm, reported below coal to 300 feet; below 300 feet shale, carbonaceous, with shell fragments to total depth of 310 3/10 feet. (No laboratory study.)

HOLE A-6

[Drilling by the Bureau of Reclamation]

Hole A-6 was drilled after completion of the report but coal cores were sent to the Coal Geology laboratory for study and sampling. The laboratory description of these cores is included below, but none of the conclusions in this report are based upon information obtained from hole A-6.

Location: Near center of east line, NE¼SW¼SW¼, sec. 31, T. 53 N., R. 82 W., Johnson County, Wyo.

Remarks: Apparent dip of bedding in core ranges from approximately normal at 188 feet to as much as 30° at 132 feet, 6 inches and 45° at 199 feet, 4 inches. Dips of lesser magnitude, some approaching horizontal, intervene between all extreme dips cited.

Thickness (feet)	(inches)		Thickness (feet)	(inches)
101	7 1/4	Overburden of soil and clinker above coal.....	101	7 1/4
3	4 3/4	Coal(?) very hard and brittle, not cored.....	105	
1		Shale(?) not cored.....	106	
6	6	Coal(?) very hard and brittle, not cored.....	112	6

Sample A-6-1

Thickness (inches)			Depth (feet)	(inches)
4	1/4	Coal, abundantly medium banded, about 33 percent woody. Top of sample at.....	112	6
4	3/4	Shale, dark gray, with woody fragments and 1/4-inch resin blebs, excluded from sample.		
11	1/2	Loss in coring above 114 feet, 2 1/2 inches.		
78		Coal, sparsely thin to medium banded, about 3 percent woody, 1/8-inch fusain streak at 115 feet, 6 inches and 115 feet, 7 inches, 1/8-inch to 1/4-inch resin blebs at 119 feet, 5 inches to 119 feet, 7 inches, and 1/8-inch to 1/4-inch resin blebs at 120 feet, 7 inches.		
2	3/4	Shale, dark gray, with woody fragments and small resin blebs, excluded from sample.		
3		Coal, nonbanded.		
12		Loss in coring above 122 feet, 1/4 inch.		
2	3/4	Coal, sparsely medium banded, about 9 percent woody.		
33		Shale, dark gray to black, with numerous woody fragments, excluded from sample. Bottom of sample at.....	125	2

Sample A-6-2

Thickness (inches)			Depth (feet)	(inches)
88		Coal, sparsely, medium and thick banded, about 14 percent woody. Dip on base of bed, 30°. Top of sample at.....	125	2
7	1/2	Loss in coring above 133 feet, 1 1/2 inches. Bottom of sample at.....	133	1 1/2

Sample A-6-3

Thickness (inches)		Depth (feet)	(inches)
6 1/2	Shale, dark brown to black, with numerous woody fragments, excluded from sample. Top of sample at	133	1 1/2
21	Coal, moderately medium banded, about 22 percent woody, 1/8-inch to 1/4-inch resin blebs at 134 feet, 5 inches and 134 feet, 9 inches to 135 feet.		
8 1/2	Shale, black, carbonaceous, excluded from sample.		
14 1/4	Coal, abundantly very thick banded, about 50 percent woody. Dip on top of bed, 20°.		
3	Shale, dark gray, excluded from sample.		
36 1/4	Coal, moderately medium and thick banded, about 20 percent woody, 1/4-inch fusain streak at 139 feet, 9 inches. Dip on top of bed, 20°		
7 7/8	Loss in coring above 141 feet, 2 7/8 inches.		
8 1/4	Coal, moderately medium banded, about 20 percent woody, with 1/8-inch to 1/4-inch resin blebs scattered throughout.		
1 1/2	Shale, dark brown to black, excluded from sample.		
31	Coal, abundantly medium and thick banded, about 36 percent woody.		
8 1/4	Shale, dark gray black, with numerous woody fragments, excluded from sample.		
40 1/2	Coal, moderately medium banded, about 18 percent woody.		
21	Clay, gray, soft, plastic, excluded from sample.		
9 3/8	Loss in coring above 151 feet, 2 3/4 inches.		
7	Clay, dark gray to black, soft, excluded from sample.		
3 3/4	Shale, black, with numerous wood fragments, excluded from sample.		
50	Coal, moderately medium banded, about 17 percent woody.		
7 1/2	Loss in coring above 156 feet, 11 inches.		
7 3/4	Coal, sparsely medium banded, about 7 percent woody.		
24 3/4	Clay shale, black, with numerous woody fragments, excluded from sample. Bottom of sample at	159	7 1/2

Sample A-6-4

Thickness (inches)		Depth (feet)	(inches)
18 1/2	Coal, moderately medium and thick banded, about 26 percent woody. Top of sample at	159	7 1/2
12 1/2	Loss in coring above 162 feet, 2 1/2 inches.		
111 1/2	Coal, moderately medium and thick banded, about 23 percent woody, 1/8-inch fusain streak at 163 feet, 4 inches; 1/4-inch streak at 165 feet, 5 inches and 1/8-inch streak at 166 feet, 4 inches, 1/4-inch resin blebs at 165 feet, 10 inches to 166 feet, 1 inch and 170 feet, 2 inches to 170 feet, 5 inches. 17 inches of woody coal at 168 feet, 3 inches to 169 feet, 11 inches, possibly representing an upright stump. Sample A-6-woody.		
2 1/4	Loss in coring above 171 feet, 8 1/4 inches.		
90 1/8	Coal, moderately medium and thick banded, about 21 percent woody, 1/8-inch to 1/4-inch resin blebs at 174 feet, 2 inches to 174 feet, 6 inches, 175 feet, 6 inches and 176 feet, 2 inches to 177 feet, 5 inches.		
2 1/2	Shale, black, excluded from sample.		
27 1/2	Loss in coring above 181 feet, 8 3/8 inches. Bottom of sample at	181	8 3/8

Sample A-6-5

Thickness (inches)		Depth (feet)	(inches)
93 1/8	Coal, abundantly medium and thick banded, about 30 percent woody, 1/4-inch resin blebs at 183 feet, 8 inches, to 184 feet, 2 inches, 1/4-inch fusain streak at 184 feet, 7 1/2 inches and 1/8-inch streak at 187 feet, 10 inches. Top of sample at	181	8 3/8
1 1/2	Siltstone, white, excluded from sample. Bottom of sample at	189	7

HOLE A-6—Continued

Sample A-6-6

Thickness (inches)		Depth (feet)	(inches)
186 1/2	Coal, abundantly medium and thick banded, about 36 percent woody, 1/4-inch resin blebs at 193 feet, 7 inches to 193 feet, 11 inches and 194 feet, 5 inches, thin fusain streak at 199 feet, 6 1/2 inches. Top of sample at.....	189	7
2 1/2	Shale, black, with numerous woody fragments, excluded from sample. Bottom of sample at	205	4

Sample A-6-7

Thickness (inches)		Depth (feet)	(inches)
173 3/8	Coal, moderately medium and thick banded, about 26 percent woody, 1/8-inch resin blebs at 213 feet, 8 inches to 213 feet, 9 inches. Top of sample at.....	205	4
1	Shale, dark gray, excluded from sample.		
3	Coal, sparsely medium banded, about 13 percent woody. Bottom of sample at.....	220	1 3/8

220 feet, 1 3/8 inches depth to 228 feet, 2 3/8 inches; no laboratory study made.

Shale, silty and sandy, gray, moderately to slightly consolidated, more carbonaceous and darker toward top.

HOLE A-7

[Drilling by the Bureau of Reclamation]

Location: Near center of NW¼SE¼NE¼, sec. 1, T. 52 N., R. 83 W., Johnson County, Wyo.
Remarks: Description and sampling record of coal core from hole 7, submitted by U. S. Bureau of Reclamation, was prepared by personnel of the U. S. Bureau of Mines. 121 feet, 9 inches of core was received from 95 feet to 224 feet, 11 inches, depth interval; 20 feet, 2 inches of claystone and bone was rejected for analytic purposes from the core received; material apparently lost in drilling accounts for 8 feet, 2 inches; the sample included a total thickness of 101 feet, 7 inches coal.

Thickness (feet)		Depth (feet)
95	Overburden and clinker above coal.....	0-95

Thickness (inches)		Depth (feet)	(inches)
8	Coal. Top of sample at.....	95	
3	Bone.		
2 1/2	Coal.		
15	Claystone and bone.		
10 1/2	Coal.		
1 1/2	Bone and shale.		
32	Coal.		
6	Bone and claystone.		
85 1/2	Coal (5/8-inch loss in drilling).		
7	Claystone.		
5 1/2	Coal.		
1	Claystone.		
26 1/2	Coal.		
2	Claystone.		
17 1/2	Coal.		
3	Coal and clay.		
2	Coal.		
1 1/2	Claystone.		
11 1/2	Coal.		
1 1/2	Coaly claystone.		
1 1/2	Coal.		
6 1/2	Claystone.		

HOLE A-7—Continued

Thickness (inches)		Depth (feet)	(inches)
1	Coal.		
3 1/2	Claystone.		
38 1/2	Coal.		
5 1/2	Bone and claystone.		
18	Coal.		
3 1/2	Bone.		
4	Coal.		
2	Claystone.		
1 1/2	Coal.		
14 1/2	Claystone.		
12 1/2	Coal.		
3 1/2	Claystone.		
11 1/4	Coal.		
3/4	Pyrites.		
118	Coal. Top of coal.....	125	10
2 3/4	Claystone.		
1 3/4	Coal.		
2	Clay.		
20	Coal.		
1 1/2	Bone.		
14 1/2	Coal.		
1	Coaly claystone.		
31	Coal.		
1 1/2	Claystone.		
37 1/2	Coal.		
3 1/2	Bone.		
10 1/2	Coal.		
2 1/2	Claystone.		
16 1/2	Coal.		
4	Claystone.		
71 1/2	Coal.		
1/2	Claystone.		
17	Coal.		
25 1/2	Claystone.		
7	Coal. Top of coal.....	157	9
6	Claystone.		
8	Coal.		
3 1/2	Ironstone.		
26	Coal.		
15 1/2	Clay (2 3/4-inch loss in drilling).		
3	Coal.		
2 1/2	Claystone.		
12 1/2	Coal.		
1 1/4	Claystone.		
3	Coal.		
1 1/2	Claystone.		
113 1/2	Coal (3 3/4-inch loss in drilling).		
21 1/4	Claystone.		
128	Coal (7-inch loss in drilling).		
4	Claystone.		
16 3/4	Coal. Bottom of coal.....	189	9 1/4
9 3/4	Claystone.		
9 1/2	Coal.		
3 1/4	Bone.		
25	Coal.		
2	Claystone.		
38 3/4	Coal.		
6 1/2	Claystone.		
15 3/4	Coal.		
2 1/4	Claystone.		
47	Coal.		
1 1/2	Bone.		
16 1/2	Coal.		
3 1/4	Bone.		
5 3/4	Coal.		
3	Claystone.		

HOLE A-7—Continued

Thickness (inches)		Depth (feet)	(inches)
5	Coal.		
5	Bone.		
78 1/2	Coal (1 1/2-inch loss in drilling).		
10	Claystone.		
45 3/4	Coal (1 inch loss in drilling).		
12 1/2	Bone.		
61 1/4	Coal.		
3/4	Claystone.		
3 1/2	Coal.		
3/4	Clay.		
3 1/4	Coal.		
5 3/4	Claystone. Bottom of claystone and end of sample.....	224	11
49	Sandstone. Bottom of core.....	229	

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