AVAILABILITY OF LOW-SULFUR COAL IN FAYETTE COUNTY, WEST VIRGINIA

by

Donald G. Hadley

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2. Availability of low-sulfur coal in Fayette County, West Virginia, by Donald G. Hadley. 20 p., 3 figs., 1 table.

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11. Availability of low-sulfur coal in Wyoming County, West Virginia, by Kenneth J. Englund. 22 p., 3 figs.

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12. Cheshire glass sand deposits in the Cheshire area, Massachusetts, by Newton E. Chute. 11 p.

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THE AVAILABILITY OF LOW-SULFUR COAL IN FAYETTE COUNTY, WEST VIRGINIA

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ABSTRACT

Fayette County is in central West Virginia. Rocks exposed at the surface are about 3,200 feet thick and comprise the Pocahontas, New River, Kanawha, and Allegheny Formations of Pennsylvanian age. The stratigraphic relations and distribution of coal in these formations were studied by the U.S. Geological Survey in connection with a low-sulfur coal program of the U.S. Bureau of Mines.

The coal in Fayette County is medium-volatile and high-volatile A and B bituminous ranks. Of 51 coal beds in the county, 22 are 28 inches to as much as 9 feet thick and contain substantial reserves. Several coals have been mined locally in the past by underground, stripping, and auger methods. Of the 22 coals discussed, 17 contain less than 1.0 percent sulfur, and the remainder average less than 2.0 percent sulfur.

Of an original 2,210 million tons of recoverable coal estimated for Fayette County, 678 million tons were mined between 1888 and 1966. Thus, the remaining recoverable coal reserves at the end of 1966 were 1,530 million tons. Of this amount, 86 percent or 1,320 million tons of coal is classified as low sulfur, and 210 million tons is classified as medium sulfur.

INTRODUCTION

Location

Fayette County is in the rugged coal field of south-central West Virginia (fig. 1). The county is irregular in shape, bounded by the Meadow and Gauley Rivers on the north and partly by the New River on the south. The New River cuts a prominent gorge across the county along which the local relief is commonly 500-1,000 feet. Total relief in the county is about 2,000 feet.

Previous investigations

Early studies of coal in Fayette County were made by White (1903, 1908) who described the stratigraphic relations and named several of the coals. Hennen and others (1919) published an account of the coals and the stratigraphy, and presented a detailed geologic map showing coal crops and locations of holes drilled for coal and oil and gas. Analyses of Fayette County coals have been published by Cooper and others (1942, p. 50-63) and by Deurbrouck (1965).

Present investigation

The stratigraphic sequence and distribution of coal beds in Fayette County were determined in the present study by measuring stratigraphic sections in road cuts, strip mines, and in natural exposures. Correlation between sections was determined by tracing key beds or by following strip-mine scars on aerial photos; by using logs of oil, gas, and coal test holes; and by referring to published reports.

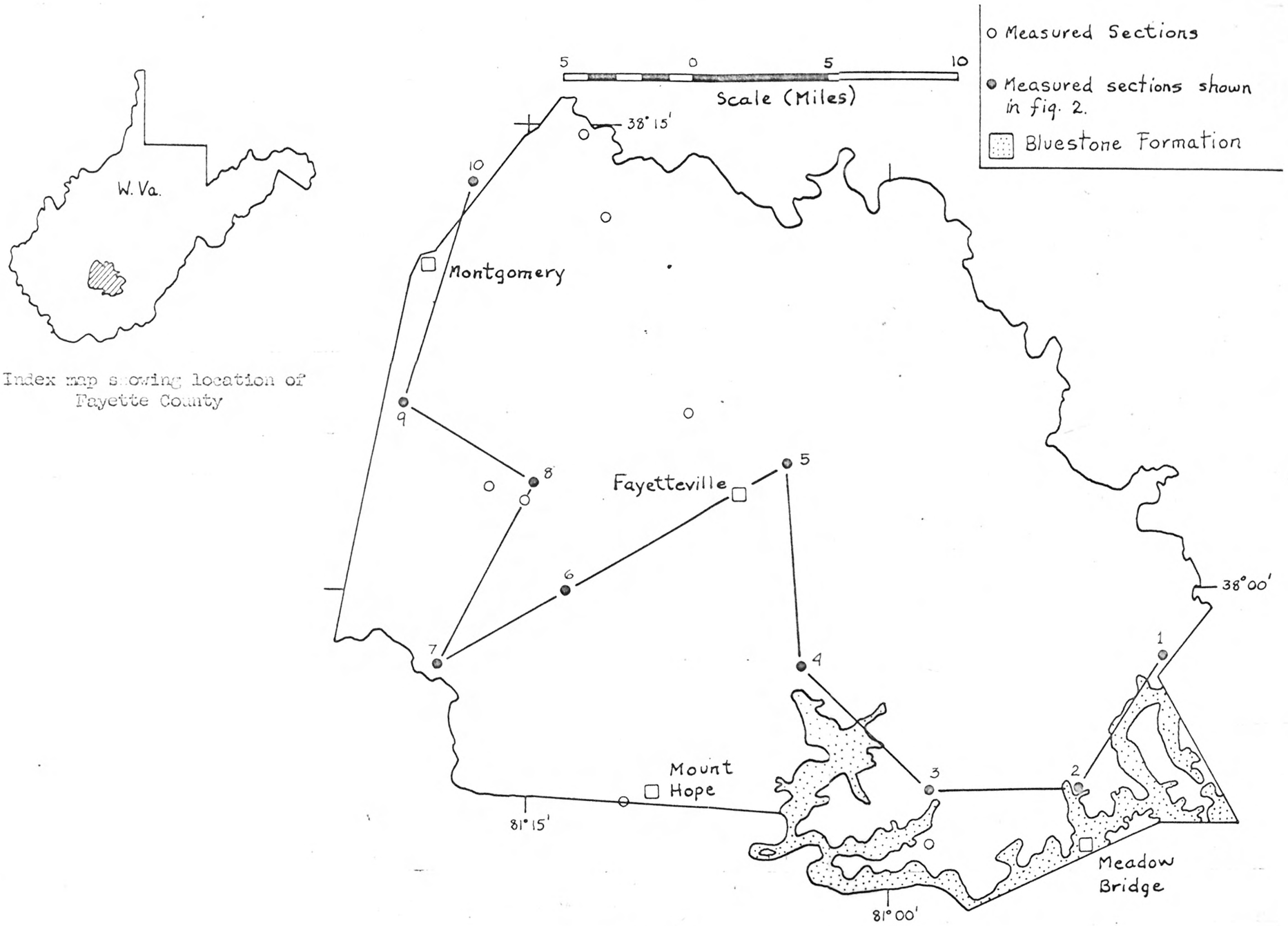

Figure 1.--Index map and location of measured sections in Fayette County, West Virginia

Assistance in the field was given by A. O. Delaney, R. B. O'Sullivan, M. J. Bergin, L. S. Page, and M. D. Carter. Miss Carter assisted in preparing the illustration.

The following list gives the location of selected sections that were measured and are shown graphically in figure 2.

Location of measured sections shown in figure 2

1. Along U.S. Route 60, beginning about 0.5 mile west of Rainelle, W. Va.
2. Along W. Va. Highway 41, beginning about 1.5 miles west of Meadow Bridge, W. Va.
3. Measured in two parts: (1) Along the hillside road of Little Laurel Creek from State Routes 19 and 41 up to the Fire Creek coal bed; (2) Along State Routes 19 and 41 from the Fire Creek coal to Gentry, W. Va.
4. Along the steep hillside road on the east side of the New River at Thurmond, W. Va., beginning at the railroad level.
5. From the railroad level at Fayette Station, W. Va., along the steep hillside road to Lansing, W. Va.
6. Along hillside road south of Wriston, W. Va.
7. Along the road from Kingston, W. Va., to the summit of Lick Knob.
8. Along the steep hillside road west of Cokeoven Hollow, Page, W. Va.
9. Steep hillside road of Jenkins Fork, Powellton, W. Va.
10. Along road of Bullpush Hollow, Cannelton, W. Va.

STRATIGRAPHY

Upper Mississippian and Pennsylvanian rocks having an aggregate thickness of as much as 3,200 feet crop out in Fayette County. These rocks are divided into the Bluestone Formation, which does not have coal, and the overlying Pocahontas, New River, Kanawha, and Allegheny Formations, all of which are coal-bearing. A generalized section of these rocks is given in figure 3.

Bluestone Formation

The Bluestone Formation of Late Mississippian and Early Pennsylvanian age occupies a very small area along the New River and its tributaries at the southeastern edge of the county (fig. 1) where it is less than 200 feet thick. It is composed mostly of red shale and reddish gray sandstone. The Bluestone Formation does not contain coal.

Pocahontas Formation

The Pocahontas Formation of Early Pennsylvanian age ranges in thickness from 0 to 450 feet in Fayette County. It crops out in the southeastern one-fourth of the county and is composed of interbedded gray shale, sandstone, underclay, and coal. The sandstone is wedge to lenticular bedded, fine grained to pebbly, and generally contains abundant mica, rock fragments, and heavy minerals. Quartzose sandstone containing 90 percent or more quartz grains also occurs in the Pocahontas at several localities. Eight coal beds occur in the Pocahontas, as shown in figure 3. Of these, only the Pocahontas No. 3 and Pocahontas No. 6 coal beds are mined to any great extent.

New River Formation

The New River Formation, which overlies the Pocahontas Formation, ranges in thickness from 730 to 900 feet, and is of Early Pennsylvanian age. The thick, Nuttall Sandstone Members cap the formation and crop out prominently along the New River gorge. In addition, several other conglomeratic sandstones make conspicuous ledges in the New River Formation. Of 12 coals occurring in the formation, the Fire Creek, Beckley, and Sewell coal beds are minable; the Beckley, however, is mined only on a limited scale, and data on reserves and sulfur content are not available for it. Several of the other coals have been mined locally but are generally too thin to have much value.

Kanawha Formation

The Kanawha Formation crops out in the western one-third of Fayette County, and ranges in thickness from 1,000 to 1,700 feet. It is composed of dark- to light-gray carbonaceous shale, siltstone, and cross-laminated lenticular wedge-bedded sandstone of subgraywacke to quartzose composition. The sandstones are dark- to light-gray, medium-grained to pebbly, and generally contain abundant rock fragments, muscovite, and small amounts of heavy minerals. The top of the Kanawha Formation is capped by the resistant Homewood Sandstone Member, which is 75-225 feet thick. Siderite nodules are abundant in many shale units, and calcareous shale and limestone beds are also common, including the conspicuous Eagle Limestone Member of White (1891) and the Winifrede Limestone Member of

Hennen and others (1919). Perhaps the most distinctive and easily correlated member of the Kanawha Formation is a black fissile to massive flint called the Kanawha Black Flint by White (1891). It generally occurs within 20 feet above the Stockton coal near the top of the formation.

There are 27 coal beds at closely spaced intervals in the Kanawha Formation. Of these, 14 beds are more than 28 inches in thickness at places. These include the Douglas, Gilbert, Glenalum Tunnel, Little Eagle, Eagle, Powellton, No. 2 Gas, Peerless, Alma, Cedar Grove, Chilton, Winefrede, Coalburg, and Stockton.

Allegheny Formation

The lower part of the Alleghney Formation caps high ridges in the western part of the county, and is generally less than 150 feet thick. It is similar in lithology to the underlying Kanawha Formation. Conglomerates are conspicuous in the Allegheny Formation in surrounding counties, but were not observed in Fayette County. Of the minable coals, only the No. 5 Block and Middle Kittanning underlie areas large enough to contain important reserves.

STRUCTURE

Pennsylvanian rocks exposed in Fayette County are nearly flat lying. The strata have a regional northwest dip of about 100 feet per mile (Hennen and others, 1919), except where the dip increases locally to as much as 5° on the flanks of several broad anticlines and synclines. Among these folds, the Mann Mountain anticline is the most notable. Faults of more than a few feet displacement have not been reported in the county (Hennen and others, 1919).

COAL

Fayette County contains 51 bituminous coal beds that have been named or described. The beds consist of banded varieties of coal of medium-volatile to high-volatile A and B rank. Constituents of the coal are predominantly thin bands of vitrain and clarain interbedded with less numerous bands of durain and fusain. In a few of the beds cannel coal forms as much as 50 percent of the coal. The coals are generally fine cleated and easily disaggregated, but hard and blocky varieties are also common. The blocky varieties generally are those having a higher percentage of durain and fusain. Shale, underclay, bony coal, and thick bands of fusain form partings in many of the coals. Coal 28 inches or more in thickness, excluding partings, is classified as recoverable coal. The stratigraphic sections, figure 2, show the correlation of coal beds in different parts of the county, and figure 3 summarizes variations in thickness.

Coal beds of the Pocahontas Formation

Eight coal beds occur in the Pocahontas Formation of Fayette County and two of these, the Pocahontas No. 3 and Pocahontas No. 6, are sufficiently thick and persistent to be classed as minable. Each has been developed by underground, stripping, and augering methods.

Pocahontas No. 3 coal bed.--The Pocahontas No. 3 coal bed occurs about 200 feet above the base of the Pocahontas Formation and about 130 feet below the Pocahontas No. 6 coal bed. Its thickness ranges from 0 to 67 inches. The Pocahontas No. 3 is thicker than 28 inches

only in the extreme southeastern edge of the county where it averages about 36 inches. It commonly contains thin partings of shale and underclay. Bands of bright vitrain and clarain are the most common lithotypes of the Pocahontas No. 3. Smaller amounts of durain and fusain are also present at many exposures. As of 1963 the bed was not being mined in Fayette County (Deurbrouck, 1965, p. 5). Based on one analysis (Hennen and others, 1919, p. 877) the sulfur content of the Pocahontas No. 3 is 1.9 percent.

Pocahontas No. 6 coal bed.--The Pocahontas No. 6 is the most productive coal in the Pocahontas Formation in Fayette County. It lies about 130 feet above the Pocahontas No. 3 coal bed and 75-90 feet below the base of the New River Formation. Distribution of the Pocahontas No. 6 in Fayette County is similar to that of the Pocahontas No. 3. It ranges from 8-45 inches in thickness and averages approximately 30 inches. Usually it contains one or more partings. The coal is columnar jointed and nonresistant. The composition of the coal is similar to that of the Pocahontas No. 3. Sulfur content of the Pocahontas No. 6 ranges from 0.54 to 0.80 and averages 0.7 percent (Deurbrouck, 1965, p. 46).

Coal beds of the New River Formation

Of 12 coal beds occurring in the New River Formation, the Fire Creek and Sewell are sufficiently thick and persistent to be of commercial value. The Beckley coal bed is being mined only on a limited scale. The range in thickness of the coal beds and their sulfur contents are indicated in figure 3.

Fire Creek coal bed.--The Fire Creek coal bed usually occurs 115-165 feet below the Beckley coal. It is as much as 46 inches thick and averages about 32 inches in the area of this report. The Fire Creek usually contains thin partings of shale, underclay, and bone. It tends to split into several beds away from the area of thickest coal, which is in the vicinity of Lawton. The coal is finely cleated, nonresistant, and consists of bands 1/4-1/2 inch thick of vitrain and clarain; small amounts of durain and fusain are also common. Except for an area about 5 miles wide along the southeastern border of the county, the Fire Creek coal is generally minable throughout the eastern one-third of the county. The sulfur content of the Fire Creek coal bed averages 0.7 percent and ranges from 0.5 to 1.2 percent (Deurbrouck, 1965, p. 45-46; Cooper and others, 1942, p. 50-63).

Beckley coal bed.--The Beckley coal bed lies 200-225 feet below the Sewell coal. It varies from 0 to 50 inches in thickness and averages about 18 inches. The Beckley is composed of bright-banded coal commomly interbedded with thin partings of shale. The Beckley is mined on a very limited scale in Fayette County, and reserve figures have not been published for it. Nine samples of the Beckley coal bed from adjoining Raleigh County average less than 1.0 percent sulfur and contain no more than 1.5 percent (Miller and others, 1954, p. 14).

Sewell coal bed.--The commercially most important coal bed in the county is the Sewell bed, which is 200-225 feet above the Beckley coal. The Sewell bed is minable across the entire central part of the county.

Its average thickness is 50 inches, but in some exposures the coal is as much as 9 feet in thickness. The bed thins to less than 28 inches in the western part of the county, but remains very persistent. The Sewell coal consists mostly of interlaminated bands 1/4-3/8 inches thick of finely cleated vitrain and clarain interspersed with minor lenses of fusain. The lower 6-12 inches of coal in the bed are commonly separated from the main part by about 1 foot of medium-gray shale. Based on 80 analyses, the sulfur content ranges from 0.4 to 2.6 percent and averages 0.7 percent.

Coal beds of the Kanawha Formation

The Kanawha Formation contains 28 beds of medium-volatile to high-volatile A and B bituminous coal. It contains the most coal beds, and the most beds of minable thickness, of any formation in the county. Ten beds are mined, and they all contain low- to medium-sulfur coal suitable for metallurgical or steam purposes. The mined coals that are more than 28 inches in thickness are the Gilbert, Little Eagle, Eagle, Powellton, No. 2 Gas, Peerless, Cedar Grove, Winifrede, Coalburg, and Stockton. Four coal beds, the Douglas, Glenalum Tunnel, Alma, and Chilton, although gnerally less than 28 inches in thickness, were mined on a limited scale in the past.

Douglas coal bed.--The Douglas coal bed crops out 50-70 feet above the base of the Kanawha Formation. It is as much as 36 inches thick at some places, and averages about 24 inches. The Douglas coal is not being mined at present, but was mined on a limited scale in the past. Two analyses show a sulfur contnet of 0.9 percent.

Gilbert coal bed.--The Gilbert coal bed lies about 70 feet above the Douglas coal. Locally the Gilbert is as much as 36 inches in thickness, It is mostly bright-banded coal of high-volatile A bituminous rank. The Gilbert coal bed contains 1.2 percent sulfur, based on one analysis.

Glenalum Tunnel coal bed.--The Glenalum Tunnel coal bed lies 80-140 feet above the Gilbert coal, ranges in thickness from 9 to 34 inches, and averages about 20 inches. The Glenalum Tunnel coal is a bright-banded to semi-splint coal that commonly contains several thin shale partings. It is not presently being mined, principally because it is too thin, although appreciable reserves have been calculated for it (table 1). Three analyses of the coal average 0.6 percent sulfur.

Little Eagle coal bed.--The Little Eagle coal bed occurs 110-190 feet above the Glenalum Tunnel bed. Its average thickness is 30 inches, but it varies from 4 to 31 inches. The Little Eagle is a finely cleated high-volatile A bituminous coal consisting mostly of bright and dull bands of vitrain and clarain. Shale partings are common throughout the coal in the area where the bed is thickest. The Little Eagle in some areas joins the overlying Eagle coal bed, but generally the two are about 30 feet apart. Based on two analyses, the sulfur content is 1.1 percent.

Eagle coal bed.--The Eagle coal bed crops out along ridge tops and valley sides in the western one-third of the county, approximately 110 feet below the Powellton coal bed and 0-30 feet above the Little Eagle.

The bed ranges from 15 to 72 inches in thickness and averages 46 inches. The coal is of medium-volatile to high-volatile A bituminous rank. It generally contains partings of shale and underclay, and is fine cleated and columnar jointed. In some exposures the Eagle combines with the Little Eagle to form a single bed. The Eagle coal bed is second only to the Sewell coal bed in Fayette County in tonnage of coal originally present. The average sulfur content is 0.8 percent and the range is 0.6-1.4 percent.

Powellton coal bed.--The Powellton coal bed lies about 70-80 feet below the No. 2 Gas coal bed and 110 feet above the Eagle coal. It varies in thickness from 9-58 inches and averages about 36 inches, and it is sufficiently thick and persistent to be minable in the western one-third of Fayette County. It everywhere contains partings of shale, and is otherwise similar in its physical properties to the Eagle coal bed. The rank of the Powellton is high-volatile A bituminous, and it averages 0.9 percent sulfur based on 10 analyses.

No. 2 Gas coal bed.--The No. 2 Gas coal bed occurs 70-80 feet above the Powellton coal and 10-40 feet below the Peerless coal bed. The No. 2 Gas is thickest in the southwestern edge of the county where in some exposures 3-5 feet of solid coal were measured. It is less than 10 inches in thickness at some places, but averages about 30 inches. The rank of the No. 2 Gas is high-volatile A bituminous, and it is composed mostly of cleated bands of vitrain and clarain interlaminated with a few thin bands of durain and fusain. Partings of shale or

underclay are common in the coal. Because the No. 2 Gas is only a few feet below the Peerless seam, both of these coals commonly are stripped and augered from one high wall. The sulfur content of the No. 2 Gas ranges from 0.7 to 2.5 percent and averages 1.1 percent.

Peerless coal bed.--The Peerless coal bed is 10-40 feet above the No. 2 Gas and about 50 feet below the Cedar Grove coal. Thickness of the Peerless is greatest in the southwestern and western portions of the county where it averages around 30 inches. The Peerless is lithologically identical to and has virtually the same distribution as the No. 2 Gas. Data on sulfur content were not available for the Peerless.

Alma coal bed.--The Alma coal occurs 25-50 feet above the Peerless seam in roughly the western one-third of Fayette County. It is as much as 35 inches thick and averages about 15 inches. The Alma coal bed is not being mined at present largely because of its thinness at most places. It is a low-sulfur coal that contains an average of 0.7 percent sulfur.

Cedar Grove coal bed.--The Cedar Grove coal bed lies about 50 feet above the Peerless coal and 125 feet below the Williamson coal bed. Its average thickness is about 21 inches but is as much as 52 inches in thickness in some exposures. The Cedar Grove is finely cleated and is composed mostly of thin bands of vitrain and clarain. The Cedar Grove thickens westward into Kanawha County. The sulfur content for the Cedar Grove coal bed, based on 1 analysis, is 1.1 percent.

Chilton coal bed.--The Chilton coal bed contains considerable reserves but has received only limited development in the past and is not currently being mined. It lies about 150 feet below the Winifrede coal. The Chilton is as much as 46 inches thick in places but generally does not maintain a minable thickness of 28 inches for any great distance in Fayette County. The coal is bright banded and semi-splint; one analysis shows a sulfur content of 0.7 percent.

Winifrede coal bed.--The Winifrede coal bed crops out about 150 feet above the Chilton coal and 35-80 feet below the Coalburg coal bed. Its average thickness is about 23 inches, but locally it is as much as 5 feet in thickness. The Winifrede consists mostly of thin bands of soft to hard vitrain and clarain, but one or more beds of cannel coal as much as 8 inches thick commonly occur near the base. Shale and underclay partings are common, particularly near the top of the bed. The Winifrede occurs along ridges in the western one-fourth of the county and is minable in some of those areas. Sulfur content of the Winifred is 0.8 percent based on two analyses.

Coalburg coal bed.--The Coalburg coal bed lies 35-80 feet above the Winifred seam and 65-200 feet below the Stockton coal bed. Thickness of the Coalburg averages about 28 inches, and ranges from 9-35 inches. Rank of the Coalburg is high-volatile A bituminous, and the coal is generally soft, finely cleated, and composed mostly of thin bands of vitrain and clarain. Thin irregular lenses of fusain and durain are common, as are shale and underclay partings. The Coalburg coal bed has

a similar but more restricted distribution than the Winifrede in the northwestern part of Fayette County. Like the Winifrede, it crops out along the sides of the higher ridges. Based on 3 samples, the Coalburg averages 0.9 percent sulfur.

Stockton coal bed.--The Stockton coal bed, also known as the Stockton-Lewiston, crops out 0-20 feet below the Kanawha Black Flint and 75-225 feet below the No. 5 Block coal bed. It ranges from 15 to 60 inches in thickness in Fayette County and averages about 30 inches; the Stockton coal bed increases in thickness to as much as 9 feet in Kanawha County. The bed commonly contains abundant splint coal, but it is generally composed of finely cleated bands of vitrain and clarain. The Stockton coal bed is generally confined to the tops of a few ridges in the western part of the county. The sulfur content of the Stockton is 1.1 percent based on 1 analysis.

Coal beds of the Allegheny Formation

Three coal beds of the Allegheny Formation, the No. 5 Block, Middle Kittanning, and Upper Kittanning, occur in Fayette County. The No. 5 Block is the basal coal of the Allegheny Formation and only it and the Middle Kittanning are mined in the county.

No. 5 Block coal bed.--The No. 5 Block underlies small areas near ridge tops in northwestern Fayette County. Its interval above the Stockton is 75-225 feet. The No. 5 Block averages about 50 inches in thickness; however, in some areas it is as much as 8 feet thick. The coal is easily disaggregated, finely cleated, and composed dominantly

of vitrain and clarain in thin bands. Splint coal comprises as much as 50 percent of the bed at some localities. Thin partings of carbonaceous shale are common in the bed. The No. 5 Block averages 0.7 percent sulfur based on 10 analyses.

Middle Kittanning coal bed.--The Middle Kittanning coal occurs about 55 feet above the No. 5 Block. The bed crops out in a few isolated areas near the tops of the highest ridges in northwestern Fayette County where it is about 4 feet thick. The Middle Kittanning coal is composed mostly of vitrain and clarain in thin bands. In some exposures thin partings of carbonaceous shale are present. No analyses for sulfur were available in Fayette County for the Middle Kittanning.

Upper Kittanning coal bed.--The Upper Kittanning coal occurs about 20 feet above the Middle Kittanning coal bed and is about 30 inches in thickness. It is generally a bright-banded coal. No information is available on its sulfur content in the county.

Sulfur content of coal beds

In the present study, low-sulfur coal is classified as coal containing 1.0 percent or less sulfur, and medium-sulfur coal is coal containing between 1.0 and 3.0 percent sulfur on the as-received basis. The range in sulfur content for the beds for which analyses are available is given in figure 3. Available analyses (Hennen and others, 1919; Cooper and others, 1942, p. 50-63; Deurbrouck, 1965) indicate that the coals almost everywhere in Fayette County contain less than 2.0 percent sulfur and at most places contain less than 1.0 percent sulfur. The

Sewell coal bed has the highest sulfur content and greatest range in sulfur--0.4-2.6 percent; but it averages only 0.7 percent based on 80 analyses. The Pocahontas No. 3, Gilbert, and Little Eagle coal beds contain between 1.0 and 2.0 percent sulfur, but these values are based on only one or two analyses. The No. 2 Gas coal bed averages slightly over 1.0 percent sulfur (1.03 percent) based on 22 analyses, and could be considered a low-sulfur coal.

Coal reserves

Table 1 (slightly modified from Hennen and others, 1919) gives the estimated original reserves for 20 coal beds in Fayette County. A summary of mining in the county, taken from U.S. Bureau of Mines Minerals Yearbooks, is given below.

	Millions of short tons (rounded)
Original reserves	4,420
Total recoverable reserves (based on 50 percent recovery rate	2,210
Coal produced from 1184-1934	359
Coal produced from 1934-1966	319
Total coal produced to the end of 1966	678
Remaining recoverable reserves, end of 1966	1,530

The summary shown above indicates that the remaining recoverable coal reserves in the county, as of the end of 1966, were 1,530 million tons. Of this amount, about 86 percent or 1,320 million tons is low sulfur, and the remaining 14 percent or 210 million tons is medium sulfur.

Table 1.--Estimated original coal reserves in Fayette County, West Virginia.[1/]

Coal bed	Original reserves (thousands of short tons, rounded)
Middle Kittanning	10,260
No. 5 Block	61,950
Stockton	71,740
Coalburg	115,500
Winifrede	100,600
Chilton	113,400
Cedar Grove	203,300
Alma	196,700
Peerless and No. 2 Gas	767,200
Powellton	302,500
Eagle	511,400
Little Eagle	247,300
Glenalum Tunnel	37,940
Gilbert	34,510
Douglas	33,590
Sewell	967,200
Fire Creek	442,800
Pocahontas No. 6	124,700
Pocahontas No. 3	77,920
Total (rounded)	4,421,000

1/ After Hennen and others, 1919.

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