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UNIVERSITY OF VIRGINIA

THOMAS LEONARD WATSON, PH. D.  
DIRECTOR

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The Geology and Coal Resources  
of Buchanan County, Virginia

BY

HENRY HINDS

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PREPARED IN CO-OPERATION WITH THE  
UNITED STATES GEOLOGICAL SURVEY

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WITH A CHAPTER ON

The Forests of Buchanan  
County, Virginia

BY

W. G. SCHWAB

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PREPARED IN CO-OPERATION WITH THE  
OFFICE OF STATE FORESTER

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CHARLOTTESVILLE  
UNIVERSITY OF VIRGINIA

1918



## STATE GEOLOGICAL COMMISSION

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By HENRY HINDS.

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## LETTER OF TRANSMITTAL

VIRGINIA GEOLOGICAL SURVEY,

UNIVERSITY OF VIRGINIA,

CHARLOTTESVILLE, November, 1918.

*Governor Westmoreland Davis, Chairman, and Members of the State  
Geological Commission:*

Gentlemen:—I have the honor to transmit to you herewith, and to recommend for publication as Bulletin No. XVIII of the Virginia Geological Survey Series of Reports, a manuscript and illustrations of a report on "The Geology and Coal Resources of Buchanan County, Virginia," by Mr. Henry Hinds, with a chapter on "The Forests of Buchanan County, Virginia," by Mr. W. G. Schwab.

The report has been prepared by the Virginia Geological Survey in coöperation with the United States Geological Survey and the Office of State Forester. It is the third one of a series of detailed reports published by the Virginia Geological Survey on the coal resources of southwest Virginia under the coöperative agreement of the State and Federal Surveys, and the first one of the county reports. The report is accompanied by county topographic and geologic maps, and by a map of the forests of the county.

Respectfully submitted,

THOMAS L. WATSON,

*Director.*

# THE GEOLOGY AND COAL RESOURCES OF BUCHANAN COUNTY, VIRGINIA

BY HENRY HINDS.

## INTRODUCTION

*Location and importance of the county.*—Buchanan County is in southwest Virginia (see fig. 1), and is bounded on the northeast by McDowell and Mingo counties, West Virginia, on the southeast by Tazewell and Russell counties, Virginia, on the southwest by Dickenson County, Vir-

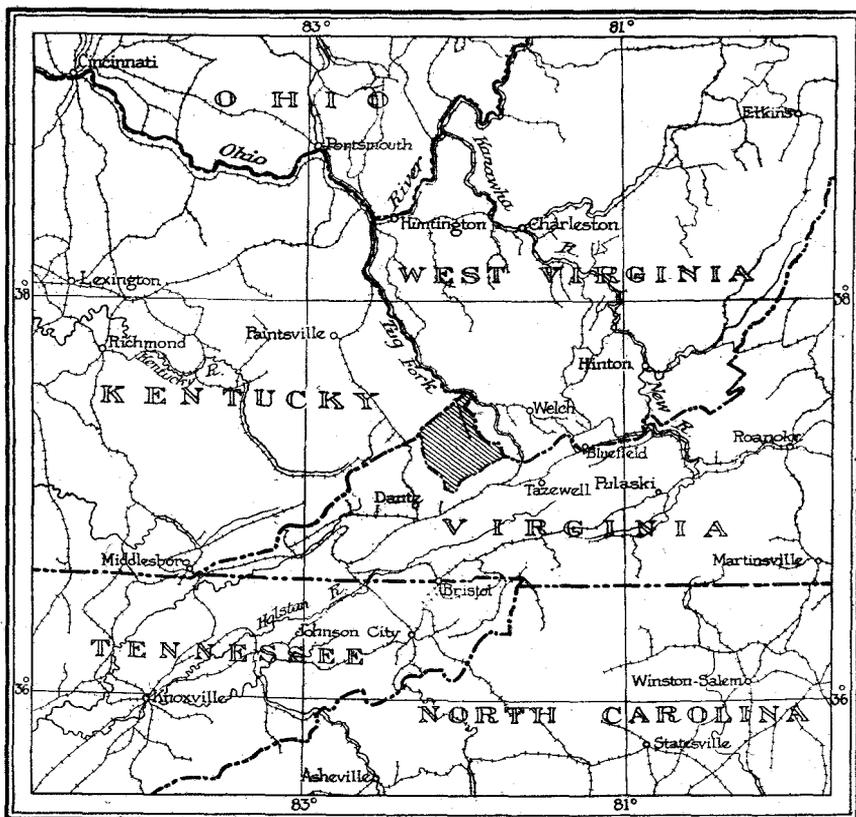


Fig. 1.—Index map showing location of Buchanan County (the shaded area).

ginia, and on the northwest by Pike County, Kentucky. The county contains 507 square miles, according to the most recent maps of the Federal and State geological surveys.

The survey upon which this report is based was undertaken primarily because of the great potential value of the coal resources of the region and the lack of detailed knowledge concerning them. The county lies on the southeast border of the central part of the great Appalachian coal field and contains about 12,000,000,000 tons of high-grade, coking, bituminous coal in beds of minable thickness. Although great quantities of coal are mined annually in McDowell County, West Virginia, and mining activity in neighboring parts of Virginia and Kentucky has recently received great impetus, practically no Buchanan County coal has ever been mined for other than local consumption. The explanation lies in the lack of transportation facilities, a lack which could be remedied without great difficulty.

The region is inhabited chiefly by the descendants of those who came into the mountains many years ago. The population in 1910 was 12,334, all white, as negroes have not been encouraged to remain. About the only occupations of the people are farming and lumbering. Corn, raised in small cleared patches on remarkably steep slopes, a little garden truck, and hogs that are allowed to run wild during most of the year, are the chief, and almost the only, farm products. Except for clearings whose aggregate area is comparatively small, the whole region is covered with dense forests filled with undergrowth. These forests have been a very important source of revenue and still contain many large and valuable trees.

The largest permanent town is Grundy, the county-seat, with a population of 264 in 1910. There are lumber mills at Hurley, Blackey, Kelsa (Pawpaw), and Whitewood, and they are centers for the lumbering industry. Logs cut in the southern part of the Russell Fork basin are hauled across Sandy Ridge to a large mill at Honaker.

*Method of work.*—Both the geologic and the topographic work was done in coöperation by the Virginia Geological Survey and the U. S. Geological Survey, the expense being shared by both organizations. Most of the Russell Fork drainage basin was surveyed in 1913, the southeastern part of the county in 1916, and the remainder of it in 1914.

The geologic survey of most of the county was made at the same time as a detailed topographic survey of the surface features, and the topographic corps determined the location and elevation of a number of coal openings and exposures and established many stadia stations in addition to those

whose elevations appear on the topographic map accompanying this report. This method forced the geologists to work without the aid of completed and adjusted contour sketching, though they were able to check their barometers at many stations along stadia and level lines, in order to correct errors arising from variations in atmospheric pressure. Except when it was necessary to work far from the principal roads and trails, in localities where no instrumental topographic traverses had been made, barometers were reset many times each day and large errors in elevation were thereby avoided.

Geologic profiles were made of all roads and paths and all reported coal openings were visited. The locations of many openings which were so covered by débris that no measurements could be obtained are shown on the accompanying geologic map but are not mentioned in the text. Stratigraphic sections 400 to 800 feet long were measured up spurs at intervals of half a mile to a mile along all the principal valleys. More detailed work was done than has been customary in public geologic surveys in the Appalachian region, and was made necessary by the lack of well-defined stratigraphic markers, the heavy growth of brush and trees, and the rarity of natural or artificial coal exposures.

*Acknowledgments.*—The writer desires to express his great indebtedness to the efficient aid given by his assistants. T. K. Harnsberger assisted during nearly all of both the field and the office work and mapped many areas independently. C. A. Davidson and C. M. Bauer assisted during the field season of 1914, the former for nearly four months and the latter for one month. David White, Chief Geologist of the U. S. Geological Survey, had general supervision of the work.

W. D. Tyler, of the Clinchfield Coal Corporation, furnished maps of transit surveys of coal outcrops in a large part of the Russell Fork basin, measurements of coal beds in the same area, and records of drill holes on Russell Fork and Indian Creek. Outcrops and coal measurements, chiefly in the Levisa Fork basin, were contributed by E. V. d'Invilliers and J. B. Dilworth, and by Charles Catlett. Valuable information concerning the Keen Mountain district, including outcrop surveys, coal measurements, and geologic sections, was given by J. P. Williams, Jr. Many coal measurements recently made in the northern half of the county were supplied by W. B. Crawford and R. H. Cunningham. Information of value was also furnished by W. A. Ohley, W. L. Dennis, A. S. Higginbotham, P. M. Snyder, G. W. St. Clair, and many others. All citizens of the county were notably hospitable and helpful in many ways.

Only parts of the county have been described in previous geologic reports. The most recent report<sup>1</sup> deals with the southwestern part and with neighboring parts of Dickenson and Russell counties. A report by R. W. Stone<sup>2</sup> gives the results of a hurried reconnaissance in the Russell Fork drainage basin. A folio by M. R. Campbell<sup>3</sup> contains engraved maps and brief descriptions of the eastern part of Buchanan County and neighboring parts of Virginia and West Virginia, prepared before many coal openings had been made in the region. Recent volumes by R. V. Hennen and D. B. Reger<sup>4</sup> describe the West Virginia region which borders on Buchanan County.

## SURFACE FEATURES.

### Relief.

The surface of the entire county is rugged and has many of the features of mountains. Flat lands even a few acres in extent are rare, and valley slopes, though not precipitous, are very steep. The region has been thoroughly dissected by streams, so that the principal water courses are only a few miles apart and are separated by ridges that rise 500 to 1,000 feet or more above them. The valleys are deep, narrow, and V-shaped, and even the largest of them have only very narrow flat bottom lands. (See Pl. I.)

Many of the valleys are winding, so that water in the streams travels long distances between points not far apart. The ridges are steep-sided, winding, and have many short side spurs jutting out from them. They are sufficiently flat-topped to present a nearly even sky-line, and the heights of neighboring ridges are approximately the same in most districts. Some of the principal ridges, chiefly those in the southern part of the county, are sufficiently wide for roads and for a few houses, but others are so narrow that they are without clearings of any kind.

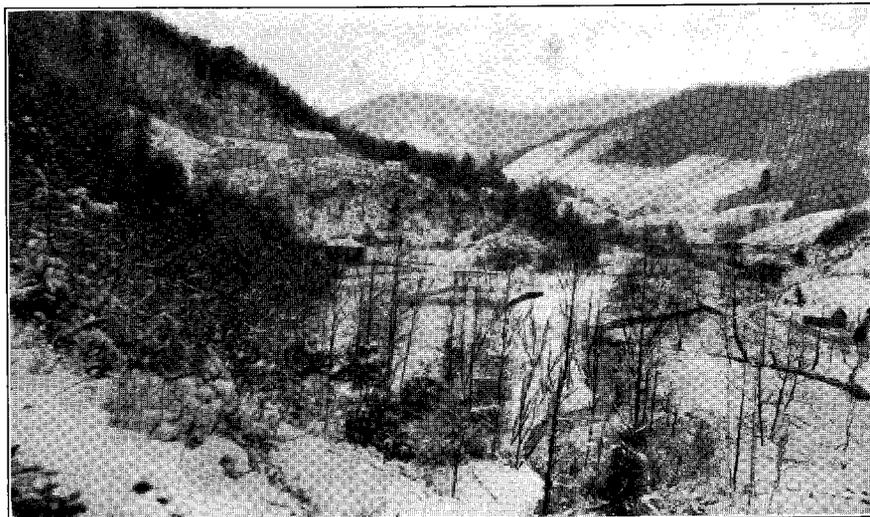
The maximum relief of the county is 2,890 feet, the lowest point being on Levisa Fork at the Kentucky boundary, where the elevation is 845 feet, and the highest on Big A Mountain, where the elevation is 3,735 feet. The greatest local relief is near Big A, where there are differences in elevation

<sup>1</sup> Hinds, Henry, Coal resources of the Clintwood and Bucu quadrangles, Virginia: Virginia Geol. Survey Bull. XII, 1916.

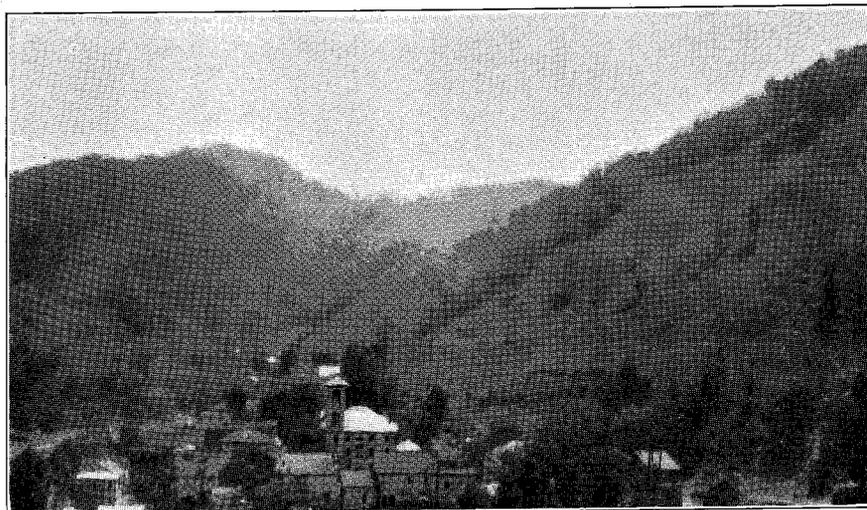
<sup>2</sup> Stone, R. W., Coal resources of the Russell Fork basin in Kentucky and Virginia: U. S. Geol. Survey Bull. 348, 1908.

<sup>3</sup> Campbell, M. R., U. S. Geol. Survey Geol. Atlas, Tazewell folio (No. 44), 1897.

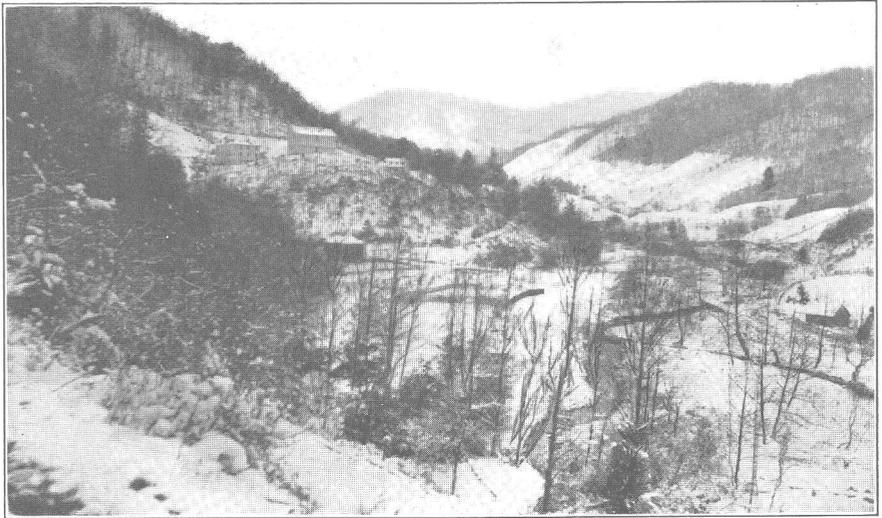
<sup>4</sup> Hennen, R. V., and Reger, D. B., Logan and Mingo counties: West Virginia Geol. Survey, 1914. Hennen, R. V., Wyoming and McDowell counties: idem, 1915.



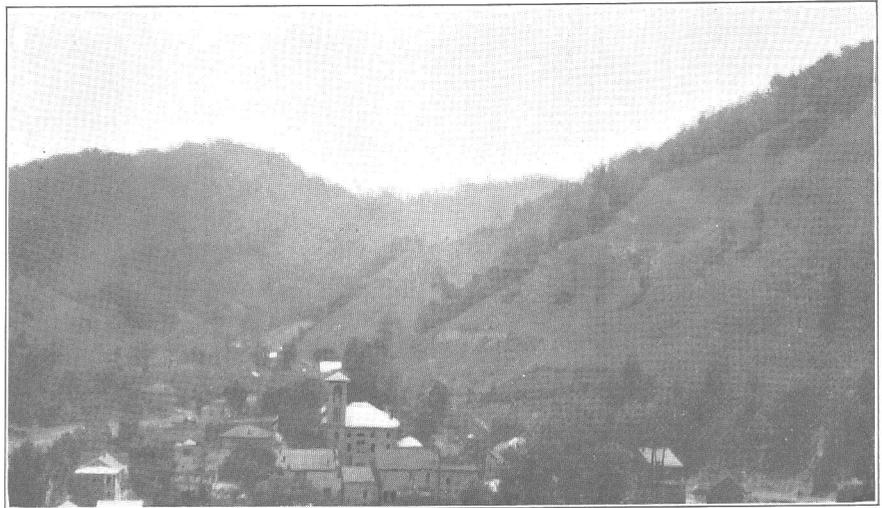
(A) View of Russell Fork valley from Council, with northeast end of Big A Mountain in distance.



(B) View of Grundy and the valley of Slate Creek.



(A) View of Russell Fork valley from Council, with northeast end of Big A Mountain in distance.



(B) View of Grundy and the valley of Slate Creek.

of 1,700 feet in distances of about one mile. Big A Mountain, an exceptionally high part of Sandy Ridge about  $2\frac{1}{2}$  miles long, is the most prominent landmark in the region.

Sandy Ridge, the divide which forms the county boundary on the southeast, is the natural barrier which has prevented easy communication between this region and other parts of Virginia. The elevation of its highest points, exclusive of Big A Mountain, is 2,500 to 2,625 feet near the head of Indian Creek and increases northeastward to about 3,050 feet near Bearwallow. The lowest points, located in gaps at the heads of streams and commonly utilized by roads crossing the ridge, are only 150 to 350 feet below neighboring high points. Streams which flow northward from this ridge have very steep gradients for the first mile. Long spurs, almost as high as Sandy Ridge itself, branch off from it to form the divides between the main streams. Big Fork and Jewell ridges, though not the longest of these spurs, are best known because rather thickly settled; their northern ends are at an elevation of about 2,750 feet, about a thousand feet above neighboring large streams.

Another main divide which is slightly higher than its neighbors forms the boundary between Buchanan County and McDowell County, West Virginia, and is sometimes called State Line Ridge. It is long, narrow, and winding and is broken by only a few shallow gaps. The elevation of its highest points ranges from 1,700 feet near Tug Fork to 2,180 at the head of Upper Elk Creek, 2,250 at the head of Guess Fork, 2,600 at the head of Slate Creek, 2,800 at Height, to 3,095 on Bearwallow Knob, a conspicuous feature near the junction of this ridge with Sandy Ridge. Subsidiary spurs, shorter than those of Sandy Ridge, branch off to form the divides between streams which head near the State line. A small knob on one of these spurs, at the head of Middle Elk Creek, is higher than neighboring parts of State Line Ridge and is about 1,100 feet above a stream only one mile distant.

All large streams are separated by dividing ridges with subsidiary spurs between tributary streams. Keen Mountain is a well-known feature between Levisa Fork and lower Dismal Creek. It is nearly 7 miles long and its elevation ranges from 2,150 to 2,750 feet, the highest point, which is near Antioch School, being 1,200 feet above a point on Dismal Creek only one mile distant. Fletcher Ridge, with its small but conspicuous dome-shaped knob 3 miles north of Council, is another fairly well-known surface feature. The most notable height near the Kentucky boundary is the knob northeast of Upper Rocklick School, which rises 1,300 feet above a point on Rocklick

Creek that is less than a mile distant. The average elevation of the divides declines uniformly to the northwest from nearly 3,000 feet above sea-level near Bearwallow to about 1,800 feet along the Kentucky boundary.

### Drainage.

All the drainage of the county is tributary to Big Sandy River through its three main branches—Russell Fork, Levisa Fork, and Tug Fork. Through the Big Sandy the waters flow northward to Ohio River and continue their long journey to the Mississippi and the Gulf of Mexico. The largest of the three basins in Buchanan County is that of Levisa Fork, whose chief tributaries in the region are Conoway, Bull, Poplar, Prater, Garden, Contrary, Dismal, Slate, Home, Looney, Linn Camp, and Rocklick creeks. The chief tributaries of Russell Fork are Indian, Hurricane, Fox, and Pawpaw creeks, and parts of Russell Prater, Barts Lick, and Grassy creeks. Most of the Tug Fork basin is tributary to Knox Creek, whose chief branches are Pawpaw, Upper Elk, Middle Elk, and Lower Elk creeks, and Race, Lester, Right, and Guess forks. Greenbrier Creek, Long Branch, and a few other small streams flow directly into Tug Fork.

Although even small tributaries contain some running water during most of the year, none of the streams has a very large flow. Even rowboats have trouble in navigating Levisa and Tug forks, the largest streams, for any considerable distances. There are only three wagon bridges in the county, but there are many fairly easy fords on every stream. The rainfall is greater than in most parts of the United States, but the sandy soil, dense growth of trees and brush, and high stream gradients prevent floods. According to common usage in this region the "right" and "left" sides or forks of a stream are considered relatively to the position of a person facing upstream.

### Accessibility.

Wagon roads are rocky and very steep in places, and most of them are in the valleys. Most travel is on horseback, and bridle paths are plentiful. A few automobiles have been introduced recently for use on some of the main roads. It would be possible to greatly improve many roads, for better grades could be constructed at small cost, and little labor is needed to adequately drain the sandy soil.

The only railroads in the county are used primarily in the lumbering industry, though they also carry some general freight. One logging railroad connects Honaker, on the Clinch Valley division of the Norfolk and

Western, with the upper part of the Russell Fork basin. Another runs from Doran, on the same division, to Whitewood and points farther down Dismal Creek. A third connects Devon, on the main line of the Norfolk and Western, with points on Knox and State creeks, and operates a regular freight and passenger service between Devon and Matney. None of these roads could now carry the traffic that would be the result of large coal-mining operations, but all could be converted into coal carriers by constructing tunnels under the divides, by otherwise decreasing the worst grades, and by improving road-beds. It has been planned to construct a railroad down Right Fork of Garden Creek from Drill, a station on the present line from Honaker to Russell Fork. It would not entail prohibitive expense to connect any part of the region with trunk lines now operating in all adjoining counties.

## GEOLOGIC FORMATIONS

### GENERAL STATEMENT.

A large part of the surface of the county is covered with a mantle of residual soil and most of the valley bottoms contain small deposits of alluvium. Underlying indurated rocks, however, especially the more resistant sandstones, can be seen on many narrow points and spurs and along roads and paths from which the soil has been washed away. In nearly all the county these exposed indurated rocks belong to the Pennsylvanian series of the Carboniferous system, the series which contains nearly all the coal deposits in the eastern half of the United States.

In a small area on and near Big A Mountain formations which normally underlie the Pennsylvanian series have been thrust up over it along great faults. These older rocks form parts of the Ordovician and Silurian systems and of the Mississippian series of the Carboniferous system. They are not of much economic importance, though they contain impure iron ores and some shales and building stones that might be utilized.

### ORDOVICIAN SYSTEM.

#### Bays sandstone.

The Bays consists chiefly of loose-textured red and reddish-brown sandstones, probably grading into red and drab sandy shales in the lower part. It outcrops only in a very small area at the northeastern end of Big A Mountain, where it is faulted up against Carboniferous rocks and is poorly exposed because of débris from the overlying Clinch sandstone.

### SILURIAN SYSTEM.

#### Clinch sandstone.

The Clinch is a white, massive sandstone composed chiefly of clear quartz grains so firmly cemented that the rock forms cliffs and has a notable effect upon the topography. It is about 100 feet thick. A few quartz pebbles were found near its base and many long cylindrical worm tubes near its top. It outcrops only in two strips on Big A Mountain—one near the top of the northeastern knob and the other along the northwestern border.

**"Rockwood" formation.**

The surface rocks of most of Big A Mountain belong to the formation that has commonly been classed as "Rockwood" in reports on neighboring areas. The formation consists of shale and sandstone, but only the more resistant layers are exposed. Campbell states that it is 300 to 400 feet thick in the Tazewell quadrangle, and it is at least that thick on Big A. The lower and middle parts of the formation are chiefly deep brownish-red, medium-grained sandstone, rather loosely cemented and containing layers full of very small yellow and white pebbles. Near the base are at least 50 feet of deep red sandstone that is so ferruginous as to suggest the presence of valuable iron ore. Most of the iron, however, is simply a coating on quartz grains, giving the rock a misleading resemblance to purer oolitic ores.

The most conspicuous member of the "Rockwood" is a white, coarse sandstone near the top of the formation. This rock resembles the Clinch in general character and in the fact that it forms cliffs and governs topographic expression, but it is only about 40 feet thick. It caps the little knobs at the west end of the central part of the mountain and forms the broad dip slopes of bare rock southwest of them, at the head of Weaver Creek, in Russell County.

**CARBONIFEROUS SYSTEM.****Mississippian series.****PENNINGTON SHALE.**

The greater part of the Pennington shale, the only Mississippian formation exposed in this region, outcrops on the northwestern slopes of Big A Mountain. The rocks are overturned, so that the oldest beds appear near the top of the mountain, where they have been overridden by the Clinch sandstone. The greater part of the formation consists of shale, chiefly drab but in considerable part with a strong red or green tinge. Some shale beds are yellow and a few are blue or blue-black. There are also some layers of dense sandstone, chiefly light gray but also showing greenish or reddish hues. Most of the sandstones are rather fine-grained and less than 50 feet thick, but some are coarser and slightly thicker; the ridge trending southwest from the place where the county boundary crosses the road around the west end of Big A Mountain is capped by one of the most prominent sandstones. Many Pennington beds closely resemble those common in the

Pennsylvanian series, but strong red and green hues are restricted to the former. Some thin, fine-grained limestones were found in the lower part of the Pennington in adjoining parts of Russell County, and probably underlie the talus near the top of the mountain in Buchanan County.

About 2,000 feet of the formation is exposed in this area and in adjacent parts of Russell County, the basal portion being everywhere concealed by the older rocks which have been thrust over it. The entire Pennington is only about 800 feet thick on Pine ("Cumberland") Mountain, on the northern border of Dickenson County, and only 85 to 510 feet thick in three wells in eastern Pike County, Kentucky. The formation is probably much thinner, therefore, in northern Buchanan County than near Big A Mountain, both because many beds thin to the north and northwest and because the upper beds of the southern area are not present in the northern area. The absence of the upper beds is due chiefly or wholly to their removal by erosion before the deposition of the Pennsylvanian, and great local irregularity in the thickness of the formation has resulted from the same cause.

### **Pennsylvanian series.**

#### GENERAL STATEMENT.

The Pennsylvanian series, in which are all the commercially important coal beds of this area, consists of sandstone, shale, coal, and thin beds of clay. The only limestone is in small nodules at a very few horizons. These rocks, which all belong to the Pottsville group, were divided by Campbell in his reports on the Big Stone Gap coal field into the following formations, named in ascending order: Lee formation, Norton formation, Gladeville sandstone, and Wise formation. These formations can not be differentiated from one another by any lithologic or stratigraphic peculiarities that have wide application. No formation contains any type of bed that is not present in the others, and no member exhibits the same thickness or exactly the same lithologic character in all localities. The intervals between coal or other horizons are different in different parts of the region, so that the members of a measured section can rarely be identified with certainty by comparing it with a section 5 miles or more distant. In spite of these facts, however, and of difficulties due to the thick brush and timber, the more or less omnipresent residual soil, and the local irregularities in dips, it is possible to ascertain stratigraphic relations by the methods described as used in the work upon which this report is based.

Sandstone constitutes about one-third of the Pennsylvanian rocks. It includes considerable fine-grained and thin-bedded material that has the appearance of sandy shale in weathered exposures. The most persistent sandstone beds are thick bedded and coarse-grained and form cliffs and benches on the valley sides. By far the greater part are buff or brownish and arkosic, stained with iron oxide and containing decomposed feldspars, mica, and other minerals as well as the much more abundant quartz grains. Other beds that are firmly held together by siliceous cement are gray and contain a large proportion of quartz grains. Another type of sandstone that is very uncommon and is confined to the Wise formation is almost pure white, fine-grained, and very resistant to weathering.

Sandstones containing rounded quartz pebbles an inch or less in diameter are common at many horizons. This conglomeratic phase is not characteristic of any bed at all localities, so that it is not a reliable marker to use in making stratigraphic determinations. It occurs in many beds in certain areas and is uncommon in the same beds in other places, being geographic rather than stratigraphic in its distribution.

Most of the shales, the most common rock type, are very sandy and grade into sandstone. Drab is the most common shade, though fresh exposures of several beds, especially among the lower rocks, are distinctly blue. Some of the more argillaceous shales are yellowish, and thin beds, commonly those within a few feet of coal beds, are black.

The coal beds will be discussed later. The clay beds are usually associated with coal, either as very thin partings between coal layers or as the stratum upon which the coal rests. The underclays are a few inches to a few feet thick, most of them are sandy, and many are slightly laminated, so that they resemble and grade into true shales. Limestone was found only as impure nodules and lenses at two horizons, one in the Norton and the other in the Wise.

The fossils of the Pennsylvanian are almost wholly plants which are very common at many horizons, chiefly in the roof-shales of coal beds. They are especially abundant in the roof of the Splash Dam coal. Many plants were collected and were examined by David White, the results being of great value in making correlations. Fossil shells were found at two horizons in the eastern part of the county. One horizon is in a thin bed of black and greenish shale 50 to 90 feet above the Haggy coal, and contains marine invertebrates which have a widespread distribution and were successfully used by the West Virginia Geological Survey for correlation purposes in McDowell County, where the beds in which they lie are known as the

"Eagle shale." A few marine shells were found 60 to 90 feet below the Hazy coal on Long Branch of Dismal Creek, probably at the Oceana limestone horizon of the West Virginia Geological Survey. A few shells, probably brackish water types, were found by David White and the writer in railroad cuts at the Kennedy coal horizon at Elkhorn City, Ky.

#### LEE FORMATION.

The lowest formation of the Pennsylvanian series is above the surface only low down in the valleys of Indian Creek and its tributaries, and in the small area at the head of Lambert Fork of Indian Creek, near Big A Mountain. Some Lee beds may possibly be included in the rocks mapped as undifferentiated Pennsylvanian near Council. The Lee exposed on Indian Creek includes only a few of the highest beds and that at the head of Lambert Fork is only the lower part of the formation. The beds on Lambert Fork have been thrust over younger rocks along a great fault, are overturned, and are dipping steeply to the southeast. A few miles southeast, in Russell County, the belt of overturned Lee widens so as to include all of the formation, but poor exposures and steep dips make it impossible to determine exactly the relations and character of all the beds. Part of the Lee is exposed in The Breaks, near the northwest corner of Buchanan County, and all of it crops out on neighboring parts of Pine Mountain. All of the formation is also exposed in West Virginia and Virginia, a few miles east and southeast of Bearwallow Knob. The nature of these rocks in Buchanan County must be deduced chiefly from information obtained in these neighboring areas.

Along the southern border of the county the formation has about the same characters as the Norton and Wise, containing no exceptional proportion of conglomerate and coarse sandstone. The exposures on Indian Creek show a thin, coarse sandstone at the top, shales, and a 30-inch coal bed about 50 feet below the top. The lowest of the overturned beds southwest of Big A Mountain is a moderately thick conglomerate, but other sandstone beds are not exceptionally coarse-grained or siliceous, and shale constitutes a third or a half of the formation. The nature of the beds farther northeast is best shown by the drill-record given below. The Lee is probably 1,500 or 1,600 feet thick near Big A Mountain and about 1,650 feet near Bearwallow Knob.

The Lee thins considerably to the north and northwest and becomes more sandy. On Pine Mountain, near the northwest corner of Buchanan

County, it is only 800 feet thick and consists of 475 feet of sandstone at the top, 75 feet of shales and thin coals in the middle, and 250 feet of sandstone at the base. These sandstones are grayish-white and are composed chiefly of large translucent quartz grains firmly bound together by a siliceous cement, so that the beds make great cliffs along their outcrops. They also contain many white quartz pebbles. Four well records from eastern Pike County, Kentucky, show the Lee to be 110 to 800 or 950 feet thick and to consist very largely of sandstone.

The great northward thinning of the formation and its irregularity in thickness are from two causes, one being an actual thinning of the constituent beds and the other being the irregularity of the surface upon which the Lee was deposited. This uneven surface is the result of erosion which washed away part of the rocks underlying the Lee before the latter was deposited. It is probable that the deposition of Lee beds in the northern area did not begin until the lower part of that formation, including most of the Pocahontas coals, had already been laid down in the southern part of the county.

The following excellent record of a diamond-drill boring near the head of Seng Camp Fork of Dismal Creek, furnished by officers of the Pocahontas Mining Corporation, shows all of the Lee except 300 or 350 feet at the base. The correlations of the coals are those contained in a report in preparation by T. K. Harnsberger, and are based on detailed surveys made by him in Tazewell County.

*Record of deep boring on Seng Camp Fork of Dismal Creek.*

(Elevation at top about 2,260 feet.<sup>1</sup>)

	Thickness.		Depth.	
	Ft.	in.	Ft.	in.
<b>Alluvium:</b>				
Sand and boulders (Tiller coal horizon 3 feet below top) .....	23		23	
<b>Norton formation:</b>				
Shale, sandy .....	20		43	
Sandstone .....	35		78	
Shale, sandy .....	70		148	
Shale, blue .....	1		149	
Coal .....		10	149	10
Fireclay .....		8	150	6

<sup>1</sup> An error in the topographic mapping makes this bore-hole (marked D. H.) appear to be too low in elevation on the county geologic map.

Lee formation:	Thickness.		Depth.		
	Ft.	in.	Ft.	in.	
Sandstone .....	61		211	6	
Shale, dark .....		1	211	7	
Coal .....	1	1	212	8	
Shale, dark .....	6	2	218	10	
Sandstone .....	33	6	252	4	
Shale, with sandstone partings .....	28		280	4	
Shale, blue, sandy .....	23		303	4	
Sandstone .....	9	8	313		
Shale, blue, sandy .....	10		323		
Shale, with sandstone partings .....	13		336		
Shale, blue, sandy .....	28		364		
Sandstone, with shale partings .....	8		372		
Shale, blue, sandy .....	10		382		
Shale, dark .....	2		384	4	
Coal .....	1 ft. 0 in.				
Shale, dark, 0 " 9 " } (Greasy Creek)	2	3	386	7	
Coal .....	0 " 6 "				
Shale, dark .....	6		392	7	
Shale, light .....	4		396	7	
Sandstone, with shale partings .....	25		421	7	
Shale, with sandstone partings .....	30		451	7	
Shale, blue, sandy .....	12	5	464		
Shale, dark .....	1	6	465	6	
Shale, with coal partings .....		6	466		
Coal .....	0 ft. 2 in.				
Shale, dark ..	0 " 2 "				
Coal .....	0 " 3 "				
Shale, black..	3 " 2 "				
Coal .....	0 " 11 "				
		4	8	470	8
Shale, dark .....		6	471	2	
Shale, light .....	11		482	2	
Sandstone .....	42	10	525		
Shale, blue .....	11		536		
Shale, black .....		4	536	4	
Coal (Lower Seaboard) .....	1	10	538	2	
Shale, dark .....	1	3	539	5	
Sandstone, with shale partings .....	11		550	5	
Sandstone .....	13		563	5	
Shale, dark, with coal partings .....	4	7	568		
Coal .....		4	568	4	
Fireclay .....		8	569		
Shale, sandy .....	2	2	571	2	
Sandstone .....	19		590	2	
Shale, blue .....	4	7	594	9	
Coal .....		9	595	6	
Fireclay .....	1	6	597		
Shale, blue, sandy .....	2	6	599	6	
Sandstone .....	85	4	684	10	
Shale .....	4	6	689	4	
Coal (Upper Horsepen) .....	2		691	4	
Fireclay .....		8	692		
Shale, dark .....	8		700		
Sandstone, with shale partings .....	32		732		
Shale, blue, sandy .....	14		746		
Shale, dark .....		8	746	8	
Coal (Middle Horsepen) .....	2	4	749		

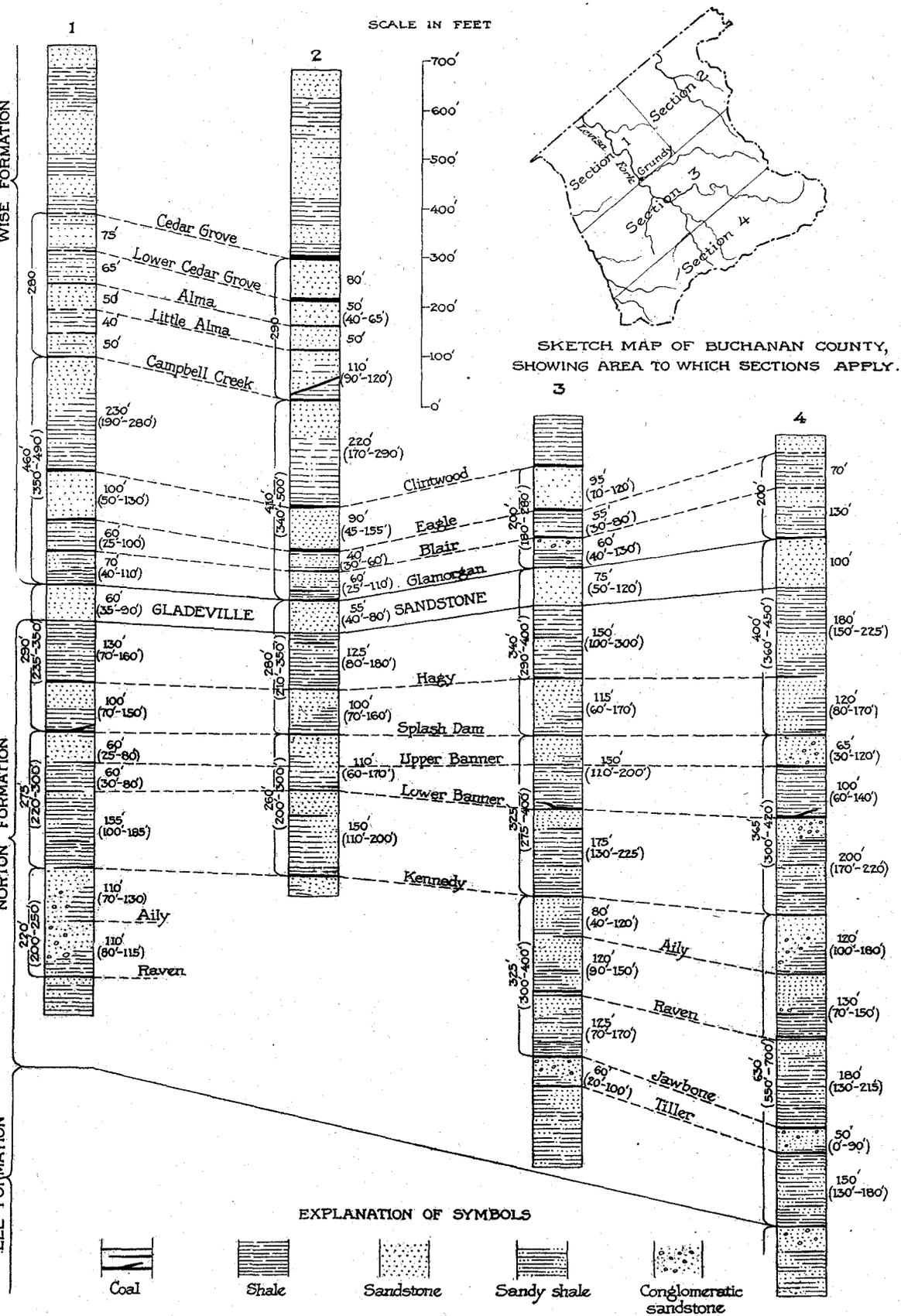
GEOLOGIC FORMATIONS.

Lee formation:	Thickness.		Depth.	
	Ft.	in.	Ft.	in.
Shale, dark .....	3		752	
Shale, blue .....	13		765	
Shale, dark, sandy .....	80		845	
Shale, dark .....	12		857	
Coal .....	2 ft. 6 in.			
Slate .....	0 " 1 "			
Coal .....	0 " 6 "			
Bone and slate, 0 " 6 "				
Coal .....	2 " 8 "	(War Creek) .....	10	6
Slate .....	0 " 4 "			
Bone and coal, 2 " 10 "				
Coal .....	1 " 1 "			
Fireclay .....	3			
Shale, dark .....	3	6	874	
Shale, light, sandy .....	3		877	
Sandstone .....	38		915	
Shale, light, sandy .....	30		945	
Shale, black .....	1		946	
Coal (Lower Horsepen) .....		3	946	3
Fireclay .....	1	6	947	9
Shale, light .....	3		950	9
Sandstone, very hard .....	30		980	9
Sandstone, with shale partings .....	5		985	9
Sandstone .....	47	3	1,033	
Coal .....	0 ft. 7 in.			
Shale, dark ... 0 " 3 "				
Coal .....	0 " 4 "			
Shale, dark .....		10	1,035	
Shale, light, sandy .....	3		1,038	
Sandstone .....	22		1,060	
Shale, dark .....	1	4	1,061	4
Coal (No. 9 Pocahontas) .....		8	1,062	
Fireclay .....	1		1,063	
Shale, light, sandy .....	2		1,065	
Sandstone .....	18		1,083	
Shale, light .....	4		1,087	
Shale, with coal partings .....		6	1,087	6
Shale, light .....	1		1,088	6
Shale, dark .....		6	1,089	
Bone .....		1	1,089	1
Shale, dark .....		11	1,090	
Coal .....	0 ft. 2 in.			
Shale, dark ... 0 " 4 "				
Coal .....	0 " 2 "			
Shale, dark .....		2	1,090	10
Shale, light, sandy .....	3	2	1,094	
Sandstone, with shale partings .....	14	6	1,108	6
Shale, dark .....	3	6	1,112	
Coal (No. 8 Pocahontas) .....		8	1,112	8
Fireclay .....		6	1,113	2
Shale, light, sandy .....	11	10	1,125	
Sandstone, gray .....	56		1,181	
Shale, dark .....	2		1,183	
Sandstone and shale .....	3		1,186	
Shale, sandy .....	6	6	1,192	6
Shale, blue .....	8		1,200	6

Lee formation:	Thickness.		Depth.	
	Ft.	in.	Ft.	in.
Shale, dark .....		6	1,201	
Coal (No. 7 Pocahontas) .....	1		1,202	
Fireclay .....		6	1,202	6
Shale, blue .....	12	6	1,215	
Sandstone, gray .....	30		1,245	
Shale, dark .....	49		1,294	
Coal (No. 6 Pocahontas) .....	1		1,295	
Shale, dark .....		2	1,295	2
Fireclay .....	4		1,299	2
Shale, light, sandy .....	1	8	1,300	10
Shale, dark .....	4		1,304	10
Fireclay .....	3		1,307	10
Shale, sandy .....	4	6	1,312	4
Sandstone, gray .....	13		1,325	4
Shale, blue, sandy .....	9		1,334	4
Coal (No. 5 Pocahontas) .....	1	2	1,335	6
Shale, light .....	1	6	1,337	
Sandstone, gray .....	6	6	1,343	6
Shale, sandy .....	6	6	1,350	
Shale, gray, sandy .....	9		1,359	
Shale, dark .....	2		1,361	
Bone .....		2	1,361	2
Coal .....		10	1,362	
Fireclay .....	1		1,363	
Shale, dark .....	8	6	1,371	6
Coal (No. 4 Pocahontas) .....		4	1,371	10
Shale, dark .....	1	2	1,373	
Sandstone, with shale partings .....	5		1,378	
Shale, with sandstone partings .....	12		1,390	
Shale, blue .....	8		1,398	
Shale, dark .....	4		1,402	
Coal .....		4	1,402	4
Fireclay .....	1	8	1,404	
Sandstone .....	60		1,464	
Coal .. 1 ft. 0 in. } (No. 3 Pocahontas)				
Shale .. 0 " 1 " }				
Coal .. 0 " 11 " }	2		1,466	
Bone .....		3	1,466	3
Fireclay .....	2		1,468	3
Shale, sandy .....	16		1,484	3
Sandstone .....	15	9	1,500	

## NORTON FORMATION.

The surface rocks of the greater part of Buchanan County belong to the Norton formation, parts of which are exposed in every deep valley. The thickness of the Norton ranges from 825 feet in the northwestern corner of the county and about 900 feet along Tug Fork to about 1,300 feet on Sandy Ridge near Big A Mountain. The thickness increases more or less uniformly in a direction slightly east of south, chiefly because nearly all of the constituent beds thicken in that direction. A few beds found in the



Generalized columnar sections of the Pennsylvanian rocks exposed in Buchanan County. (Numbers in parentheses show, in feet, the maximum and minimum intervals between the principal coals; other numbers show the most common intervals.)

southern part of the county are absent from the northern border, and most of those below the Jawbone horizon are lacking in exposures in The Breaks, near the northwestern corner.

The formation consists chiefly of beds of sandstone, shale, and coal having the characteristics described as common to all Pennsylvanian strata. Layers of clay are associated with some of the coals and small limestone nodules were found a short distance above the Kennedy horizon on Grassy Creek and on Knox Creek near Kelsa. The most important deposits are the coals, which will be fully described in the part of this report devoted to coal resources. The stratigraphic succession, including the position of all coal beds, is shown in the generalized sections (Pl. II). The characteristics of exposed beds in many places are shown in the local sections (pp. 23-53). The intervals between coal beds and the most significant stratigraphic features in each drainage basin are described in the detailed descriptions of coal resources. Only a few facts of a more or less general nature will be mentioned here.

The most easily identified horizon, considering the county as a whole, is that of the Kennedy coal, near the middle of the Norton formation. As this bed is underlain everywhere by coarse sandstone that forms ledges and cliffs, and is overlain everywhere except near Tug Fork by a thick series of shales and thin-bedded, fine-grained sandstones that forms comparatively gentle slopes, its position can be easily found. The Kennedy horizon has been used, therefore, as the dividing line between two divisions of the Norton on the county geologic map accompanying this report, thus bringing out certain geologic features more clearly than if the formation were mapped as only one unit. The usefulness of the Kennedy as a specially emphasized stratigraphic horizon is increased by the fact that it outcrops for long distances only a few hundred feet above many of the principal streams.

In most of the Dismal Creek basin the sandstone underlying the Kennedy is very coarse, is about 100 feet thick, and contains many quartz pebbles near its base. The bed is only a short distance above the Aily bottom-rock, another coarse sandstone of equal thickness and also conglomeratic at base, so that the two together make very conspicuous cliffs and ledges. The sandstone underlying the Raven coal is only a short distance below the two just mentioned. Practically the same conditions prevail in the northwestern corner of the county, where the first two sandstones below the Kennedy are joined together to form a gray, quartzose, conglomeratic sandstone about 170 feet thick. This rock forms part of

the canyon through which the wagon road passes near Jane and also forms cliffs under the road between Grassy Creek and Elkhorn City, Ky. It makes the upper cliff in The Breaks (see Pl. III).

Several other sandstones in the lower part of the Norton make conspicuous cliffs and ledges in a large part of the region. The lowest of these is a gray, quartzose, locally conglomeratic sandstone that separates the Tiller and Jawbone coals and is conspicuous mainly along Russell Fork near Council, in parts of the Indian Creek basin, and near the junction of Dismal Creek and Levisa Fork. The sandstones a few feet below the Raven and Aily coals have already been mentioned. The one below the Raven is not a particularly good marker and the one below the Aily is not so thick or coarse in other parts of the county as in the Dismal Creek and upper Levisa Fork basins.

The most persistent sandstones in the upper part of the Norton are those a few feet below the Lower Banner, Splash Dam, and Haggy coal beds. The Lower Banner bottom-rock is thick and coarse in the southeastern part of the county and near Tug Fork, but is very thin near Grundy and farther northwest, and is only moderately thick in the Knox Creek basin. On Tug Fork this bed forms great cliffs along the railroad. It also outcrops conspicuously on parts of Sandy Ridge, and especially near Bearwallow Knob, where it contains many quartz pebbles. The Splash Dam bottom-rock is conglomeratic near Bearwallow Knob, which it caps. Both the Splash Dam and Haggy bottom-rocks make fairly conspicuous cliffs and ledges in many areas.

The top of the Norton everywhere is a drab to yellow shale that is commonly about 100 feet thick and is not very sandy. Most other shales are sandy and grade in part into shaly sandstones. The thickest series of shales and shaly sandstones are those just above the Kennedy coal and above the Jawbone coal or its sandstone cap. The shales and shaly sandstones are rarely well exposed and form long slopes between ledges of the massive sandstones.

#### GLADEVILLE SANDSTONE.

The Gladeville is commonly 50 to 100 feet thick, is brownish-red, and contains considerable mica and other minerals in addition to the more common quartz grains. It differs very little from several other Pennsylvanian beds and is not, therefore, shown separately on the county geologic map. In southern Dickenson County and in Wise County it is a very useful stratigraphic marker for field use, but in Buchanan, especially in northern areas, it does not outcrop conspicuously and is not easy to identify.

## WISE FORMATION.

The lower part of the Wise formation, 1,080 feet thick, is exposed in Buchanan County and has the same character as the Norton formation. The stratigraphic succession and other features are shown in the generalized sections (Pl. II), the local sections (pp. 23-53), and in the descriptions of coal resources. Except near Kentucky the Wise of Buchanan County is confined to the upper parts of the ridges, and is only in small patches in the southeastern half of the region. Several hundred feet of the highest strata are present only on a high knob near the head of Rocklick Creek, and all of the beds above the Campbell Creek coal are poorly exposed in most districts.

The lower 200 feet of the formation includes much sandstone, interbedded with shale and several coal beds near the base. The lowest sandstone is thick and conglomeratic between Slate and Dismal creeks, but is much less prominent elsewhere. The sandstone between the Eagle and Clintwood coals is a gray, compact, cliff-maker, and the presence of nearly 200 feet of easily eroded shales above it makes it the most easily identified bed in the formation and the only one that can be used with safety as a stratigraphic marker. From a short distance below the Campbell Creek coal to the highest beds present the strata are thick, loosely cemented sandstones, interbedded with thin shales and several coal beds. A few compact sandstones form moderately conspicuous ledges in some districts, but grade laterally into more easily eroded rocks.

The only limestones seen in the formation were thin ferruginous lenses 65 feet above the Clintwood coal in the Big Rock district, probably at the horizon which has been named Cannelton (Stockton) limestone by the West Virginia Geological Survey.

## QUATERNARY SYSTEM.

## Recent series.

## ALLUVIUM.

Every stream flows through unconsolidated sands, silts, and gravels which have been transported to their present more or less temporary position by the action of running water. These deposits are all thin and are only 100 to 500 feet wide along most parts of even the large rivers. Along the smaller streams they are represented only by a few feet of coarse

material over which the stream flows. There are exceptionally wide bottom lands of alluvium along Hunts Creek and Middle Fork near Jane.

The alluvium is highly siliceous, being composed largely of sand. Most of it is coarse and porous and contains much gravel. The bed of nearly every stream is filled with sandstone pebbles, sub-angular blocks, and rounded bowlders of medium size (Pl. IV). Where the stream gradient is comparatively low some alluvium along the larger streams contains more clayey material and is a fertile, sandy loam.

#### SOIL.

All slopes are covered in greater part by a sandy loam derived from the disintegration and weathering of outcropping ledges. Since only the heavier materials remain on the slopes the resulting soil is commonly very sandy and contains many fragments of undecomposed sandstone. Most of the soil is several feet thick and much of it is as much as 15 feet thick. It is slowly carried down the slopes and finally washed into the streams, its place being taken by fresh products of disintegration.

#### Correlations with adjoining areas.

The correlation of the Campbell Creek and lower Pennsylvanian coal beds of Buchanan County with those of the Bristol quadrangle, Virginia, and the Pound quadrangle, Virginia-Kentucky, has been discussed in a previous report by the writer.<sup>1</sup> The Pennsylvanian formations and the principal Norton coal beds of the Coeburn and Dante mining districts have been traced through Dickenson and Russell counties to Buchanan County, and it is proposed to use in all parts of the State the old names so well known to Virginia coal miners. One exception is the so-called Imboden coal of eastern Wise County, which lies between the Jawbone and the Kennedy coals and is not the true Imboden of the Big Stone Gap field. The writer renamed this bed the Garden Hole in a former report, but now recommends that it be called the Raven, as recent work has established its equivalence with the well-known Raven of western Tazewell County, Aily, Big Fork, Splash Dam, and Hagy are new names for coals which have no well-known equivalents in Virginia mining districts, although the Hagy may be the Edwards of eastern Wise County.

Strata in the lower 200 feet of the Wise formation have been traced from northern Wise County across Dickenson to Buchanan County, and

<sup>1</sup> Hinds, Henry, The coal resources of the Clintwood and Bucu quadrangles, Va.: Virginia Geol. Survey Bull. XII, pp. 15-16, 1916.

the names Glamorgan, Blair, and Clintwood, given to lower Wise coals by Charles Butts,<sup>1</sup> are used in this report. The principal coal between the Blair and Clintwood, having been given no name by Butts, is here called the Eagle on the strength of correlations made by the West Virginia Geological Survey. Beds above the Clintwood in Buchanan County can not be safely correlated with those in northern Wise County, as they are absent from most of Dickenson and Russell counties, so that the names given them in this report are those used in West Virginia.

The correlation of the formations and coals of Buchanan County with those recently described in Mingo and McDowell counties by the West Virginia Geological Survey<sup>2</sup> is shown in figure 2 and is also mentioned in the general description of coal beds on succeeding pages of this report. Some local names not shown in figure 2 are in common use in some West Virginia mining districts; for example, the Hagy is the Lower War Eagle, the Eagle is the Middle War Eagle and Mohawk, the Campbell Creek is the Upper War Eagle, Freeburn, Burnwell, and Warfield, the Lower Cedar Grove is the Lower Thacker, and the Cedar Grove is the Thacker, Upper Thacker, and Red Jacket.

The correlation of Buchanan County coals with those described by Stone in the Russell Fork basin of Kentucky<sup>3</sup> is also shown in figure 2. The massive, cliff-making sandstone upon which Elkhorn City is built and which was called the top of the Lee formation by Stone, is now known, through the recent detailed geologic surveys in Virginia, to be just below the Kennedy coal of the Norton formation. Some geologists have correlated this sandstone with the Dotson sandstone that makes very similar cliffs on Tug Fork near War Eagle, but the top of the Dotson is just below the Lower Banner coal and is certainly stratigraphically higher than the Kennedy horizon. The Upper Elkhorn bed of Stone is the thick coal mined at Jenkins, Ky., and the upper of the two beds mined on Marrowbone Creek; it may be the Alma of Buchanan County, but can not be correlated with certainty until additional work has been done in Pike County.

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<sup>1</sup>Butts, Charles, The coal resources and general geology of the Pound quadrangle in Virginia: Va. Geol. Survey Bull. IX, 1914, and The coal resources and general geology of the Pound quadrangle in Virginia and Kentucky: U. S. Geol. Survey Bull. 541, 1914.

<sup>2</sup>Hennen, R. V., and Reger, D. B., Logan and Mingo counties: West Va. Geol. Survey, 1914. Hennen, R. V., Wyoming and McDowell counties: idem, 1915.

<sup>3</sup>Stone, R. W., Coal resources of the Russell Fork basin in Kentucky and Virginia: U. S. Geol. Survey Bull. 348, 1908.



Correlations with Campbell's section in the Tazewell folio<sup>1</sup> are rather difficult because the great disadvantages under which that early geologic work was conducted caused inevitable errors in mapping. The sandstone he mapped as Raleigh along Dismal Creek, upper Levisa Fork, and Garden Creek is the bottom-rock of the Jawbone coal and is higher than the bed mapped as Raleigh in the eastern part of the Tazewell quadrangle. His Dismal conglomerate lentil is the coarse bottom-rock of the Kennedy coal. At its type locality on Bearwallow Knob the Bearwallow conglomerate is the sandstone a few feet below the Lower Banner coal and the Dotson sandstone includes the beds between it and the Splash Dam coal. The Dotson, however, is the sandstone whose top lies about 10 feet below the Lower Banner coal horizon at its type locality at Wyoming (formerly Dotson) on Tug Fork, and the Bearwallow is mapped as a lower rock. The highest bed in the Sequoyah formation is the sandstone between the Clintwood and Eagle coals, all higher beds falling in the Tellowa formation.

#### Local sections.

The following sections are inserted without comment, as it is believed that they are self-explanatory. They have been chosen from among several hundred chiefly because they show an exceptional number of exposed beds and were made where dips are low. These local sections should be used with caution, as parts of every one of them are poorly exposed and the elevations upon which the intervals are based are chiefly barometric readings subject to error. Corrections that should be made in thicknesses of beds because of dip are indicated at the top of each section; in the column showing intervals between coals the necessary correction for dip has already been made. Some thin and poorly exposed beds, such as many "underclays" and "roof-shales" of coal beds, are not mentioned. Shale and other partings in coal beds are not given and the thicknesses of most coals are only to the nearest foot, exact descriptions being reserved for the detailed treatment by drainage basins.

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<sup>1</sup> Campbell, M. R., U. S. Geol. Survey, Geol. Atlas, Tazewell folio (No. 44), 1897.

## LOCAL SECTION 1.

*From Lambert Fork of Indian Creek, one-half mile northeast of mouth, up spur to northwest.*

	Thickness.	Interval.
	Feet.	Feet.
Norton formation:		
Sandstone, medium-grained to coarse and massive, lower part not well exposed.....	60	
Concealed, probably shale .....	40	
Sandstone, not well exposed .....	15	
Shale .....	15	
Sandstone, coarse at top, medium-grained below, forms conspicuous cliff .....	25	155
Coal .....	..	
Shale .....	20	20
Coal (Raven, elevation 2,025) .....	..	
Concealed .....	10	
Sandstone, coarse and very massive, forms cliff...	55	
Concealed, shaly at top .....	70	135
Coal (Jawbone, elevation 1,890).....	..	
Sandstone, medium-grained .....	20	
Concealed, partly sandstone .....	70	90
Coal (Tiller, elevation 1,800).....	..	
Concealed .....	30	
Sandstone, medium-grained to very coarse, bears a few pebbles, not well exposed at top.....	65	
Concealed, some sandstone in middle part.....	60	
Lee formation:		
Sandstone, compact, resistant, very coarse.....	45	200
	600	600

## LOCAL SECTION 2.

*From Council north along road to top of ridge.*

	Thickness.	Interval.
	Feet.	Feet.
Norton formation:		
(Splash Dam coal horizon, elevation 2,520)....	..	
Sandstone, reddish-brown, coarse, granular.....	25	
Shale, sandy shale, and some sandstone, poorly ex- posed .....	115	
Shale, good exposure .....	40	180
(Lower Banner coal horizon, elevation 2,340)..	..	
Sandstone, mostly coarse and granular, forms ledge .....	40	
Shale, in part sandy .....	40	
Sandstone, fairly coarse, forms ledge.....	8	
Shale .....	20	
Sandstone, fairly coarse .....	5	
Shale, with some sandstone near top, not well ex- posed .....	80	
Coal pit (Kennedy, location 33, elevation 2,142) .....	5	198
Clay and shale .....	10	

LOCAL SECTIONS.

Norton formation:	Thickness. Feet.	Interval. Feet.
Sandstone, coarse, resistant, forms conspicuous ledge .....	20	
Shale, chiefly, not well exposed .....	72	102
Coal bloom (elevation 2,040) .....	..	
Shale .....	5	
Sandstone, fairly coarse, shaly at top .....	25	30
Coal bloom (elevation 2,010) .....	..	
Shale .....	8	
Sandstone, not conspicuous .....	25	
Shale .....	37	75
Coal bloom, thin (Raven, elevation 1,940) .....	..	
Sandstone, fairly coarse, resistant .....	30	
Shale, well exposed in upper part .....	140	170
(Jawbone coal horizon, elevation 1,770) .....	..	
Sandstone, coarse, weathers granular, a few small pebbles at base .....	49	
Shale .....	5	54
Coal bloom (Tiller, elevation 1,716) .....	..	
Sandstone, coarse, very compact .....	30	
Concealed, probably sandstone .....	15	
Shale, bluish .....	25	70
	874	874

LOCAL SECTION 3.

*From Hurricane Creek, at mouth of Rockhouse Branch, up spur to northeast.*

Norton formation:	Thickness. Feet.	Interval. Feet.
Sandstone, medium-grained, weathers soft .....	15	
Shale .....	15	
Sandstone, coarse, weathers soft and granular .....	20	
Shale, with thin, fine-grained sandstone in upper part .....	110	160
(Lower Banner coal horizon, elevation 2,110) .....	..	
Sandstone, coarse, massive .....	35	
Shale .....	70	
Sandstone, fairly coarse .....	10	
Shale .....	65	180
(Kennedy coal horizon, elevation 1,930) .....	..	
Sandstone, mostly coarse, weathers soft at top, lower 50 feet forms cliff .....	86	
Shale, mostly drab .....	42	
Shale, mostly sandy, with some fine-grained sandstone .....	92	
Sandstone, fairly coarse .....	5	
Shale, not well exposed .....	10	235
(Raven coal horizon, elevation 1,695) .....	..	
Sandstone, fairly coarse and massive at top, medium-grained, thin-bedded and cross-bedded below .....	75	75
	650	650

## LOCAL SECTION 4.

*From Fox Creek, one mile east of the mouth of Left Fork, up spur to northwest.*

	Thickness. Feet.	Interval. Feet.
Wise formation:		
Shale .....	30	30
(Glamorgan coal horizon, elevation 2,100).....	..	..
Gladeville sandstone:		
Sandstone, coarse-grained, weathers reddish-brown and granular, forms conspicuous cliff.....	75	75
Norton formation:		
Shale, grayish-yellow to drab .....	80	
Sandstone, fine-grained at top to fairly coarse below .....	30	
Concealed, probably sandstone .....	10	
Shale .....	20	215
(Hagy coal horizon, elevation 1,885).....	..	..
Sandstone, medium-grained to fairly coarse.....	30	
Concealed .....	15	
Sandstone, fine-grained, shaly .....	20	
Shale, mostly sandy .....	55	120
(Splash Dam coal horizon, elevation 1,765)....	..	..
Sandstone, medium-grained to coarse, lower part compact and forms conspicuous cliff.....	70	70
(Upper Banner coal horizon, elevation 1,695)....	..	..
Sandstone, fine-grained, shaly .....	30	
Sandstone, medium-grained to fairly coarse.....	20	
Concealed, probably mostly shale .....	25	75
(Lower Banner coal horizon, elevation 1,620)....	..	..
Sandstone, medium-grained .....	20	
Concealed .....	25	
Sandstone, fine-grained, shaly .....	25	70
	580	580

## LOCAL SECTION 5.

*From Russell Fork, at mouth of Fox Creek, up spur to southeast.*

	Thickness. Feet.	Interval. Feet.
Norton formation:		
Shale .....	25	25
(Splash Dam coal horizon, elevation 1,795).....	..	..
Sandstone, coarse, cliff-forming, not well exposed in upper part .....	80	80
(Upper Banner coal horizon, elevation 1,715)....	..	..
Shale, mostly bluish, good exposure .....	75	75
(Lower Banner coal horizon, elevation 1,640)....	..	..
Sandstone, very coarse and massive.....	30	
Shale, very sandy, and shaly sandstone .....	125	
Sandstone, medium-grained .....	25	
Concealed .....	10	190
(Kennedy coal horizon, elevation 1,450).....	..	..
Sandstone, medium-grained to fairly coarse.....	30	
Sandstone, fine-grained and in part shaly.....	70	
Sandstone, medium-grained .....	15	115
	485	485

## LOCAL SECTION 6.

*Northeast from Russell Prater Creek, at location 77, to high knob northwest of Poplar Creek gap.*

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
Sandstone, white, compact, weathers orange-red, coarse-grained .....	10	
Shale, sandy at top, and with thin, medium-grained sandstone .....	170	180
(Clintwood coal horizon, elevation 2,140) .....		
Sandstone, coarse, arkosic, weathers granular, massive .....	90	
Concealed .....	15	105
Coal (Eagle, elevation 2,035) .....		
Interval, chiefly shale .....	130	130
(Glamorgan coal horizon, elevation 1,905) .....		
Gladeville sandstone:		
Sandstone, buff, medium-grained to coarse, forms cliff, not well exposed near base .....	60	
Norton formation:		
Concealed .....	30	
Shale, sandy in part .....	122	
Coal (Hagy, location 77, elevation 1,690) .....	3	215
	630	630

## LOCAL SECTION 7.

*From Russell Prater Creek, about one mile southwest of Prater, north to top of ridge.*

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
Shale .....	50	50
(Clintwood coal horizon, elevation 2,060) .....		
Sandstone, buff, mostly coarse, massive, forms cliffs .....	95	95
(Eagle coal horizon, elevation 1,965) .....		
Shale and a few thin sandstones, not well exposed ..	165	165
(Glamorgan coal horizon, elevation 1,800) .....		
Gladeville sandstone:		
Sandstone, medium-grained to coarse .....	60	
Norton formation:		
Shale .....	60	
Sandstone, medium-grained, resistant in part .....	50	
Shale .....	30	200
(Hagy coal horizon, elevation 1,600) .....		
Sandstone, medium-grained, coarse at base .....	50	
Concealed .....	50	
Shale .....	10	
Sandstone, medium-grained .....	10	120
(Splash Dam coal horizon, elevation 1,480) .....		
Shale .....	10	
Sandstone, medium-grained .....	10	20
	650	650

## LOCAL SECTION 8.

*From location 83 east along road to head of Hunts Creek. Lower part of section 50 feet too short because of dip.*

	Thickness. Feet.	Corrected Interval. Feet.
Wise formation:		
Sandstone, weathers white, coarse, compact, exposed both above and below gap.....	70	
Sandstone, buff, massive at top, shaly below..... (Campbell Creek coal horizon (?), elevation 2,060) .....	35	105
Sandstone, coarse to fine-grained, thin-bedded....	70	
Shale, in part sandy, includes thin sandstone layers .....	120	190
(Clintwood coal horizon, elevation 1,870).....	..	
Sandstone, light-buff, very coarse, massive cliff-maker .....	90	100
(Eagle coal horizon, elevation 1,780).....	..	
Sandstone chiefly, some shale near middle and at base .....	90	
Coal (Glamorgan, location 97, elevation 1,685) ..	5	115
Gladeville sandstone:		
Sandstone, brown, in strong ledges.....	85	
Norton formation:		
Shale and some shaly sandstone .....	65	
Sandstone, fine-grained, shaly at base.....	15	
Shale, drab .....	12	
Coal (Hagy, location 83, elevation 1,505).....	3	200
	660	710

## LOCAL SECTION 9.

*From location 70 on Abes Fork of Grassy Creek northeast nearly along State boundary.*

	Thickness. Feet.	Interval. Feet.
Wise formation:		
Shale or shaly sandstone..... (Campbell Creek coal horizon (?), elevation 1,840) .....	30	30
Sandstone, light-brown, coarse, weathers granular, bench-maker .....	40	
Shale and shaly sandstone .....	150	190
(Clintwood coal horizon, elevation 1,650).....	..	
Sandstone, brownish, coarse, compact, cliff-maker.	45	
Sandstone, medium-grained, shaly at top.....	35	80
(Eagle coal horizon, elevation 1,570).....	..	
Shale .....	40	40
(Blair coal horizon (?), elevation 1,530).....	..	
Sandstone, medium-grained, probably includes shale in middle .....	50	
Shale .....	20	70
(Glamorgan coal horizon, elevation 1,460).....	..	

LOCAL SECTIONS.

	Thickness.	Interval.
	Feet.	Feet.
Gladeville sandstone:		
Sandstone, brown, coarse, in small ledges.....	50	
Norton formation:		
Shale, poorly exposed .....	90	140
(Hagy coal horizon, opposite location 89, elevation 1,320) .....	..	
Sandstone, moderately coarse, in small ledges....	60	
Concealed, chiefly shale .....	48	
Coal (Splash Dam, location 70, elevation 1,210) ...	2	110
	660	660

LOCAL SECTION 10.

*From Conoway School west up Conoway Creek one-fourth mile, thence south to head of branch. Lower part of section 50 feet too long because of dip.*

	Thickness.	Corrected Interval.
	Feet.	Feet.
Wise formation:		
Sandstone, brown to white, coarse, weathers granular .....	100	100
Coal (Campbell Creek, elevation 1,995) .....	..	
Sandstone, moderately coarse, weathers granular..	100	
Shale, drab, in part sandy .....	115	
Shale, yellow .....	30	245
(Clintwood coal horizon, elevation 1,755) .....	..	
Sandstone, coarse, compact, strong ledge-maker ...	50	
Shale, drab, sandy .....	10	
Coal (Eagle, location 225, elevation 1,690) .....	5	65
Sandstone, medium-grained, not resistant.....	40	
Shale and weak sandstone ledges.....	110	150
(Glamorgan coal horizon, elevation 1,540) .....	..	
Gladeville sandstone:		
Sandstone, brown, coarse at base, strong ledge-maker .....	60	
Norton formation:		
Shale, well exposed .....	80	
Sandstone, poorly exposed .....	20	
Shale, poorly exposed .....	10	170
(Hagy coal horizon, elevation 1,370) .....	..	
Sandstone, in weak ledges .....	40	
Shale, sandy .....	35	
Sandstone, fine-grained, not conspicuous .....	10	
Shale, light-drab, sandy .....	5	90
Coal (Splash Dam, elevation 1,280) .....	..	
Shale .....	10	
Sandstone, coarse, massive .....	40	
Shale and weak ledges of shaly sandstone.....	230	230
(Kennedy coal horizon, elevation 1,000) .....	..	
	1,100	1,050

## LOCAL SECTION 11.

*From Poplar Creek up Duty Branch to last house, thence south to top of ridge. Section 15 feet too short because of dip.*

	Thickness.	Corrected
	Feet.	Interval.
		Feet.
Wise formation:		
Sandstone .....	13	
Shale .....	3	
Coal (Eagle, location 227, elevation 1,980).....	4	20
Sandstone, coarse at top, poorly exposed below....	43	
Shale, chiefly .....	10	
Coal (Blair, location 221, elevation 1,920).....	7	60
Concealed .....	57	
Coal reported (Glamorgan, elevation 1,860)....	3	60
Gladeville sandstone:		
Probably all sandstone, not exposed at top.....	100	
Norton formation:		
Concealed, probably chiefly shale .....	130	230
Coal (Hagy, elevation 1,630) .....	..	
Sandstone, coarse, massive .....	50	
Concealed, probably chiefly shale .....	53	
Coal (Splash Dam, location 198, elevation 1,520) .....	7	115
Sandstone .....	34	
Coal (Upper Banner, under location 199, elevation 1,485) .....	1	40
Concealed, probably shale .....	65	65
Coal reported (Lower Banner, elevation 1,420) ..	..	
Concealed, probably shale and fine-grained sandstone .....	135	140
Coal reported (Kennedy, elevation 1,285).....	..	
Concealed, probably shale .....	15	
Sandstone, coarse, strong ledge-maker .....	40	55
	770	785

## LOCAL SECTION 12.

*From Levisa Fork, 2,000 feet south of mouth of Looney Creek, up hollows to west and north.*

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
Shale and fine-grained sandstone.....	57	
Coal (Blair, location 162, elevation 1,810).....	3	60
Shale and sandstone, poorly exposed.....	50	50
(Glamorgan coal horizon, elevation 1,760).....	..	
Gladeville sandstone:		
Sandstone, coarse, weathers granular, forms cliff at base .....	90	
Norton formation:		
Shale, chiefly, poorly exposed .....	80	
Coal (Hagy upper bench) .....	..	
Shale .....	20	190

LOCAL SECTIONS.

	Thickness. Feet.	Interval. Feet.
Norton formation:		
Coal (Hagy lower bench, elevation 1,570).....	..	
Sandstone, coarse, massive, forms cliffs.....	70	
Shale .....	36	
Coal (Splash Dam, location 136, elevation 1,460) .....	4	110
Shale, grading into fine-grained sandstone at top..	19	
Coal (Splash Dam split).....	1	20
Sandstone, coarse, massive .....	45	45
Coal in two 4-inch benches (Upper Banner, elevation 1,395) .....	..	
Shale .....	34	
Coal (Lower Banner, elevation 1,360).....	1	35
Concealed, probably shale and thin-bedded sandstone .....	165	165
Coal (Kennedy, elevation 1,195).....	..	
Sandstone, coarse, massive, cliff-maker .....	50	
Concealed above, shale below .....	55	105
(Aily coal horizon, elevation 1,090).....	..	
Shale, chiefly, blue .....	50	50
(Raven coal horizon, elevation 1,040).....	..	
Sandstone, medium-grained, compact .....	55	55
	885	885

LOCAL SECTION 13.

*From mouth of Big Lick Branch of Trace Fork of Prater Creek northwest along road to gap, thence up spur to north. Section 50 feet too short because of dip.*

	Thickness. Feet.	Corrected Interval. Feet.
Wise formation:		
Shale .....	20	20
(Clintwood coal horizon, elevation 2,250).....	..	
Sandstone, coarse, massive, white in lower part...	60	
Concealed .....	20	80
(Approximate position of Eagle coal, elevation 2,170) .....	..	
Concealed .....	30	
Shale .....	40	
Sandstone, not well exposed .....	10	
Interval, chiefly shale .....	70	150
(Glamorgan coal horizon, elevation 2,020).....	..	
Gladeville sandstone:		
Sandstone, mostly coarse, not well exposed.....	65	
Norton formation:		
Concealed .....	25	
Shale, mostly sandy, and thin sandstone.....	115	
Sandstone, fine-grained .....	25	
Shale .....	40	
Sandstone, coarse in part, micaceous.....	18	
Coal (Splash Dam, location 321, elevation 1,730) .....	2	335

	Thickness.	Corrected
	Feet.	Interval.
		Feet.
Norton formation:		
Concealed, some sandstone in upper part.....	30	
Sandstone, not well exposed at top .....	20	
Concealed .....	85	
Shale, mostly sandy, with some thin, fine-grained sandstones .....	135	
Sandstone, fine-grained, thin-bedded .....	10	280
(Kennedy coal horizon, elevation 1,450).....		
Sandstone, not well exposed .....	65	
Concealed .....	50	
Sandstone, fine-grained to coarse.....	40	
Shale, sandy, and fine-grained, thin-bedded sandstone .....	38	
Coal (Raven, location 299, elevation 1,255)....	2	202
	1,015	1,065

## LOCAL SECTION 14.

*South on road along upper part of Trace Fork of Prater Creek, from one mile southwest of Leemaster to gap, thence up spur to west.*

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
Sandstone, coarse, massive, weathers soft and granular .....	40	
Shale, sandy in part, with thin sandstone bed near middle .....	65	105
(Glamorgan coal horizon, elevation 2,135).....		
Gladeville sandstone:		
Sandstone, uniformly coarse and very massive, top weathers round and smooth .....	60	
Norton formation:		
Shale, top not well exposed, sandy at base.....	100	
Concealed .....	20	
Sandstone, coarse, forms ledge .....	20	
Shale, sandy at top, drab to blue at base.....	30	
Coal (Hagy, location 326, elevation 1,911).....	3	233
Concealed, probably shale .....	10	
Sandstone, medium-grained, massive .....	15	
Shale, sandy .....	35	60
	398	398

LOCAL SECTION 15.

*From coal opening 100 yards southwest of location 301, on Crooked Branch of Prater Creek, one-fourth mile southeast along road, thence up spur to northeast.*

	Thickness.	Interval.
	Feet.	Feet.
Norton formation:		
(Splash Dam coal horizon, elevation 2,225) . . . . .	..	
Sandstone, coarse to medium-grained, very massive in upper part, forms conspicuous cliffs . . . . .	60	60
(Upper Banner coal horizon, elevation 2,165) . . . . .	..	
Shale, in part sandy . . . . .	155	
Sandstone, fine-grained . . . . .	10	
Shale . . . . .	53	
Sandstone, medium-grained, resistant . . . . .	15	
Shale, mostly sandy . . . . .	76	309
Coal bloom (Kennedy, elevation 1,856) . . . . .	..	
Sandstone, medium-grained to coarse, mostly compact, but weathers granular in parts, lower part most conspicuous . . . . .	55	
Shale . . . . .	52	
Sandstone, medium-grained, compact . . . . .	15	
Shale, sandy . . . . .	15	
Coal (location 301, elevation 1,717) . . . . .	2	139
Shale, sandy . . . . .	60	
Coal (Raven, elevation 1,665) . . . . .	2	62
	570	570

LOCAL SECTION 16.

*From location 346 on Youngs Branch of Garden Creek northwest along path to gap, thence south along ridge.*

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
Shale . . . . .	80	80
Coal bloom (Glamorgan, elevation 2,490) . . . . .	..	
Gladeville sandstone:		
Sandstone, coarse, weathers reddish-brown and granular, massive, not well exposed in lower part . . . . .	90	
Norton formation:		
Shale . . . . .	50	
Concealed, probably mostly shale . . . . .	70	
Sandstone, fairly coarse, weathers granular, upper part not well exposed . . . . .	80	
Shale . . . . .	40	
Sandstone, coarse, resistant, forms ledge . . . . .	25	
Shale, not exposed at base . . . . .	55	410
(Splash Dam coal horizon, elevation 2,080) . . . . .	..	
Sandstone, coarse, forms ledge . . . . .	20	
Concealed, probably mostly sandy shale and fine- grained sandstone, includes Lower Banner coal horizon in lower part . . . . .	180	

	Thickness. Feet.	Interval. Feet.
Norton formation:		
Shale, sandy, and thin, fine-grained, shaly sandstones .....	135	
Coal (Kennedy, location 346, elevation 1,740) ..	5	340
Sandstone, coarse, massive, compact .....	65	65
	<hr/>	<hr/>
	895	895

## LOCAL SECTION 17.

*South on road along upper part of Whitt Fork of Garden Creek to gap, thence northwest along path to top of ridge. Lower part of section 70 feet too long and upper part 20 feet too short because of dip.*

	Thickness. Feet.	Corrected Interval. Feet.
Norton formation:		
Sandstone, coarse .....	10	
Concealed, probably mostly shale .....	40	50
(Hagy coal horizon, elevation 2,725) .....	..	
Sandstone, coarse, massive .....	65	
Shale, sandy .....	30	105
(Splash Dam coal horizon, elevation 2,630) .....	..	
Sandstone, coarse to medium-grained .....	50	
Shale .....	15	
Sandstone, fine-grained .....	10	
Shale, sandy .....	30	115
(Lower Banner coal horizon, elevation 2,525) .....	..	
Sandstone, coarse to medium-grained .....	35	
Shale, sandy .....	25	
Sandstone, fine-grained, and shale, not well exposed in lower part .....	158	
Coal (Kennedy, location 355, elevation 2,305) ..	2	220
Sandstone, coarse, compact, resistant .....	60	
Concealed .....	40	
Shale .....	40	130
Coal, in opening under road (elevation, 2,165) ..	..	
Concealed .....	25	
Sandstone .....	20	
Shale, sandy and fine-grained, shaly sandstone, poor exposure .....	40	
Sandstone, forms ledge .....	15	
Concealed .....	35	75
Coal, in opening under road (Raven, elevation 2,030) .....	..	
	<hr/>	<hr/>
	745	695

LOCAL SECTION 18.

*From Levisa Fork along road up Pistol Branch to Pistol Gap, thence west on Sandy Ridge to knob. Section 60 feet too long because of dip.*

	Thickness.	Corrected Interval.
	Feet.	Feet.
Norton formation:		
Shale .....	30	30
(Lower Banner coal horizon, elevation 2,670) ...	..	
Sandstone, brown, massive at top, weathers granular .....	70	
Shale and thin sandstone beds .....	135	205
(Kennedy coal horizon, elevation 2,465) .....	..	
Sandstone, gray, coarse, massive, forms cliffs.....	55	
Shale and shaly sandstone .....	45	
Sandstone, buff, coarse at base, massive at top....	65	
Shale .....	10	165
Coal pit, small (elevation 2,290) .....	..	
Shale, in part sandy .....	90	85
(Approximate position of Raven coal, elevation 2,200) .....	..	
Sandstone, medium-grained, thin-bedded .....	35	
Sandstone, coarse, in part resistant .....	85	
Shale, well exposed .....	90	165
Coal pit (Jawbone, location 381, elevation 1,990) ..	..	
Concealed, probably chiefly shale .....	30	
Sandstone, coarse, poorly exposed .....	90	120
(Tiller coal horizon, elevation 1,870) .....	..	
Sandstone, medium-grained .....	30	30
	<hr/>	<hr/>
	860	800

LOCAL SECTION 19.

*From Contrary Creek, 2,000 feet north of Levisa Fork, northwest to top of ridge. Section 50 feet too short because of dip.*

(By J. P. Williams, Jr., with slight changes by the writer.)

	Thickness.	Corrected Interval.
	Ft. in.	Feet.
Norton formation:		
Coal (Lower Banner, elevation 2,175) .....	.. ..	
Concealed, probably sandstone .....	29 1	30
Coal (Big Fork, elevation 2,145) .....	.. 11	
Concealed, probably shale .....	60	
Sandstone .....	40	
Shale .....	28 8	
Coal (Kennedy split) .....	1 4	
Sandstone and shale .....	18 8	
Coal (Kennedy, elevation 1,995) .....	1 4	170
Shale .....	10	
Sandstone, massive, cliff-maker .....	75	
Shale .....	9 2	
Coal (Aily, elevation 1,900) .....	.. 10	100
Shale .....	5	

Norton formation:	Thickness.		Corrected
	Ft.	in.	Interval. Feet.
Sandstone, massive, cliff-maker, contains pebbles at base .....	75		
Shale .....	8	1	
Coal (elevation 1,810) .....	1	11	95
Shale .....	35	3	
Coal and partings (Raven "twin"; see description of location 414, elevation 1,765) .....	9	9	50
Shale, including a coal bloom .....	74	2	
Coal (elevation 1,690) .....		10	80
Shale and sandstone .....	48		
Coal (Jawbone, elevation 1,640) .....	2		55
Shale .....	3		
Sandstone, cliff-maker .....	47		
Concealed, probably shale .....	19	4	
Coal (Tiller, elevation 1,570) .....		8	75
Concealed to creek .....	40		40
	645		695

## LOCAL SECTION 20.

*From Levisa Fork, at mouth of Garden Creek, up spur to northeast.*

(By J. P. Williams, Jr.)

Norton formation:	Thickness.		Interval.
	Ft.	in.	Feet.
Shale .....	35		
Sandstone .....	20		
Shale and concealed .....	20		
Sandstone .....	10		
Shale and concealed .....	15		100
(Splash Dam coal horizon, elevation 2,045) .....			
Shale .....	5		
Sandstone, massive .....	60		
Shale .....	35		
Sandstone, thin-bedded .....	15		
Shale .....	29	6	
Coal (Lower Banner, elevation 1,895) .....	5	6	150
Sandstone .....	25		
Shale .....	75		
Sandstone .....	30		
Shale .....	35		
Sandstone .....	5		
Shale .....	23		193
(Kennedy coal horizon, elevation 1,702) .....			
Shale .....	2		
Sandstone, massive .....	65		
Shale .....	30		97
Coal bloom, very thin (Aily, elevation 1,605) .....			
Shale .....	5		
Sandstone .....	30		
Shale .....	13	1	
Coal (elevation 1,555) .....	1	11	50
Shale .....	10		
Sandstone, shaly .....	15		

LOCAL SECTIONS.

Norton formation:	Thickness.		Interval.
	Ft.	in.	
Shale .....	15	2	
Coal bloom (Raven upper bench) .....	1	10	
Shale .....	12	9	
Coal bloom (Raven lower bench, elevation 1,498) .....	2	3	57
Shale .....	3		
Sandstone, gray, coarse, massive .....	65		
Shale, dark blue .....	42		
Sandstone .....	8		
Shale .....	3	9	
Coal (elevation 1,375) .....	1	3	123
Concealed .....	20		
Sandstone in part coarse and thick-bedded .....	27		
Shale, very sandy .....	4	11	
Coal (Jawbone, location 235, elevation 1,320) ...	3	1	55
Shale, bluish, sandy (to river) .....	10		10
	835		835

LOCAL SECTION 21.

*From Dismal Creek, about halfway between Mill and Grapevine branches, southeast to top of ridge. Section 28 feet too long because of dip.*

(By J. P. Williams, Jr.)

Norton formation:	Thickness.		Corrected Interval.
	Ft.	in.	
Sandstone, cliff-maker .....	60		
Shale .....	20		77
Coal bloom (Lower Banner, elevation 1,820) ...			
Sandstone and shale .....	49		
Coal (Big Fork, elevation 1,770) .....	1		48
Shale, sandy, forms cliffs .....	137	4	
Coal (Kennedy, location 458, elevation 1,630) ..	2	8	135
Shale .....	10		
Sandstone, massive, cliff-maker .....	80		
Shale .....	14	4	
Coal (Aily, elevation 1,525) .....		8	100
Shale .....	12		
Sandstone, shaly .....	8		
Shale .....	6	3	
Coal (elevation 1,497) .....	1	9	27
Shale .....	75	2	
Coal (Raven, location 448, elevation 1,420) ...	1	10	75
Shale .....	10		
Sandstone, cliff-maker .....	70		
Shale, dark blue .....	43	11	
Coal (elevation 1,295) .....	1	1	115
Sandstone and shale .....	32	4	
Coal .....	1	3	
Coal and shale, alternating in 1-inch layers (Jawbone, elevation 1,260) .....	1	5	35
Shale .....	5		
Sandstone, very coarse and compact, to Dismal Creek .....	40		45
	685		657

## LOCAL SECTION 22.

*From Dismal Creek up road to Bill Young Gap, thence northwest along Keen Mountain road to knob beyond Antioch School. Lower part of section 120 feet too long and upper part 175 feet too short because of dip.*

	Thickness.	Corrected
	Feet.	Interval.
Wise formation:		
Shale .....	10	10
Coal bloom (Glamorgan, altitude 2,730) .....	..	
Gladeville sandstone:		
Sandstone, coarse, weathers granular .....	35	
Shale, very sandy .....	20	
Sandstone, medium-grained .....	10	
Norton formation:		
Shale, argillaceous, true thickness about 105 feet..	55	
Coal bloom, thick (Hagy upper bench) .....	..	
Shale .....	15	200
Coal bloom, thin (Hagy lower bench, elevation 2,595) .....	..	
Shale .....	5	
Sandstone, coarse, true thickness 35 feet.....	15	
Shale, argillaceous, true thickness 70 feet.....	35	
Coal bloom, thick (Splash Dam, upper bench) ...	..	
Shale, in part sandy .....	38½	
Coal (Splash Dam lower bench, elevation 2,500) ..	1½	155
Sandstone, very coarse, massive, true thickness 70 feet .....	50	70
Coal bloom, thin (Upper Banner, elevation 2,450) ..	..	
Sandstone, medium-grained .....	15	
Shale, sandy, poorly exposed .....	20	
Sandstone, coarse .....	10	
Shale, sandy, and some shaly sandstone .....	50	110
Coal bloom (Lower Banner, elevation 2,355) ....	..	
Sandstone, coarse .....	15	
Concealed, probably chiefly sandstone .....	25	
Sandstone, medium-grained .....	15	
Shale, and thin, fine-grained sandstone.....	135	205
(Kennedy coal horizon, elevation 2,165) .....	..	
Shale .....	5	
Sandstone, light brown, coarse, cliff-maker .....	80	
Shale .....	15	
Concealed, probably sandstone .....	35	
Sandstone .....	10	
Concealed (includes Raven coal) .....	100	
Shale or shaly sandstone .....	40	
Shale, in part very compact .....	40	
Shale and shaly sandstone .....	44	
Shale, sandy .....	8	
Coal (Jawbone, location 439, elevation 1,785) ...	3	360
Shale, weathers blue, true thickness 10 feet.....	15	
Sandstone, coarse, compact, true thickness 40 feet.	75	
Concealed .....	30	75
Bloom reported (Tiller, elevation 1,665(?)) ..	..	
Sandstone, medium-grained, true thickness 40 feet.	95	40
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	1,170	1,225

## LOCAL SECTION 23.

*From Laurel Fork, near Whitewood, up path to northwest. Section 40 feet too short because of dip.*

	Thickness. Feet.	Corrected Interval. Feet.
Norton formation:		
(Splash Dam coal horizon above surface, elevation 2,625) .....	..	..
Sandstone, brown, coarse, weathers granular.....	40	40
(Upper Banner coal horizon, elevation 2,585) ..	..	..
Concealed, in part sandstone .....	40	..
Sandstone, brown, coarse, weathers granular.....	25	..
Shale, sandy at base .....	65	130
Coal bloom (Lower Banner, elevation 2,455) ....	..	..
Shale .....	5	..
Sandstone, brown, coarse, compact .....	45	50
Coal reported (Big Fork, elevation 2,405) .....	..	..
Shale and shaly sandstone .....	90	..
Sandstone, medium-grained .....	15	..
Shale and shaly sandstone .....	50	170
Coal reported (Kennedy, elevation 2,250) .....	..	..
Sandstone, coarse, massive, cliff-maker, pebbles at base .....	75	..
Shale, bluish, sandy .....	25	..
Sandstone, very coarse, contains many pebbles, cliff-maker .....	50	..
Shale, drab, sandy .....	15	..
Sandstone, compact .....	30	..
Concealed .....	65	..
Sandstone, light buff, medium-grained, thin-bedded .....	20	..
Shale, bluish-drab .....	75	..
Sandstone, coarse, cliff-maker .....	20	..
Shale or shaly sandstone .....	22	..
Coal (Jawbone, location 512, elevation 1,850) ..	3	425
Shale or shaly sandstone .....	60	60
(Tiller coal horizon, elevation 1,790) .....	..	..
Sandstone, thin-bedded .....	20	..
Shale and shaly sandstone .....	70	..
Sandstone .....	10	100
	935	975

## LOCAL SECTION 24.

*From Hurricane Branch of Laurel Fork, one mile north of Wolfpen Knob, up spur to east.*

	Thickness. Feet.	Interval. Feet.
Norton formation:		
Shale .....	20	..
Sandstone, not resistant .....	15	..
Shale and shaly sandstone .....	50	85
(Lower Banner coal horizon, elevation 2,690) ...	..	..
Shale .....	10	..
Sandstone, brown, massive, weathers granular ...	60	..

	Thickness. Feet.	Interval. Feet.
Norton formation:		
Shale in upper half and chiefly shale in lower half. (Kennedy coal horizon, elevation 2,460) .....	160	230
Shale .....	10	
Sandstone, coarse, massive, weathers granular....	60	
Shale or shaly sandstone .....	30	
Shale .....	35	135
(Aily coal horizon, elevation 2,325).....	..	
Sandstone, coarse, massive, cliff-maker, lower 15 feet a mass of quartz pebbles .....	85	
Concealed .....	10	
Sandstone, not very resistant .....	20	
Shale or shaly sandstone .....	40	
Sandstone, coarse, makes cliffs, contains pebbles...	25	
Concealed .....	35	
Sandstone, poorly exposed .....	15	
Concealed, probably nearly all shale .....	55	
Shale, bluish .....	40	325
(Jawbone coal horizon, at creek level, elevation 2,000) .....	..	
	775	775

## LOCAL SECTION 25.

*From drill hole (D. H.) near head of Seng Camp Fork of Dismal Creek up spur to southeast to knob at junction of Sandy and Big Fork ridges. Section 120 feet too long because of dip.*

	Thickness. Feet.	Corrected Interval. Feet.
Norton formation:		
Sandstone, coarse, massive (bottom rock of Lower Banner coal) .....	90	
Shale .....	2½	
Coal, (Big Fork, location 552, elevation 2,960) ..	2½	75
Shale or shaly sandstone .....	70	
Sandstone, not resistant .....	25	
Shale and shaly sandstone .....	95	150
(Kennedy coal horizon, elevation 2,770).....	..	
Shale or shaly sandstone .....	20	
Sandstone, coarse, massive, a few pebbles at base..	60	
Shale, with some sandstone near top .....	55	
Sandstone, very coarse and resistant, massive....	35	
Shale .....	10	
Sandstone, coarse, resistant .....	25	
Shale or shaly sandstone .....	20	
Sandstone, coarse, makes cliffs .....	35	
Shale .....	15	
Coal in small caved prospect .....	..	
Sandstone, coarse, makes cliffs .....	20	
Shale .....	5	270
(Probable position of Raven coal, elevation 2,470, coal seen at location 530 in adjacent hollow) ..	..	
Concealed .....	90	
Shale and shaly sandstone, poorly exposed.....	90	150

	Thickness.	Corrected
	Feet.	Interval.
		Feet.
Norton formation:		
(Jawbone coal horizon, elevation 2,290, coal seen at location 520 a short distance east) . . .	..	
Concealed . . . . .	30	30
(Top of drill hole, elevation 2,260, see record on page 13) . . . . .	..	
Shale . . . . .	3	
Coal (Tiller, location 509, elevation 2,255) . . . . .	2	5
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	800	680

LOCAL SECTION 26.

*From Mill Branch, about three miles northeast of Whitewood, up path to northeast to top of Brushytop Ridge. Section 40 feet too long because of dip.*

	Thickness.	Corrected
	Feet.	Interval.
		Feet.
Norton formation:		
(Splash Dam coal horizon, elevation 2,720) . . .	..	
Sandstone, coarse, massive, weathers granular . . .	75	
Shale and shaly sandstone . . . . .	25	
Sandstone, compact . . . . .	20	
Shale, contains fossil plants at base . . . . .	4½	
Coal (Upper Banner or upper bench of Lower Banner, location 567, elevation 2,593) . . . . .	2½	127
Shale . . . . .	5	
Sandstone, not resistant . . . . .	10	
Shale . . . . .	53	53
(Lower Banner coal horizon, elevation 2,525) . . .	..	
Sandstone, coarse, massive, weathers granular . . .	50	
Shale . . . . .	80	
Sandstone . . . . .	25	
Shale and shaly sandstone . . . . .	75	220
(Kennedy coal horizon, elevation 2,295) . . . . .	..	
Sandstone, coarse, resistant, contains quartz peb- bles at base . . . . .	70	
Concealed . . . . .	45	
Sandstone, coarse, contains a few quartz pebbles . .	40	
Shale or shaly sandstone . . . . .	45	
Sandstone . . . . .	15	
Concealed . . . . .	20	220
Coal, probably thin (Raven or a short distance above Raven, elevation 2,060) . . . . .	..	
Concealed . . . . .	45	
Sandstone, massive (to stadia station 1,990 at forks) . . . . .	25	70
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	730	690

## LOCAL SECTION 27.

*From Levisa Fork, near mouth of Bens Branch, up spur to north.*

	Thickness.	Interval.
	Feet.	Feet.
Norton formation:		
(Kennedy coal horizon, elevation 1,500).....	..	
Sandstone, upper half coarse and compact, lower half finer-grained, forms conspicuous cliffs....	115	
Concealed, probably mostly sandy shale, with some sandstone in lower part (Raven coal horizon near base) .....	105	
Sandstone, very fine-grained, forms ledge .....	10	
Concealed, mostly shaly .....	80	310
(Jawbone coal horizon, elevation 1,190) .....	..	
Sandstone, very coarse, quartz pebbles at base....	30	
Shale .....	11	
Sandstone .....	20	
Shale, blue .....	18	
Coal (Tiller, location 233, elevation 1,110) .....	1	80
Clay, blue, with abundant stems .....	4	
Shale, drab, sandy, ripple-marked .....	4	8
	<hr/>	<hr/>
	398	398

## LOCAL SECTION 28.

*Up spur to northeast from forks of road opposite mouth of Little Prater Creek.*

	Thickness.	Interval.
	Feet.	Feet.
Norton formation:		
(Hagy coal horizon, elevation 1,775).....	..	
Sandstone, fairly coarse, forms conspicuous cliff...	80	
Shale, sandy .....	25	
Sandstone, medium-grained, forms ledge .....	20	
Shale, sandy .....	20	145
(Splash Dam coal horizon, elevation 1,630)....	..	
Sandstone, coarse, massive, forms conspicuous cliff (Upper Banner coal horizon) .....	65	65
Shale, mostly sandy .....	55	
Sandstone, medium-grained .....	10	
Shale, sandy .....	35	100
(Lower Banner coal horizon, elevation 1,465) ...	..	
Sandstone, fairly coarse at top, fine-grained below, forms cliffs .....	75	
Shale, sandy, and some fine-grained, shaly sandstone .....	75	150
(Kennedy coal horizon, elevation 1,315) .....	..	
Sandstone, coarse, massive, forms very conspicuous cliff .....	100	
Shale, sandy, with fine-grained, shaly sandstone at base .....	72½	
Coal (Raven, elevation 1,140) .....	2½	175
Shale, in part sandy .....	8	
Sandstone, forms cliff .....	20	
Shale, in part blue .....	30	58
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	693	693

## LOCAL SECTION 29.

*From Slate Creek north up spur between Bee and Nighway branches.*

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
(Blair coal horizon, elevation 2,385) ..	..	
Sandstone, very coarse, weathers granular .....	50	
Shale, yellowish .....	20	70
(Glamorgan coal horizon, elevation 2,315) ..	..	
Gladeville sandstone:		
Sandstone, medium-grained, weathers granular ...	70	
Norton formation:		
Shale, yellow to greenish .....	50	
Sandstone, medium-grained .....	10	
Shale .....	60	190
(Hagy coal horizon, elevation 2,125) ..	..	
Sandstone, coarse, massive, weathers granular ...	50	
Shale, yellow .....	35	
Shale and fine-grained sandstone .....	55	140
(Splash Dam coal horizon, elevation 1,985) ..	..	
Sandstone, coarse, massive .....	40	
Concealed .....	110	150
(Lower Banner coal horizon, elevation 1,835) ...	..	
Sandstone, coarse, compact .....	50	
Concealed, probably all shaly .....	125	175
(Kennedy coal horizon, elevation 1,650) ..	..	
Sandstone, coarse, very compact .....	15	15
	740	740

## LOCAL SECTION 30.

*From Slate Creek up Enochs Branch to stadia station 1435, thence up branch to west. Section 115 feet too short because of dip.*

	Thickness.	Corrected
	Feet.	Interval.
	Feet.	Feet.
Wise formation:		
Sandstone, weathers white, coarse, cliff-maker ...	20	
Shale and sandstone .....	30	
Sandstone, fine-grained, shaly at base .....	30	
Shale .....	74	
Coal (Clintwood, location 634, elevation 2,050) ..	6	165
Shale .....	5	
Sandstone, weathers white, compact, forms cliff ...	45	
Concealed .....	27	
Shale, drab, with coal streaks near top .....	4½	
Coal (Eagle, location 631, elevation 1,965) .....	3½	85
Concealed .....	15	
Sandstone, weathers white and granular, resistant.	20	
Concealed, probably shaly .....	50	85
Coal bloom (Blair, elevation 1,880) ..	..	
Sandstone, medium-grained, makes cliffs .....	20	
Shale and shaly sandstone .....	25	45
(Glamorgan coal horizon (?), elevation 1,835) ..	..	

	Thickness. Feet.	Corrected Interval. Feet.
Gladeville sandstone:		
Sandstone, medium-grained, weathers granular, poorly exposed .....	70	
Norton formation:		
Shale .....	30	
Sandstone, shaly .....	20	
Shale or shaly sandstone .....	30	160
Coal bloom (Hagy, elevation 1,685) .....	..	
Sandstone, shaly near top, coarse and massive at base .....	55	
Shale .....	10	
Coal bloom, faint .....	..	
Shale and shaly sandstone .....	55	
Shale .....	7½	
Coal (Splash Dam, location 607, elevation 1,555) .....	2½	140
Concealed, probably chiefly sandstone .....	50	
Concealed, probably shale and shaly sandstone.... (Kennedy coal horizon, elevation 1,290) .....	215	315
Sandstone, coarse, quartz, pebbles at base, true thickness 70 feet .....	35	
Concealed .....	15	
Sandstone, dark buff, fine-grained, compact .....	18	
Coal (Aily, location 578, elevation 1,220) .....	2	110
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	990	1,105

## LOCAL SECTION 31.

*From pit near school on Linn Camp Creek up path to south for 1,800 feet,  
thence west up hollows.*

	Thickness. Feet.	Interval. Feet.
Wise formation:		
(Campbell Creek coal horizon (?), elevation 2,155) .....	..	
Shale .....	10	
Sandstone, white, medium-grained to coarse .....	75	
Shale .....	120	205
(Clintwood coal horizon, elevation 1,950) .....	..	
Sandstone, coarse, massive, forms cliffs .....	95	
Shale, drab, sandy .....	31	
Coal (Eagle, location 672, elevation 1,820) .....	4	130
Concealed .....	40	40
Coal, thick (Blair, elevation 1,780) .....	..	
Sandstone, coarse .....	25	
Concealed .....	30	55
(Glamorgan coal horizon (?), elevation 1,725) ..	..	
Gladeville sandstone:		
Sandstone, coarse, resistant .....	40	
Norton formation:		
Concealed, probably chiefly shale .....	55	
Shale .....	9	
Coal reported .....	½	

LOCAL SECTIONS.

	Thickness.	Interval.
	Feet.	Feet.
Norton formation:		
Concealed .....	60	
Coal reported (Hagy, elevation 1,560) .....	1/2	165
Sandstone, coarse .....	70	
Concealed .....	15	
Sandstone, medium-grained .....	15	
Concealed .....	32	
Sandstone, medium-grained .....	20	
Coal (Splash Dam, location 642, elevation 1,404) .....	4	156
	751	751

LOCAL SECTION 32.

*From Levisa Fork, 3,500 feet northwest of Rocklick Creek, north up spur to knob.*

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
Sandstone .....	20	
Shale, brown .....	40	
Sandstone, brown, coarse, weathers granular .....	70	130
(Campbell Creek coal horizon (?), elevation 1,830) .....	..	
Shale, yellow .....	30	
Sandstone, coarse, weathers granular .....	55	
Shale .....	48	
Limestone, ferruginous .....	2	
Shale .....	65	200
(Clintwood coal horizon, elevation 1,630) .....	..	
Sandstone, light gray, coarse, makes cliffs .....	60	60
(Eagle coal horizon, elevation 1,570) .....	..	
Shale .....	20	
Sandstone, brown, medium-grained .....	20	
Shale and shaly sandstone .....	65	
Sandstone, not resistant .....	10	
Shale .....	20	135
(Glamorgan coal horizon, elevation 1,435) .....	..	
Gladeville sandstone:		
Sandstone, brown to white, medium-grained, compact, makes cliffs .....	55	
Norton formation:		
Shale .....	30	
Sandstone, reddish-brown, medium-grained, makes cliffs .....	40	
Shale .....	40	165
(Hagy coal horizon, elevation 1,270) .....	..	
Sandstone, medium-grained, compact .....	15	
Shale .....	20	
Sandstone, not resistant .....	10	
Shale and shaly sandstone .....	26	
Sandstone, medium-grained, massive .....	3	
Shale, contains fossil plants .....	2	
Coal (Splash Dam, location 148, elevation 1,190) .....	4	80
Shale .....	10	

Norton formation:	Thickness.	Interval.
	Feet.	Feet.
Sandstone, coarse, thick-bedded .....	45	
Shale and shaly sandstone .....	110	
Shale, mostly dark blue .....	85	250
(Kennedy coal horizon, elevation 940).....	..	
Shale .....	5	
Sandstone, quartzose, cross-bedded, and very coarse at top .....	65	70
	<hr/> 1,090	<hr/> 1,090

## LOCAL SECTION 33.

*Along Rocklick Creek road from halfway between Grass Spring and Old Field branches to Dicks Branch, thence along path up Dicks Branch to gap at head, thence east along ridge to high knob. Lower part of section 50 feet too short and upper part 30 feet too long because of dip.*

Wise formation:	Thickness.	Corrected Interval.
	Feet.	Feet.
Sandstone, coarse, moderately coherent .....	80	
Shale .....	65	
Sandstone, coarse, weathers granular .....	30	
Sandstone, shaly, and shale .....	15	
Sandstone, reddish-brown, medium-grained, poorly exposed at base .....	100	
Shale .....	20	
Sandstone, white and coarse at top, brown and medium-grained at base .....	50	
Shale .....	30	360
(Cedar Grove coal horizon (?), elevation 2,000) ..	..	
Sandstone, fine-grained .....	10	
Shale .....	10	
Sandstone, coarse, weathers white to yellow and granular .....	50	
Shale, yellow .....	20	
Sandstone, fine-grained, shaly .....	10	
Shale .....	10	
Sandstone, light brown, medium-grained, compact. (Alma coal horizon, elevation 1,760) .....	30	140
..	..	
Sandstone .....	25	
Shale .....	50	
Sandstone, coarse .....	25	
Shale or shaly sandstone .....	15	
Sandstone, fine-grained .....	15	
Shale .....	10	140
(Campbell Creek coal horizon, elevation 1,720) ..	..	
Sandstone, moderately coarse .....	35	
Concealed, chiefly shale .....	146	
Sandstone, fine-grained .....	10	
Shale .....	5	
Coal (Clintwood, location 702, elevation 1,520) ..	4	205
Sandstone, coarse, massive .....	75	80
(Eagle coal horizon, elevation 1,445) .....	..	

LOCAL SECTIONS.

	Thickness.	Corrected
	Feet.	Interval.
	Feet.	Feet.
Wise formation:		
Shale, blue .....	30	30
(Approximate position of Blair coal, elevation 1,415) .....	..	
Concealed .....	85	95
Coal bloom (Glamorgan, elevation 1,330) .....	..	
Shale .....	10	
Gladeville sandstone:		
Sandstone, medium-grained .....	60	
Norton formation:		
Concealed, probably shale .....	45	130
(Hagy horizon, elevation 1,215) .....	..	
Sandstone .....	25	
Shale, blue, compact .....	15	
Concealed, probably shale .....	15	
Sandstone .....	20	
Shale and shaly sandstone .....	25	115
(Splash Dam coal horizon, elevation 1,115) .....	..	
	1,275	1,295

LOCAL SECTION 34.

*From forks near head of Wolfpen Branch of Lester Fork south up spur to knob.*

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
(Campbell Creek coal horizon (?), elevation 2,060) .....	..	
Sandstone, medium-grained .....	75	
Sandstone or sandy shale .....	40	
Shale .....	115	230
Coal bloom (Clintwood, elevation 1,830) .....	..	
Sandstone, moderately coarse .....	20	
Concealed, in part sandstone .....	35	
Shale .....	10	
Coal (Eagle, location 784, elevation 1,760) .....	5	70
Concealed .....	60	60
(Blair coal horizon, elevation 1,700) .....	..	
Sandstone, medium-grained .....	35	
Concealed .....	25	60
(Glamorgan coal horizon, elevation 1,640) .....	..	
Gladeville sandstone:		
Sandstone, coarse, cross-bedded .....	50	
Norton formation:		
Concealed, probably chiefly shale .....	130	180
(Hagy coal horizon, elevation 1,460) .....	..	
Sandstone, moderately coarse .....	30	
Concealed .....	15	
Sandstone .....	15	60
	660	660

## LOCAL SECTION 35.

*From half a mile south of school on Left Fork of Lester Fork up road to slopes beside gap at head of Elkins Creek. Section 30 feet too long because of dip.*

	Thickness.	Corrected
	Feet.	Interval.
		Feet.
Wise formation:		
(Campbell Creek coal horizon (?), elevation 2,260) .....	..	
Sandstone, fine-grained, weathered .....	35	
Sandstone, medium-grained, compact, makes cliffs .....	20	
Sandstone, thin-bedded, shaly at base .....	55	
Shale and shaly sandstone .....	50	
Shale .....	110	260
(Clintwood coal horizon, elevation 1,990) .....	..	
Sandstone, coarse, compact .....	30	
Shale and concealed .....	20	50
(Eagle coal horizon, elevation 1,940) .....	..	
Sandstone, brown, coarse, makes long bench .....	50	
Shale and shaly sandstone .....	40	
Sandstone, coarse, shaly at base .....	20	105
(Blair coal horizon, elevation 1,830) .....	..	
Sandstone, very coarse, weathers granular, makes strong bench .....	40	
Shale .....	40	80
Coal bloom (Glamorgan, elevation 1,750) .....	..	
Shale .....	10	
Gladeville sandstone:		
Sandstone, coarse, compact .....	50	
Norton formation:		
Shale and shaly sandstone .....	70	
Sandstone .....	20	
Shale or shaly sandstone .....	20	165
(Hagy coal horizon, elevation 1,580) .....	..	
Sandstone, compact .....	15	
Concealed .....	20	
Sandstone, thin-bedded .....	10	
Concealed .....	100	135
(Splash Dam coal horizon, elevation 1,435) .....	..	
	825	795

## LOCAL SECTION 36.

*From Knox Creek at bench-mark 999, three-fourths mile southeast of Hurley, up hollow and spur to south.*

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
Coal (Eagle, elevation 1,685) .....	..	
Sandstone and concealed .....	45	45
Coal (Blair, elevation 1,640) .....	..	
Sandstone, coarse, massive .....	35	

	Thickness.	Interval.
	Fect.	Fect.
Wise formation:		
Shale and shaly sandstone .....	50	85
(Glamorgan coal horizon, elevation 1,555).....	..	
Gladeville sandstone:		
Sandstone, coarse, massive .....	50	
Norton formation:		
Shale at top, sandstone at base .....	50	
Shale, yellow and dark drab.....	85	185
(Hagy coal horizon, elevation 1,370) .....	..	
Sandstone, coarse, makes cliff.....	60	
Shale, bluish-drab .....	29	
Coal (Splash Dam, location 806, elevation 1,275)	6	95
Shale .....	5	
Sandstone, coarse, massive, makes cliffs .....	74 $\frac{3}{4}$	
Coal (Upper Banner, elevation 1,195).....	$\frac{1}{4}$	80
Concealed .....	25	
Shale .....	15	40
(Lower Banner coal horizon, elevation 1,155) ...	..	
Sandstone, in part coarse .....	55	
Shale and shaly sandstone .....	95	150
(Kennedy coal horizon, elevation 1,005).....	..	
Sandstone, medium-grained, thin-bedded, compact.	6	6
	686	686

LOCAL SECTION 37.

*From bench-mark 1358 on Right Fork of Knox Creek up railroad to gap at head of Upper Rockhouse Branch, thence east. Section 135 feet too long because of dip.*

	Thickness.	Corrected Interval.
	Ft. in.	Fect.
Gladeville sandstone:		
Sandstone, light buff, medium-grained .....	25	
Norton formation:		
Shale and a little thin-bedded sandstone.....	75	
Sandstone, medium-grained .....	20	
Concealed, probably includes shale .....	15	
Sandstone, medium-grained .....	18	9
Coal (Hagy, location 813, elevation 1,910).....	1	3
Shale .....	3	155
Sandstone, medium-grained at top to coarse at base .....	45	
Shale, dark, and a coal streak .....	2	
Sandstone .....	50	
Shale, blue .....	15	
Coal (Splash Dam split) .....	6	
Shale .....	5	
Sandstone, fine-grained and very shaly in part....	24	5
Coal (Splash Dam, location 809, elevation 1,762)	3	1
Shale and sandstone .....	32	125
Sandstone, slightly coarse, true thickness 55 feet..	70	
Shale, chiefly yellowish-drab .....	45	
Sandstone, fine-grained .....	11	

	Thickness.		Corrected
	Ft.	in.	Interval. Feet.
Norton formation:			
Shale, gray .....	2	2	
Coal (Lower Banner, location 803, elevation 1,600) .....	1	10	125
Sandstone, medium-grained, true thickness 25 feet.	50		
Shale, yellow and gray, true thickness 110 feet....	155		
Coal (Kennedy split) .....	1	3	
Shale, sandy .....	7	6	
Coal (Kennedy, location 797 A, elevation 1,385)	1	3	145
Sandstone, medium-grained .....	27		22
	707		572

## LOCAL SECTION 38.

*From near head of Right Fork of Guess Fork, 2,000 feet west of West Virginia boundary, up spur to north.*

	Thickness.		Interval.
	Feet.	Feet.	Feet.
Wise formation:			
Shale .....	130		130
(Clintwood coal horizon, elevation 2,050) .....	..		
Sandstone, coarse, compact .....	95		95
(Eagle coal horizon, elevation 1,955) .....	..		
Shale and shaly sandstone .....	40		
Sandstone and concealed .....	35		75
(Glamorgan coal horizon, elevation 1,880) .....	..		
Gladeville sandstone:			
Sandstone, coarse, massive .....	40		
Norton formation:			
Concealed at top, shale at base .....	30		
Sandstone, medium-grained .....	20		
Shale, drab .....	28		
Shale, green and black, contains marine fossil shells .....	2		
Shale, yellowish-drab .....	90		
(Hagy coal horizon, elevation 1,670) .....	..		210
Concealed, probably sandstone .....	50		50
	560		560

## LOCAL SECTION 39.

*From Left Fork of Guess Fork, 1,500 feet west of stadia station 1312, up hollow to south.*

	Thickness.		Interval.
	Feet.	Feet.	Feet.
Wise formation:			
(Campbell Creek coal horizon, elevation 1,970) ..	..		
Sandstone .....	20		
Concealed .....	20		
Shale and probably some shaly sandstone .....	175		215
(Clintwood coal horizon, elevation 1,755) .....	..		
Sandstone, coarse at base, compact .....	49		
Coal (Eagle, location 864, elevation 1,700) .....	6		55

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
Shale and perhaps some sandstone .....	55	
Sandstone .....	20	
Concealed .....	15	90
(Glamorgan coal horizon (?), elevation 1,610)	..	
Gladeville sandstone:		
Sandstone, brown, medium-grained .....	15	
Concealed, probably sandstone .....	20	
Norton formation:		
Shale .....	40	
Shale and shaly sandstone .....	50	
Sandstone, fine-grained .....	15	
Concealed, probably chiefly shale .....	70	210
(Hagy coal horizon, elevation 1,400) .....	..	
Sandstone, coarse, resistant .....	35	
Concealed .....	40	
Coal bloom (Splash Dam split) .....	..	
Concealed .....	25	100
(Probable position of Splash Dam coal, elevation 1,300) .....	..	
	<hr/>	<hr/>
	670	670

## LOCAL SECTION 40.

*From bench-mark 904 on Knox Creek northeast up spur at mouth of Sulphur Creek.*

	Thickness.	Interval.
	Feet.	Feet.
Wise formation:		
Shale, light drab, sandy at top .....	80	80
(Clintwood coal horizon, elevation 1,480) .....	..	
Sandstone, weathers light gray, coarse, compact, makes cliffs .....	80	80
(Eagle coal horizon, elevation 1,400) .....	..	
Shaly sandstone and shale .....	100	100
(Glamorgan coal horizon, elevation 1,300) .....	..	
Gladeville sandstone:		
Sandstone, brown to light gray, coarse .....	20	
Concealed, probably sandstone .....	30	
Norton formation:		
Shale and some shaly sandstone .....	85	135
(Hagy coal horizon, elevation 1,165) .....	..	
Sandstone, coarse, resistant .....	60	
Shale at top, sandstone near base .....	45	105
(Splash Dam coal horizon, elevation 1,060) .....	..	
Concealed .....	15	
Sandstone, coarse .....	20	
Shale and shaly sandstone .....	65	100
(Lower Banner coal horizon, elevation 960) .....	..	
Sandstone, coarse, makes cliff .....	55	
Shale .....	5	60
	<hr/>	<hr/>
	660	660

## LOCAL SECTION 41.

*From Upper Elk Creek, 1,800 feet from its head, north up hollow to ridge, thence north along State boundary to knob.*

Wise formation:	Thickness.	Interval.
	Feet.	Feet.
Sandstone, weathers granular at top, coarse and very compact at base .....	75	
Shale, light drab .....	70	
Sandstone, weathers granular, poorly exposed .... (Cedar Grove coal horizon, elevation 1,995) ....	40	185
Sandstone, weathers granular, very coarse and compact at base .....	90	
Sandstone and sandy shale, poorly exposed..... (Alma coal horizon (?), elevation 1,875).....	30	120
Sandstone and sandy shale, poorly exposed.....	70	
Sandstone, coarse, compact .....	15	
Concealed, probably includes sandstone .....	50	
Coal and partings (Campbell Creek, location 897, elevation 1,720) .....	20	155
Sandstone, mostly shaly .....	55	
Shale, very sandy .....	80	
Sandstone, coarse .....	5	
Shale .....	35	175
Coal (Clintwood, elevation 1,545) .....	..	
Shale .....	10	
Sandstone, massive, makes cliffs .....	67	
Coal (Eagle, location 873, elevation 1,465).....	3	80
	715	715

## LOCAL SECTION 42.

*From Tug Fork, half a mile northeast of Alnwick, south up spur to low knob on State boundary.*

Wise formation:	Thickness.	Interval.
	Feet.	Feet.
Shale, mostly yellowish-drab .....	90	90
(Clintwood coal horizon, elevation 1,540).....	..	
Sandstone, coarse, weathers brown and granular, in part thin-bedded .....	70	70
(Eagle coal horizon, elevation 1,470).....	..	
Sandstone, brown and medium-grained at top, white and coarse at base, lower half makes cliff.....	65	
Concealed .....	25	90
(Blair coal horizon, elevation 1,380).....	..	
Sandstone, brown, medium-grained .....	20	
Concealed .....	15	35
(Glamorgan coal horizon, elevation 1,345).....	..	
Gladeville sandstone:		
Sandstone, brown, medium-grained .....	55	

Norton formation:	Thickness.	Interval.
	Feet.	Feet.
Concealed, probably shale	70	125
(Hagy coal horizon, elevation 1,220)	..	
Sandstone, medium-grained	25	
Concealed	25	
Sandstone, medium-grained	20	
Shale and shaly sandstone	40	110
(Splash Dam coal horizon, elevation 1,110)	..	
Sandstone, coarse, resistant	55	
Shale, very sandy, in part indurated	50	105
(Lower Banner coal horizon, elevation 1,005)	..	
Sandstone, light gray, quartzose near base, coarse, massive, makes great cliffs along railroad	100	
Concealed to river	35	135
	760	760

### Deep drilling.

The only available drill record which throws much light on the nature of underground formations within the county is that of the boring on Seng Camp Fork of Dismal Creek, which has been included in the description of the Lee formation on pages 13 to 16 of this report. The records of five borings on the border of the county, one on Indian Creek and four on Russell Fork (C75, C64, C62, C73, and C70 on the accompanying geologic map), have been given graphically in a previous report.<sup>1</sup> The Indian Creek boring was not very deep and those on Russell Fork penetrated only a few beds below the top of the Lee formation, and were all in faulted and crumpled areas where correlations are not certain. For these reasons and also because the thickness of the coal beds penetrated has not been made public the records are not included in this report. Those particularly interested should consult the previous report mentioned, as it also includes the records of many borings in Dickenson and Russell counties. No other borings have been made in Buchanan County except two shallow holes in the Grundy district, the records of which were not carefully preserved.

## GEOLOGIC STRUCTURE.

### Method of representation.

The position in which coal and other beds lie in a region in which dips are low and there are few sharp folds is most readily shown by means of structure contours,—lines so drawn that some easily recognizable reference

<sup>1</sup>Hinds, Henry, Coal resources of the Clintwood and Bucu quadrangles, Virginia: Virginia Geol. Survey Bull. XII, Plate III, 1916.

stratum is at the same elevation at every point along any one of them and is a certain distance above or below that elevation along the next line. On the geologic map of Buchanan County accompanying this report the Splash Dam coal bed has been chosen as the reference stratum, and its elevation along one structure contour is 50 feet different from that along the next contour. By this method the direction of the dip and its magnitude in feet per mile or other unit can be quickly ascertained from the map. The dip of other beds is nearly but not exactly the same as that of the Splash Dam, the difference being caused by irregularities in the distance between beds not contiguous. As most strata thin to the northwest in this region, the general northwesterly dip of beds above the Splash Dam is slightly greater than that shown by the contours, and the dip of beds below the Splash Dam is slightly less than that shown by the contours; the greater the vertical distance between the Splash Dam and any bed, the greater will be this difference in dip.

Another use of the structure contours is to show the position of the outcrop of any bed on the map or its depth beneath the surface where it is covered by other rocks. For example, if it is desired to find the position of the Raven coal bed at some point along Slate Creek, the elevation of the Splash Dam horizon shown by the structure contours is first noted. Then the interval between the Raven and the Splash Dam coals is ascertained by consulting the detailed descriptions of the Raven in the Slate Creek drainage basin, the generalized sections in Plate II, or a local section of neighboring exposures. As the Raven is below the Splash Dam, this interval subtracted from the elevation of the latter bed will give the elevation of the Raven. By turning to the map the Raven outcrop can then be located by noting the position of the surface contour with the same elevation. If the bed under discussion is below the surface, the depth to which it is necessary to drill in order to reach it can be determined by subtracting the elevation of the bed from that of the surface at that point.

The usefulness of structure contours naturally depends largely on their accuracy. There are so many possible sources of error in this region that it is not maintained that absolute accuracy has been achieved. It is believed, however, that inaccuracies of more than 50 feet in vertical distance are very rare. Errors are most likely to be made where dips are exceptionally steep, as near faulted and buckled areas like those in the Russell Fork basin, where few coal exposures were found, and where observations were made at a distance from topographic instrument stations.

### Folds.

*Monoclinical structure.*—The structure of by far the greater part of the county is that of a simple monocline dipping northwestward. The general northwesterly dip is interrupted locally by small subsidiary folds and is profoundly modified and in part reversed by large open folds and faults in the southern part of the Russell Fork drainage basin and in the northwestern part of the county. In the northern part of the Dismal Creek basin and near the head of Slate Creek the general dip is nearly due west.

The strata are highest on Sandy Ridge at the head of Jones Fork, where the Splash Dam is 3,410 feet above sea-level, and are lowest on Pounding Mill Branch of Tug Fork, where the Splash Dam is 940 feet above sea-level or 2,470 feet lower than at its highest point. The distance between these two points is 27 miles, so that the average dip between them is,  $91\frac{1}{2}$  feet per mile. The dip of the monocline is greatest in the southeastern and southern parts of the county and least near Kentucky, however, so that the average dip between Wolfpen Knob and Hanger is 121 feet per mile, while that between Hanger and Grundy is 81 feet per mile and that between Grundy and Big Rock is 53 feet per mile.

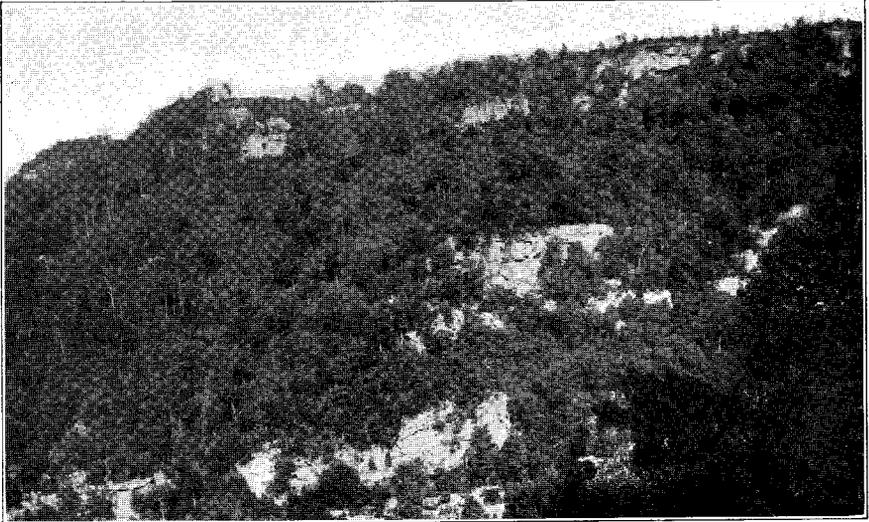
Few of the subsidiary folds are sufficiently long or well marked to be of any great significance. One of the strongest of these features is a low dome between lower Dismal and Slate creeks; others are short synclines (trough-shaped structures) along War Fork of Russell Prater Creek and along Pounding Mill Branch of Tug Fork. Many small folds are mere wrinkles, and some affect only a few beds and are due to irregularities in the thickness of parts of the Pennsylvanian series. Faults and large folds, all of which are outside the area of strictly monoclinical structure, are discussed below.

*Dry Fork anticline.*—One of the principal structural features of the region is the Dry Fork anticline (arch-shaped structure) whose axis trends northeast from Russell Fork at Council through Russell and Tazewell counties. Only the west end of the anticline is in Buchanan County and that part of it plunges slightly to the west and is a broad, low arch with a flat top. It is a stronger feature farther east, however, and its axis crosses Russell and Tazewell counties along a line that is nearly parallel to the southeast boundary of Buchanan County and is only a short distance from it. It enters West Virginia near Dry Fork and extends northeast as far as Bramwell, W. Va. This axis is the dividing line between the northwesterly dips described in the preceding section and southerly dips that characterize the coal field south of it.

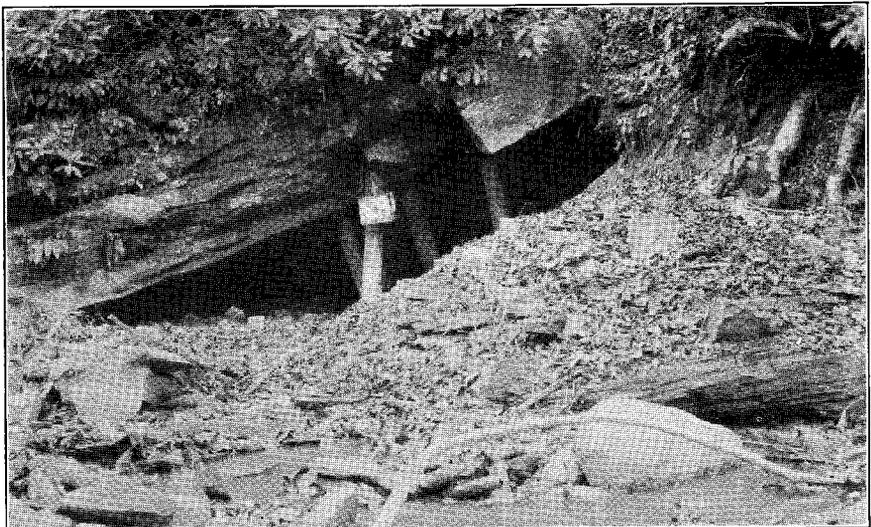
*Sourwood Mountain anticline.*—The axis of the Sourwood Mountain anticline extends in a curved line from near Davenport, on Russell Fork, to the southern boundary of the coal field in Russell County. In Buchanan County the general dip northwest of the axis is to the northwest, and that west of it is to the east and southeast, the southeasterly dips being exceptionally steep near Big A Mountain. This anticline was probably once a continuation of the Dry Fork anticline, but it has been accentuated and its axis shifted to the northwest by differential movement in the zone of shear faulting along Russell Fork.

*Pine Mountain anticline.*—An arch which is here named the Pine Mountain anticline extends southwest from Levisa Fork near the mouth of Home Creek to Pine Mountain, its axis passing through Jane, the central part of The Breaks, and Skegg Gap. Along Pine Mountain the south limb of the structure is steep and the anticlinal structure is obscured by the great thrust fault which lies near the position of the axis and replaces the north limb of the arch. In Buchanan County, however, and also in Dickenson County east of Skegg Gap, the fault lies a short distance north of the axis and the anticlinal structure is better defined. The arch plunges very steeply to the northeast and dies out almost completely west of Levisa Fork, only to reassert itself slightly as a low dome close to that stream. Near Levisa Fork each stratum is about 550 feet lower than it is at Jane, 1,000 feet lower than in The Breaks, and 2,800 feet lower than at Skegg Gap. In Buchanan County the general dip is northeast between the axis and the fault and is southeast between this axis and the axis of the Middlesboro syncline.

*Middlesboro syncline.*—All of Buchanan County between the Pine Mountain anticline and the Dry Fork and Sourwood Mountain anticlines might be considered part of a great trough which has been named the Middlesboro syncline. The very long southeast limb of this structure forms part of what has just been described as monoclinical structure, and it merges with the longer monocline which extends uninterruptedly past the east end of the Pine Mountain anticline. The synclinal structure, therefore, is in evidence only in the northwestern part of the county. The synclinal axis swings in a curved line from the Dickenson County boundary near Barts Lick Creek to a point near the end of the Pine Mountain anticline. Dips are low near this axis, but they are greater near Jane.



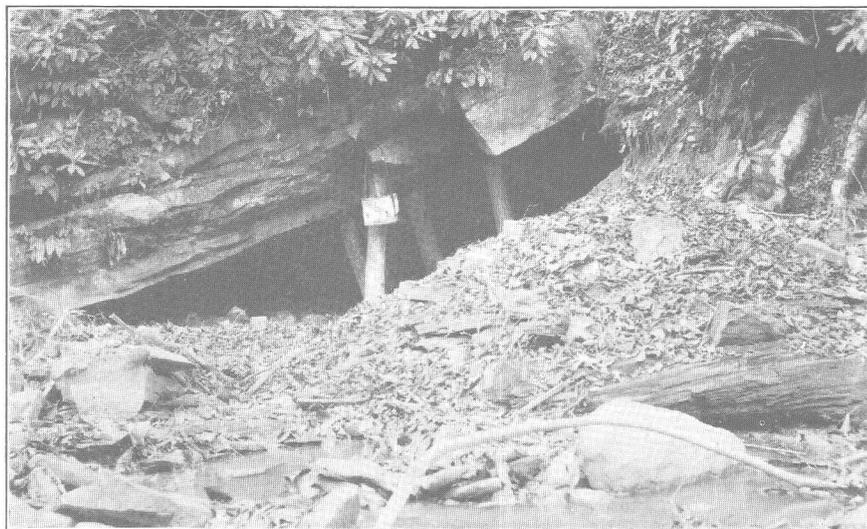
(A) Pine Mountain overthrust in east wall of The Breaks. (The rocks on the right have been thrust over those on the left, both the cliff at the top and the one in the lower left corner being the Kennedy bottom-rock. The lower cliff on the right is at the top of the Lee formation.)



(B) Dipping beds in the faulted and crumpled area on Russell Fork, three-fourths mile west of Hale School (near location 3).



(A) Pine Mountain overthrust in east wall of The Breaks. (The rocks on the right have been thrust over those on the left, both the cliff at the top and the one in the lower left corner being the Kennedy bottom-rock. The lower cliff on the right is at the top of the Lee formation.)



(B) Dipping beds in the faulted and crumpled area on Russell Fork, three-fourths mile west of Hale School (near location 3).

### Faults.

*Pine Mountain fault.*—The great Pine Mountain overthrust fault mentioned in preceding paragraphs extends from Buchanan County southwest into Tennessee along the northern slope of Pine Mountain and is primarily responsible for that long, high ridge. Along Pine Mountain the rocks south of the fault have been thrust far over and above those north of it, so that the Pennington shale and lower Mississippian formations, and even Devonian rocks, overlie part of the Wise formation. The magnitude of the thrust decreases greatly northeast of Skegg Gap, so that the vertical displacement, which reaches a maximum of 5,300 feet a few miles southwest of the gap, is only 650 to 850 feet in The Breaks, near the mouth of Grassy Creek (see Pl. III), and 400 feet near the mouth of Hunts Creek where the fault enters Buchanan County.

The displacement continues to decrease northeast of Hunts Creek, being only about 300 feet where the fault crosses Cow Fork near its mouth, and dying out completely at the end of the fault about 2 miles farther northeast. The Lee and lower formations are not exposed along the fault in Buchanan County, therefore, the lowest beds which reach the surface on Hunts Creek being about 40 feet below the Raven coal, in the lower part of the Norton formation.

*Russell Fork faulted and crumpled areas.*—The rocks in a narrow zone along and near Russell Fork from its head to Little Fox Creek and in a smaller area near the mouth of Pawpaw and Big Fox creeks are shown on the accompanying geologic map as undifferentiated Pennsylvanian beds because the rocks in them dip so steeply and irregularly in places that the exact position of coal and other outcrops is uncertain. Attempts to mine coal in these areas would yield very uncertain profits.

One disturbed zone extends for 8 miles along Russell Fork, from its head to about halfway between Murphy and Indian, and was caused by shearing along one or more vertical faults whose positions could not be exactly located everywhere, but which lie close to the broken fault line shown on the geologic map. Beds north of the faulted zone remained nearly stationary during the faulting, but those south of it were forced a short distance northwestward and were folded to form or accentuate the feature described as the Sourwood Mountain anticline. Beds within parts of the zone were dragged and crumpled so as to produce irregular dips (see Pl. III).

In several exposures along Russell Fork between Murphy and a point about a mile northwest, and for short distances back from the stream, there are dips of 50 degrees and less in several directions. Evidences of faulting were also seen in two places. The exact conditions are not very clear in this area, but it is probable that there has been shearing along a line from near Indian northwest to Murphy and beyond. Beds southwest of this line were probably moved northwest past those northeast of it, the movement being of the same kind as that described in the preceding paragraph but in a slightly different direction.

Dips in different directions, some at high angles, were noted at several places near the mouths of Pawpaw and Little Pawpaw creeks and along Russell Fork for a short distance southeast. The results of the disturbance are most noticeable along the county road where it makes a cut-off at a sharp bend of the river east of Cannaday. The area is in line with the faulted area near Murphy, but it is separated from the latter by undisturbed beds. The irregular dips were probably caused by crumpling resulting from incipient shearing.

*Big A Mountain faulted and folded area.*—The Virginia coal field is bounded on the southeast by great thrust faults and overturned folds which have caused older beds to be thrust far up and over the coal-bearing Pennsylvanian series. A small part of this faulted area includes 2 or 3 square miles of territory in Buchanan County near Big A Mountain. Coals and other strata in the Pennsylvanian series are only very slightly disturbed, even close to the faulted area, so that mining operations could be conducted to within a few hundred yards or rods of it. A few coals also extend a short distance southeast beneath the folded and faulted beds, but could not be profitably mined under such conditions.

The Lee and Pennington beds mapped near Coombs School, near the heads of Lambert and Russell forks, are in the lower limb of an overturned anticline which has been thrust over younger Pennsylvanian strata. All these beds are upside down and dip steeply to the southeast at angles of 35 to 65 degrees, the most common dip being about 40 degrees. (See fig. 3.)

The Silurian and Ordovician beds mapped on Big A Mountain are in the lower limb of an overturned syncline that has been thrust far over the overturned anticline just mentioned. Beds near the top of the central part of Big A Mountain are nearly level. The Bays and Clinch sandstones and neighboring parts of the "Rockwood" dip southeast at angles of 20 to

40 degrees, the highest dips being those in the Clinch. As shown on the geologic map there are at least two faults within this area of Ordovician and Silurian outcrops, both thrusts along which the movement has been to the west and northwest. (See fig. 3.)

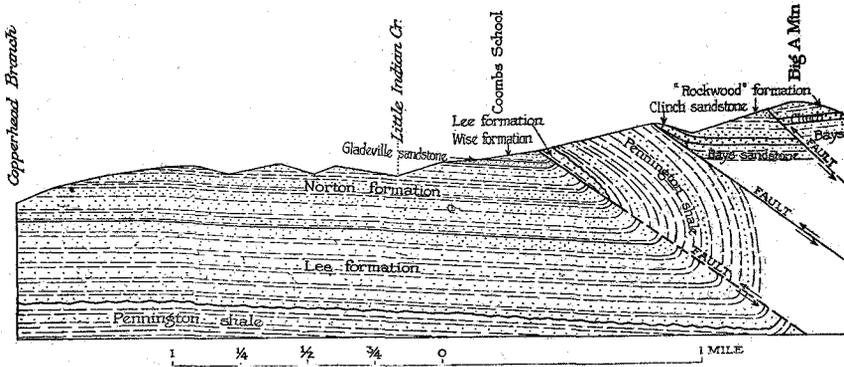


Fig. 3.—Cross-section from the mouth of Copperhead Branch southeast through Coombs School to Big A Mountain.

## COAL RESOURCES

### GENERAL DESCRIPTION OF COAL BEDS.

#### Introduction.

Buchanan County contains many beds of high-grade coking coal, the quantity and quality of which are described in other parts of this report. At least fifteen beds could be profitably mined in one or more of the localities in which they are exposed, and several lower beds, which could be reached only by shafting, are workable in parts of the county. The thinner parts of these beds, as well as many non-persistent beds that are nowhere very thick, will become valuable assets as soon as the thicker deposits in this and competing fields approach exhaustion. The total available tonnage, both in deposits minable under present market conditions and in the thinner reserves for the future, is truly enormous.

Although many coals are persistent, none of them has exactly the same characteristics throughout even small districts. Not only is the tonnage per acre of any bed likely to be different in neighboring localities, but the expense of mining would vary greatly because of differences in the number, thickness, and position of partings and in the type of roof. Because of these factors an exact determination of the coal resources of a district can not be made in advance of the thorough prospecting which has been done in only a very small part of the county. As natural exposures are very rare the greatest need is for numerous prospect drifts, dug wherever there are seeps or other indications that coal is concealed beneath the deep surface soil. The outline of a coal body and its dip should then be determined by running transit lines along its outcrop, using the nearest rock ledge as a guide, or, in difficult areas, utilizing the services of a competent geologist. The close spacing of deep valleys in which the upper coals are exposed makes it unnecessary to drill on the ridges. The drill should be used in the valleys, however, to explore beds which do not reach the surface in the district.

Most of the partings so generally present in the coal beds are shale or hard clay. Thin layers of bone and, more rarely, of cannel are fairly common. Another type is "rash," an intimate mixture of coal and shale, in some places contorted and slickensided by movements along the bedding planes. "Laminated coal," composed of very thin alternating layers of

bone and coal, is characteristic of one or two of the higher beds. Sandstone is not a common parting, but a thin layer of it is a persistent feature of the Upper Banner coal. Shale partings may range from a few inches to several feet in thickness in even a small mine. In many instances a parting that is thin in one exposure is so thick in a neighboring pit that only one coal bench is recoverable, and it may be so much thicker not far distant that both coal benches can be mined as separate beds.

The underclay of the coals is commonly sandy and very hard, so that little trouble would arise from "squeezing" or "heaving" in mines. The prevailing color is light gray or drab. The material overlying the coals is either drab shale or sandstone which would make a fairly firm roof in most mines. In places there are a few inches of soft "muck" next the coal, or a little insecure "draw slate." The boundary between the coal and the roofing material is sharp, but a slight transition from one to the other may be caused by shale streaks in the upper few inches of the coal and by coal streaks and carbonized plant remains in the roof. The character of the roof is rarely constant, even in small mines, so that the exact conditions to be encountered can not be safely predicted in advance of large mining operations.

The thickest coals in the southern part of the county are much lower stratigraphically than the most valuable beds in northern areas. The most obvious reason for this is the fact that the higher beds have been removed from the southern areas by erosion. Another reason is that the lower coals thin to the north and northwest. This is known to be true of the Pocahontas and other Lee coals in McDowell County, West Virginia, and is probably true of Lee coals in Virginia. The coals in the lower part of the Norton formation of Buchanan County thin notably to the northwest before passing below the surface. A few of the coals in the upper part of the Norton are also very thin or lacking in most of the northern border of the county. In general, however, the coals of the Wise formation are no thinner on the northwest than farther southeast, and some of them are exceptionally thick near the Kentucky boundary. The tendency of the lower beds, beginning with the lowest, to thin to the northwest, combined with the general northwesterly dip, is the cause of a striking characteristic of the region,—the restriction of the thickest coal deposits to the higher parts of the ridges in most localities.

The thicknesses of coal, the intervals between coal beds, and other economic factors are described by drainage basins in another section of this report. Only brief summaries of the characteristics of the principal

beds are given in this section. The intervals used here are averages only and do not apply exactly to all parts of the county, for nearly all intervals decrease more or less uniformly from southeast to northwest. Maximum and minimum distances between coals in different areas are shown in the generalized sections (Pl. II), as well as in the detailed descriptions by drainage basins. Intervals measured in many places are shown in the local sections (pp. 23-53).

#### Coals in the Lee formation.

Only small parts of the Lee formation are exposed in Buchanan County and most of these beds crop out where faulting and folding have obscured their relationships. Elsewhere the formation is beneath the surface and its coal resources can be ascertained only with the drill. The record of one boring, made on Seng Camp Fork of Dismal Creek, gives information concerning the southeastern border of the county (see p. 13). Drilling has also been done on upper Russell Fork and on Indian Creek by the Clinchfield Coal Corporation,<sup>1</sup> but the thicknesses of the coal beds encountered have not been made public and only the top of the Lee was penetrated.

Certain deductions concerning Lee coals can be made on the basis of exposures and borings in neighboring parts of adjacent counties. All of the formation is exposed on Pine ("Cumberland") Mountain in northern Dickenson County, Virginia, and in an overturned area in Russell County, Virginia, a short distance southwest of Big A Mountain. No economically important coal was found in these places, though exposures are poor and some thick deposits might have escaped notice. Part of the Lee, however, is clearly exposed in The Breaks, close to the western extremity of Buchanan County, and no minable coal was found in it. This is in harmony with the known tendency of the lower coals to thin out to the north and west in the Appalachian fields. A few imperfect drill records from Pike County, Kentucky, also indicate the absence of the lower coals from northern areas.

In the southern part of McDowell County, West Virginia, and the northern part of Tazewell County, Virginia, in areas not far from the head of Dismal Creek, Lee coals, including the famous Pocahontas beds, have been mined and opened by prospectors. There is a strong probability, therefore, that some of these beds are sufficiently thick to justify exploitation in some localities in the eastern parts of the Levisa Fork, Dismal Creek, and Slate Creek basins, and possibly in neighboring areas. The-

<sup>1</sup>Hinds, Henry, Coal resources of the Clintwood and Bucu quadrangles, Va.: Virginia Geol. Survey Bull. 12, Plate III, 1916.

oretical considerations are also fairly favorable for the Indian Creek basin and the area near the head of Russell Fork. Details as to the probable depths to the most promising horizons will be given with the detailed descriptions of coal in those drainage basins which are near the mining areas mentioned in McDowell and Tazewell counties.

The somewhat inadequate data upon which suppositions are based leads to the conclusion, therefore, that some Lee coals are sufficiently thick to be minable under good market conditions in parts of the southern portion of Buchanan County, especially in the southeastern quarter. The prospects are much less favorable in the northern portion of the county, especially in the northwestern quarter. Most or all of the famous Pocahontas coals are absent from the northern border. Holders of large tracts of land in any part of the county, however, should not be satisfied until they have drilled at least one hole to the top of the red and green shales and sandstones of the Mississippian series.

Analyses of Lee coals mined on a large scale at War, McDowell County, West Virginia, and at Seaboard and Coaldan, Tazewell County, Virginia, are given elsewhere in this report (p. 234). These mines are within a few miles of the head of Dismal Creek.

### Coals in the Norton formation.

#### TILLER COAL.

The lowest coal of much commercial importance in the Norton formation is the Tiller, though there are some coal deposits in the 150-foot interval between it and the top of the Lee formation. The rocks in this interval are alternating shales and sandstones with no striking characteristics, except that an exceptionally coarse and locally pebble-bearing sandstone lies a few feet below the coal. The Tiller is above the surface only along Indian Creek, along Russell Fork near Council, along Levisa Fork near the mouth of Dismal Creek and south of Marvin, along Garden Creek near its head, and along upper Dismal Creek and its tributaries. The position of its outcrop in the Russell Fork drainage basin is shown on the geologic map; elsewhere it can be deduced from the outcrop of the Jawbone coal, which is 100 feet or less above it.

The Tiller makes its best showing near the heads of Indian and Dismal creeks, where it is united with the Jawbone coal and will be described with that bed. Where separated from the Jawbone the Tiller is 2 feet or less thick in most areas. Along Lambert Fork of Indian Creek, however, as

well as along Russell Fork and on Grassy Creek of upper Levisa Fork, the Tiller contains  $2\frac{1}{2}$  to nearly 5 feet of coal.

The name Tiller was first applied by Stone to the thick coal bed on upper Indian Creek. As the upper part of this thick deposit is now known to be the equivalent of the Jawbone, the name Tiller is restricted to the lower part in this report. The Lower Iaeger coal of the West Virginia Geological Survey is probably the Tiller.

The Tiller has been utilized at the "slope mine" of the Clinchfield Coal Corporation in Russell County, about 4 miles southwest of the head of Indian Creek, and at the "East mine" of the Big Town Hill Creek Coal Corporation in Tazewell County, about  $1\frac{1}{2}$  miles northwest of Richlands. Analyses of coal samples from these mines are given elsewhere in this report (p. 236).

#### JAWBONE COAL.

A coarse, quartzose, locally pebble-bearing sandstone separates the Jawbone coal from the Tiller, the interval between the two being 100 feet or less. The bed is above the surface in the same localities as the Tiller, though its outcrop is, of course, slightly longer. The position of the bed in the Levisa Fork drainage basin is shown on the geologic-map. Its outcrop is not mapped in the Russell Fork drainage basin, but can be determined from the fact that it is coincident with that of the Tiller at the head of Indian Creek and is 10 to 100 feet above that bed in other parts of the area. The Jawbone derived its name from Jawbone Hollow, a tributary of Bull Run between Virginia City and Banner in Wise County. It is the same as the Iaeger coal of the West Virginia Geological Survey.

As already mentioned the Jawbone and Tiller coals unite near the heads of Indian and Dismal creeks. These combined beds contain an aggregate thickness of  $4\frac{1}{2}$  to 15 feet of coal, though shale and other partings render the upper part unworkable in places. The Jawbone alone is 2 to 6 feet thick on Russell Fork near Council, 3 to 6 feet thick in the Dismal Creek drainage basin southeast of Dwight,  $2\frac{1}{2}$  to 6 feet near the head of Garden Creek, 2 to 5 feet in the upper Levisa Fork region and along Contrary Creek, and 3 feet or less along Levisa Fork west of Marvin and along lower Dismal Creek. The Jawbone is below the surface in the northern and western parts of the county, so that its thickness there is problematical. It is almost certainly fairly thick under upper Slate Creek and the headwaters of Knox Creek. It may also be of minable thickness in areas farther west and northwest, though its absence from Pine Mountain and



## RAVEN COAL.

There is a thin coal a short distance above the Jawbone, but the next higher bed of much economic importance is the Raven. The Raven crops out in many of the principal valleys in the southern half of the county, but is shown separately on the geologic map only near Sandy Ridge, where it is thickest. Its position in other parts of the county can be easily determined from the fact that it is about halfway between the Kennedy and the Jawbone coals, being about 200 feet below the former and about 150 feet above the latter. In the southeastern part of the county the Raven is only a short distance below a coarse, cliff-making sandstone that contains many large pebbles. This rock thins and becomes finer grained to the northwest and another sandstone just below the Raven takes its place as the best marker for the coal prospector.

The name Raven or "Raven Red Ash" was given to this bed in Tazewell County, where it has been mined for many years at Red Ash, near Raven. In a former report on part of Buchanan County,<sup>1</sup> the writer called this coal the Garden Hole, a name used locally in northern Dickenson County. As Mr. T. K. Harnsberger and the writer have now traced the bed from the Garden Hole to Raven, it seems best to substitute the better-known commercial name for the one not in common use. The Raven is probably the same as the "so-called Imboden" of Campbell's reports on the Coeburn region, but, as that authority has shown, it is not the true Imboden so famous west of Norton. It is the same as the Lower Douglas coal of the West Virginia Geological Survey.

In most of southeastern Buchanan County the Raven coal is in two benches only a few feet apart, and a higher coal, which is commonly thin, appears locally 25 to 80 feet above them. On the southeastern border of the Dismal Creek basin and in a small area near the head of Indian Creek the two benches unite to form a bed containing 3 to 5 feet of minable coal. Where the two benches are separated only one is minable in most places and it is commonly less than 3 feet thick. In parts of the upper Levisa Fork and upper Dismal Creek regions, however, one bench contains 3 to 4 feet of coal. One Raven bench and the coal a short distance above the Raven thin out to the north and northwest and the thickness of the other Raven bench decreases in the same directions to about 2 feet or less on Slate Creek and along Levisa Fork northwest of Grundy. (See fig. 5.)

<sup>1</sup>Hinds, Henry, Coal resources of the Clintwood and Bucu quadrangles, Va.: Virginia Geol. Survey Bull. 12, p. 46, 1916.



The fuel value of the Raven is excellent, as shown by the analyses of mine samples from the large mines at Jewell and Red Ash in Tazewell County (p. 237). The Jewell samples were collected under Sandy Ridge near the head of Laurel Fork of Dismal Creek. The Red Ash samples were obtained only about 3 miles south of the head of Levisa Fork.

#### AILY COAL.

The name Aily was applied by the writer to a thin but persistent coal about halfway between the Raven and Kennedy beds in Dickenson County. This bed was also found in many parts of Buchanan County, though it is less than 2 feet thick except in parts of the Russell Fork and upper Dismal Creek basins, where it is 2 to 3 feet thick.

#### KENNEDY COAL.

A coal that lies about 200 feet above the Raven in most of Buchanan County has long been known as the Kennedy or Widow Kennedy in mining districts southwest of the region. It is the same as the Douglas coal of the West Virginia Geological Survey and is known locally as the Harris along upper Levisa Fork. Because of the coarse, massive sandstone which forms conspicuous ledges a few feet below it, the Kennedy is one of the most easily recognized horizons in the Virginia field. Its outcrop is plainly shown on the geologic map of Buchanan County as the boundary between the upper and lower parts of the Norton formation.

Southwest of Russell Fork the chief characteristics of the Kennedy are its generally crushed condition and its great irregularity in thickness, and these features have caused loss to operators who have attempted to mine it in parts of Russell and Wise counties. Northeast of Russell Fork the bed is crushed in only a few localities, though some of the irregularity in thickness is evident. The Kennedy contains about 3 to 4½ feet of minable coal along Levisa Fork between the mouth of Dismal Creek and Marvin, in most of the Garden Creek basin, along upper Dry Fork of Prater Creek, and near Council. It is 2½ to 3 feet thick around the borders of this area (see fig. 6), and is nearly 2½ feet thick along most of Slate Creek and part of Dismal Creek. Elsewhere in the region the coal is about 2 feet or less in thickness, and it may be absent from the northeastern and northwestern corners of the county.

The Kennedy is mined for shipping purposes in several moderately large mines near Drill, in Russell County, only 4 miles nearly east of

Council. Analyses of samples from two of these mines are given elsewhere in this report (p. 238).

#### BIG FORK COAL.

There are two coals between the Kennedy and Lower Banner beds on and near Sandy Ridge and in a few other areas, but the lower one, which lies about 40 to 100 feet above the Kennedy, is too thin to be of value. The higher bed is slightly thicker and more persistent and is here given the name Big Fork because it is mined for household purposes in many small pits on Big Fork and neighboring ridges. This bed is immediately beneath the massive sandstone which underlies the Lower Banner coal and its distance from the Lower Banner is most commonly about 60 feet, though very irregular. The Big Fork can be considered minable only on and near Sandy Ridge and even there it is very dirty, has a maximum thickness of about 3 feet, and is less than 2 feet thick in most places.

#### LOWER BANNER COAL.

The Lower Banner coal is only a few feet above the sandstone mentioned in the last paragraph and is about 175 feet above the Kennedy bed. Where the coal is thickest its line of outcrop is shown separately on the county geologic map; elsewhere its position can be easily determined from its relations to the Kennedy outcrop below and the Splash Dam outcrop above. The name Lower Banner was applied many years ago to one of the principal coals of southwestern Virginia, and it is now extensively mined in Russell County at Dante and Wilder. It is known locally as the Cary seam along Levisa Fork near Marvin and Hanger, and is the same as the Gilbert coal of the West Virginia Geological Survey.

The Lower Banner has its best development in the Keen Mountain district, being exceptionally free from partings and 4 to 6 feet thick on nearly all parts of the ridges bordering main Garden Creek, Levisa Fork southeast of Dismal Creek, and Dismal Creek between Mill and Hale branches. (See fig. 7.) The minable thickness decreases considerably within short distances from this district, both because the thick bed splits into two parts and also because each part thins. The minable coal is 3 feet thick in a few rather small areas, the chief of which are on Sandy Ridge at the heads of Russell Fork and Garden Creek and in part of the Knox Creek basin south and northwest of Hurley. Elsewhere the coal is 2 feet thick or less, and it is probably very thin in nearly all of the western third of the county.

Analyses of Lower Banner coal samples from the large mine at Wilder, only 4 miles southwest of the southwest corner of Buchanan County, are given in a table in this report (p. 238).

#### UPPER BANNER COAL.

The average interval between the Lower Banner and Upper Banner coals is about 80 feet, the higher bed lying only a few feet below the massive sandstone bottom-rock of the Splash Dam coal. The Upper Banner is one of the best known and most important coal beds in Russell, Dickenson, and eastern Wise counties and is extensively mined near Wilder, Dante, and Coeburn. In Buchanan County, however, it is not one of the best beds, as it is very thin except in a few localities. Its line of outcrop is shown near the head of Indian Creek on the county geologic map and can be estimated elsewhere by reference to the position of the Lower Banner and Splash Dam coals.

On Sandy Ridge near the head of Indian Creek the coal is in two benches, the thickest being  $3\frac{1}{2}$  feet thick or less. On and near the State line ridge at the heads of tributaries of Dismal and Slate creeks coal tentatively correlated with the Upper Banner is as much as 3 feet thick in places. In most other parts of the county the bed is less than 2 feet thick, and it may be absent from large areas in the northern part of the region.

Analyses of coal samples from a large mine in the Upper Banner at Wilder, Russell County, are given elsewhere in this report (p. 239).

#### SPLASH DAM COAL.

The Splash Dam bed is a few feet above a ledge-making sandstone and is about 60 feet above the Upper Banner coal. Its outcrop is shown separately on the county geologic map, except south of Russell Fork where its position can be easily determined by reference to that of the Upper Banner. This coal is one of the most persistent beds in the county, it can usually be identified easily in the field, and it has a long outcrop in nearly every valley; it has been used in this report, therefore, as a datum to which the stratigraphic position of other beds is referred and which forms the chief basis for the structure contours.

The name of this coal is derived from its exposures at a splash dam near the mouth of Pound River in Dickenson County. It has been called the Wilson seam along upper Levisa Fork near Marvin, but is slightly

lower than the so-called Wilson of Prater Creek. It is the same as the Glenalum Tunnel coal of the West Virginia Geological Survey.

The Splash Dam has its best development in the basins of Conoway, Bull, and Poplar creeks, where it contains 4 to 7 feet of minable coal and shale partings that would be seriously troublesome in only a few localities. The proportion of workable coal decreases considerably within short distances from the borders of this area, chiefly because some of the partings thicken and split the bed into two or three parts, only one of which could be profitably mined. A large portion of the northern part of the county, however, in addition to the area just mentioned, contains  $2\frac{1}{2}$  to 4 feet of recoverable coal in the best bench of the Splash Dam. (See fig. 4.) There are also a few small areas of 3-foot coal on the ridges bordering Garden Creek and at the east end of Keen Mountain. In most other districts the best bench contains only about 2 feet of minable coal.

No large mines utilize the Splash Dam in or near Buchanan County, but it is believed that fresh coal samples were obtained in two small mines, one near Big Rock in Buchanan County and the other near the mouth of Russell Prater Creek in Dickenson County. Analyses of these samples are published elsewhere in this report (p. 240).

#### HAGY COAL.

The highest persistent coal in the Norton formation is the Hagy, a bed lying a few feet above a ledge-making sandstone and about 110 feet above the Splash Dam bed. A coal was found about 100 feet above the Hagy in a few places in the northeastern part of the county, but its acreage is small. Although the Hagy outcrop is not shown on the county geologic map, its position can be easily determined from its relation to the Splash Dam outcrop.

The name Hagy was given this bed by the writer because of exposures near Hagy School at Leemaster and in the Hagy mine on Trace Fork of Prater Creek. It is the same as the Lower War Eagle coal of West Virginia and may be the same as the Edwards bed of Campbell, which he tentatively correlates with the true Imboden of the Big Stone Gap coal field.

In most of the western border of the county the Hagy is fairly free from shale partings and is  $2\frac{1}{2}$  to about 4 feet thick, averaging about 3 feet. It is  $2\frac{1}{2}$  to about 3 feet thick in parts of the Slate Creek and upper Knox Creek basins. (See fig. 5.) It was not found in most of the northern border of the county east of Levisa Fork, either because it is absent or

because prospecting is incomplete. It is thin near the head of Guess Fork of Knox Creek. It is probably thin south of Dismal Creek and in the southeastern part of the Russell Fork basin, and underlies only small areas on the ridges.

### Coals in the Wise formation.

#### GLAMORGAN COAL.

The Glamorgan coal is less than 15 feet above the base of the Wise formation and is about 200 feet above the Haggy bed. Its line of outcrop is practically the same as the boundary mapped between the Wise formation and underlying beds. The type locality of the coal is Glamorgan in Wise County, where it is mined for shipment. It is called the Cedar coal by the West Virginia Geological Survey. In many places there are two or more coal benches separated by several feet of shale, and the top bench is probably the Lyons coal of Wise and Dickenson counties and the Little Cedar coal of West Virginia.

The Glamorgan is thickest along and near Barts Lick Creek, but shale partings commonly reduce the thickness of minable coal to an aggregate of  $1\frac{1}{2}$  to 3 feet. The best bench probably contains 2 to  $3\frac{1}{2}$  feet of minable coal in most other areas. Exposures are rare and little is known about the bed in many large districts.

#### BLAIR COAL.

The Blair bed, so named by Butts in northern Wise County, is about 60 feet above the Glamorgan and is probably the same as the Bens Creek coal of the West Virginia Geological Survey. The position of its outcrop is not shown on the county geologic map, but can be easily determined because of the short interval between it and the base of the Wise formation.

The Blair is thick on the ridges bordering Russell Prater and Little Prater creeks, the aggregate thickness of minable coal ranging from a few inches to as much as  $5\frac{1}{2}$  feet. It contains 3 to  $6\frac{1}{2}$  feet of coal along Poplar, Looney, and Linn Camp creeks. In all these areas, however, several shale and bone partings decrease the value of the bed and in places separate the coal into benches several feet apart. Along Home and Rocklick creeks and the large western tributaries of Knox Creek the minable coal is about  $2\frac{1}{2}$  to 4 feet thick in most districts. In other parts of the county the Blair was either not found or could not be differentiated from the Eagle coal with certainty.



elsewhere by its relations to the Clintwood coal outcrop and the geologic boundary at the base of the Wise formation. In the field the position of the coal is marked by a coarse, massive sandstone, which is a few feet above it and which makes conspicuous cliffs and ledges. A thin and unimportant coal appears locally in this sandstone, not far above the Eagle.

Except in small areas at the heads of Barts Lick and Little Greenbrier creeks, north of Rocklick Creek, and in a few other places, the Eagle contains more than 30 inches of minable coal in the region from which it has not been removed by erosion. (See fig. 6.) In the greater part of the region the coal is about 3 feet thick, but in a few places, notably near the head of Russell Prater Creek and in a large area along and near Lester Fork of Knox Creek, it is about 4 to 5 feet thick.

In another part of this report (p. 240) are given typical analyses of Eagle coal from two large mines in the War Eagle district of West Virginia and from moderately large mines near Blackey, Buchanan County, and near Mart, on a branch of Barts Lick Creek in Dickenson County.

#### CLINTWOOD COAL.

The coal named Clintwood because of its great thickness near the seat of Dickenson County is about 95 feet above the Eagle and is separated from it chiefly by massive sandstone which crops out conspicuously beneath a thick overlying series of less resistant beds. The Clintwood is the same as the Matewan coal of the West Virginia Geological Survey and has been called the Feds Creek seam on Rocklick Creek and in neighboring parts of Kentucky. The position of its outcrop is shown on the geologic map in the northwestern and north-central parts of the county and may be easily estimated elsewhere from its relation to the Eagle outcrop.

The Clintwood is 2½ to 7 feet thick in most of the northern part of the county west of Knox Creek and is free from partings in many places where it is thick. (See fig. 7.) The bed underlies only the high ridges in most areas, but has sufficient tonnage to justify more attention than it has yet received from prospectors. The coal was not found east of Knox Creek and may be thin in part of that area, though certainly minable in places. It has been removed by erosion from all of the southern and southeastern parts of the county.

#### CAMPBELL CREEK COAL.

The Powellton coal, about 65 feet above the Clintwood, was not found, though it may be present. The next higher coal is the Campbell Creek



As shown by its outcrop on the county geologic map, the Campbell Creek is confined to the northern part of the county and underlies only very small areas except near the Kentucky boundary. It has been opened in only a few places. East of Knox Creek it is in two benches a few feet to 50 feet or more apart, the lower bench containing  $3\frac{1}{2}$  to 5 feet and the upper bench 2 to 3 feet of workable coal. The only measurement obtained west of Knox Creek is one of  $34\frac{1}{2}$  inches on Hunts Fork of Pawpaw Creek. It is reported to be 5 feet thick at the head of State Line Branch of Levisa Fork. Openings in Kentucky indicate that the bed includes about  $2\frac{1}{2}$  to 6 feet of coal in parts of the Pawpaw Creek and Rocklick Creek basins.

An analysis of a sample of Campbell Creek coal from a large mine in the War Eagle, W. Va., district, only 2 miles from Buchanan County, is given in another part of this report (p. 241).

#### LITTLE ALMA AND ALMA COALS.

The characteristics of the Little Alma and Alma coals in Buchanan County are not well known. The position of their outcrops on the geologic map may be inferred from their relations to the Campbell Creek, the Little Alma being about 100 feet above the lower bench of that bed and the Alma about 50 feet above the Little Alma. The Little Alma is thought to be less than 2 feet thick, and the Alma about  $2\frac{1}{2}$  feet thick.

#### LOWER CEDAR GROVE AND CEDAR GROVE COALS.

A coal about 60 feet above the Alma and 210 feet above the Campbell Creek is known in West Virginia as the Lower Cedar Grove, or, locally, as the Lower Thacker. A coal 80 feet higher is called the Cedar Grove and, locally, the Red Jacket, Thacker, and Upper Thacker. As shown by the outcrop of the higher bed on the geologic map, these two coals underlie only very small areas on the northern border of Buchanan County, being confined to the high ridges between Pawpaw and Rocklick creeks and to some of those north and northeast of Upper Elk Creek. In the northern tip of the county both beds are very thick, the Lower Cedar Grove containing an aggregate thickness of 9 feet of minable coal in one pit, and the Cedar Grove about 15 feet of coal in two pits.

The quality of the Cedar Grove coal is shown by an analysis of a mine sample from near Matewan, W. Va., given in another part of this report (p. 241).

**DETAILED DESCRIPTION OF COAL BY DRAINAGE BASINS.****Method of statement.**

In this region the construction of railroads and exploitation of coal resources will necessarily be planned with special reference to the positions of the principal valleys, as well as to the location of the thickest and most widespread coal deposits. It has been deemed advisable, therefore, to treat each of the principal drainage basins separately. Each coal bed in each of these basins is described separately, beginning with the lowest, and its outcrop is traced along one side of the major stream, including tributaries on that side, and back along the other side. A brief summary of the stratigraphy, structure, and principal coal resources of each basin is given first, and summaries of the principal points of interest concerning each coal bed are given at the beginning of the detailed description of that bed.

To each measured coal exposure is given a number which corresponds to the number opposite its location on the county geologic map accompanying the report. Since the numbers are assigned in the order in which the exposure is mentioned in the text, it is easy to refer from the map to the written descriptions. Unless otherwise stated, all measurements were made by the writer or his assistants.

The elevations given are not all of the same degree of accuracy. Most of them were obtained with aneroid barometers which were frequently reset at bench-marks but which were not absolutely reliable when weather conditions were changing rapidly. Readings farthest from the main roads are most likely to be in error. The elevations of many exposures that are within sight of roads upon which there are topographic bench-marks or stadia stations were measured with stadia and are accurate within a very few feet. Some elevations of the Lower Banner coal in the Keen Mountain district were measured with transit by engineers of the Big Vein Pocahontas Co. All elevations which are not multiples of five were obtained with stadia or transit or by hand-leveling from neighboring topographic stations.

Many measurements of coal, chiefly those more than 30 inches thick, are shown in graphic sections and are also described in the text. The numbers at the sides of the graphic sections indicate thicknesses in inches those on the right being for layers of coal, and those on the left for partings that would be discarded in mining.

### Upper Russell Fork and tributaries.

*General features.*—The principal streams in the area discussed, in addition to Russell Fork itself, are Indian Creek and its eastern tributaries, and Grissen, Hurricane, Little Fox, Fox, Pawpaw, and Little Pawpaw creeks. Aside from older rocks in faulted areas, which are mentioned below, the strata exposed include the upper 150 feet of the Lee formation, the Norton formation and the Gladeville sandstone, and the lower 350 feet of the Wise formation. Most of the valley slopes are formed by the Norton formation. The character of the exposed beds is shown by generalized sections 3 and 4 (Pl. II) and by local sections 1, 2, 3, 4, 5, and 14 (pp. 24-26 and 32). Most intervals between beds are greater on the southeast than on the northwest.

Several structural features will have an important effect upon the commercial development of the coal resources, and these include great overthrusts on the southeast and shear faults and buckling along Russell Fork, described on pages 57 and 58. As a result of the buckling there are along and near Russell Fork narrow strips in a large part of which the crushing of the coal and the steep and irregular dips would make mining unprofitable. These strips are shown on the geologic map as undifferentiated Pennsylvanian, but it is chiefly the lower half of the Norton formation that is known to be exposed. As a result of the overthrust faults a small area on the slopes of Big A Mountain contains no coal, the surface rocks belonging to formations that underlie all coal beds. The small area of Lee exposed at the head of Lambert Fork may contain some coal. This part of the Lee, however, together with the non-coal-bearing Pennington shale southeast of it, has been overturned and thrust to the northwest, all the beds now dipping to the southeast at angles of 30° or more. The still older Silurian and Ordovician rocks forming the top and the northwestern slopes of Big A Mountain have not been overturned, but have been thrust upward and far to the northwest. Rocks on most of the mountain top lie nearly level, but the Clinch sandstone dips at fairly high angles to the southeast and south. The Clinch is a massive, white, quartzose sandstone that forms conspicuous cliffs and has often been mistaken for part of the Lee formation, though its normal position is several thousand feet below that of the Lee.

The dips in most of the area not included in the faulted zones described in the last paragraph are to the northwest at low angles, as in most of Buchanan County. Because of the Sourwood Mountain and Dry Fork anticlines, described on pages 55 and 56, the dips are to the southeast in the

southeastern part of the area, and are more than 500 feet per mile near the head of Lambert Fork.

The area contains some important coal deposits in the Tiller, Jawbone, and Raven beds on the upper part of Indian Creek, in the Tiller and Jawbone locally along Russell Fork near Council, and in the Kennedy along Russell Fork and its tributaries east of Hurricane. (See figs. 4, 5, 6, and 8.) The Lower Banner may be about 3 feet thick locally on Grissen Creek and Sycamore Fork, and the Upper Banner contains  $3\frac{1}{2}$  feet and less of coal along the upper part of Lambert Fork. In most other localities these beds are less than 3 feet thick, as are also a number of coal beds at other horizons, though in many places the thinner deposits are utilized for local supplies and will play a more important part in a more or less distant future. That part of the region which lies north of Russell Fork has not been thoroughly prospected and comparatively little is known about parts of the Hurricane Creek basin and the territory northwest of it. The possibilities of at least the north border of the region are indicated by prospect pits on the opposite side of the divides—on War Fork of Russell Prater Creek, on both forks of Prater Creek, and on the right fork of Garden Creek—and the reader is referred to the description of them for further information. The Hazy bed may be 3 or 4 feet thick near the heads of Fox and Pawpaw creeks, and the Glamorgan, the Blair, and especially the Eagle beds are fairly thick in the same districts, though underlying only small areas on the ridge tops. (See figs. 5 and 6.)

The thickest coal deposit is in the united Tiller and Jawbone beds, in which there are 5 to 15 feet of coal on Cane Gap Creek and Patton Branch of Indian Creek. North of this district the two beds separate, though both contain minable deposits in many exposures. The Raven bed is persistent, though less than 30 inches thick in most places. Near the heads of Cane Gap Creek and Patton Branch it contains 3 to 5 feet of coal with only thin shale partings. The Kennedy is also persistent and thin in most places, and is irregular in thickness everywhere. It is reported to be as much as 4 feet thick locally on the divide between Lambert Fork and Indian Creek, though thinner in most places. On Fuller Branch and other streams near the head of Russell Fork it contains  $2\frac{1}{2}$  to 4 feet of minable coal in many places, and furnishes the coal mined and shipped from Drill and other places on Lewis Creek in Russell County.

Only deeper drilling than has yet been done in this area can determine whether the Lee formation contains coals that could be profitably mined

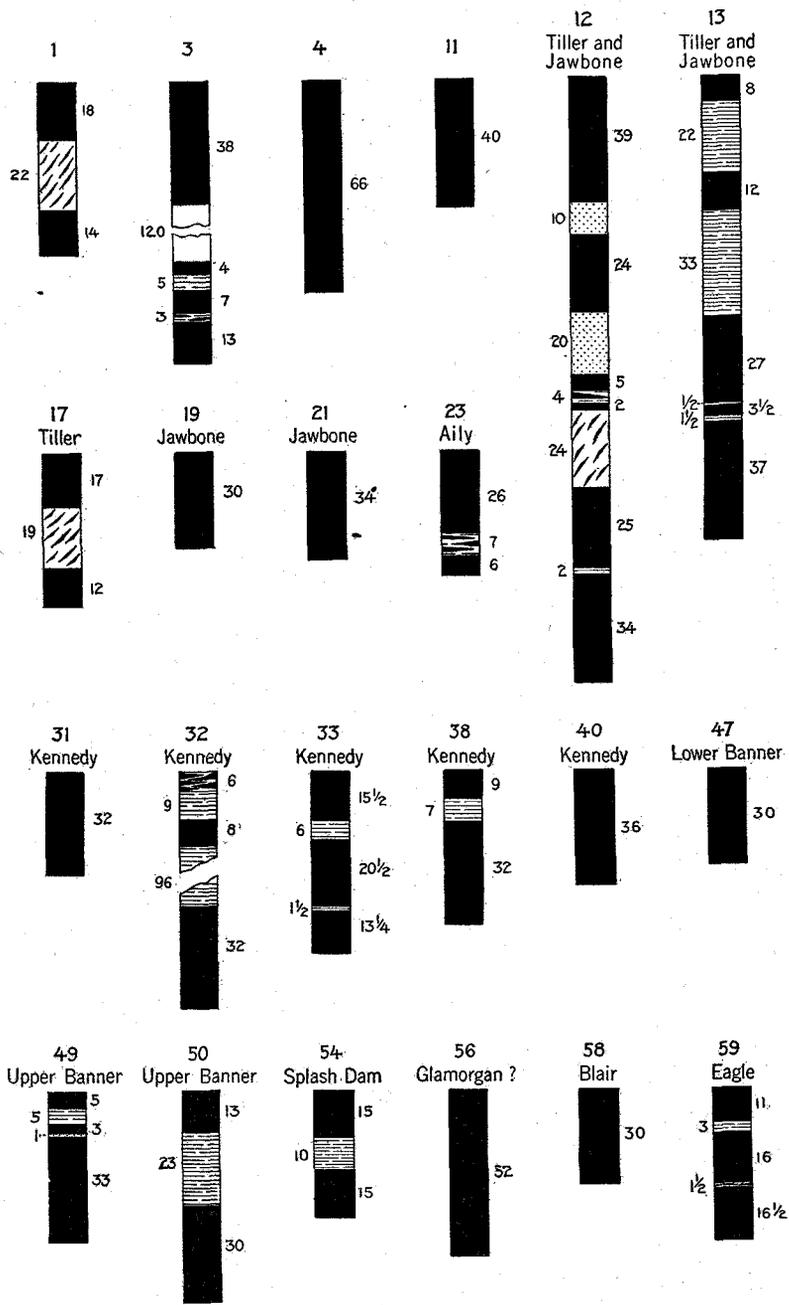


Fig. 8.—Sections of coal beds in the upper Russell Fork basin.

by shafting. Here, as elsewhere in the southern part of Buchanan County, there is a fair probability that some of the Lee coals are minable.

*Outcrops not correlated.*—The rocks along and near Russell Fork that are mapped as undifferentiated Pennsylvanian include several coal beds, and there are many prospect pits in coal 1 to 5 feet thick. Most of these pits are on the southern slopes of Russell Fork valley east of Davenport and are chiefly in the Tiller and Jawbone beds. The presence of one or more faults and of steep and irregular dips in parts of this district makes it inadvisable to attempt to make exact correlations.

Coal in a small mine southeast of Davenport (location 1, elevation 1,690) is overlain by a thick bed of coarse sandstone containing a few pebbles and may be the Tiller bed. There are 22 inches of rash in the middle, with 18 inches of coal above it and 14 inches below. Another opening in the same neighborhood (location 2, elevation 1,575) is in 30 inches of coal under a sandstone cap like that just mentioned. There are several exposures and pits near the mouth of Carroll Presley Branch, a small stream west of Hale School, one of which shows coal 30 inches thick at an elevation of 1,730 feet, and another is in 22 inches of coal at an elevation of 1,600 feet. The following measurements were made at a pit a short distance west of the two just mentioned:

*Coal beds on Carroll Presley Branch.*

(Location 3, elevation 1,750.)

	Ft.	in.
Shale.....		
Coal .....	3	2
Concealed .....	10	
Coal .....		4
Clay shale .....		5
Coal .....		7
Shale and coal .....		3
Coal .....	1	1

A clean bed of coal 66 inches thick was seen half a mile southwest of Council (location 4, elevation 2,085). A few feet of shale that forms the roof is overlain by 50 feet of sandstone. Coal at least 28 inches thick lies under a thinner sandstone bed half a mile south of Council (location 5, elevation 1,900).

Only a few prospect pits in what appeared to be thin beds were found among the strata mapped as undifferentiated Pennsylvanian on the north side of Russell Fork valley. One bed is about 2 feet thick near Indian (location 6, elevation 1,450). There are 16 inches of coal, dipping south-

east, in the road west of Indian (location 7, elevation 1,440). A coal bed 23 inches thick outcrops beside the same road a short distance south of Murphy (location 8, elevation 1,403).

*Exposed coals below the Tiller.*—There are several thin and unimportant coal beds in the basal part of the Norton formation. A fairly persistent bed 30 to 60 feet below the top of the Lee formation is 28 inches thick in a hollow near the mouth of Lambert Fork (location 9, elevation 1,660), and at least 30 inches thick half a mile north (location 10, elevation 1,530). Near the level of Russell Fork half a mile southeast of the mouth of Hurricane Creek (location 11, elevation 1,503) coal 40 inches thick lies about 170 feet below the Tiller. Only sandstone shows at the coal horizon a short distance from the prospect pit.

*Tiller and Jawbone coals.*—The Tiller lies 900 feet below the Splash Dam coal horizon near Sandy Ridge and 840 feet below it near Council. Along the upper part of Indian Creek it combines with the Jawbone coal to form one remarkable bed said to contain 5 to 15 feet of coal. The upper or Jawbone part of the united beds contains several layers of shale and rash, and could not be profitably mined in some localities. Some of the rash, which is crushed, flaky coal mixed with more or less shale, might be utilized for certain purposes, but most of it is simply waste that would give much trouble in mines. Along Lambert Fork and lower Indian Creek the two beds are too far apart to be mined as one, but the Tiller contains some thick coal along its outcrop south and east of the mouth of Lambert Fork. Along Russell Fork the Tiller lies 30 to 90 feet below the Jawbone and a few feet below a coarse, siliceous sandstone containing quartz pebbles. The coal layers aggregate 2 to 4 feet thick, though a thick parting of impure coal and shale (rash) in the middle of the bed greatly impairs its commercial value. The Jawbone coal of the same locality is only a few feet above the conglomeratic sandstone cap-rock of the Tiller bed, is fairly clean in most places, and is 2 to about 6 feet thick. The roof of the coal is blue shale overlain by medium-grained sandstone.

The united Tiller and Jawbone coal is a notable bed along most of Cane Gap Creek, John Fork, and Patton Branch of Indian Creek. It is said, however, that the proportion of shale in the Jawbone member of the bed is greater near the mouths of those streams, and that the two members are rather widely separated by shale and sandstone farther north on Indian Creek. The first of the following measurements was made near the head of John Fork and the second opposite the mouth of Cane Gap Creek:

*United Tiller and Jawbone beds near head of Indian Creek.*

(Location 12, elevation 2,020.)

(Location 13, elevation 1,820.)

	Ft.	in.		Ft.	in.
Sandstone.			Shale .....	7	
Coal .....	3	3	Coal .....		8
Sandstone .....		10	Shale .....	1	10
Coal .....	2		Coal .....	1	
Sandstone .....	1	8	Shale .....	2	9
Coal .....		5	Coal .....	2	3
Shale and coal .....		4	Shale .....		1½
Coal .....		2	Coal .....		3½
Rash .....	2		Shale .....		11½
Coal .....	2	1	Coal .....	3	1
Shale .....		2			
Coal .....	2	10	Coal .....	7	3½
			Partings .....	4	9
Coal .....	10	9			
Partings .....		5			

The Tiller was found by Stone near the mouth of Puncheon Camp Branch of Lambert Fork (location 14, elevation 1,720), and is reported to be 57 inches thick, including an inch of shale and 3 inches of rash near the middle. Half a mile farther up Lambert Fork (location 15, elevation 1,690) the same bed is 32 inches thick. Northwest of the mouth of Lambert Fork the coal is probably thinner. No full measurement of the Jawbone bed was obtained on Lambert Fork or on lower Indian Creek except in the Indian Creek road near Sullivan Branch (location 16, elevation 1,462), where the coal is 29 inches thick. Blooms and caved pits do not indicate that the Jawbone is worth much where separated from the Tiller in the Indian Creek basin.

The Tiller has been opened at many places near Council and is well exposed in a mine a few feet above the level of Russell Fork less than half a mile southeast of the village (location 17, elevation 1,686). In this district the bed is in two benches separated by 19 to 36 inches of shale and a mixture of crushed coal and shale. The upper bench of coal is 12 to 18 inches thick and the lower bench is 9 to 22 inches thick. In one pit on Fuller Branch at Council the shale and impure coal parting is 5 feet thick.

The Jawbone is at least 22 inches thick by the wagon road up the right fork of Russell Fork (location 18, elevation 1,740), and is 30 inches thick on Fuller Branch, north of Council (location 19, elevation 1,720), where it is 60 feet above a pit in the Tiller bed. The coal is reported to be more than 3 feet thick at an abandoned mine on Dry Pen Branch (location 20, elevation 1,660). A small mine on Russell Fork west of Dry Pen Branch (location 21, elevation 1,680) is in a bed that is either the Jawbone

or about 35 feet higher, and is 34 inches thick. A partially caved pit in the Jawbone in a small hollow nearly a mile east of Davenport (location 22, elevation 1,645) is in coal 5 or 6 feet thick. Shale occupies the position of the lower part of this coal near Davenport.

*Raven and associated coals.*—The Raven lies about 190 feet above the Tiller and ranges from 700 feet below the Splash Dam coal horizon on the south to 600 feet below it on the north. In the northern part of the area it is in most places only 1 or 2 feet thick, but in the southern part, near the head of Indian Creek, it commonly contains 3 to 5 feet of coal with thin shale partings in the middle. The bed has been thoroughly prospected in the district last mentioned, but most of the prospect pits are caved and are difficult to find on the wooded slopes.

There are several coal beds between the Raven and the Kennedy, one being about 50 feet above the Raven and another, the Aily, about 100 feet still higher. Each of these coals is only a few inches to about 36 inches thick, but is used to supply local needs in a few places. The Aily makes a good showing south of Russell Fork on McFarlan Branch (location 23, elevation 1,985), where the coal is 39 inches thick, including 7 inches of impure coal and shale near the bottom, and lies under 80 feet of coarse sandstone that forms the bottom-rock of the Kennedy bed.

The Raven is about 30 inches thick in two pits near the mouth of Sycamore Fork, east of Council, and only 15 inches a short distance north, 20 feet above the railroad track up Grissen Creek (location 24, elevation 1,850). A mile farther up Grissen Creek (location 25, elevation 2,070) a coal 24 inches thick and 100 feet above the Raven horizon is 65 feet above the stream. The same bed is 19 to 27 inches thick on Harris Fork (location 26, elevation 1,995), and has a roof of 2 feet of clay shale under sandstone.

The Raven and associated coals are exposed low down in the valleys of both forks of Hurricane Creek. The Raven bed has been opened beside the road up Rockhouse Branch of the right fork (location 27, elevation 1,723), where it is 22 to 25 inches thick and lies under 9 feet of blue shale that grades upward into sandstone. The coal is reported to be about the same thickness in pits farther north on Hurricane Creek, but only 16 inches of what may not be a complete exposure shows in the road near the mouth of this fork (location 28, elevation 1,601). Half a mile west (location 29, elevation 1,530) the coal is 19 inches thick and underlies 7 feet of blue shale. The Raven is reported to be slightly thicker in pits farther north. No complete measurements of the coal beds between the

Raven and Kennedy horizons were obtained in the Hurricane Creek drainage basin, but the Aily was reported 2 to 3 feet thick in a few caved pits.

*Kennedy coal.*—The Kennedy is 400 feet below the Splash Dam coal horizon on the south side of the area, 375 feet on the northeast, and 325 feet on the northwest. Its outcrop, even on wooded slopes, may be easily found because of its position a few feet above a coarse-grained, cliff-making sandstone and under nearly 200 feet of shale and rather fine-grained sandstone that make long, gentle slopes. It is everywhere irregular in thickness and is thin or only moderately thick in most places. It makes a fair showing, however, along Russell Fork and its tributaries near and east of Council.

Near the heads of Indian Creek the Kennedy is only 2 feet thick or less, but on the divide north of Indian Creek and Lambert Fork the bed is reported to contain 12 to 48 inches of coal.

A bed about 100 feet above the Kennedy makes a conspicuous bloom in the wagon road at the head of Russell Fork, and 25 inches of coal, probably in the Big Fork bed, is exposed near it and 25 feet higher stratigraphically (location 30, elevation 2,215). The Kennedy itself is clean and 32 inches thick at the head of Grissen Creek, and shows plainly in a railroad cut (location 31, elevation 2,290), the roof being a few feet of sandy shale under thin-bedded sandstone and the floor a sandstone. The first of the following measurements was made near the head of Harris Fork and the second in a pit beside the road up Fuller Branch, half a mile northeast of Council:

*Kennedy bed on Harris Fork and Fuller Branch.*

(Location 32, elevation 2,115.)			(Location 33, elevation 2,142.)		
	Ft.	in.		Ft.	in.
Shale, blue .....	10		Shale .....	4	
Coal, dirty .....	6		Coal .....	1	3½
Shale .....	9		Clay .....		6
Coal .....	8		Coal .....	1	8½
Shale .....	8		Clay .....		1½
Coal .....	2	8	Coal .....	1	1¼
	<hr/>			<hr/>	
Coal .....	3	10	Coal .....	4	1¼
Partings .....	8	9	Partings .....		7½

The coal is about 2 feet thick and overlain by 5 feet of sandy shale on the slopes east of the principal fork of Hurricane Creek (location 34, elevation 1,915), and is 25 inches thick in two pits near the head of the

same fork (location 35, elevation 1,880, and location 36, elevation 1,990). Less than half a mile from the pit last mentioned (location 37, elevation 1,960) the coal is in two benches separated by 56 inches of shale, the lower bench being 18 inches thick and the upper 8 inches. Near the head of the left fork of Hurricane Creek (location 38, elevation 1,815), where the bed has a sandy shale roof and a sandstone floor, an upper bench of coal 9 inches thick and a lower bench 32 inches thick are separated by 7 inches of carbonaceous shale. On a tributary  $2\frac{1}{2}$  miles southwest (location 39, elevation 1,785) the coal is only 24 inches thick.

A short distance east of Murphy (location 40, elevation 1,589) the coal is 3 feet thick and has 4 feet of irregularly bedded shale in the roof. The Kennedy is 23 inches thick in a pit on the upper part of Little Fox Creek (location 41, elevation 1,630) and 25 inches on the lower part (location 42, elevation 1,480). It is 2 feet thick in two small mines near the mouth of Fox Creek (locations 43 and 44, elevation 1,420). The coal is 28 inches thick a little farther up Fox Creek (location 45, elevation 1,433), but the top 6 inches are slightly impure and slickensided. A pit on Pawpaw Creek (location 46, elevation 1,390) is in coal only 22 inches thick.

*Lower Banner coal.*—The Lower Banner horizon is 110 to 200 feet below that of the Splash Dam. The coal is 2 to 4 feet thick near Grissen Creek and other streams at the head of Russell Fork and also locally at the heads of Indian Creek, but is probably thinner elsewhere in this area.

In a spring near the triangulation station at the head of Patton Branch of Indian Creek (location 47, elevation 2,440) the coal is 30 inches thick, but blooms elsewhere in this locality indicate a thinner bed at the Lower Banner horizon. In a railroad cut near the head of Grissen Creek (location 48, elevation 2,470), the coal is 28 inches thick and is overlain by shale and underlain by at least a foot of clay resting on sandstone. No complete measurements of the Lower Banner were obtained west and northwest of Grissen Creek, but it is known that there is a general thinning of the bed to the northwest.

*Upper Banner coal.*—The Upper Banner has been thoroughly prospected only in an outlier on Sandy Ridge at the heads of eastern tributaries of Indian Creek, where the bed is in two benches and lies 50 feet below the Splash Dam horizon. The following two measurements were made at openings in which the thickness of coal is greater than in most places in the district in which they are located. The first section is on a small

western tributary of Lambert Fork, a short distance south of the mouth of Copperhead Branch; the second, which may not include all of the coal, is at the head of Copperhead Branch:

*Upper Banner bed near upper part of Lambert Fork.*

(Location 49, elevation 2,339.)		(Location 50, elevation 2,400.)	
	Ft. in.		Ft. in.
Sandstone.		Sandstone.	
Coal .....	5	Coal .....	1 1
Shale .....	5	Shale .....	1 11
Coal .....	3	Coal .....	2 6
Sandstone .....	1		
Coal .....	2 9	Coal .....	3 7
Sandstone.		Partings .....	1 11
Coal .....	3 5		
Partings .....	6		

The bed is probably thin nearly everywhere north of Russell Fork, the only complete measurement obtained being on Pawpaw Creek (location 51, elevation 1,660), where it is 25 inches thick, including 5 inches of clay, and lies 80 feet below the Splash Dam horizon.

*Splash Dam and higher coals.*—The Splash Dam coal outcrops well up on the principal ridges and is not well exposed in many places. It lies a few feet above a massive sandstone that forms the cap-rock of the Upper Banner coal bed and which contains many pebbles on the ridge northeast of Indian and in some other localities. There are thick sandstones between the coal and the top of the Norton formation, most of them being coarse, friable, and brownish. Where measured in three places the coal is 22 to about 36 inches thick and it is not likely to be much thicker elsewhere. At least 3 feet of coal bloom shows in the road on Fletcher Ridge, at the head of Hurricane Creek (location 52, elevation 2,395), with about 2 feet more 15 feet higher and a thinner bed 25 feet lower. Near the head of New Camp Branch of the left fork of Hurricane Creek (location 53, elevation 2,065) the bed is only 23 inches thick, including an inch of shale 5 inches from the bottom. The Splash Dam contains 30 inches of coal on the upper part of Fox Creek (location 54, elevation 1,800), split in the middle by shale 10 inches thick.

Few complete exposures of coals above the Splash Dam were found near Sandy Ridge and in the Hurricane Creek basin. The Haggy bed, which is 100 feet above the Splash Dam, may be 2 or 3 feet thick in the Hurricane Creek basin. In a pit at the north end of Big A Mountain (location 55, elevation 2,610) this coal is 30 or 36 inches thick. A 14-inch

coal lies 60 feet below the Gladeville sandstone on the high knob on Fletcher Ridge. What may be the Glamorgan bed consists of 52 inches of coal under 3 feet of shale in an opening near the wagon road at the head of Lambert Fork (location 56, elevation 2,358). The outcrop of this bed is very close to the fault which bounds the coal field on the south, so that the area of available coal is small. There may be several moderately thick coal beds in the small areas in which the Wise formation is exposed near Big A Mountain.

Few openings were found in beds higher than the Splash Dam on Fox and Pawpaw creeks and neighboring streams in this region. The following generalizations, therefore, are made from measurements in neighboring parts of the Russell Prater and Prater Creek drainage basins. The Hagy coal may be 3 or 4 feet thick near the heads of Pawpaw and Fox creeks. The Eagle bed, which is about 160 feet above the base of the Wise formation and directly under a thick sandstone, is 3 to 6 feet thick at the head of Pawpaw Creek, but underlies only very small areas. The Blair coal, 50 feet below the Eagle, is probably 2 or 3 feet thick.

The Hagy bed is reported to be 2 feet thick at the head of Little Pawpaw Creek (location 57, elevation 1,695), and may be slightly thicker. The Blair bed is 30 inches thick near the head of Little Pawpaw Creek (location 58, elevation 2,080). The Eagle has the following section on the ridge south of Pawpaw Creek:

*Eagle bed near head of Pawpaw Creek.*

(Location 59, elevation 2,190.)

	Ft.	in.
Clay, under sandstone .....	1	2
Coal .....		11
Shale .....		3
Coal .....	1	4
Bone .....		1½
Coal .....	1	4½
		<hr/>
Coal .....	3	7½
Partings .....		4½

RUSSELL PRATER, BARTS LICK, AND GRASSY CREEKS.

*General features.*—The rocks exposed in this area include those from about 100 feet below the Raven coal horizon, near the base of the Norton formation, to those 600 feet above the base of the Wise formation. The lowest rocks exposed along Russell Prater Creek in Buchanan County, however, are only a few feet below the Splash Dam horizon, and the lowest

along Barts Lick are only a short distance below the Gladeville sandstone. The general character of the rocks is shown by generalized section 1 (Pl. II) and by local sections 6, 7, 8, 9, and 13 (pp. 27, 28, and 31).

The structure of the area is governed largely by three features—the Middlesboro syncline, the Pine Mountain anticline, and the Pine Mountain fault—that are discussed on preceding pages in connection with the general description of the structure of the county. South of the axis of the syncline the general dip is northwest at low angles, though small anticlines and synclines, notably a syncline in the basin of War Fork of Russell Prater Creek, cause local alterations in the general dip. North of the axis of the syncline the strata rise toward the axis of the Pine Mountain anticline, and north of the latter they dip, in most places, to the northeast or north. Along the great Pine Mountain fault, which dies out near the head of Abes Fork of Grassy Creek, the rocks on the southeast have been thrust up and over those on the northwest, so that lower beds appear at the surface southeast of the fault than northwest of it. Strata northwest of the fault dip rather steeply to the northwest, but do not appear to have been greatly crushed or crumpled.

The lowest bed of much economic importance in the area is probably the Splash Dam. The Raven bed outcrops in a small area near the fault and may be fairly thick under part of the area, though probably too irregular in thickness to be reliable. Lower coals are probably thin or absent, as most of the coal horizons below the Raven are exposed in The Breaks and along Pine Mountain, not far from the mouth of Grassy Creek, and are barren of thick coal. Coals between the Raven and Splash Dam are also thin. The Splash Dam bed is in several benches, each only 25 inches or less thick where they outcrop in this area. It is probable, however, that these benches unite to form a thick coal deposit under part of the high lands bordering the Conoway, Bull, and Poplar Creek drainage basins.

The Hagy coal bed is minable throughout the area, being 2½ to 4½ feet thick along War Fork of Russell Prater Creek and along Cow and Abes forks of Grassy Creek, and 2 to 3½ feet thick along most other parts of its outcrop. The Glamorgan coal bed contains as much as 4 feet of coal locally, interbedded with thin layers of shale, but is thinner in most places and is commonly impaired by partings. The Blair, though found only in the Russell Prater Creek basin, and slightly thicker than the Glamorgan in places, is probably fairly persistent and similar to the Glamorgan so far as partings are concerned. The Eagle is an excellent

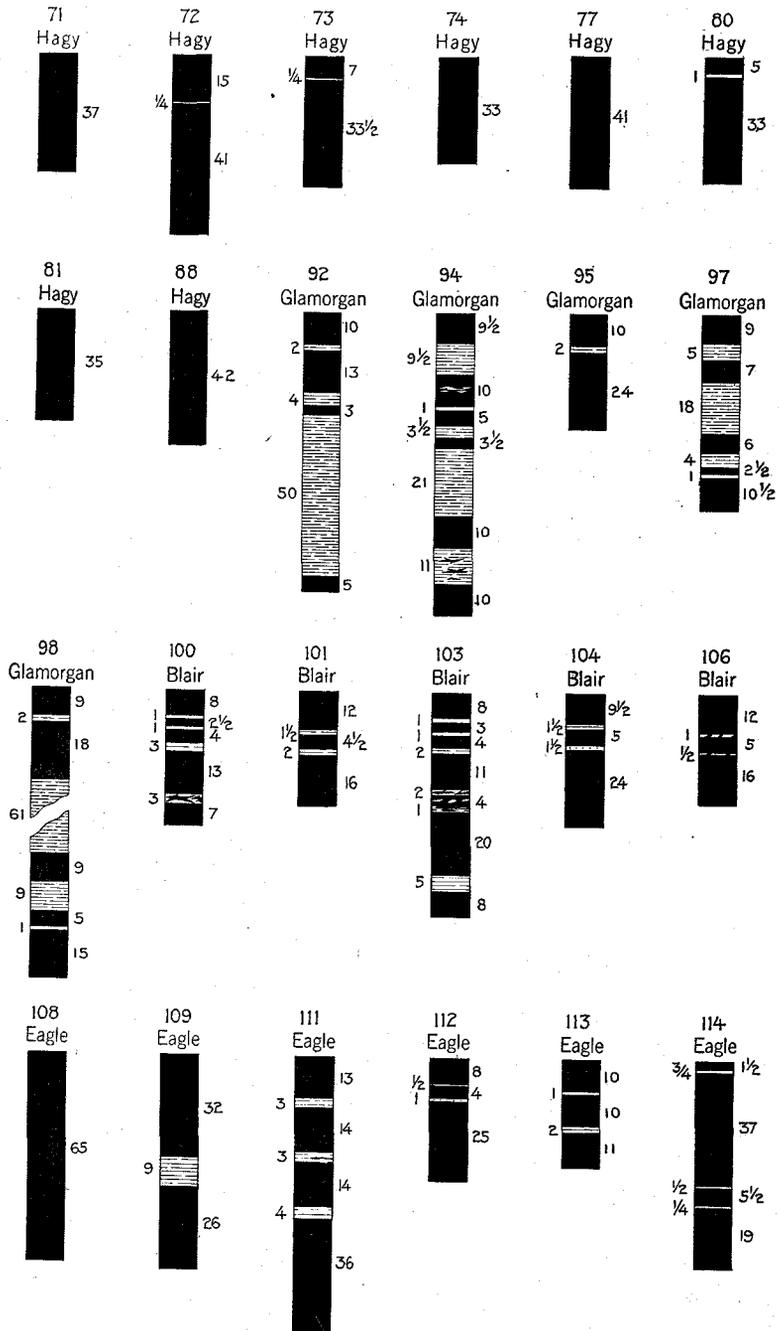


Fig. 9.—Sections of coal beds in the basins of Russell Prater, Barts Lick, and Grassy creeks.

bed locally, being fairly clean and containing 3 to 6½ feet of coal in parts of the Russell Prater Creek drainage basin. It may also be thick in some districts farther north, though underlying only small areas on the ridges. There is probably thick coal at horizons higher than the Eagle, but in still smaller areas. (See figs. 4, 5, 6, 7, and 9.)

*Raven coal.*—The Raven comes to the surface only for a short distance low in the valley between Jane and the Pine Mountain fault, where it is only about 475 feet below the Splash Dam horizon and a short distance below a thick, massive, quartzose conglomeratic sandstone that forms great cliffs along the creek northwest of Jane and also at the top of The Breaks, in a neighboring part of Dickenson County. The horizon of the Kennedy coal bed is at the top of this sandstone, 200 feet above the Raven, but no coal was found at it. The only opening in the Raven seam in this part of Buchanan County is three-fourths mile northwest of Jane, beneath the wagon road (location 60, elevation 1,275), where the coal is 26 inches thick and has a sandstone roof. Exposures in The Breaks show that this bed is very irregular in thickness.

*Splash Dam coal.*—The Splash Dam horizon can be easily traced because of its position just above a massive sandstone that forms fairly conspicuous ledges. The coal outcrops low in the valley of Russell Prater Creek and War Fork and parts of the Grassy Creek drainage basin, but is fairly high in the hills near the Pine Mountain fault. North of the fault, along lower Grassy Creek and Abes Fork, the bed is everywhere at low elevations. The Splash Dam is split into two or more separate beds along both Russell Prater and Grassy creeks in Buchanan County, and there are only 25 inches or less of coal in the pits examined in that area.

Halfway between the mouths of Greenbrier Creek and War Fork, in a spring beside the road (location 61, elevation 1,462), what is probably the thickest bench of the Splash Dam includes 16 inches of coal and an inch of shale and is overlain by 5 inches of black shale under sandstone. The roads up Russell Prater Creek and War Fork cross the Splash Dam bed many times. One coal bench, capped by 7 feet of shale, is 22 inches thick near the head of War Fork (location 62, elevation 1,700). Three benches, separated by two 10-foot shale beds, are exposed in the road half a mile north of Prater, the upper bench (location 63, elevation 1,530) being 19 inches thick and the other two partially concealed. The lower bench is 19 inches thick, including an inch of shale, in a pit between Prater and the exposure just mentioned, and the upper bench is 21 to 24 inches

thick in several exposures farther northeast. The middle bench, however, is probably very thin. Two benches are 16 feet apart near the mouth of Greenbrier Creek, as shown in a road cut (location 64, elevation 1,410) in which the lower bench is 16 inches thick and the upper is 17 inches.

Farther northwest, on Hunts Creek (location 65, elevation 1,495), one bench of the Splash Dam coal is 21 inches thick, and another bench 29 feet higher is only 9 inches thick. The thicker bench is reported to be 2 to 2½ feet thick elsewhere in this vicinity. On Middle Fork 1.2 miles east of Jane (location 66, elevation 1,515) the Splash Dam is 23 inches thick, with a streak of shale 3 inches from the top. The bed is nearly the same along most of Cow Fork and is 25 inches thick, including half an inch of shale near the top, in a pit 85 feet below a mine in the Hagy bed (location 67, elevation 1,605). Near the mouth of Cow Fork, just north of the Pine Mountain fault, it is only 17 inches thick in a pit (elevation 1,230) 80 feet below an opening in the Hagy at location 87. The Splash Dam shows near the level of Abes Fork, in several pits, some being in Virginia and some in Kentucky. A bed of sandstone here lies a few feet above the coal, though the roof is a plant-bearing shale. At the forks of Old House Branch (location 68, elevation 1,200) the coal is 25 inches thick, and is the same in a neighboring pit on Abes Fork (location 69, elevation 1,175). The coal has the same thickness near the mouth of the next southern tributary (location 70, elevation 1,210) and in two openings between it and location 69, though there is a bony layer in the lower half of the bed. Stone found 19 inches of coal in a higher bench of the Splash Dam, 20 feet above the lower.

*Hagy coal.*—The Hagy lies only 80 to 100 feet above the Splash Dam, so that nearly as much territory is underlain with it, and the position of its outcrop can be readily estimated by referring to that of the Splash Dam on the geologic map. This coal, like the Splash Dam, commonly lies on a bench formed by a massive sandstone; in most places the roof is bluish shale. The bed is clean, shale partings being commonly thin or absent. The Hagy is fairly thick and is minable in nearly all of the area, and is exceptionally good along War Fork of Russell Prater Creek, where it is 2½ to 4½ feet thick. Along Greenbrier Creek and the left fork of Russell Prater Creek and along Hunts Creek and Middle Fork the coal is 2 to 3½ feet thick. On Cow and Abes forks of Grassy Creek it is 3 to 4½ feet thick.

On a southern tributary of War Fork (location 71, elevation 1,730), the Hagy is 37 inches thick. The following two sections near the heads of

War Fork, the first at Larkin Owens' on the right branch of the stream and the second on the left branch, show the bed at its best:

*Hagy bed on War Fork of Russell Prater Creek.*

(Location 72, elevation 1,810.)		(Location 73, elevation 1,810.)	
	Ft. in.		Ft. in.
Shale .....	8 6	Shale .....	4
Coal .....	1 3	Coal .....	7
Shale .....	1/4	Shale .....	1/4
Coal .....	3 5	Coal .....	2 9 1/2
<hr/>		<hr/>	
Coal .....	4 8	Coal .....	3 4 1/2
Parting .....	1/4	Parting .....	1/4

The coal is 33 inches thick on Bear Branch of War Fork (location 74, elevation 1,760) and about the same on Laurel Branch. Coal 30 inches thick was reported in the hollow back of Prater store (location 75, elevation 1,660). The coal is 32 inches thick in one pit near the road at the head of the main fork of Russell Prater Creek (location 76, elevation 1,722), the upper part being very impure, and at another pit is 41 inches thick, including three streaks of shale (location 77, elevation 1,690).

The Hagy is only 20 inches thick a mile west of Prater (location 78, elevation 1,565) and also half a mile distant on Greenbrier Creek (location 79, elevation 1,530). It is 23 inches thick on the north side of the creek, northwest of location 79. Northwest of Prater, on a tributary of Greenbrier Creek (location 80, elevation 1,565), the bed is 39 inches thick, including an inch of shale 5 inches from the top, but farther north, at the mouth of Rough Branch, it is only 25 inches thick. The thickness in a pit near one of the heads of Greenbrier Creek (location 81, elevation 1,600) is 35 inches.

Four openings near the road on the upper part of Hunts Creek (locations 82 and 83, elevation 1,505; location 84, elevation 1,530; and location 85, elevation 1,545) show the Hagy to be 31 to 33 inches thick, with a thin, slightly bony layer 4 inches from the bottom. The bed is reported to be slightly thicker farther down Hunts Creek and on the lower part of Middle Fork. Less than a mile from the head of Middle Fork (location 86, elevation 1,538) it is 37 inches thick, though the lower 3 1/2 inches are bony.

Near the mouth of Cow Fork, just north of the Pine Mountain fault (location 87, elevation 1,310), the bed is 37 1/2 inches thick, including 4 inches of shale 8 1/2 inches from the bottom. A small mine in a hollow

farther up Cow Fork (location 88, elevation 1,690) is in 42 inches of clean coal with a thick shale roof. The coal is also thick along Abes Fork, though mining conditions may have been impaired by the neighboring Pine Mountain faulting. Stone states that in the No. 4 opening of the Yellow Poplar Lumber Co. on the left of Old House Branch, the first southern tributary of Abes Fork above Cow Fork, the bed was more than 6 feet thick at the face and a foot less at the mouth. He gives the thickness at two other openings in the vicinity as 50 to 60 inches, including a 7-inch clay band. About a mile northeast of Old House Branch (location 89, elevation 1,320) the Hagy appears to be about 3 feet thick.

*Glamorgan coal.*—The Glamorgan coal is only a few feet above the base of the Wise formation and is 270 to 380 feet above the Splash Dam horizon. Its line of outcrop is, therefore, practically the same as that of the top of the massive Gladeville sandstone. It has been thoroughly prospected in the Barts Lick and Grassy drainage basins and found to contain layers of coal aggregating a few inches to about 4 feet, though in most places it is either thin or contains intercalations of shale that greatly impair its commercial value. In many districts the bed splits into three or more benches, and it is possible that the upper part of it represents the Lyons coal.

The Glamorgan was not found along War Fork and the upper part of Russell Prater Creek, though probably present as a thin bed. It was measured at two places on the upper part of Deel Branch of Greenbrier Creek; in one pit (location 90, elevation 1,675) an upper bench of coal 11 inches thick was separated from a lower 19 inches thick by 9 inches of shale, in the other pit (location 91, elevation 1,660) an upper bench 8 inches thick was separated from a lower 12 inches by a foot of shale and bony coal. There is probably more coal beneath a parting at the base of both exposures. The first of the following sections was measured on the right fork of Little Greenbrier Creek and the second on the left fork:

*Glamorgan bed on Little Greenbrier Creek.*

(Location 92, elevation 1,660.)		(Location 93, elevation 1,620.)	
	Ft. in.		Ft. in.
Coal .....	10	Coal .....	1 9
Shale .....	2	Shale .....	5
Coal .....	1 1	Coal .....	4
Clay .....	4	Shale .....	1 10
Coal .....	3	Coal .....	8
Shale, soft .....	4 2	Shale .....	5
Coal .....	5	Coal .....	10
Coal .....	2 7	Coal .....	3 7
Partings .....	4 8	Partings .....	7 3

The character of the bed is much the same on a southern tributary of Barts Lick Creek, less than half a mile northwest of location 93:

*Glamorgan bed on branch of Barts Lick Creek.*

(Location 94, elevation 1,615.)

	Ft.	in.
Shale, sandy, light drab .....	5	
Coal .....		9½
Shale .....		9½
Coal, with bony streak near middle .....	10	
Shale .....		1
Coal .....		5
Shale .....		3½
Coal .....		3½
Shale, with layer of bony coal .....	1	9
Coal .....		10
Shale, with streaks of bony coal .....		11
Coal .....		10
Coal .....	4	
Partings .....	3	10

Northwest of the last section the bed is thinner, though with as much or more minable coal. Near the head of the north fork of Barts Lick Creek (location 95, elevation 1,623) the Glamorgan is 3 feet thick, including a 2-inch shale layer 2 feet from the bottom. A short distance west (location 96, elevation 1,628) the parting is only an inch thick, the upper coal layer being 9 inches thick and the lower coal 17 inches.

The Glamorgan is thin along much of the upper part of Hunts Creek and even where thick, as shown below, it includes several shale partings. The first of the following sections was measured in a pit above the road near the head of Hunts Creek, and the second near a sharp bend in the same road a mile to the west:

*Glamorgan bed on Hunts Creek.*

(Location 97, elevation 1,685.)

(Location 98, elevation 1,790.)

	Ft.	in.
Coal .....	9	
Shale .....	5	
Coal .....	7	
Shale .....	1	6
Coal .....		6
Shale .....		4
Coal .....		2½
Shale .....		1
Coal .....		10½
Coal .....	2	11
Partings .....	2	4

	Ft.	in.
Coal .....		9
Shale .....		2
Coal .....	1	6
Shale .....	5	1
Coal .....		9
Shale .....		9
Coal .....		5
Shale .....		1
Coal .....	1	3
Coal .....	4	8
Partings .....	6	1

Along Middle Fork the bed is badly split into two or three benches. Near the head of the fork (location 99, elevation 1,710) the lower bench is only 9 inches thick and another is 21 feet higher and consists of two 8-inch layers of coal separated by 15 inches of shale. Along Cow and Abes forks of Grassy Creek the Glamorgan is in thin benches in most places.

*Blair coal.*—The Blair is 50 to 120 feet above the base of the Wise formation and 370 to 475 feet above the Splash Dam horizon, the intervals being greater south of War Fork than elsewhere. The bed was measured only in the Russell Prater Creek drainage basin, where it contains a few inches to about 5 feet of coal, though several thin layers of incombustible material are also commonly present and render much of the coal unavailable. In places the Blair is split into two benches, separated by shale several feet thick.

The first of the following sections was measured on a southern tributary of War Fork and the second at the head of the right fork of War Fork:

*Blair bed on War Fork of Russell Prater Creek.*

(Location 100, elevation 2,105.)

	Ft.	in.
Coal .....		8
Shale .....		1
Coal .....	2	1/2
Shale .....		1
Coal .....		4
Shale .....		3
Coal .....	1	1
Bone .....		3
Coal .....		7
<hr/>		
Coal .....	2	10 1/2
Partings .....		8

(Location 101, elevation 2,170.)

	Ft.	in.
Shale.		
Coal .....	1	
Shale .....		1 1/2
Coal .....		4 1/2
Coal .....		2
Coal .....	1	4
Shale.		
Coal .....	2	8 1/2
Partings .....		3 1/2

At the head of a hollow about half a mile west of Prater (location 102, elevation 1,870) the Blair is about 5 feet thick, including shale partings. The following sections are on southern tributaries of Greenbrier Creek:

*Blair bed on Greenbrier Creek.*

(Location 103, elevation 1,810.)

	Ft.	in.
Shale.		
Coal .....	8	
Shale .....	1	
Coal .....	3	
Shale .....	1	
Coal .....	4	
Shale .....	2	
Coal .....	11	
Bone .....	2	
Coal, impure .....	4	
Bone .....	1	
Coal .....	1	8
Shale .....	5	
Coal .....	8	
<hr/>		
Coal .....	4	10
Partings .....	1	

(Location 104, elevation 1,850.)

	Ft.	in.
Shale .....	3	
Coal .....		9½
Shale .....		1½
Coal .....		5
Sandstone .....		1½
Coal .....	2	
Shale.		
<hr/>		
Coal .....	3	2½
Partings .....		3

The first of the following sections is exposed on Deel Branch of Greenbrier Creek, 105 feet above a pit in the Glamorgan coal, and may not include all of the bed. The second section is on an eastern tributary of Little Greenbrier Creek, 100 feet below a pit in the Eagle bed. The third section is in a small hollow on the west side of Little Greenbrier.

*Blair bed on Deel Branch and Little Greenbrier Creek.*

(Location 105, elevation 1,780.)

	Ft.	in.
Coal .....	6	
Shale .....	4	
Coal .....	9	
Shale .....	4	
Coal .....	1	3
<hr/>		
Coal .....	2	6
Partings .....		8

(Location 106, elevation 1,750.)

	Ft.	in.
Shale.		
Coal .....	1	
Rash .....		1
Coal .....		5
Rash .....		½
Coal .....	1	4
<hr/>		
Coal .....	2	9
Partings .....		1½

(Location 107, elevation 1,720.)

	Ft.	in.
Coal .....	1	
Bone .....		8
Coal .....		10
<hr/>		
Coal .....	1	10
Parting .....		8

The Blair, including a shale parting, is less than 2 feet thick near the low gap between Little Greenbrier and Barts Lick creeks.

*Eagle coal.*—The Eagle is 120 to 190 feet above the base of the Wise formation and 400 to 500 feet above the Splash Dam horizon, being 450 feet or less north of main Russell Prater Creek. It lies high in the hills, a few feet beneath a thick massive sandstone that makes conspicuous cliffs and separates the Eagle from the overlying Clintwood coal. One of the peculiarities of the Eagle in places is a very thin sandstone parting much like the one that is characteristic of the Upper Banner bed farther south. The Eagle contains 3 to 6½ feet of coal near the heads of Russell Prater Creek and War Fork and along the lower parts of Greenbrier and Little Greenbrier creeks. It is thinner near the heads of Greenbrier, Little Greenbrier, and Barts Lick creeks and their tributaries, though minable. No measurements of the bed were obtained north of Barts Lick Creek, but it is probable that it is fairly thick at many places along its outcrop, which is 60 to 100 feet below that of the Clintwood coal.

At the head of the right fork of War Fork (location 108, elevation 2,215) the bed is 65 inches thick and remarkably clean. The roof is 10 feet of shale under sandstone and there is a 12-inch coal bed 75 feet above the Eagle. The Eagle is nearly as thick 2½ miles northwest, in the bottom of a hollow near the head of Russell Prater Creek (location 109, elevation 2,070), where there are 58 inches of coal in addition to a 9-inch shale parting 32 inches from the top. Sandstone 25 feet thick may be seen resting on the coal, and the total thickness of this cap is probably about 100 feet.

There are no indications of very thick coal at the Eagle horizon along Greenbrier Creek above the mouth of Little Greenbrier, though there may be some near the head of the stream. The bed is 32 inches thick, including an inch of shale, in the first hollow to the right above Little Greenbrier Creek (location 110, elevation 1,830). Three of the measurements given below show thicker coal on tributaries of Little Greenbrier Creek:

*Eagle bed on Little Greenbrier Creek.*

(Location 111, elevation 1,850.)			(Location 112, elevation 1,800.)		
	Ft.	in.		Ft.	in.
Coal .....	1	1	Coal .....	?	?
Shale .....		3	Shale .....	1	8
Coal .....	1	2	Coal .....		8
Shale .....		3	Shale .....		½
Coal .....	1	2	Coal .....		4
Shale .....		4	Sandstone .....		1
Coal .....	3		Coal .....	2	1
	<hr/>			<hr/>	
Coal .....	6	5	Coal .....	3	1
Partings .....		10	Partings .....		1½

(Location 113, elevation 1,760.)

	Ft.	in.
Sandstone.		
Coal .....	10	
Shale .....	1	
Coal .....	10	
Shale .....	2	
Coal .....	11	
	-----	
Coal .....	2	7
Partings .....		3

(Location 114, elevation 1,810.)

	Ft.	in.
Shale .....	1	
Coal .....		1½
Clay .....		¾
Coal .....	3	1
Clay .....		½
Coal .....		5½
Sandstone .....		¼
Coal .....	1	7
	-----	
Coal .....	5	3
Partings .....		1½

*Clintwood and higher coals.*—No measurements were obtained of the Clintwood or Campbell Creek coals in this area, though a number of blooms and caved pits were seen. Exposures in neighboring parts of the Levisa Fork drainage basin indicate that both beds probably contain thick clean coal at many places. As may be ascertained from an inspection of the accompanying geologic map, these beds outcrop near the ridge tops and occupy only small areas in the Russell Fork basin. The Clintwood is 60 to 100 feet above the Eagle coal and can be easily located because of its thick sandstone bottom-rock. It is 200 to 250 feet above the base of the Wise formation. These intervals are slightly greater on the southeastern border of the area. The Campbell Creek is 200 to 300 feet above the Clintwood and has thick loose-textured sandstones a short distance both above and below it. There may also be one or two other coal beds above the Campbell Creek in very small areas on high knobs.

LEVISA FORK AND SMALL TRIBUTARIES NORTHWEST OF GRUNDY.

*General features.*—This area includes the main valley of Levisa Fork between Grundy and Kentucky, together with the drainage basins of the smaller tributaries, including Stilton and Six and Twentymile creeks and Buckeye, Elijah, Caney Island, Mikes, Schoolhouse, Rocky, Harper, and State Line branches. The area is, therefore, long and narrow, expanding slightly at Stilton Creek and near the State line. The coal resources of the drainage basins of Conoway, Bull, Poplar, Looney, Linn Camp, Home, and Rocklick creeks will be described later.

The general features of the rock sequence are shown in generalized section 1 (Pl. II), most intervals between coals beds being more than the average near Grundy and decreasing to less than the average near Kentucky. Local characteristics are shown in local sections 12 and 32 (pp. 30 and 45). The structure of the area is simple, as the rocks dip to the

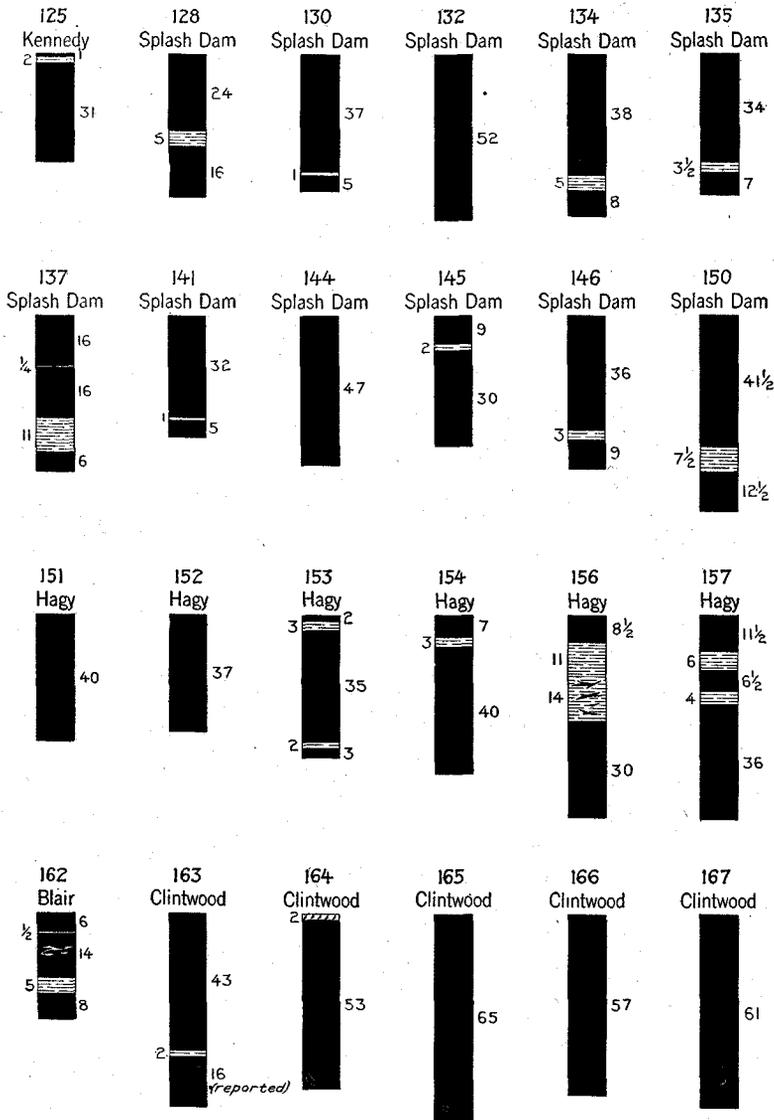


Fig. 10.—Sections of coal beds on Levisa Fork and small tributaries northwest of Grundy.

northwest at 150 feet or less to the mile nearly everywhere except near Harper Branch, where there are small flexures and a low arch marking the end of the Pine Mountain anticline. Rocks exposed include those from near the Raven coal to 600 feet above the base of the Wise formation.

The area forms part of a region in which there are coal deposits that will undoubtedly be the basis of an active mining industry as soon as railroad facilities are supplied (see figs. 4, 5, 6, 7, and 10). The most important coal bed from the standpoint of area and thickness combined is the Splash Dam, which contains 3 to nearly 6 feet of coal. The Hagy bed underlies nearly as large an area and averages 3 to 4 feet thick in many districts. The Blair and Eagle beds are probably fairly thick in places, though including several shale partings. The Clintwood is a clean coal bed  $3\frac{1}{2}$  to  $5\frac{1}{2}$  feet thick, though it underlies only small areas except near the State line. The Campbell Creek coal may be moderately thick, but remains only in very small outliers near the State line. There are several other persistent coal beds—notably the Raven, Aily, Kennedy, and Glamorgan—that are, however, less than 30 inches thick nearly everywhere. There are also several thin nonpersistent coals, including splits off some of the thicker beds. Nothing is known about beds which lie below the lowest that outcrops, but it is not probable that any of them will prove minable.

*Raven and Aily coals.*—The lowest coal bed exposed in the area is the Raven. It outcrops a short distance above river level from Grundy to near the mouth of Poplar Creek and is 420 to 460 feet below the Splash Dam horizon. The coal is only 1 to 2 feet thick and overlies a coarse-grained sandstone, the roof being a thin bed of blue shale under an inconspicuous sandstone. The Aily bed is 60 to 90 feet above the Raven and outcrops along the river from Grundy to near the mouth of Mikes Branch. It is also commonly less than 2 feet thick. Shale rests on the coal locally; elsewhere the roof is the thick massive cliff-maker which forms the bottom-rock of the Kennedy coal.

The Raven is a little more than 20 inches thick at a small quarry in its bottom-rock in the northern part of Grundy (location 115, elevation 1,095). A pit beside the road at the mouth of Six and twentymile Creek (location 116, elevation 1,050) shows the bed to be at least 21 inches thick, including  $2\frac{1}{2}$  inches of shale near the base, with probably a few inches more of coal at the top. About  $1\frac{1}{2}$  miles down the road (location 117, elevation 984) the coal is only 14 inches thick.

The Aily coal is 15 inches thick on the south side of the river near Stilton Branch (location 118, elevation 1,080) and is reported 26 inches thick  $1\frac{1}{2}$  miles up the river. On the east side of the river, a mile below Grundy (location 119, elevation 1,130) the bed is 19 inches thick. It is 13 to 20 inches thick at the mouth of Linn Camp Creek (location 120, elevation 938).

*Kennedy coal.*—The Kennedy horizon is easily located in this part of the field, as it lies 5 to 15 feet above a massive, coarse-grained sandstone that makes conspicuous cliffs along Levisa Fork. It lies 225 feet above the river at Grundy and gradually descends toward the northwest, passing beneath the river a few rods from the Kentucky boundary. The interval between it and the Splash Dam coal decreases gradually to the northwest from 290 feet at Grundy to 220 feet near the Kentucky line, and may include very thin coal deposits at the Big Fork, Lower Banner, and Upper Banner horizons. The Kennedy is persistent but not thick, being less than 30 inches nearly everywhere.

On the west side of the river the coal is 2 feet thick half a mile south of Linn Camp Creek (location 121, elevation 1,030). It is 26 inches thick opposite the mouth of Six and Twentymile Creek (location 122, elevation 1,210), and 19 inches thick  $1\frac{1}{4}$  miles northwest of Grundy (location 123, elevation 1,225), where the upper part resembles a cannel.

On the east side of the river the Kennedy is 28 inches thick in a hollow near Looney Creek (location 124, elevation 1,130). Opposite the mouth of Poplar Creek (location 125, elevation 1,100), in a local mine, it is 34 inches thick, including 2 inches of shale 1 inch from the top. It appears to be only about 14 inches thick half a mile southeast of Big Rock (location 126, elevation 955), where the rocks are involved in a local buckling or faulting that causes steep dips in a very small area. Coal 18 inches thick is reported at the Kennedy horizon by the road opposite the mouth of Conway Creek (location 127, elevation 925).

*Splash Dam coal.*—Throughout this area the Splash Dam is a valuable bed containing 3 to nearly 5 feet of coal. In places the bed is clean; elsewhere it has one or more shale partings, which, however, would not seriously interfere with profitable mining. As the bed lies only moderately high in the hills, the area underlain by it is large. The coal horizon is easily located by means of a thick ledge-making sandstone a few feet below it. The roof is a drab shale containing fossil plants.

The Splash Dam is exceptionally thick on Buckeye Branch, as shown by the following sections, the second of which was measured and the first reported on good authority:

*Splash Dam bed on Buckeye Branch.*

(Location 128, elevation 1,130.)

	Ft.	in.
Shale .....	10	
Coal .....	2	
Shale .....		5
Coal .....	1	4
<hr style="width: 20%; margin-left: 0;"/>		
Coal .....	3	4
Parting .....		5

(Location 129, elevation 1,130.)

	Ft.	in.
Shale .....	15	
Coal .....		10
Rash .....		1½
Coal .....	1	6
Shale .....		6
Coal .....	1	2½
Shale .....		7½
Coal .....	1	4½
<hr style="width: 20%; margin-left: 0;"/>		
Coal .....	5	11
Partings .....	1	3

The bed is 43 inches thick in the first hollow below the mouth of Conoway Creek (location 130, elevation 1,170) and a thickness of 38 inches is reported in a small valley less than half a mile southwest of Big Rock (location 131, elevation 1,175). In both these places there is an inch or less of shale about 3 to 5 inches from the bottom of the bed, and there are probably one or two thin coal layers a few inches below the parts exposed. There are 52 inches of clean coal less than a mile south of Big Rock (location 132, elevation 1,255) and 42 inches on a tributary of Elijah Branch (location 133, elevation 1,200). A shale parting that is only a mere streak at location 133 is 5 inches thick and 8 inches from the bottom of the bed on Caney Island Branch (location 134, elevation 1,245), the total thickness of the Splash Dam being 51 inches. The same parting is 3½ inches thick several miles southeast, near the mouth of Stilton Creek (location 135, elevation 1,455), where there are 34 inches of coal above it and 7 inches below it. The bed is reported to be 4 feet thick, probably including some shale, in a hollow nearly three-fourths of a mile southeast (location 136, elevation 1,460), and there are 16 inches of coal 20 feet below it. The following measurements show the principal bench of the Splash Dam near the mouth of Six and twentymile Creek; a pit near the first section shows 18 inches of coal about 25 feet below it.

*Splash Dam bed 2 miles northwest of Grundy.*

(Location 137, elevation 1,480.)			(Location 138, elevation 1,480.)		
	Ft.	in.		Ft.	in.
Coal .....	1	4	Coal .....	7	$\frac{1}{2}$
Shale .....		$\frac{1}{4}$	Shale .....		$\frac{1}{4}$
Coal .....	1	4	Coal .....		9
Shale .....		11	Shale .....		$\frac{1}{4}$
Coal .....		6	Coal .....	1	8
			Shale (reported) ..	1	2
Coal .....	3	2	Coal (reported) ..	1	2
Partings .....		$11\frac{1}{4}$			
			Coal .....	4	$2\frac{1}{2}$
			Partings .....	1	$2\frac{1}{2}$

On the east side of the river, near the northern part of Grundy, Mr. Crawford reports that the Splash Dam includes at least two benches of coal, separated by 9 inches of clay, the upper bench being 32 inches thick and the lower bench 14 inches. In the first large hollow east of Stilton Creek (location 139, elevation 1,435) the coal exposed is 33 inches thick and without partings, and on the upper part of Stilton Creek (location 140, elevation 1,390) it is 32 inches thick. There may be lower benches of coal in both these localities, as indicated by the following two sections in tributaries of the lower part of Stilton Creek:

*Splash Dam bed on Stilton Creek.*

(Location 141, elevation 1,395.)			(Location 142, elevation 1,390.)		
	Ft.	in.		Ft.	in.
Coal .....	2	8	Coal .....	2	10
Shale .....		1	Shale .....		3
Coal .....		5	Coal .....		9
Coal .....	3	1	Coal .....	3	7
Parting .....		1	Parting .....		3

The bed is the same opposite the mouth of Poplar Creek (location 143, elevation 1,355) as at location 142, except that the parting is  $4\frac{1}{2}$  inches thick. Half a mile north (location 144, elevation 1,325) there are 47 inches of clean coal. The first of the following measurements was made in a small mine on Schoolhouse Branch and the second in another mine on Rocky Branch:

*Splash Dam bed on Schoolhouse and Rocky branches.*

(Location 145, elevation 1,250.)			(Location 146, elevation 1,240.)		
	Ft.	in.		Ft.	in.
Shale .....	7		Shale .....	25	
Coal .....		9	Coal .....	3	
Clay .....		2	Shale .....		3
Coal .....	2	6	Coal .....		9
	<hr/>			<hr/>	
Coal .....	3	3	Coal .....	3	9
Parting .....		2	Parting .....		3

A mine one-fourth of a mile north of Rocky Branch (location 147, elevation 1,220) is in 4 feet of clean coal, and 20 inches more are reported 18 inches below it. This lower bench of coal may also be present at other pits where it is not exposed. A mine above the wagon road nearly three-fourths of a mile southwest of Big Rock (location 148, elevation 1,190) is in 45 inches of coal, the upper 3 inches of which contain streaks of shale. An analysis of a sample from this mine is given in another part of this report. Two other measurements east of Levisa Fork, near the mouth of Conoway Creek, are as follows:

*Splash Dam bed about a mile west of Big Rock.*

(Location 149, elevation 1,160.)			(Location 150, elevation 1,145.)		
	Ft.	in.		Ft.	in.
Shale .....	10		Shale .....	5	
Coal .....	3	5	Coal .....	3	5½
Shale .....		7	Shale .....		7½
Coal .....	1		Coal .....	1	½
Shale .....		2		<hr/>	
Coal .....		2	Coal .....	4	6
	<hr/>		Parting .....		7½
Coal .....	4	7			
Partings .....		9			

*Hagy coal.*—The Hagy is 80 to 110 feet above the Splash Dam coal, averaging close to 100 feet in most places. Like the Splash Dam it lies a few feet above a ledge-making sandstone and commonly has a shale roof. It is minable in many districts, though not quite so thick as the lower bed. It commonly contains 3 to 4½ feet of coal northwest of Big Rock and between Poplar Creek and Grundy, averaging nearer the lower figure than the higher. Shale partings are absent from many pits and are not seriously detrimental anywhere. It is possible that the coal is not present in part of the district that lies between Big Rock and Poplar Creek.

There are at least 40 inches of coal, with perhaps more under a shale parting, in a pit on the west side of Levisa Fork valley, close to the State line (location 151, elevation 1,155). The coal is 37 inches thick in a pit nearly a mile southwest of Big Rock (location 152, elevation 1,270). No measurements were obtained between Big Rock and Poplar Creek. The first of the following two sections is opposite Big Rock and the second about one-fourth of a mile southeast of the mouth of Poplar Creek:

*Hagy bed at Big Rock and near mouth of Poplar Creek.*

(Location 153, elevation 1,265.)		(Location 154, elevation 1,495.)	
	Ft. in.		Ft. in.
Shale .....	10	Shale .....	10
Coal .....	2	Coal .....	7
Shale .....	3	Shale .....	3
Coal .....	2 11	Coal .....	3 4
Shale .....	2		
Coal .....	3	Coal .....	3 11
		Parting .....	3
Coal .....	3 4		
Partings .....	5		

The Hagy is at least 37 inches thick one-fourth of a mile east of the last section given (location 155, elevation 1,515), 9 inches of it, lying 8 inches below the top, being shale and bony coal.

The following measurements were made in hollows further southeast:

*Hagy bed about two miles northwest of Grundy.*

(Location 156, elevation 1,570.)		(Location 157, elevation 1,580.)	
	Ft. in.		Ft. in.
Shale .....	10	Shale .....	15
Coal .....	8½	Coal .....	11½
Shale .....	11	Shale .....	6
Shale and bony coal	1 2	Coal .....	6½
Coal .....	2 6	Shale .....	4
		Coal .....	3
Coal .....	3 2½		
Parting .....	2 1	Coal .....	4 6
		Partings .....	10

In an eastern tributary of Levisa Fork, half a mile east of Stilton Creek (location 158, elevation 1,555), the Hagy is only 16 inches thick in a natural exposure, though it is possible that only an upper bench is represented. No other complete measurements were made east of the river. On State Line Branch (location 159, elevation 1,230) the bed is reported to

consist of 37 inches of clean coal, and on a branch of Hackney Creek, in the next valley east of State Line Branch (location 160, elevation 1,210), 18 inches of coal shows in a partial exposure at a caved opening.

*Glamorgan, Blair, and Eagle coals.*—The line of outcrop of the Glamorgan bed is practically the same as that of the base of the Wise formation and is 240 to 320 feet above the Splash Dam bed, the shortest intervals being near the State line. The coal is probably less than 30 inches thick in most of this area, though a complete measurement was made only near the head of Six and twentymile Creek (location 161, elevation 1,800), where it is about 26 inches thick.

The Blair and Eagle coals lie high in the hills in most of the area, and have not been opened in many places. Measurements in neighboring areas indicate, however, that both beds contain more coal than the Glamorgan in most districts, though also including several shale and bone partings. The Blair lies 40 to 110 feet above the Glamorgan, averaging 70 feet, and the Eagle is 25 to 100 feet higher, averaging 130 feet above the Glamorgan. The position of the Blair can be easily estimated from that of the base of the Wise formation, shown on the geologic map in pocket. The outcrop of the Eagle is mapped in part of the area and can be estimated elsewhere from the positions shown for the base of the Wise and for the Clintwood coal. The Blair is as follows in a hollow half a mile southeast of the mouth of Stilton Creek:

*Blair bed about two and one-half miles northwest of Grundy.*

(Location 162, elevation 1,810.)

	Ft.	in.
Shale, grading to sandstone at top .....	10	
Coal .....		6
Shale .....		1½
Coal, with bony streak near middle .....	1	2
Shale .....		5
Coal .....		8
		<hr/>
Coal .....	2	4
Partings .....		5½

*Clintwood coal.*—The Clintwood bed is 60 to 130 feet above the Eagle and separated from it by a massive cliff-forming sandstone that occupies nearly all of the interval. It is 420 to 485 feet above the Splash Dam bed near the Kentucky boundary, the interval increasing to the southeast to 550 feet at the head of Stilton Creek. Although the Clintwood occupies

only small areas under the ridge tops, it is important because of its thickness of  $3\frac{1}{2}$  to  $5\frac{1}{2}$  feet of coal without partings of incombustible material.

The only place where the Clintwood was measured west of Levisa Fork in this area is in a tributary of Buckeye Branch, a few rods north of the State boundary (location 163, elevation 1,510), where 43 inches of clean coal were seen and 16 inches more were reported under a 2-inch shale parting.

The Clintwood contains 53 inches of coal, besides 2 inches of rash at the top, in a small mine at the head of Stilton Creek (location 164, elevation 1,990) and the clean coal is 65 inches thick half a mile north (location 165, elevation 1,940). The coal is 57 inches thick on a tributary of Harper Branch (location 166, elevation 1,620), and is about 61 inches thick at the head of State Line Branch (location 167, elevation 1,605). It is reported 55 inches thick in a pit in Kentucky, on a branch of Hackney Creek (location 168).

*Campbell Creek coal.*—The Campbell Creek bed is 175 to 250 feet above the Clintwood, in the midst of a thick series of sandstones. It occupies areas so small that it is not economically important in this area, though probably a fairly thick and persistent bed. On the upper part of Buckeye Branch, in Kentucky, it is reported to be 58 inches thick, including 4 inches of splint and an inch of shale. It is reported to be 60 inches thick, including 4 inches of splint, at the head of the left fork of State Line Branch.

#### CONOWAY, BULL, AND POPLAR CREEKS.

*General features.*—Rocks exposed in this area include those from near the Raven coal horizon, in the lower part of the Norton formation, to those about 600 feet above the base of the Wise formation. The principal features of the stratigraphy are shown by generalized section 1 (Pl. II) and in local sections 6, 8, 9, 10, 11, 12, and 32 (pp. 27-30 and 45). Most of the average intervals in the generalized section are larger than the local intervals on the northwest side of the area and smaller than those on the southeast side.

Dips are low, being 150 feet or less per mile, and their direction is governed largely by the positions of the axes of the Middlesboro syncline and the Pine Mountain anticline, which have been described in the chapter on structure and are shown on the large geologic map. Dips are to the northwest and north except between these two axes, where beds dip in easterly directions into the syncline. No trace of an extension of the Pine Mountain fault was found.

The area is rich in coal deposits and will repay more thorough prospecting than has yet been undertaken (see figs. 4, 5, 6, 7, and 11). The most important bed in the area, and probably the lowest that is minable under present market conditions, is the Splash Dam, which contains 4 to 7 feet of coal that is in greater part recoverable. The Hagy bed contains 3 to 4 feet of coal in most places and underlies nearly as much territory as the Splash Dam. Four beds in the lower part of the Wise formation would yield large tonnages, though so high in the hills that their acreages are much smaller than those of the lower beds. The Glamorgan is 3 feet thick in places. The Blair contains 4 to 7 feet of coal on Poplar Creek, and also considerable shale in partings; little is known about its character farther northwest. The Eagle is thought to include 3 or 4 feet of coal in most places. The Clintwood is a remarkably clean bed  $3\frac{1}{2}$  to  $4\frac{1}{2}$  feet thick where measured. In addition to the tonnages of these lower Wise beds there is an unknown amount of coal in small outliers of the Campbell Creek and perhaps one or two higher beds.

*Coals below the Splash Dam.*—There are probably no coal deposits in this area more than 2 or 3 feet thick in beds lower than the Splash Dam, though only the drill can prove or disprove this assertion. The lowest bed that is exposed near the area is the Raven, and it is only 1 to 2 feet thick along Levisa Fork between Poplar Creek and Grundy and 26 inches thick near Jane, in the northwestern corner of the county. The Aily coal bed, which is 60 to 90 feet above the Raven, and about 100 feet below the Kennedy, is exposed near the stream levels along the lower parts of Poplar and Bull creeks and on neighboring parts of the Levisa. It is also a thin bed in this region and is 18 inches thick near the mouth of Big Log Branch of Poplar (location 169, elevation 1,125).

The Kennedy bed, which is exposed for a mile or two along the lower courses of Conoway, Bull, and Poplar creeks, is about 250 feet below the Splash Dam on Bull and Conoway creeks, and 270 to 300 feet on the Poplar. A coarse massive sandstone lies a few feet below it, and the roof is commonly shale. The average thickness of coal is probably about 2 feet; where measured at Bull Creek School (location 170, elevation 1,040) it is 19 inches thick, and it is 2 feet thick in an old opening on Poplar Creek (location 171, elevation 1,210).

The Lower and Upper Banner beds were found in a few places as blooms indicating very thin deposits. In one pit on Duty Branch of Poplar (40 feet below pit in Splash Dam at location 199) a bed that is probably the Upper Banner is as much as 17 inches thick.

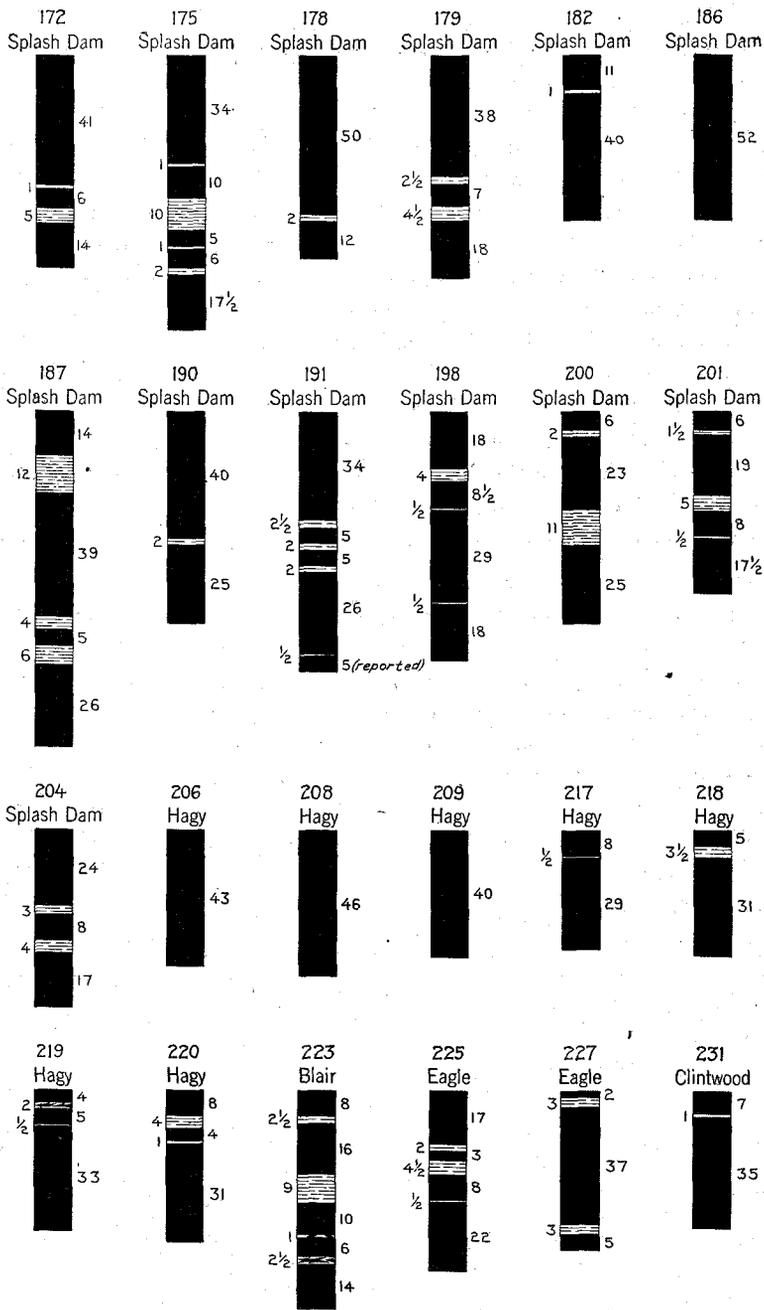


Fig. 11.—Sections of coal beds in the basins of Conoway, Bull, and Poplar creeks.

*Splash Dam coal.*—The Splash Dam would be an excellent mining proposition in this area, as it contains 4 to 7 feet of coal, underlies a large area, and can be easily reached by means of drifts not too far above the main streams. In many districts all or nearly all of the coal could be recovered; in others shale partings are so thick or so numerous that it would be necessary to leave part of the coal in the ground, though a large part of the bed is minable everywhere. It outcrops along main Conoway, Bull, and Poplar creeks from their mouths to within one or two miles of their heads, and appears also along the lower parts of their principal tributaries. The roof is commonly a drab clay shale bearing fossil plants, and a massive ledge-making sandstone lies a few feet below the coal. In many places there are splits off the main part of the bed, and in some of these localities the thickest bench of coal does not lie so close to the sandstone bottom-rock.

About three-fourths of a mile from the mouth of Conoway Creek, in a small western tributary and also on the west side of the main valley, there are four openings in the Splash Dam. The first of the following measurements, which is in one of these openings, is essentially the same as in two of the others; the section at the fourth pit is slightly different, as shown in the second measurement given below, and may not include the lowest thin coal bench:

*Splash Dam bed on lower Conoway Creek.*

(Location 172, elevation 1,200.)			(Location 173, elevation 1,200.)		
	Ft.	in.		Ft.	in.
Shale .....	10		Sandstone .....	5	
Coal .....	3	5	Coal .....	3	7½
Shale .....		1	Shale .....		10
Coal .....		6	Coal .....	1	½
Shale .....		5			
Coal .....	1	2	Coal .....	4	8
			Parting .....		10
Coal .....	5	1			
Partings .....		6			

The bed is thicker farther up the Conoway, as shown in the first of the following sections, which is reported to be about the same as on a western tributary (location 174, elevation 1,210), where only 30 inches of the principal bench is now exposed. The second of the following sections is on the south side of the creek, half a mile west of Conoway School.

*Splash Dam bed on upper Conoway Creek.*

(Location 175, elevation 1,310.)			(Location 176, elevation 1,260.)		
	Ft.	in.		Ft.	in.
Shale .....	5		Shale .....	10	
Coal .....	2	10	Coal .....	2	6
Shale .....		1	Shale .....		1
Coal .....		10	Coal .....	1	3
Shale .....		10	Shale .....		1½
Coal .....		5	Coal .....		7
Shale .....		1	Shale .....		9
Coal .....		6	Coal .....	1	7
Clay .....		2			
Coal .....	1	5½	Coal .....	5	11
			Partings .....		11½
Coal .....	6	½			
Partings .....	1	2			

Measurements in a hollow less than half a mile southwest of Conoway School (location 177, elevation 1,250) are almost identical with those at location 176. Two of the partings are absent from the coal in the next southern tributary east of Conoway School (location 178, elevation 1,210), where the entire bed is reported as 64 inches thick and with only one parting 2 inches thick and a foot from the base. Measurements on small tributaries of Levisa Fork, previously given for locations 131 to 134, throw light upon the character of the bed east of lower Conoway Creek.

The measurement made in a small mine nearly half a mile northwest of Bull Creek School (location 179, elevation 1,275) is essentially the same as the first section given below, which is from another mine 1,700 feet northwest of the first. The second of the following sections is from a mine on Johns Branch of Bull Creek and is probably not complete.

*Splash Dam bed northwest of Bull Creek School.*

(Location 180, elevation 1,265.)			(Location 181, elevation 1,280.)		
	Ft.	in.		Ft.	in.
Shale .....	10		Shale .....	10	
Coal .....	2	7	Coal .....	2	11
Shale .....		½	Shale .....		2
Coal .....		9	Coal .....		7
Shale .....		2	Shale .....		2
Coal .....		8	Coal .....	1	10+
"Rash" .....		2			
Coal .....	1	7	Coal .....	5	4+
			Partings .....		4
Coal .....	5	7			
Partings .....		4½			

In a small mine on the west side of the mouth of Deel Fork of the Bull (location 182, elevation 1,320) and in a pit across the road to the east, the principal bench of the Splash Dam is 52 inches thick, including an inch of shale 11 inches from the top, and there are at least 2 feet more of coal 25 feet below the mine. A little farther down the creek (location 183, elevation 1,305) this bed is also 52 inches thick, but the shale parting is 2½ inches thick. A small mine on the lower part of Belcher Branch (location 184, elevation 1,315) shows the principal bench of the Splash Dam to be 58 inches thick there, including 2 inches of shale a foot from the top, and it is much the same in openings short distances both north and south. About half a mile up Belcher Branch (location 185, elevation 1,355) the parting is only one-fourth of an inch thick in a coal bed of 52 inches. Half a mile farther up the fork (location 186, elevation 1,390) the coal is also 52 inches thick and partings are mere films.

A 35-inch bench of the Splash Dam is mined in the first hollow below the mouth of Belcher Branch, and at a pit across the hollow the full bed is reported to be as in the first of the following sections; the second of these sections was measured in the next hollow on the north:

*Splash Dam bed on Bull Creek near Belcher Branch.*

(Location 187, elevation 1,320.)

	Ft.	in.
Coal .....	1	2
Shale .....	1	
Coal .....	3	3
Shale .....	4	
Coal .....	5	
Shale .....	6	
Coal .....	2	2
<hr/>		
Coal .....	7	
Partings .....	1	10

(Location 188, elevation 1,300.)

	Ft.	in.
Shale .....	10	
Coal .....	2	10
Shale .....		10
Coal .....		8
Shale .....		3
Coal (reported) ...	2	
<hr/>		
Coal .....	5	6
Partings .....	1	1

The following sections on Left Fork and near its mouth show plainly the irregularity of the shale partings. All of the bed may not have been opened at all of the pits.

*Splash Dam bed on Left Fork of Bull Creek.*

(Location 189, elevation 1,285.)

	Ft.	in.
Shale .....	10	
Coal .....	3	4
Shale .....		4
Coal .....		9
Shale .....		5
Coal (reported) ..	1	6
	<hr/>	
Coal .....	5	7
Partings .....		9

(Location 190, elevation 1,400.)

	Ft.	in.
Shale .....	10	
Coal .....	3	4
Shale .....		2
Coal .....	2	1
	<hr/>	
Coal .....	5	5
Parting .....		2

(Location 191, elevation 1,467.)

	Ft.	in.
Shale .....	20	
Coal .....	2	10
Shale .....		2½
Coal .....		5
Shale .....		2
Coal .....		5
Shale .....		2
Coal .....	2	2
Shale .....		½
Coal (reported) ..		5
	<hr/>	
Coal .....	6	3
Partings .....		7

(Location 192, elevation 1,490.)

	Ft.	in.
Shale .....	20	
Coal .....		7
Shale .....		¾
Coal .....	3	4
Shale (reported) ..		2¼
Coal (reported) ..		6
Shale (reported) ..		4
Coal (reported) ..	2	1
	<hr/>	
Coal .....	6	6
Partings .....		7

(Location 193, elevation 1,460.)

	Ft.	in.
Shale .....	10	
Coal .....	1	3½
Shale .....		9
Coal .....	2	8
	<hr/>	
Coal .....	3	11½
Parting .....		9

(Location 194, elevation 1,425.)

	Ft.	in.
Shale .....	15	
Coal .....	3	5
Shale (reported) ..		8
Coal (reported) ..		10
Shale (reported) ..		1
Coal (reported) ..		7
	<hr/>	
Coal .....	4	10
Partings .....		9

In a hollow near the mouth of Poplar Creek (location 195, elevation 1,385) 44 inches of the Splash Dam bed are mined, including 3 inches of shale 8 inches from the bottom. Nearly three-fourths of a mile farther south (location 196, elevation 1,460) a 40-inch bench of clean coal is utilized. An old pit on Big Log Branch (location 197, elevation 1,515) shows 65 inches of the bed, including 2 to 8 inches of shale about 21 inches from the bottom. It is almost certain that one or two rather thin lower benches of coal are concealed at all three of these openings, and are separated from the part exposed by shale partings. The entire bed was

probably seen at the first of the following pits, which is on the upper part of Duty Branch, though the lowest bench of coal is probably concealed at the second pit, which is on the lower part of the same stream:

*Splash Dam bed on Duty Branch of Poplar Creek.*

(Location 198, elevation 1,520.)

	Ft.	in.
Coal .....	1	6
Shale .....		4
Coal .....		8½
Shale .....		½
Coal .....	2	5
Shale .....		½
Coal .....	1	6
<hr/>		
Coal .....	6	1½
Partings .....		5

(Location 199, elevation 1,525.)

	Ft.	in.
Coal .....	1	9
Shale .....	2	1
Coal .....		7
Shale .....		1
Coal .....	1	8
<hr/>		
Coal .....	4	
Partings .....	2	2

South of Duty Branch the upper 21-inch coal bench of the last section separates so far from the rest of the bed that it could not be mined with it, and near the mouth of Camp Branch it is 22 to 28 inches thick and about 18 feet above the next lower bench. In this vicinity a third bench about a foot thick is said to lie about 15 feet below the benches mined. The principal bench of the Splash Dam south and southeast of Duty Branch is shown in the following sections at small mines, the first being on Knotty Poplar Fork; the second, third, and fourth on Poplar Creek near Camp Branch; the fifth opposite the mouth of the Knotty Poplar; and the sixth in the next hollow on the northeast. A sandstone cap-rock overlies the thin shale roof noted in these sections.

*Splash Dam bed on upper Poplar Creek and tributaries.*

(Location 200, elevation 1,525.)

	Ft.	in.
Shale .....	1	6
Coal .....		6
Shale .....		2
Coal .....	1	11
Shale .....		11
Coal .....	2	1
<hr/>		
Coal .....	4	6
Partings .....	1	1

(Location 201, elevation 1,510.)

	Ft.	in.
Shale .....	5	
Coal .....		6
Shale .....		1½
Coal .....	1	7
Shale .....		5
Coal .....		8
Shale .....		½
Coal .....	1	5½
<hr/>		
Coal .....	4	2½
Partings .....		7

(Location 202, elevation 1,515.)

	Ft.	in.
Shale .....	7	
Coal .....		6
Shale .....		5
Coal .....	1	7
Shale .....	1	4
Coal .....	2	4
	<hr/>	
Coal .....	4	5
Partings .....	1	9

(Location 204, elevation 1,525.)

	Ft.	in.
Sandstone .....	6	
Coal .....	2	
Shale .....		3
Coal .....		8
Shale .....		4
Coal .....	1	5
	<hr/>	
Coal .....	4	1
Partings .....		7

(Location 203, elevation 1,530.)

	Ft.	in.
Shale .....	4	
Coal .....		5
Shale .....		1
Coal .....		2
Shale .....		3½
Coal .....	1	4½
Shale .....		2
Coal .....	1	9
Shale .....		1
Coal .....		4½
	<hr/>	
Coal .....	4	1
Partings .....		7½

(Location 205, elevation 1,530.)

	Ft.	in.
Shale .....	1	
Coal .....	2	2
Shale .....	1	
Coal .....		8
Shale .....		5
Coal .....	1	4
	<hr/>	
Coal .....	4	2
Partings .....	1	5

No complete measurements were obtained on the east side of Poplar Creek valley north of the last section given above, but the character of at least the principal benches of the Splash Dam between lower Poplar Creek and Levisa Fork is indicated by the sections at locations 135-138 on small tributaries of the Levisa, described on preceding pages. The bed is reported to be 76 inches thick, including 10 inches of shale, on a small tributary of Poplar Creek, about a mile southeast of the Levisa.

*Hagy coal.*—The Hagy lies 80 to 120 feet above the Splash Dam, the most common interval being 100 feet, and is a few feet above a moderately conspicuous sandstone. The roof is commonly sandy shale, over which is a thin sandstone cap-rock locally. The Hagy bears few shale partings in this area and is a persistent bed containing 3 or 4 feet of coal in most places. Like the Splash Dam, it has a large acreage and outcrops in all the principal valleys.

The Hagy has been opened in several of the western tributaries of upper Conoway Creek, being 43 inches thick in two of the pits (location 206, elevation 1,320, and location 207, elevation 1,410). Near the head of Conoway Creek it is 46 inches thick in a pit west of the road (location 208, elevation 1,510) and 40 inches thick in one beside the road (location 209,

elevation 1,506). There are 3 feet of coal not quite half a mile east of Conway School (location 211, elevation 1,290). In all these openings the upper 2 to 4 inches of the bed is cannel coal.

The Hagy coal is 3 feet thick on Jess Fork of Bull Creek (location 212, elevation 1,425), in addition to 4 inches of alternating coal and shale layers at the top. It is 31 inches thick in a pit on a branch of Belcher Branch of the Bull (location 213, elevation 1,440) and 27 inches in another opening 900 feet southwest. The thickness is reported as 40 inches in an old pit on another southern branch of Belcher Branch (location 214, elevation 1,515) and about the same in a stream bed 1,200 feet southwest. It is 29 inches in a small mine near the head of Belcher Branch (location 215, elevation 1,565) and 30 to 36 inches in two old openings still farther east (location 216, elevation 1,590).

The Hagy is reported to be 48 inches thick and nearly clean on Duty Branch of Poplar Creek, though the one caved Hagy pit found on that stream appeared to be in much thinner coal. Other measurements in the Poplar Creek basin are shown in the following sections, the first being on Knotty Poplar Fork, the second in a hollow between Knotty Poplar Fork and Camp Branch, the third on a tributary of Camp Branch, and the fourth on an eastern tributary which joins Poplar Creek a mile above its mouth:

*Hagy bed in Poplar Creek drainage basin.*

(Location 217, elevation 1,640.)

	Ft.	in.
Shale .....	10	
Coal .....	8	
Shale .....	2	½
Coal .....	2	5
<hr/>		
Coal .....	3	1
Parting .....		½

(Location 218, elevation 1,630.)

	Ft.	in.
Shale .....	8	
Coal .....		5
Shale .....		3½
Coal .....	2	7
<hr/>		
Coal .....	3	
Parting .....		3½

(Location 219, elevation 1,630.)

	Ft.	in.
Coal .....	4	
Bone .....	2	
Coal .....	5	
Shale .....		½
Coal .....	2	9
<hr/>		
Coal .....	3	6
Partings .....		2½

(Location 220, elevation 1,605.)

	Ft.	in.
Coal .....		8
Shale .....		4
Coal .....		4
Shale .....		1
Coal .....	2	7
<hr/>		
Coal .....	3	7
Partings .....		5

The character of the Hagy east of lower Poplar Creek is also shown by sections already given at locations 154-157 on small tributaries of Levisa Fork.

*Glamorgan and Blair coals.*—The Glamorgan coal is only a few feet above the base of the Wise formation, so that its line of outcrop is practically the same as the formation boundary, and it ranges from 270 feet above the Splash Dam bed along Conoway Creek to 330 feet above it along upper Poplar Creek. The coal lies rather high in the hills and has been opened in very few places. It is reported to be 3 feet thick on Duty Branch of Poplar Creek, but is probably thinner farther northwest.

The Blair bed is 60 to 100 feet above the Glamorgan and is thick in the Poplar Creek drainage basin, though commonly including many shale partings. It is probably thin in much of the northern part of the area, but has not been prospected sufficiently to reveal its exact status. It is exceptionally clean on Duty Branch of Poplar Creek (probably location 221, elevation 1,920), where the entire bed is reported to be 83 inches thick, including 6 inches of clay 22 inches from the top. The first of the following sections is reported to represent the bed on Knotty Poplar Fork, and the second was measured on a fork of Camp Branch:

*Blair bed on Knotty Poplar Fork and Camp Branch of Poplar Creek.*

(Location 222, elevation 1,950.)			(Location 223, elevation 1,930.)		
	Ft.	in.		Ft.	in.
Coal .....	1	1	Coal .....		8
Shale .....		2	Shale .....		2½
Coal .....		4	Coal .....	1	4
Shale .....		3	Shale .....		9
Coal .....	1		Coal .....		10
Shale .....		5	Bone .....		1
Coal .....		10	Coal .....		6
Shale .....		3	Bone .....		2½
Coal .....		8	Coal .....	1	2
<hr/>			<hr/>		
Coal .....	3	11	Coal .....	4	6
Partings .....	2	11	Partings .....	1	3

*Eagle coal.*—The Eagle is 100 to 170 feet above the base of the Wise formation, the interval differing considerably within short distances, and lies only a few feet below a thick conspicuous sandstone. The bed probably contains 3 to 4 feet of coal in many districts, as well as several thin shale and bone partings, but has been opened in only a few localities.

The two following measurements were made in the southwestern part of the Conoway Creek drainage basin, the first near the road gap at the head of Cow Fork of Grassy Creek and the second at the head of the first large tributary west of Conoway School:

*Eagle bed near heads of Conoway Creek.*

(Location 224, elevation 1,850.)

	Ft.	in.
Sandstone .....	15	
Coal, bony at top.	8	
Bone .....		½
Coal .....	1	10
Clay .....		4½
Coal .....		8+
	<hr/>	
Coal .....	3	2+
Partings .....		5

(Location 225, elevation 1,690.)

	Ft.	in.
Shale .....	10	
Coal, bony .....	1	5
Shale .....		2
Coal .....		3
Shale .....		4½
Coal .....		8
Bone .....		½
Coal .....	1	10
	<hr/>	
Coal .....	4	2
Partings .....		7

At the head of Belcher Branch of Bull Creek (location 226, elevation 1,970) a pit in the Eagle shows only 28 inches of coal, in addition to an inch of shale 8 inches from the bottom, but it is likely that more coal is concealed below. The first of the following sections was made near the head of Duty Branch of Poplar Creek and the second at the head of Knotty Poplar Fork:

*Eagle bed on Duty Branch and Knotty Poplar Fork of Poplar Creek.*

(Location 227, elevation 1,980.)

	Ft.	in.
Shale .....	3	
Coal .....		2
Shale .....		3
Coal .....	3	1
Clay .....		3
Coal .....		5
	<hr/>	
Coal .....	3	8
Partings .....		6

(Location 228, elevation 1,990.)

	Ft.	in.
Shale .....	10	
Coal .....	2	3
Shale .....		1½
Coal .....		3
Shale .....		3
Coal .....		8
Shale .....		9
Coal (reported) ..	1	
	<hr/>	
Coal .....	4	2
Partings .....	1	1½

*Clintwood coal.*—The Clintwood coal lies 60 to 100 feet above the Eagle and is separated from it chiefly by a thick conspicuous sandstone. The Clintwood is about 3½ to 4½ feet thick where measured and is probably equally thick in other districts. The coal is exceptionally clean and free from partings. It lies high in the hills, but has minable acreages on many of the ridges northwest of the Poplar Creek drainage basin.

No measurement of the Clintwood was obtained in the Conoway Creek basin, but pits in the neighboring areas indicate an average thickness there of at least 3½ feet. A pit at the head of Burnt Poplar Fork of Bull Creek (location 229, elevation 1,770) is in 55 inches of clean coal and a lower

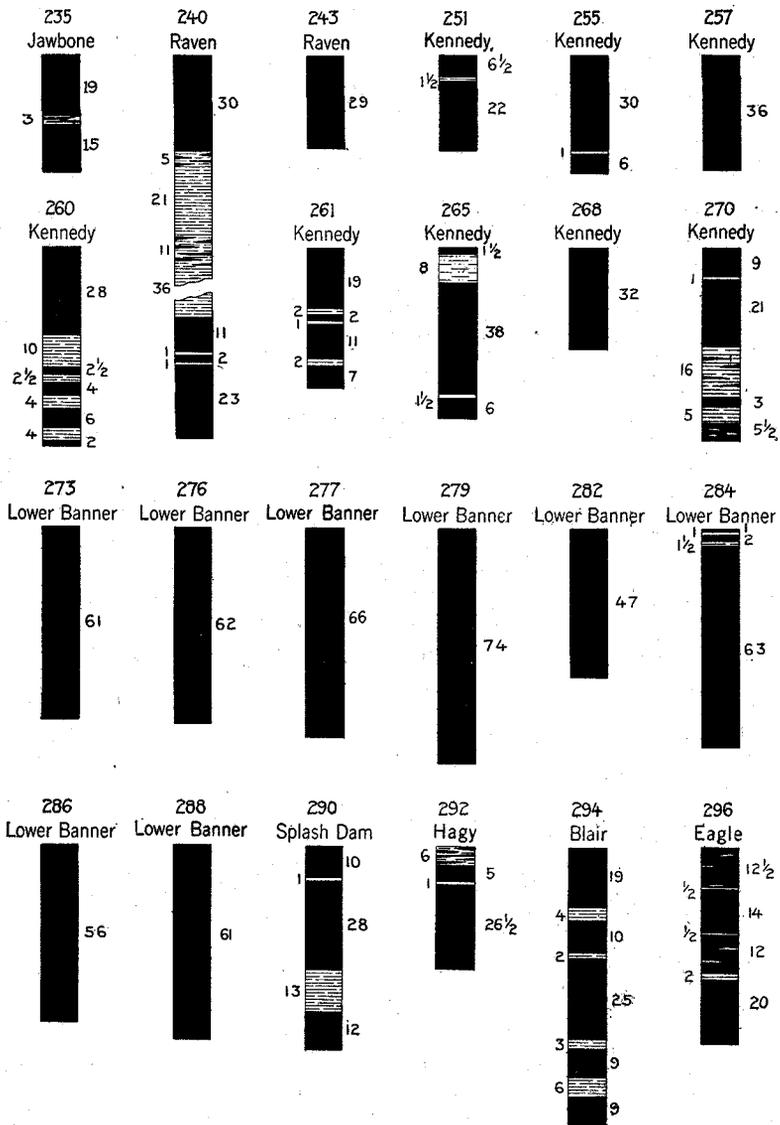


Fig. 12.—Sections of coal beds on Levisa Fork and small tributaries between Grundy and Marvin.

12-inch bench is reported under a 14-inch shale parting. Near the road gap between Bull and Hunts creeks (location 230, elevation 1,875) the coal is reported 43 inches thick. At one of the heads of Deel Fork of Bull Creek (location 231, elevation 1,830) the bed is 43 inches thick and includes an inch of shale 7 inches from the top. The coal is reported to be 54 inches thick at the head of a southern tributary of Belcher Branch of the Bull (location 232, elevation 1,855).

*Campbell Creek coal.*—The Campbell Creek bed, which is about 200 feet above the Clintwood, ranges from 350 feet above the base of the Wise formation on the north to nearly 500 feet above it on the south. Its horizon is near the tops of the ridges, and it underlies only the highest knobs in many districts. The coal was found only at the head of a southern tributary of Conoway Creek and no measurements were obtained, so that very little can be said as to its character. The bed may be fairly thick in places, but its acreage is so small that it is not very important economically. Small outliers of one or two coal beds above the Campbell Creek are probably present in the Conoway Creek basin.

#### LEVISA FORK AND SMALL TRIBUTARIES BETWEEN GRUNDY AND MARVIN.

*General features.*—This area includes, in addition to the slopes on both sides of Levisa Fork itself between Grundy and Marvin, the drainage basins of all the tributaries of that part of the river except Prater, Garden, and Dismal creeks. The largest of these tributaries are Little Prater and Childress creeks and Three and twentymile, Sixteenmile, Big, Rocklick, Bridge, Kennel, Pigeon, Moody, Stilton, Bens, and Watkins branches. The succession of outcropping rocks is shown by generalized section 3 on Plate II and by local sections 13, 19, 20, 22, 27, and 28 (pp. 31, 35-38, and 42). The structure is dominated by a general dip to the northwest, which is slightly modified locally. The strata dip about 200 feet per mile near Marvin and Van Sant and less than 100 feet per mile elsewhere.

The area contains some excellent coal deposits, especially in its southeastern part. (See figs. 4, 5, 6, 7, and 12.) Considerable attention has been given the Keen Mountain district because of the thickness and purity of the Lower Banner bed there and the presence of attractive deposits at other horizons, and it is rumored that railroad facilities for mining operations will soon be provided by a track down Garden Creek from the Clinch Valley division of the Norfolk and Western Railway. Next to the Lower Banner the most important coal in the area is the Kennedy.

The Jawbone coal is about 2 to 3 feet thick in this area, though slightly dirty. The Raven coal is in two benches so close together that only one could be mined; the best measurement obtained of either bench was 42 inches, and it is thinner elsewhere. The Kennedy bed southeast of the mouth of Little Prater Creek contains coal layers aggregating 30 to 50 inches thick, without seriously detrimental partings; in general the bed thins from southeast to northwest and this thinning continues from Little Prater Creek to Grundy, where the coal is only 19 to 27 inches thick. The Lower Banner bed contains remarkably few shale partings and is 4 to 6 feet thick under a large territory including nearly all of Keen Mountain and neighboring lands southwest of the Levisa; a short distance northwest of this district the bed is so thin as to be worthless. The Splash Dam bed is 26 to 51 inches thick along Little Prater Creek and is doubtless workable in neighboring areas; it contains more than 3 feet of recoverable coal at the only exposure found near Marvin, but is probably badly split by shale in many districts. The Haggy bed is 2½ feet thick along and near Little Prater Creek, and thins to the southeast. At least three thick coal beds are present in the Wise formation, but have only small acreages. In addition to the beds mentioned above there are several thin coals of only slight economic importance. It is possible that the area is underlain by workable beds lower than the Tiller, though they are likely to be restricted to the southeastern part of the region.

*Tiller coal.*—The Tiller bed outcrops a short distance above Levisa Fork from Bens Branch to within about a mile of the mouth of Garden Creek. It is also above the river near Marvin. Above the Tiller there are commonly 20 to 50 feet of blue and drab shale underlying a conspicuous bed of siliceous conglomeratic sandstone. The coal is probably thin in most places and is known to be only 19 inches thick near the mouth of Bens Branch (location 233, elevation 1,110), including a 4-inch shale layer in the middle. The bed is reported to contain even less coal near Marvin.

*Jawbone coal.*—The Jawbone is 50 to 100 feet above the Tiller, overlying the conglomeratic sandstone mentioned in the last paragraph. In places a moderately thick sandstone overlies the coal. The interval between the Jawbone and Splash Dam coals increases eastward from 610 feet at Van Sant to about 685 feet at the mouth of Dismal Creek and to 720 feet between the mouth of Garden Creek and Marvin. The Jawbone coal is 3 feet or less thick in this area. There is a thin coal about 50 feet above the Jawbone.

The Jawbone is 20 to 24 inches thick at Van Sant (location 234, elevation 1,125), and is reported to be 22 inches thick half a mile west of the mouth of Dismal Creek (location 234A, elevation 1,260), and 32 inches near the mouth of Pigeon Branch (location 234B, elevation 1,330). It is 37 inches thick in the bank of the Levisa opposite the mouth of Garden Creek (location 235, elevation 1,320), where there is a thin layer of bone in the middle, and 27 inches thick a mile northwest of Garden Creek in a pit beside the road (location 236, elevation 1,329).<sup>1</sup> The Jawbone is reported to be 20 inches thick at the mouth of Dismal Creek and 23½ inches on Contrary Creek near Marvin.

A coal 40 to 65 feet above the Jawbone is 10 inches thick near the mouth of Dismal Creek, 15 inches thick opposite the mouth of Garden Creek and at the mouth of Big Hollow, and 17 inches at the mouth of the next large hollow on the northwest.

*Raven coal.*—The interval between the Raven and Splash Dam horizons increases irregularly eastward from 450 feet at Grundy to 530 feet at the mouth of Dismal Creek and 590 feet at Marvin. The Raven bed is in two benches a few inches to 10 feet or more apart, though one of them probably thins out to the northwest. Another coal lies 25 to 40 feet above the Raven in places. Both benches of the Raven, as well as the coal next above them, commonly contains less than 3 feet of coal in all districts.

The Raven contains 25 inches of coal and 2 inches more 2 inches below it at the mouth of the first tributary below Little Prater Creek (location 237, elevation 1,100), and is 25 inches thick at a small mine facing Levisa Fork a short distance south (location 238, elevation 1,105). There is coal 26 inches thick at another small mine opposite Little Prater School (location 239, elevation 1,155), where the roof is a dark shale. No other openings were found on the southwest side of the Levisa valley.

The upper Raven bench is reported by J. P. Williams, Jr., to be 30 inches thick about 40 feet above the county road at the mouth of Big Hollow. Both benches, as well as the coal next above them, are shown in the following section which was measured by the same authority at the mouth of Richmond Hollow, a valley between Big Hollow and Rocklick Branch:

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<sup>1</sup>These two exposures were incorrectly correlated with the Tiller in Bull. 12, Virginia Geol. Survey, p. 144. See local section 20 in this report.

*Raven and associated beds one mile northwest of Marvin.*

(Location 240.)

	Ft.	in.
Sandstone cliff .....	15	
Shale .....	44	
Coal .....	1	11
Concealed .....	28	
Coal .....	2	6
Shale and coal .....		5
Clay shale, soft .....	1	9
Coal and shale .....		11
Shale .....	3	
Coal .....		11
Shale .....		1
Coal .....		2
Shale .....		1
Coal (elevation about 1,540) .....	1	11
Coal in lowest bench .....	3	
Partings in lowest bench .....		2

At the mouth of Rocklick Branch there are now two exposures of the upper Raven bench, one being in a small mine (location 241, elevation 1,485). Coal 26 to 28 inches thick is exposed and it is reported that there are two benches of coal 3 to 8 feet apart in the vicinity, the upper being 26 to 42 inches thick and the lower about 27 inches. The thickness of the Raven and associated beds opposite the mouth of Garden Creek is shown in local section 20, in a preceding part of this report.

The Raven is 28 to 30 inches thick on the northeast side of the Levisa valley near Van Sant (location 242, elevation 1,200), and is 29 inches opposite the mouth of Little Prater Creek (location 243, elevation 1,160). On the lower part of Watkins Branch (location 244, elevation 1,155) the coal is 23 inches thick and has a slaty shale roof; it appears to be slightly thicker in caved pits farther up the stream (location 245, elevation 1,175). The Raven is about 20 inches thick at Grundy.

*Aily coal.*—The Aily, which is 60 to 140 feet above the Raven, is probably thin everywhere. In the bank of Three and twentymile Branch (location 246, elevation 1,200), and also nearly a mile south (location 247, elevation 1,195), it is 18 inches thick. It is reported less than a foot thick at the mouth of Richmond Hollow and opposite the mouth of Garden Creek.

*Kennedy coal.*—The Kennedy bed, known locally as the Harris, is 290 feet below the Splash Dam at Grundy and 350 feet below it between Dismal Creek and Marvin. It lies a few feet above a thick massive sandstone that makes conspicuous ledges and cliffs and is an excellent marker for the posi-

tion of the coal outcrop. The roof is commonly a sandy shale overlain by a thick series of shales and fine-grained inconspicuous sandstones. The Kennedy is a thick bed southeast of the mouth of Little Prater Creek, containing coal layers aggregating 30 to 50 inches thick, and bears detrimental shale layers in only a few localities. In general it thins gradually to the north and west and averages only about 27 inches thick along Little Prater Creek and slightly less near Grundy.

The Kennedy is 19 inches thick in a small mine behind the school at Grundy (location 248, elevation 1,265), and 26 inches thick in a mine on Three and twentymile Branch (location 249, elevation 1,315). Four small mines on Little Prater Creek (locations 250, 251, 252, and 253, elevations 1,320 to 1,330) utilize the same bed, here 27 to 30 inches thick. A shale layer  $1\frac{1}{2}$  inches or less thick lies about 6 inches from the top of the coal.

In one pit a little more than a mile east of Van Sant (location 254, elevation 1,600) and in another on Sixteenmile Branch (location 255, elevation 1,645) the coal visible is about 3 feet thick and has an inch of shale 6 inches from the bottom. A measurement recently made by J. P. Williams, Jr., in a hollow between these two pits shows considerably more coal and is given as the first of the following sections. The second section was measured by the same authority in the first southern tributary of the Levisa northwest of Garden Creek.

*Kennedy bed near Dismal Creek and near Garden Creek.*

(Location 254A, elevation 1,618.)

	Ft.	in.
Shale.		
Coal .....	2	2
Shale .....		$\frac{1}{2}$
Coal .....	1	3
Shale .....		5
Coal .....		2
Shale .....		$3\frac{1}{2}$
Coal .....		1
Shale .....		1
Coal .....		6
Coal .....	4	2
Partings .....		10

(Location 255A, elevation 1,680.)

	Ft.	in.
Shale.		
Coal .....	2	6
Shale .....		$1\frac{1}{2}$
Coal .....		3
Coal, bony .....		2
Coal .....	2	11
Parting .....		$1\frac{1}{2}$

Williams also measured 30 inches of clean coal about half a mile southeast of the mouth of Garden Creek (location 256, elevation 1,700), 36 inches opposite Hanger (location 257, elevation 1,680), and 35 inches, including an inch of shale near the bottom, half a mile southeast of Hanger (location 258, elevation 1,685). The following two sections, according to

the same authority, show the nature of the bed near Marvin, the first near the mouth of Big Hollow and the second near the mouth of Richmond Hollow:

*Kennedy bed northwest of Marvin.*

(Location 259.)		(Location 260.)	
	Ft. in.		Ft. in.
Shale.		Shale.	
Coal .....	2	Coal .....	2 4
Shale .....	8	Shale .....	10
Coal .....	8½	Coal .....	2½
Shale .....	½	Shale .....	2½
Coal .....	3	Coal .....	4
		Shale .....	4
Coal .....	2 11½	Coal .....	6
Partings .....	8½	Shale .....	4
		Coal .....	2
		Coal .....	3 6½
		Partings .....	1 8½

The partings thin to the west, as shown by the following measurements made by the writer in two small mines, the first beside a path up the first hollow west of Rocklick Branch and the second on Bridge Branch:

*Kennedy bed near Rocklick Branch and Hanger.*

(Location 261, elevation 1,700.)		(Location 262, elevation 1,685.)	
	Ft. in.		Ft. in.
Shale .....	1	Shale, sandy .....	11
Coal .....	1 7	Coal .....	2 2
Shale, carbonaceous ..	2	Shale .....	1½
Coal .....	2	Coal .....	10
Shale, carbonaceous...	1		
Coal .....	11	Coal .....	3
Shale .....	2	Parting .....	1½
Coal .....	7		
Coal .....	3 3		
Partings .....	5		

The coal is reported to be clean and 34 to 35 inches thick on the east side of Kennel Branch valley (locations 263 and 264). The first of the following two sections by Williams is on the west side of Kennel Branch near its mouth and the second is on the west side of Pigeon Branch:

*Kennedy bed on Kennel and Pigeon branches.*

(Location 265, elevation 1,700.)

	Ft.	in.
Shale.....		1½
Coal.....		8
Shale.....	3	2
Coal.....		1½
Coal.....		6
<hr/>		
Coal.....	3	9½
Partings.....		9½

(Location 266, elevation 1,700.)

	Ft.	in.
Shale.....		
Coal.....	2	9
Shale.....		3½
Coal.....		2½
<hr/>		
Coal.....	2	11½
Parting.....		3½

On the first spur east of Moody Branch, which is the first large tributary west of Pigeon Branch, the Kennedy is reported 3 feet thick, including a 2-inch shale parting 2 inches from the bottom. It is only 27 inches thick on Stilton Branch (location 267, elevation 1,570). West of this there is a local thickening, so that there are 32 inches of clean coal on Bens Branch (location 268, elevation 1,470), and 35 inches a short distance southwest (location 269, elevation 1,430). As shown by the following section in a small mine about half a mile farther west, there is a little more coal beneath the thick layer in this district:

*Kennedy bed north of Van Sant.*

(Location 270, elevation 1,360.)

	Ft.	in.
Shale.....	6	
Coal.....		9
Shale.....		1
Coal.....	1	9
Shale with streaks of coal.....	1	4
Coal.....		3
Shale.....		5
Coal, impure.....		5½
<hr/>		
Coal.....	3	2½
Partings.....	1	10

Crawford reports that the upper and only minable part of the bed consists of 31 inches of coal nearly opposite the mouth of Little Prater Creek. What is probably the Kennedy is 28 inches thick where it is exposed on the upper part of Watkins Branch (location 271, elevation 1,546). On the slopes back of Grundy and for a short distance south of the town a number of openings have been made in the Kennedy to supply local trade, the coal being 24 to 27 inches thick. When the region was visited in 1914 the most active mine near Grundy was about 2,000 feet southwest of the courthouse (location 272, elevation 1,285).

*Lower Banner coal.*—The interval between the Lower Banner and Splash Dam horizons is about 100 feet at Grundy and increases to the southeast to 150 feet between Dismal Creek and Marvin. Southeast of a point about halfway between the mouths of Dismal and Garden creeks the Lower Banner, locally known as the Cary, is a remarkably clean bed 4 to 6 feet thick, but it thins notably to the west and is unworkable on Stilton Branch and farther west and northwest. Where the coal is thick it lies a few feet or inches above a moderately thick ledge-making sandstone, which, however, is thinner and less conspicuous where the coal is thin. The roof is a drab shale. A series of shaly beds 50 to 100 feet thick separates the Lower Banner from the Upper Banner coal bed, which is undoubtedly very thin in this area and is represented only by faint blooms a few feet below a massive cliff-making sandstone.

No measurements of the Lower Banner were obtained in the northwestern part of this area, and blooms indicate that the bed is thin. Williams states that the coal is 20 inches thick in a hollow near the mouth of Dismal Creek (location 272A, elevation 1,837), and 52 inches thick half a mile west of the mouth of Garden Creek (location 272B, elevation 1,870). He also reports that there are 66 inches of clean coal a short distance southeast of the mouth of the Garden, and 61 inches opposite Hanger (location 273, elevation 1,880). According to the same authority the bed is as follows farther southeast, the first measurement being in a small hollow three-fourths of a mile southeast of Hanger, and the second in Little Skeggs Branch, which is nearly opposite Rocklick Branch:

*Lower Banner bed southeast of Hanger.*

(Location 274, elevation 1,900.)		(Location 275, elevation 1,965.)	
	Ft. in.		Ft. in.
Shale, dark.		Shale, sandy.	
Coal .....	3	Coal .....	3½
Shale .....	1	Shale .....	3
Coal .....	4 6	Coal .....	4 10
Coal, splint .....	3		
	<hr/>	Coal .....	5 1½
Coal .....	5	Parting .....	3
Parting .....	1		

Pits in the heads of the next two valleys on the east are said to be in 62 inches (location 276) and 66 inches (location 277) of coal, respectively.

The Lower Banner is also in splendid condition north of the Levisa in the Keen Mountain district. Near the head of Big Hollow (location 278, elevation 2,079) the upper part of the bed consists of 64 inches of clean

coal and 6 inches more are reported beneath a 3-inch shale parting. Williams reports that the bed is clean and 74 inches thick near the mouth of Big Hollow (location 279, elevation 2,067), 53 inches thick in Richmond Hollow (location 280, elevation 2,026), 55 inches on an eastern tributary of Rocklick Branch (location 281, elevation 1,990), 47 inches at the head of the same stream (location 282, elevation 1,952), and 56½ inches on its west side (location 283, elevation 1,905). In the first two hollows west of Rocklick Branch the principal bench is a few inches thicker and an inch or two of top coal appears above a very thin parting. This feature is also shown in the following two sections, the first measured by Williams a short distance northeast of Hanger and the second by the writer in a small mine on Bridge Branch, north of Hanger:

*Lower Banner bed near Hanger.*

(Location 284, elevation 1,886.)		(Location 285, elevation 1,874.)	
	Ft. in.		Ft. in.
Shale.....		Shale.....	6
Coal.....	1	Coal.....	1
Shale.....	1	Shale.....	2
Coal.....	2	Coal.....	5
Shale.....	1½		
Coal.....	5	Coal.....	5
	<hr/>	Parting.....	2
Coal.....	5		
Partings.....	2½		

The coal is 56 inches thick near the head of Kennel Branch (location 286, elevation 1,876) and is reported to be 54 to 64 inches thick in three other pits on the same stream and 66 inches on the first point west of the mouth of Kennel Branch (see local section 20). It is reported 59 inches thick on Pigeon Branch (location 287, elevation 1,890), and is 61 inches about half a mile west in a tributary of Moody Branch (location 288, elevation 1,900). The bed thins west of Moody Branch and is reported by d'Invilliers to be only 2 feet thick at the mouth of Dismal Creek and 10 inches on Stilton Branch.

*Splash Dam coal.*—The Splash Dam lies a few feet above a massive ledge- and cliff-making sandstone which is the first conspicuous stratum outcropping above the Lower Banner coal. Although the horizon of the bed can be easily identified, the coal itself was found in very few places in this area and little is known about its thickness in many districts. The coal in the bed is reported to be 26 to 51 inches thick on Little Prater Creek, and it is probably fairly thick north of that stream. It is thinner farther

east and south and may be split into two or more beds by shale in most places. It contains considerable coal, however, in the only pit found east of Garden Creek and may be workable in much of the Keen Mountain district.

The Splash Dam coal is 26 inches thick and has a shale roof containing plants on a southern tributary of Little Prater Creek (location 289, elevation 1,650). Reports that need confirmation are that the bed is 3 feet thick, including 4 inches of shale, on Little Prater Creek less than a mile southwest of location 289, and 54 inches thick, including 3 inches of shale, half a mile east of the same location. What may be only one bench is reported 27 inches thick at the head of Sixteenmile Branch of the Levisa. The full bed is exposed in a pit at the head of Little Skeggs Branch, where it is locally known as the Wilson seam:

*Splash Dam bed one and one-fourth miles west of Marvin.*

(Location 290, elevation 2,145.)

	Ft.	in.
Shale, grading to sandstone at top .....	8	
Coal .....		10
Clay .....		1
Coal .....	2	4
Shale .....	1	
Coal .....	1	
	<hr/>	
Coal .....	4	2
Partings .....	1	2

The only opening in this bed on the north side of the Levisa is in coal 21 inches thick at the head of Bens Branch (location 291, elevation 1,790).

*Hagy coal.*—The Hagy is 110 to 150 feet above the Splash Dam horizon, the interval increasing toward Marvin, and is also only a few feet above a ledge-making sandstone. It is about 2½ feet thick near the head of Little Prater Creek, as shown by the section given below, and is probably as thick north of that stream and for a short distance south of it. No measurements were obtained in the central and eastern parts of the area, though blooms were seen on Keen Mountain. In some districts east of Van Sant there is another thin coal between the Hagy and the top of the Norton formation.

*Hagy coal bed at head of Little Prater Creek.*

(Location 292, elevation 1,773.)

	Ft.	in.
Shale, dark .....	4	
Coal and shale, interbedded .....		6
Coal .....		5
Shale .....		1
Coal .....	2	2½
Coal .....	2	7½
Parting .....		1

*Coals in the Wise formation.*—The Glamorgan, Blair, and Eagle beds, and probably also the Clintwood, are present under the highest parts of the ridges in the northwestern third of this area, but have only small acreages and are exposed in few places.

The Glamorgan bed, which lies 10 feet or less above the base of the Wise formation, was found opened only at the head of the first valley north of Little Prater Creek (location 293, elevation 1,880), where 30 inches were seen and 6 inches more reported.

The Blair bed, which is about 100 feet above the Glamorgan, is thick in places but full of partings. The first of the following sections is at a large local mine at the head of Three and twentymile Branch and the second is on the east side of the right fork of Little Prater Creek:

*Blair bed west and southwest of Grundy.*

(Location 294, elevation 1,967.)

	Ft.	in.
Shale .....	15	
Coal .....	1	7
Shale .....	4	
Coal .....	10	
Shale .....	2	
Coal .....	2	1
Shale .....		3
Coal .....		9
Shale .....		6
Coal (reported) ...		9
Coal .....	6	
Partings .....	1	3

(Location 295, elevation 1,970.)

	Ft.	in.
Shale .....	10	
Coal .....	1	6
Shale .....		10
Coal .....		7
Shale .....		1
Coal (reported) ...	2	2
Coal .....	4	3
Partings .....		11

A bed that may be the Blair was measured by Dilworth on the south side of the Little Prater valley, where the bed contains considerable coal and shale partings that are thicker than in the sections just given.

The Eagle bed, which is 150 to 170 feet above the base of the Wise and a few feet below a thick cliff-making sandstone which separates it from the Clintwood horizon, was measured only at one pit, where it is as follows:

*Eagle bed near head of Little Prater Creek.*

(Location 296, elevation 2,100.)

	Ft.	in.
Sandstone, shaly, under coarse, massive sandstone cliff.....	2	
Coal, with two or three shale streaks.....	1	½
Shale .....		½
Coal .....	1	2
Shale .....		½
Coal, with two shale streaks .....	1	
Shale, carbonaceous .....		2
Coal .....	1	8
Coal .....	4	10½
Partings .....		3

PRATER CREEK.

*General features.*—Strata from a few feet below the Jawbone coal to about 450 feet above the base of the Wise formation are exposed in the Prater Creek drainage basin, the Wise and the Gladeville sandstone occurring only on the tops of a few ridges. The principal features of the stratigraphy are shown by generalized section 3 on Plate II, and by local sections 13, 14, 15, and 16 (pp. 31-34). The structure is simple and beds dip to the north or northwest except where a few small anticlines and synclines cause local irregularities. Dips are gentle, ranging from 200 feet to less than 50 feet per mile.

The Kennedy and Hagy coal beds are commercially the most important in the area, though there are workable beds at other horizons. The Eagle coal is thick, but underlies only small areas on high ridges west of Prater Creek. (See figs. 5, 6, and 13.)

The Jawbone and Raven beds are less than 2 feet thick nearly everywhere in this area. The Kennedy coal, excluding partings, is about 4 feet thick along the upper part of Dry Fork and thins to the west and northwest to a thickness of 20 or 30 inches. The Upper Banner is probably absent except along part of Trace Fork, and the Lower Banner and Splash Dam beds are thin. The Hagy bed is about 3 feet thick in the southwestern part of the area and thinner elsewhere. The Glamorgan bed is less than 30 inches thick and the Blair probably more than 30 inches locally.

The Eagle coal is  $3\frac{1}{2}$  to about 5 feet thick, exclusive of partings. The Clintwood and perhaps higher coals may also be present in very small areas.

*Jawbone coal.*—The Jawbone coal, which is about 610 feet below the Splash Dam, is above drainage levels only along the lower part of Prater Creek and is a thin bed of little economic importance in this district. It is 17 inches thick in the bed of Prater Creek near the mouth of Trace Fork (location 297, elevation 1,171) and 15 inches a few rods down the stream. The coal is 21 to 27 inches thick near the mouth of Dry Fork (location 298, elevation 1,145).

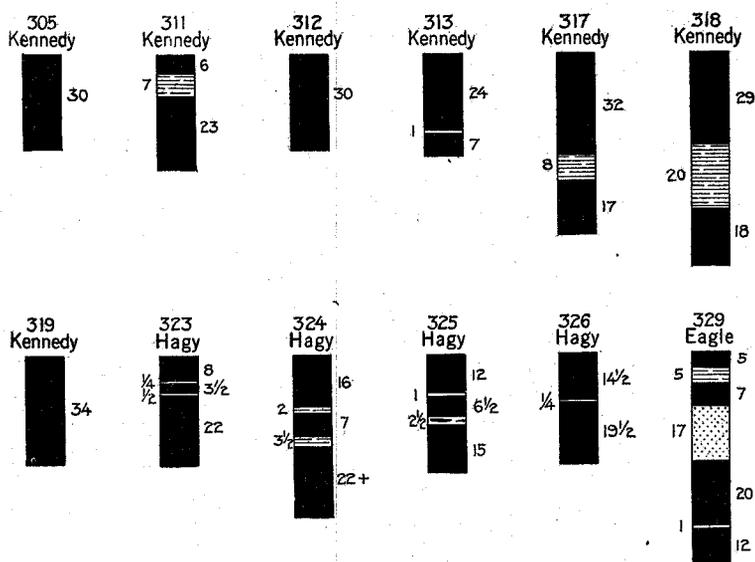


Fig. 13.—Sections of coal beds in the Prater Creek basin.

*Raven coal.*—The Raven lies about 90 feet above the Jawbone and 520 to 570 feet below the Splash Dam horizon. It outcrops low down in the valley of Prater Creek from its mouth nearly to its head and along the lower parts of the principal tributaries. The thickness of the bed is only about 2 feet. There is a 21-inch coal about 75 feet above this bed near the head of Prater Creek.

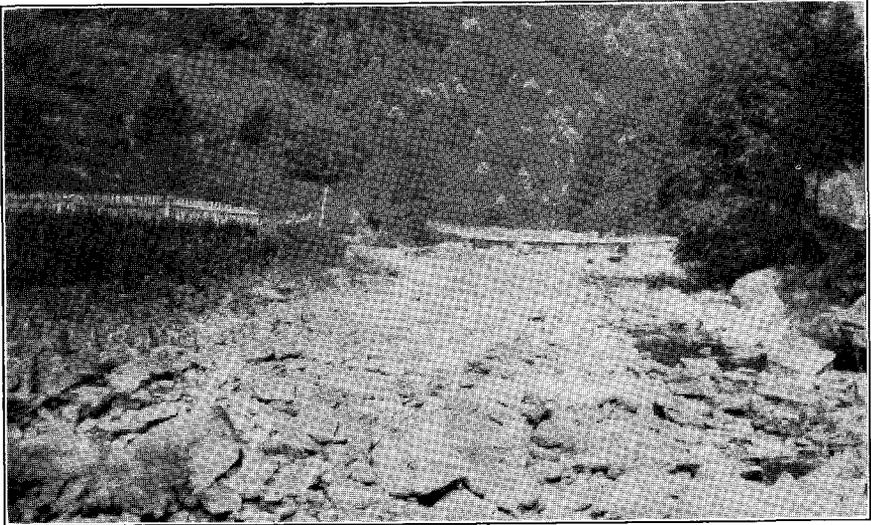
The Raven bed is 25 inches thick at the mouth of Big Lick Branch (location 299, elevation 1,255) and 19 inches at a neighboring exposure on Trace Fork. The bed 75 feet higher is 23 inches thick on Whitt Branch

of Prater Creek (location 300, elevation 1,670), and 21 inches thick by the road up Crooked Branch (location 301, elevation 1,717) and in a pit half a mile southwest. The Raven bed is about 2 feet thick in this locality, but is only 15 to 20 inches thick on Box Camp Branch (location 302, elevation 1,620). An opening on Murphy Fork (location 303, elevation 1,600) shows this bed to be 24 to 28 inches thick and it is about the same at Deskins and on Three Forks Branch (location 304, elevation 1,585).

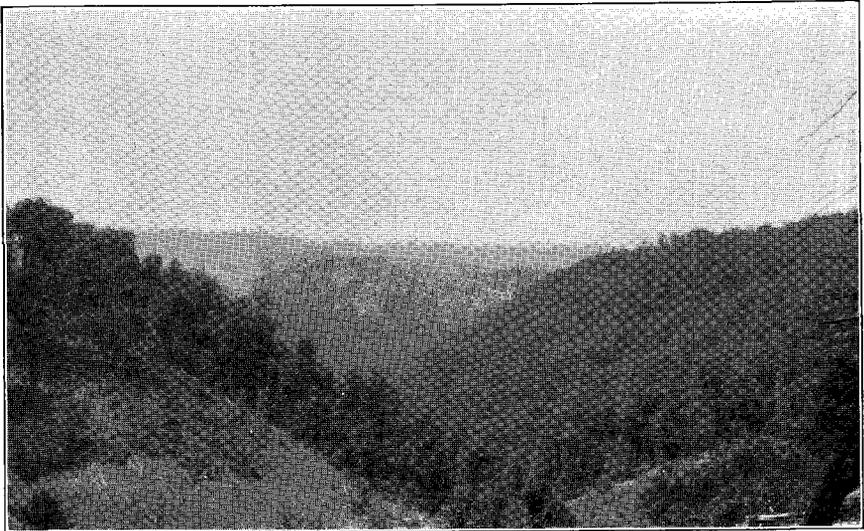
*Kennedy coal.*—The Kennedy is 200 feet and more above the Raven and 300 to 350 feet below the Splash Dam horizon, the intervals decreasing from southeast to northwest. Coal is very persistent at the Kennedy horizon, and is 20 to 30 inches thick along Trace Fork, 2 to 3 feet along Prater Creek and its small tributaries, and about 4 feet along the upper part of Dry Fork. In general, therefore, the bed thins to the west. Where the coal is thickest, the bed commonly includes a shale parting. The roof is drab shale, sandy in places, and a coarse, cliff-making sandstone lies a few feet below the coal.

The Kennedy is 30 inches thick in a small mine a short distance southwest of Van Sant (location 305, elevation 1,445). About a mile southwest of the mouth of Trace Fork (location 306, elevation 1,465), the coal is 21 inches thick and is only 19½ inches a mile farther southwest (location 307, elevation 1,439). A small family mine on Mott Branch of Trace Fork (location 308, elevation 1,485) shows the Kennedy to be only 22½ inches thick, but it is said to be 30 inches in the neighborhood. At the mouth of Trace Fork (location 309, elevation 1,480) the bed is 27 inches thick.

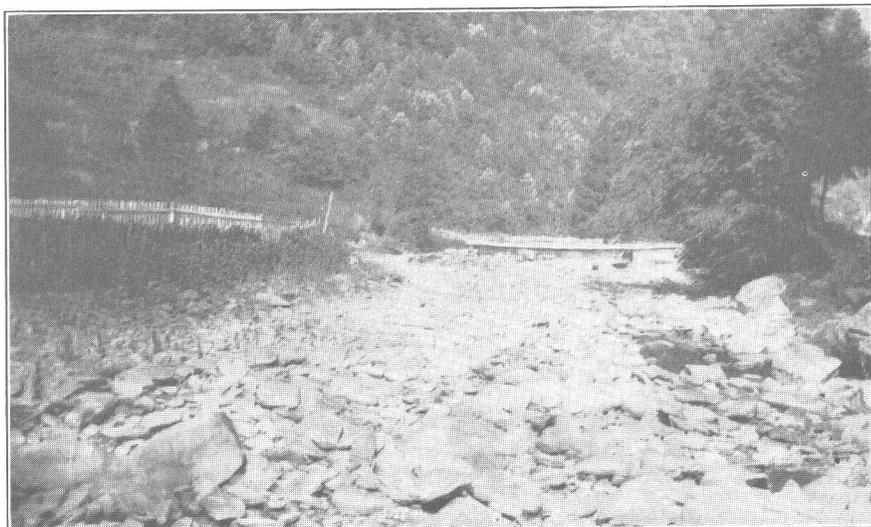
The Kennedy is 29 inches thick nearly opposite the mouth of Devil Branch of Prater Creek (location 310, elevation 1,490). A small mine near a house on Shortridge Branch (location 311, elevation 1,620) and two prospect pits in the vicinity show a carbonaceous shale parting 3 to 12 inches thick, the coal above it being 6 to 8 inches thick and that below it 20 to 26 inches thick. On Whitt Branch, half a mile west of its mouth (location 312, elevation 1,795), the bed is clean and 28 to 32 inches thick. On a northern tributary of Crooked Branch (location 313, elevation 1,850) the bed is 32 inches thick, including an inch of shale, and it is said to be thicker on a southern tributary, near Indian Grave Gap (location 314, elevation 1,855). The Kennedy is reported 30 to 32 inches thick on the upper part of Three Forks Branch (location 315, elevation 1,775) and is 29 inches on Vance Branch (location 316, elevation 1,675).



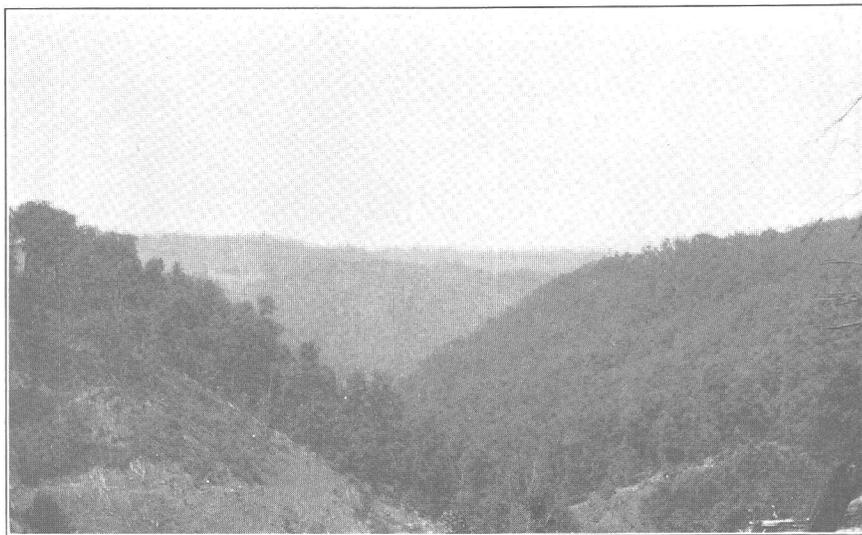
(A) Boulders in stream bed near mouth of Little Prater Creek.



(B) View of Prater Creek valley from road gap at its head.



(A) Boulders in stream bed near mouth of Little Prater Creek.



(B) View of Prater Creek valley from road gap at its head.

The bed is thickest on the upper part of Dry Fork, as shown by the following measurements in small mines:

*Kennedy bed on Dry Fork of Prater Creek.*

(Location 317, elevation 1,675.)		(Location 318, elevation 1,717.)	
	Ft. in.		Ft. in.
Coal .....	2 8	Coal .....	2 5
Shale .....	8	Shale .....	1 8
Coal .....	1 5	Coal .....	1 6
	<hr/>		<hr/>
Coal .....	4 1	Coal .....	3 11
Parting .....	8	Parting .....	1 8

The bed is 27 inches thick and without the shale parting near the mouth of Dry Fork, and is 34 inches thick in a small mine 300 yards northwest (location 319, elevation 1,475).

*Lower and Upper Banner and Splash Dam coals.*—The Lower Banner bed was not found in this area and is probably thin. The Upper Banner bed was found at only one place, shown in the section given below, and its thickness there is surprising. The Upper Banner is thin or absent in most other parts of the Levisa Fork drainage basin and neighboring parts of the Russell Fork drainage basin.

*Section in bed of tributary of Mott Branch of Trace Fork.*

(Location 320.)

	Ft.	in.
Shale .....	10	
Coal (Hagy, elevation 1,920), in caved pit .....		
Concealed .....	10	
Sandstone, massive at top, thin-bedded at base .....	86	
Shale, buff, sandy .....	4	
Coal (Splash Dam, elevation 1,820), with bony streaks....	1	6
Concealed .....	10	
Sandstone, medium-grained, firmly cemented .....	35	
Coal (Upper Banner, elevation 1,775), reported 4 feet thick, now exposed .....	2	6

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The only other measurement of the Splash Dam bed was made near the head of Big Lick Branch (location 321, elevation 1,730), where the coal is 21 inches thick. The bed is probably less than 2 feet thick in most of the Prater Creek drainage basin.

*Hagy coal.*—The Hagy bed is 80 to 120 feet above the Splash Dam horizon, a few feet above a sandstone that makes fairly strong ledges, and a few feet below a thinner and less conspicuous sandstone. Drab shale commonly lies directly on the coal. The thickness of the coal is exceptionally great on the west side of the southern part of the Trace Fork drainage basin, averaging nearly 3 feet and being about 4 feet at one pit. Elsewhere the bed is probably less than 2 feet thick. Run of mine coal from this district would be high in ash because of thin streaks of shale and bone.

The Hagy is 33 inches thick near the head of Big Lick Branch (location 322, elevation 1,850), but the upper 13 inches is a worthless mixture of interbedded shale and coal and there is an inch of shale 16 inches from the base of the bed. The upper part of the bed improves in quality to the south and includes only a few streaks of shale in the gap between Trace Fork and Pawpaw Creek, where the first of the following sections was measured. The second of these sections is from a pit nearly a mile south of the first and is not complete, as the bottom of the bed was not seen. The third and fourth sections were obtained a short distance south of the second, the fourth being from a small mine at a sharp bend in the wagon road from Fox Creek, on land of H. E. Hagy.

*Hagy bed near head of Trace Fork.*

(Location 323, elevation 1,871.)

	Ft.	in.
Shale .....	6	
Coal .....		8
Shale .....		$\frac{1}{4}$
Coal .....		$3\frac{1}{2}$
Shale .....		$\frac{1}{2}$
Coal .....	1	10
<hr/>		
Coal .....	2	$9\frac{1}{2}$
Partings .....		$\frac{3}{4}$

(Location 325, elevation 1,895.)

	Ft.	in.
Shale .....		
Coal .....	1	
Bone .....		1
Coal .....		$6\frac{1}{2}$
Bone .....		$2\frac{1}{2}$
Coal .....	1	3
<hr/>		
Coal .....	2	$9\frac{1}{2}$
Partings .....		$3\frac{1}{2}$

(Location 324, elevation 1,890.)

	Ft.	in.
Shale .....	8	
Coal .....	1	4
Shale .....		2
Coal .....		7
Shale .....		$3\frac{1}{2}$
Coal .....	1	10+
<hr/>		
Coal .....	3	4+
Partings .....		$5\frac{1}{2}$

(Location 326, elevation 1,911.)

	Ft.	in.
Shale .....	15	
Coal .....	1	$2\frac{1}{2}$
Bone .....		$\frac{1}{4}$
Coal .....	1	$7\frac{1}{2}$
<hr/>		
Coal .....	2	10
Parting .....		$\frac{1}{4}$

The Hagy is reported to be 30 inches thick in a hollow northeast of Leemaster (location 327, elevation 1,895).

*Coals in the Wise formation.*—There are known to be three coal beds in the lower part of the Wise formation, but they underlie only small areas on the tops of some of the high ridges. The Glamorgan bed, which is at the base of the formation, is probably thin in most places. It is 29 inches thick, including two 1-inch shale partings, at the head of Big Rock Branch, where it is 300 feet above the Splash Dam horizon. About 200 yards up the same hollow (location 328, elevation 2,130) a bed that is either the Eagle or the Blair has been opened at a level 140 feet above that of the Glamorgan. The coal is reported to be only 29 inches thick here, but this probably includes only the lower part of the bed. The following is a more complete section from an opening 800 feet southeast.

*Eagle (?) bed at head of Big Rock Branch.*

(Location 329, elevation 2,130.)

	Ft.	in.
Coal .....		5
Shale .....		5
Coal .....		7
Sandstone .....	1	5
Coal .....	1	8
Shale .....		1
Coal .....	1	
	<hr/>	
Coal .....	3	8
Partings .....	1	11

The thickness of the Eagle bed farther west is indicated by that in an opening already described on Little Prater Creek (location 295). An exposure of the Eagle in a southern tributary of Big Lick Branch (location 330, elevation 2,190) shows 39 inches of coal, and more is said to be separated from it by a shale parting. There is a thin coal bed a short distance above the Eagle and another, probably the Blair, a short distance below. The excellent character of the Eagle and Blair beds farther south on this ridge is shown at pits in the Russell Prater Creek (locations 101 and 108) and Pawpaw Creek (location 59) drainage basins, described on preceding pages.

The Clintwood coal may be present at the top of some of the high knobs on the west side of the area, but it has not yet been found.

GARDEN CREEK.

*General features.*—Rocks exposed in the Garden Creek drainage basin comprise all of the Norton formation except the lower 200 or 300 feet, and

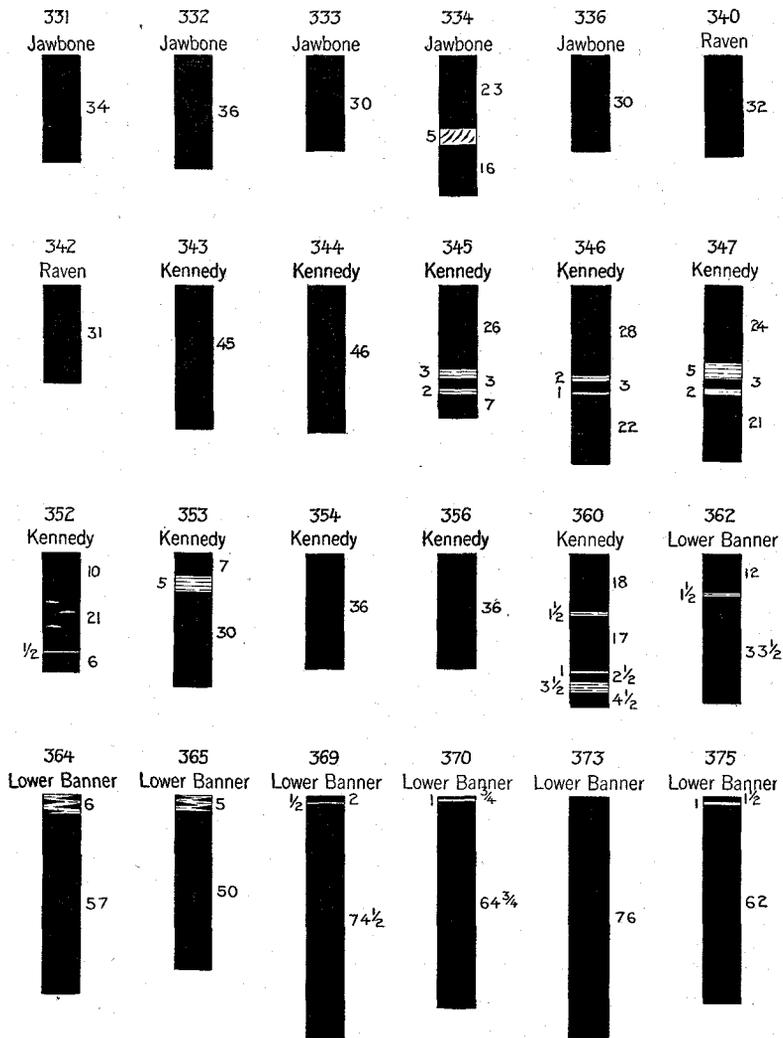


Fig. 14.—Sections of coal beds in the Garden Creek basin.

also the Gladeville sandstone and a few feet of sediments at the base of the Wise formation. The Gladeville and Wise, however, occur only as small outliers on the highest parts of the main ridges in the northwestern part of the area. The succession of strata is shown by local sections 15, 16, 17, 18, and 20 (pp. 33-37). Generalized columnar section 3 on Plate II is applicable to the northwestern part of the area and generalized section 4 to the southeastern part. The beds dip 200 feet or less to the northwest along the two main forks and 50 feet or less to the north along the lower part of the creek.

The thickest coal beds are the Kennedy and Lower Banner, the former being the most valuable bed in the western part of the area and the latter in the eastern part. Several other beds are also minable locally. (See figs. 4, 5, 6, 7, and 14.) It is probable that a few beds in the Lee formation are sufficiently thick to be minable in places, especially on the south. The lowest coal bed exposed is the Tiller, which is only 20 inches thick where seen, but may be thicker locally where beneath the surface. The Jawbone is  $2\frac{1}{2}$  to  $3\frac{1}{2}$  feet thick, with thicker pockets locally. The two benches of the Raven bed and the coal a short distance above them are probably everywhere less than 3 feet thick, the lower Raven bench being 2 to 3 feet thick and the other two coals thinner. The Kennedy contains 3 to  $4\frac{1}{2}$  feet of coal in the northern part of the basin and  $2\frac{1}{2}$  to 3 feet elsewhere. The Lower Banner is clean and about 4 to 6 feet thick in most of the area that is east of lower Garden Creek and Right Fork, but thins greatly to the west, even within short distances. Where thick it will amply reward extensive mining. The Splash Dam bed may be important in some districts, but, in general, the beds above the Lower Banner, and those below it which have not been specifically mentioned here, are thin.

*Tiller coal.*—The Tiller is above the surface only for a short distance along the left fork of Garden Creek, near its head. In one pit (45 feet below location 334 on Jawbone bed) it is reported 20 inches thick, including 2 inches of shale in the middle, and has a sandstone roof. The Tiller may be slightly thicker than this locally under the headwaters of both the right and left forks of the Garden, but is likely to be thin in most districts.

*Jawbone coal.*—The Jawbone is separated from the Tiller by a coarse, cliff-making sandstone that serves as a marker for the position of the coal. It is above the surface only for about 3 miles at the head of the left fork of the Garden, where it is about 765 feet below the Splash Dam horizon,

and for a short distance at the mouth of the Garden, where it is 720 feet below the Splash Dam. The coal is  $2\frac{1}{2}$  to about  $3\frac{1}{2}$  feet thick, with small pockets as much as 6 feet thick. The roof is commonly shale, with a thin layer of soft clay and "rash" next the coal. There is a thin coal bed about 50 feet above the Jawbone.

In a pit on the point between the forks of Presley Branch (location 331, elevation 1,820) the Jawbone consists of 34 inches of clean coal. Coal 55 inches thick was seen in the same bed 800 feet south in the left fork of Presley Branch, and the full bed was reported 6 feet thick at the face of the pit. The coal is 3 feet thick nearly opposite the mouth of Griffy Branch (location 332, elevation 1,855), and 30 inches on Hale Branch (location 333, elevation 1,880). There is also a 2-foot bed 38 feet above the pit on Hale Branch. Other sections in local mines in this vicinity are as follows, the first being 1,500 feet southeast of the mouth of Hale Branch and the second 600 feet east of Hale School:

*Jawbone bed near head of Garden Creek.*

(Location 334, elevation 1,900.)		(Location 335, elevation 1,885.)	
	Ft. in.		Ft. in.
Rash .....	1	Shale .....	3
Coal .....	1 11	Rash .....	2
Rash .....	5	Coal .....	2 6
Coal .....	1 4		
	<hr/>	Coal .....	2 6
Coal .....	3 3		
Parting .....	5		

The Jawbone is 30 inches thick in the east bank of Garden Creek, near its mouth (location 336, elevation 1,330). Here the coal is overlain by a thick sandstone that is shaly at base and fairly massive at top.

*Raven coal.*—There are two benches of the Raven coal, lying only a few feet apart and just above a massive sandstone. Along lower Garden Creek the coal is 550 feet below the Splash Dam horizon, and near the heads of the stream the interval is 580 to 610 feet. Another coal is 40 to 80 feet above the Raven. The lowest Raven bench is clean and between 2 and 3 feet thick in nearly all the area; the upper bench and the coal above it are slightly thinner. One Raven bench and the coal above the Raven may be absent from some districts.

The two Raven benches and the coal next above them are each about two feet thick opposite the mouth of Garden Creek (see page 36). One Raven bench is 20 inches thick near a house on Little Garden Creek (loca-

tion 337, elevation 1,510), and is reported 30 inches thick half a mile south of the mouth of that stream. The coal next above the Raven is 20 inches thick at stream level on Robinson Fork of Right Fork (location 338, elevation 1,735) and is slightly thicker in the road near the mouth of that stream. What may be the only representative of the two Raven benches in this locality is 26 inches thick on a western branch of Long Fork (location 339, elevation 1,820) and 27 to 32 inches in two pits on the main stream (location 340, elevation 1,865). A pit on the southwest side of the upper part of Whitt Fork (location 341, elevation 2,030) shows coal 25 inches thick, but there are only 18 inches in a pit under the wagon road a short distance east.

No measurements were obtained along the lower part of the left fork of the Garden. In a small mine on Hale Branch (location 342, elevation 2,100) there are 31 inches of clean coal in what is probably the only bench of the Raven, though it is overlain directly by a coarse sandstone which commonly overlies the coal above the Raven. Coal the same thickness and in the same bed is stripped a short distance down the branch, where 15 to 30 feet of shale separate it from the sandstone.

*Kennedy coal.*—The Kennedy coal, locally called the Harris, is a persistent and valuable bed in this area and lies about 350 feet below the Splash Dam horizon. The position of the coal is marked by a massive coarse-grained, ledge-making sandstone a few feet below it. The roof of the coal is commonly drab shale, in places so sandy as to be almost a sandstone. The Kennedy, exclusive of partings, is 3 to 4 feet thick along the lower part of Garden Creek, and is 3 to nearly 5 feet thick on both sides of the lower parts of both the main forks. Elsewhere in this drainage basin it is about 2½ to 3 feet thick or less. In some localities the bed is nearly all coal, in others there are several shale partings of irregular thickness.

Williams reports that the Kennedy is 41 inches thick, including an inch of shale near the bottom, in the head of the right fork of Little Garden Creek. In a hollow half a mile south of the mouth of Little Garden Creek (location 343, elevation 1,715) the Kennedy is 45 inches thick, possibly including an inch or two of shale. In another hollow three-quarters of a mile farther south (location 344, elevation 1,730) the bed is 46 inches thick.

There are several prospect pits and small mines on the north side of Youngs Branch, two of the sections obtained being shown below. The thickness of coal and partings is not the same in all parts of the mine in which the second section was measured and as much as 59 inches of coal was seen at one place in it.

*Kennedy bed on Youngs Branch.*

(Location 345, elevation 1,764.)			(Location 346, elevation 1,740.)		
	Ft.	in.		Ft.	in.
Shale .....	2		Shale .....		
Coal .....	2	2	Coal .....	2	4
Shale .....		3	Shale .....		2
Coal .....		3	Coal .....		3
Shale .....		2	Shale .....		1
Coal .....		7	Coal .....	1	10
	<hr/>			<hr/>	
Coal .....	3		Coal .....	4	5
Partings .....		5	Partings .....		3

The bed is about the same on the upper part of Skeggs Branch, as shown by the following section, the lower part of which was reported by Catlett:

*Kennedy bed on Skeggs Branch.*

(Location 347, elevation 1,780.)		Ft.	in.
Shale, dark blue at base .....		20	
Coal .....		2	
Shale .....			5
Coal .....			3
Shale .....			2
Coal .....		1	9
Interval to top of massive sandstone, about .....		2	6
	<hr/>		<hr/>
Coal .....		4	
Partings .....			7

Residents report that there is clean coal 42 inches thick in a caved pit near the mouth of Skeggs Branch (location 348, elevation 1,755). The Kennedy is without partings on Breeden Branch and is reported by Catlett to be 3 feet thick in a pit near the head of the valley (location 349, elevation 1,783). Farther south it is 28 inches thick in one pit (location 350, elevation 1,790) and 29 inches in another (location 351, elevation 1,840). The coal is 37½ inches thick near the head of Robinson Fork (location 352, elevation 1,820), but is slightly crushed and dirty in the middle.

The Kennedy includes 37 inches of coal on Long Fork (location 353, elevation 2,075), in addition to a 5-inch black shale parting 7 inches from the top. A small mine farther east, on a southern tributary of Whitt Fork (location 354, elevation 2,150), is in clean coal 36 inches thick. A small mine near the road at the head of Whitt Fork (location 355, elevation 2,305) shows 26 inches of coal, crushed and slickensided, underlain by 6 inches of intermingled clay and coal resting on very hard sandy shale.

The Kennedy was found at only two places on the southeast side of the Right Fork basin, at one of which (location 356, elevation 1,900) coal 36 inches thick is separated from sandstone below by only 2 inches of carbonaceous shale. Dilworth states that the coal is 43 inches thick near the mouth of North Branch, and a resident claims that the bed is a little more than 3 feet thick near one of the heads of that stream (location 357, elevation 1,920).

No complete measurements of the Kennedy were obtained in the southern part of the basin of the left fork of the Garden, but pits in neighboring districts indicate that the average thickness is 30 inches or less, with thicker lenses in places. The bed is reported to contain very little coal and a thick shale parting at head of Griffy Branch (location 358, elevation 2,340), where there is also a coal 35 feet above the Kennedy that is reported 2 feet thick.

The Kennedy is thick and more regular farther northwest. It is reported by residents to include about 4 feet of coal and 8 inches of shale in the right fork of Gum Branch (location 359, elevation 1,875). Williams reports the following in tributaries of the left fork of the Garden less than a mile from Gum Branch:

*Kennedy bed northwest of Gum Branch.*

(Location 360.)		(Location 361, elevation 1,733.)	
	Ft. in.		Ft. in.
Shale.		Shale.	
Coal .....	1 6	Coal .....	2 9
Shale .....	1 ½		
Coal .....	1 5	Coal .....	2 9
Shale .....	1		
Coal .....	2 ½		
Shale .....	3 ½		
Coal .....	4 ½		
	<hr/>		
Coal .....	3 6		
Partings .....	6		

The bed probably contains about 3 feet of coal and only a little shale farther north on the east side of Garden Creek valley.

*Lower Banner coal.*—The Lower Banner (Cary) coal is 150 to 170 feet below the Splash Dam horizon in most places and overlies a sandstone that is fairly massive and in turn overlies a thin coal, the Big Fork bed, near Sandy Ridge. It is about 4 to 6 feet thick and exceptionally free from

shale partings in most of the eastern half of this drainage basin, but thins notably to the west and is probably not minable in part of the basin of Right Fork. The roof is shale at all openings.

The Lower Banner was not found west of Lower Garden Creek or in the drainage basin of Right Fork except in its southeastern corner. The coal is reported to be 2 feet thick in a pit on the east side of Long Fork valley, 34 inches thick south of the upper part of Whitt Fork and 32 inches near the gap at the head of Whitt Fork. The bed is 47 inches thick at the head of Rosin Camp Fork (location 362, elevation 2,440), including  $1\frac{1}{2}$  inches of shale a foot from the top.

Several small local mines operate in western tributaries of the lower part of the left fork of the Garden in thick Lower Banner coal. At the most northern of these (location 363, elevation 1,985) the coal is at least 47 inches thick. At another, half a mile southwest of Cook School (location 364, elevation 2,080) the coal is 63 inches thick, the upper 6 inches containing numerous shale streaks. At a third, a short distance farther south (location 365, elevation 2,160) there are 55 inches of coal, the upper 5 inches being dirty.

The bed is reported 42 inches thick at the head of the right fork of Presley Branch (location 366, elevation 2,505) and 29 inches at the head of the left fork (location 367, elevation 2,550). Pits in Russell County, a short distance south of the Buchanan boundary, show that the bed thickens to the east to about 4 feet at the head of the left fork of Hale Branch and to nearly 5 feet between that and Lynn Spring Gap, though underlying only small areas under the ridge tops.

The Lower Banner is reported 67 inches thick at the head of the right fork of Walker Branch (location 368, elevation 2,485), and is about the same farther north. The bed is 77 inches thick on the left fork of Trace Branch (location 369, elevation 2,160) and  $66\frac{1}{2}$  inches on a southern tributary of Neely Branch (location 370, elevation 2,120). The coal is reported  $5\frac{1}{2}$  feet thick at the head of Neely Branch (location 371, elevation 2,135). Small mines show it to be 71 inches thick on one southern tributary of Gum Branch (location 372, elevation 2,050) and 76 inches on another (location 373, elevation 2,010). There is a streak of clay an inch or two from the top of the coal in the last 5 exposures. The bed is said to be 68 inches thick in a northern tributary of Gum Branch (location 374, elevation 1,970). Williams states that it is  $64\frac{1}{2}$  inches thick, including an inch of shale  $1\frac{1}{2}$  inches from the top, nearly a mile north of Gum Branch, on the south side of Meadow Branch valley (location 375), but that it is only 29

inches thick on the north side of the same valley. The coal may also be comparatively thin in some places between the exposure last mentioned and the mouth of Garden Creek.

*Upper Banner and higher coals.*—The Upper Banner bed, 50 to 100 feet below the Splash Dam, is probably thin in all this area. The only place at which it was found to be more than a few inches thick is on the side of Fletcher Ridge (location 376, elevation 2,310), where 20 inches were seen. Very little is known about the Splash Dam bed. It is probably an important bed in places, but it seems likely that it would have been more extensively prospected if it were minable in many localities. Several inhabitants said that it was 4 feet thick in a pit west of Breeden Branch (location 377, elevation 2,190), though this probably includes some shale. As previously stated, a bloom indicating coal at least 3 feet thick shows at the Splash Dam horizon on Fletcher Ridge (location 52) and the bed makes a good showing west of Marvin (location 290). The Hagy bed, 100 to 150 feet above the Splash Dam, is present in places but probably thin everywhere. The Glamorgan bed was not found, but may be present in the small outliers of the Wise formation.

#### LEVISA FORK ABOVE MARVIN, INCLUDING CONTRARY CREEK.

*General features.*—The nature of the rocks exposed in this area is shown by local sections 18, 19, 22, and 24 (pp. 35, 38, and 39), and by generalized section 4 in Plate II. These rocks include those from a short distance below the Tiller coal horizon to and including the Gladeville sandstone and the lower few feet of the Wise formation. The rocks dip 100 to 250 feet per mile to the northwest, somewhat more steeply on the northwestern border of the area than elsewhere.

The most valuable known coal deposits are in the Lower Banner, Raven, and Jawbone beds. Other outcropping beds are also minable in places. (See figs. 4, 5, 6, 7, and 15.) As no drilling has been done in the area, nothing is known with certainty as to the thickness of coal beds lying beneath the surface. Below the Tiller, however, there are at least 1,700 feet of Pennsylvanian coal-bearing rocks, and it is probable that some of the coal beds in this interval are locally minable. The drill record from Seng Camp Fork of Dismal Creek (p. 13) is a rough index of the possibilities of this area. The discussion of coals below the Tiller in the detailed description of coal along Dismal Creek above Whitewood also contains sug-

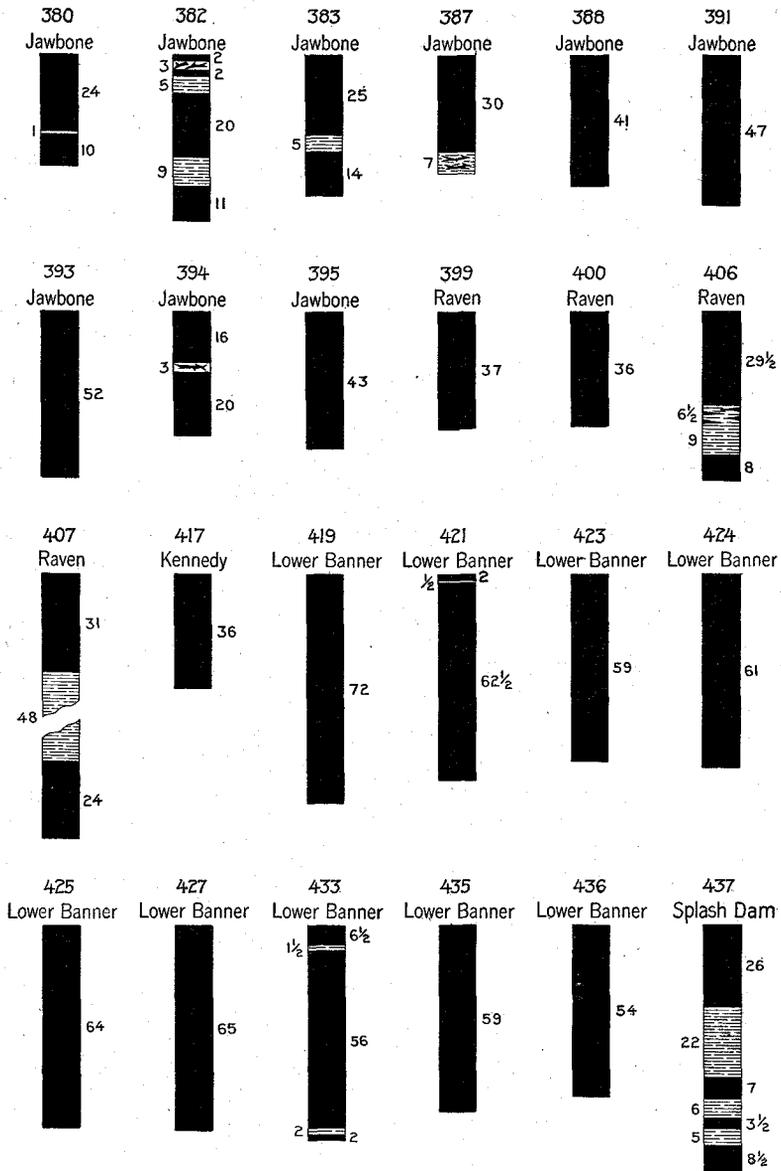


Fig. 15.—Sections of coal beds in the basin of Levisa Fork above Marvin.

gestions that are applicable to this basin. There is, however, a general tendency for the lower coal beds of the Appalachian fields to thin to the northwest.

The lowest coal bed exposed in this area, the Tiller, is probably thin except along upper Grassy Creek, where it may be a bed that is 30 to 48 inches thick. The Jawbone coal is 2 to 5 feet thick, but contains irregular bony layers that would increase the percentage of ash produced in burning. The Raven coal is 2 to 4 feet thick and of excellent quality. The Kennedy is 3 feet thick locally, but probably thinner in many places. The Big Fork bed is 2½ feet thick under part of Sandy Ridge and probably thinner elsewhere. The Lower Banner bed is the best in the area, though its acreage is not large; it is about 5 to 6½ feet thick in most places, and 2 to 3 feet thick at the heads of North Fork and neighboring tributaries of Contrary Creek. The Splash Dam bed includes minable coal in some of the small tracts it underlies. In addition to these beds there are a few others that might be utilized locally.

*Tiller coal.*—The Tiller is 50 to 80 feet below the Jawbone and is separated from it chiefly by coarse sandstone. The bed is only a few inches thick near Marvin (see local section 19) and is probably thin elsewhere in the area except along upper Grassy Creek, though very few measurements were obtained. Near the head of Grassy Creek, however, a bed that is thought to be the Tiller, but may be the Jawbone, contains 30 to 48 inches of coal in several pits. The best exposure is in a small mine north of the creek (location 378, elevation 1,990), where the bed is 40 inches thick at the face and without partings, though the lower 8 inches is bony in places. At the mouth of this mine the bed is 4 feet thick, but includes three irregular partings of rash, each 4 inches or less thick.

*Jawbone coal.*—The Jawbone, known locally as the Ratliff, outcrops low in all the principal valleys. The interval between it and the Splash Dam horizon increases to the east and southeast from 730 feet at Marvin to about 800 feet along the upper part of Carver Branch, Grassy Creek, and Levisa Fork. The roof is sandy shale and a strong coarse sandstone lies a few feet below the coal.

The Jawbone is only about 2 feet thick near Marvin, but is about 3 to 5 feet thick in the eastern part of the Contrary Creek basin, 2 to 3½ feet thick along Grassy Creek, and about 3 feet thick, exclusive of partings, along the upper part of Levisa Fork. Its value is seemingly impaired in most districts by irregularly interbedded bony layers. There is a thin coal bed 40 to 60 feet above the Jawbone.

Only blooms and caved pits were found at the Jawbone horizon along the Levisa from Marvin south to Grassy Creek and Jackson Branch. On the latter stream (location 379, elevation 1,845) the bed is reported nearly 3 feet thick. Near the head of Pistol Branch (location 380, elevation 2,045) the coal is 34 inches thick and is split by an inch of shale ten inches from the bottom. Both the coal and the partings are said to be slightly thicker in the caved pit under the wagon road a short distance north (location 381, elevation 1,990). The character of the bed along the Levisa above Pistol Branch is shown by the following measurements in local mines, the first being 2,200 feet northeast of Vandyke and the second nearly as far northwest of that post-office:

*Jawbone bed near Vandyke.*

(Location 382, elevation 2,034.)			(Location 383, elevation 2,015.)		
	Ft.	in.		Ft.	in.
Shale .....	20		Shale .....	6	
Coal .....		2	Coal .....	2	1
Bone .....		3	Shale .....		5
Coal .....		2	Coal .....	1	2
Shale .....		5			
Coal .....	1	8	Coal .....	3	3
Shale .....		9	Parting .....		5
Coal .....		11			
		<hr/>			
Coal .....	2	11			
Partings .....	1	5			

The complete thickness of the bed is reported 33 inches 800 feet south-east of Lane School (location 384, elevation 1,985), but appears to be less on Sevenmile Branch (location 385, elevation 1,990).

On Grassy Creek, near its mouth (location 386, elevation 1,825), the Jawbone is 28 inches thick and without partings. More than a mile up the creek (location 387, elevation 1,950) a small mine uses 30 inches of coal which rests on 6 to 8 inches more of impure carbonaceous material. The bed is said to be slightly thinner a short distance southeast. The coal is 41 inches thick in the small drift opposite the mouth of Boyd Branch (location 388, elevation 1,870), though somewhat bony throughout. A stripping a short distance northwest (location 389, elevation 1,835) shows 31 inches of coal, the lower 4 inches being slightly bony.

The Jawbone is reported by d'Inwilliers to be 5¼ feet thick on a tributary of Contrary Creek, a mile from Marvin (location 390, elevation 1,705), the middle portion being crushed. In a mine a short distance up Carver

Branch (location 391, elevation 1,795) the coal is 47 inches thick and very hard, some layers being slightly bony. A pit used to supply the school at the forks of Carver Branch (location 392, elevation 1,895) shows coal 35 inches thick. Halfway between the two pits last mentioned, on the north side of the valley (location 393, elevation 1,865), there are 52 inches of coal. In a northern tributary, nearly half a mile farther north (location 394, elevation 1,840), the bed is 39 inches thick, with a thin layer of bone near the middle. Opposite the mouth of South Fork, on the north side of the Contrary valley (location 395, elevation 1,820), a small mine is in coal 43 inches thick. Williams states that the Jawbone is only 19 inches thick opposite the mouth of Carver Branch (location 396), 2 feet thick southwest of the mouth of North Fork (location 397), and 23½ inches nearer Marvin, including 2 inches of bone near the base (see local section 19). The bed 45 feet above the Jawbone is only 10 inches thick near Marvin.

*Raven coal.*—In this region the Raven coal is in two benches fairly close together and there is another coal bed about 30 feet higher. In some districts a cliff-making sandstone bearing pebbles lies a few feet above the upper coal; in other districts this sandstone is not far above the Raven and the upper coal is wanting. What is probably the upper bench of the Raven bed is mined extensively near Raven, a few miles southeast of this area. It is 590 feet below the Splash Dam horizon at Marvin, and the interval increases irregularly to about 630 to 660 feet near Sandy Ridge.

The coal above the Raven is probably less than 2 feet thick everywhere. The upper bench of the Raven consists of 2 to 4 feet of excellent coal resting on a thin shaly or bony layer. The lower bench commonly contains too much interbedded shale to be of much value and lies too close to the upper bench in most places to be recovered if the latter is mined. This lower bench may be absent from the southern part of the area. The Aily bed, which lies nearly 80 feet or more above the Raven zone, is probably thin in all of this area.

One of the benches of the Raven coal, probably the upper, is stripped in the first valley south of Whetstone Branch (location 398, elevation 1,935), where it is 26 inches thick, the lower 4 inches being bony. Half a mile northwest of Lane School (location 399, elevation 2,070) the coal is 37 inches thick, with 7 feet of shale exposed both above and below it; this may be the only bench of the Raven in this locality, and is a clean bed of excellent quality. Near the head of Levisa (location 400, elevation 2,225) the same bed is just 3 feet thick, and it is 27 inches thick 1,500 feet north-

west of Vandyke (location 401, elevation 2,180) and 28 inches on Sevenmile Branch (location 402, elevation 2,110). The same bed is 2 feet thick in the next valley on the north (location 403, elevation 2,060) and there may be more coal beneath a moderately thick shale parting.

The Raven coal is reported to be 30 to 48 inches thick in a small mine on a tributary of Grassy Creek between Boyd and Betsey branches (location 404, elevation 2,100). The lower bench is said to be about 2 feet thick and about 18 inches below that mined. Coal  $3\frac{1}{2}$  feet thick is reported by d'Invilliers about a mile from the head of Grassy Creek (location 405). On Carver Branch of Contrary Creek, near the mouth, the upper bench of the Raven-coal was measured by Williams and is as in the first of the following two sections. The same bed and what may or may not be the lowest bench are shown in the second section, measured by the writer near the head of Carver Branch. A sandstone cliff containing many pebbles is 40 feet above the coal at the first pit and 20 feet above that at the second.

*Raven bed on Carver Branch of Contrary Creek.*

(Location 406, elevation 1,915(?) )		(Location 407, elevation 2,040.)	
	Ft. in.		Ft. in.
Shale.		Shale .....	15
Coal .....	2 5½	Coal .....	2 7
Shale and coal .....	6½	Shale .....	4
Shale .....	9	Coal .....	2
Coal .....	8		
	<hr/>	Coal .....	4 7
Coal .....	3 1½	Parting .....	4
Partings .....	1 3½		

The first of the following sections by Williams shows both benches of the Raven and the coal 28 feet above them, the intervals between beds being barometer readings only:

*Raven and associated beds on South Fork of Contrary Creek.*

(Location 408.)		Ft. in.
Sandstone cliff, conglomeratic.		
Concealed .....		3
Coal blossom .....		1 4
Concealed, probably shale .....		28
Coal .....		2 5
Concealed, including some sandstone.....		21
Coal .....		10½
Shale .....		3
Coal .....		3
Shale .....		8

	Ft.	in.
Coal .....	1	
Shale .....	3	
Coal .....	4	
Shale .....	1½	
Coal .....	4½	
Shale .....	2½	
Coal .....	4	
<hr/>		
Coal in lowest bed .....	2	3
Partings in lowest bed .....	1	6

The upper bench of the Raven is reported 28½ inches thick and 40 feet below the cliff on a branch of South Fork (location 409), and both lower benches are shown in the following sections by Williams, the first on Contrary Creek above the mouth of South Fork and the second back of the house at the mouth of North Fork:

*Raven bed near mouths of North and South forks.*

(Location 410.)			(Location 411.)		
	Ft.	in.		Ft.	in.
Coal .....	2	5	Coal .....	2	6
Shale and coal .....		6	Shale and coal .....		6½
Shale .....	12		Shale .....	10	
Coal .....		8	Coal .....		4
Shale .....	3	6	Shale .....	1	3
Coal .....		8½	Coal .....	1	½
Shale .....		2	Shale .....		2
Coal .....		5	Coal .....		8
Shale .....		3½	Shale .....		1½
Coal .....		10	Coal .....		3
Shale .....		2			
Coal .....		2			

It is evident that only the upper of these two benches can be profitably mined in most of the Contrary Creek basin, and that it is a clean bed of value. On North Fork, however, about half a mile from its mouth (location 412, elevation 1,790), the lower bench includes 2 feet of clean coal and is sufficiently far from the upper to be mined separately. Near this, on North Fork, the clean portion of the upper bench is reported 34 inches thick. On a tributary of the Contrary, halfway between North Fork and Marvin (location 413), the clean portion of the upper bench is reported by Williams to be 30½ inches thick and only about 5 feet from the lower bench, which is thin. Both these benches and also the next coal above them were measured by Williams about 2,000 feet north of Marvin, as shown in the following section; the relation of these beds to other coals is shown in local section 19.

*Raven and associated beds on Contrary Creek near Marvin.*

(Location 414.)

		Ft.	in.
Sandstone cliff, conglomeratic at base .....		70	
Shale .....		10	
Coal .....		1	11
Shale .....		35	3
Coal .....		2	3
Coal and shale in thin layers } (Raven "twin") {			6
Shale .....			8
Coal .....			6½
Sandstone .....		2	2
Coal .....		1	1
Shale .....		1	10
Coal (elevation 1,765) .....			9

*Kennedy and Big Fork coals.*—The Kennedy is a few feet above a thick cliff-making sandstone and is 350 feet below the Splash Dam horizon at Marvin and 375 to 400 feet below it on the eastern and southeastern borders of the area. In part of the area the Kennedy is in two benches 40 feet or less apart and each 2 feet or less thick. In the remainder of the area there is only one bench, commonly 3 feet or less thick. The bed was found in only a few localities, even in the Contrary Creek basin where systematic prospecting has been undertaken.

There is a thin coal bed of no economic importance 80 to 130 feet above the Kennedy. The Big Fork bed is 150 to 180 feet above the Kennedy, beneath a massive sandstone that separates it from the Lower Banner coal. The Big Fork coal is somewhat dirty and is 30 inches thick or less.

The Kennedy is said to be 34 inches thick at the head of the left fork of Whetstone Branch (location 415, elevation 2,195). It was not found elsewhere west of the Levisa in this area, but exposures in adjoining areas indicate that it may be in two benches 20 to 40 feet apart along the upper part of Levisa Fork, the upper being 2 to 3 feet thick and the lower thinner. One of these benches, and perhaps the only one present in that locality, is reported 18 to 24 inches thick half a mile north of Vandyke (location 416, elevation 2,450). No measurements were obtained along Grassy Creek, but a pit in Tazewell County, less than a mile southeast of Wolfpen Knob, is in 36 to 42 inches of coal at the Kennedy horizon. At the head of Carver Branch of Contrary Creek (location 417, elevation 2,315) the Kennedy is 3 feet thick and has a thick blue to drab shale roof. The lower half of the bed is probably impure between this and Bill Young Gap and the coal is probably not very thick on the northern tributaries of the Contrary. According to Williams the Kennedy on Contrary Creek near Marvin is in two 16-inch benches 20 feet apart (see local section 19).

The Big Fork bed has not been opened in many places and is probably very thin in most districts. On Sandy Ridge, however, it is  $2\frac{1}{2}$  feet thick south of the Gap of Sandy, as shown by a pit in Tazewell County, and 2 feet thick about a mile northeast of that gap (location 418, elevation 2,750). A blossom 11 inches thick is reported on Contrary Creek near Marvin (see local section 19).

*Lower Banner coal.*—The Lower Banner bed, known locally as the Cary, is a few feet or inches above a massive bench-making sandstone and is about 150 feet below the Splash Dam horizon at Marvin and 175 to 185 feet below it on the eastern and southeastern borders of the area. The roof is a thick drab shale. In nearly all of the area it is a clean bed about 5 to  $6\frac{1}{2}$  feet thick, but, unfortunately it underlies only small tracts where it is thickest. At the heads of the northern tributaries of Contrary Creek, where the acreage is fairly large, the coal is only about 2 to 3 feet thick.

The Lower Banner is just 6 feet thick in the well-known local mine a mile south of Marvin (location 419, elevation 2,215), and has no partings except films of mother coal. The coal is 67 inches thick at the head of the right fork of Whetstone Branch (location 420, elevation 2,230), according to d'Inwilliers. At the head of the left fork of the same branch (location 421, elevation 2,365) the bed is 65 inches thick, including half an inch of shale 2 inches from the top. About the same thickness probably applies to the outliers of the bed between this and Lynn Spring Gap. The coal is 70 inches thick in the outlier about half a mile northeast of Pistol Gap.

Pits on Sandy Ridge in Tazewell County, near the Gap of Sandy, show the Lower Banner to be 5 to 6 feet thick in that locality and without partings. In one small mine on the ridge between Levisa Fork and Grassy Creek (location 422, elevation 2,710) the coal is reported about 6 feet thick, and in another (location 423, elevation 2,650) it is 59 inches thick. Catlett states that the coal is 80 inches thick in a pit on the ridge west of the Road Fork of Grassy Creek, near its head. It is 61 inches thick in the small mine under Wolfpen Knob (location 424, elevation 2,730).

A small mine in the Lower Banner one mile east of Marvin (location 424A, elevation 2,385) is in 64 inches of clean coal, with a few inches more above it that is not utilized because of clay partings. The clean coal is slightly thicker in a pit a few rods east.

A local mine at the head of a fork of Carver Branch of Contrary Creek (location 425, elevation 2,615) is in 64 inches of coal. The bed is reported at least 4 feet thick at a head of the principal fork of Carver Branch

(location 426, elevation 2,510), and is 65 inches half a mile northwest, in the valley of South Fork (location 427, elevation 2,465), the upper 6 inches containing a few streaks of shale.

Williams states that the Lower Banner is only 18 inches thick a short distance west of Bill Young Gap (location 428, elevation 2,351). According to d'Inwilliers there are two benches of coal in this locality, each about 26 inches thick and separated by  $2\frac{1}{2}$  feet of shale. The coal is said to be 4 feet thick farther southwest (location 429, elevation 2,327), with a streak of shale in the middle, and 3 feet thick in another pit in the vicinity, on the west side of the ridge. Nearly a mile southwest of Bill Young Gap (location 430, elevation 2,310) the coal is 34 inches thick. It is only 22 inches at the head of North Fork (location 431, elevation 2,290), and 23 inches near the head of the left fork of that stream (location 432, elevation 2,225). The thickness increases to the south along North Fork and is as in the first of the following sections about a mile from location 432. The bed is reported to be even thicker a short distance northwest, in the long valley west of North Fork, but to be thinner near the head of that valley as shown by the second of the following sections, given on the authority of Mr. Williams.

*Lower Banner bed north of Marvin, on tributaries of Contrary Creek.*

(Location 433, elevation 2,181.)		(Location 434, elevation 2,160.)	
	Ft. in.		Ft. in.
Shale.		Shale.	
Coal .....	6½	Coal .....	4
Shale .....	1½	Shale .....	2
Coal .....	4 8	Coal .....	1 10
Shale .....	2		
Coal .....	2	Coal .....	2 2
		Parting .....	2
Coal .....	5 4½		
Partings .....	3½		

Southwest of location 434, in a local mine on the side of a point (location 435, elevation 2,110), the coal measures 56 to 61 inches, and it is also thick farther south, being reported 54 inches near the mouth of the stream (location 436, elevation 2,160).

*Coals above the Lower Banner.*—Even if the higher coals are sufficiently thick to be minable, they underlie only small tracts. The Upper Banner coal is everywhere very thin. On Keen Mountain the Hagy bed is in two benches 140 to 170 feet above the Splash Dam, and the Glamorgan coal, which is at the base of the Wise formation, is also represented by blooms. The Splash Dam lies a few feet above a massive sandstone that is the first

bed to make conspicuous ledges above the Lower Banner horizon. This coal is in two rather widely separated benches on Keen Mountain, as shown by the following section at the head of the first northern tributary of Contrary Creek, reported by Williams:

*Splash Dam bed near Keen Mountain.*

(Location 437.)

	Ft.	in.
Shale.		
Coal .....	1	7
Concealed, some sandstone at base.....	40	
Coal .....	2	2
Shale .....	1	10
Coal .....		7
Shale .....		6
Coal .....		3½
Shale .....		5
Coal (elevation 2,235) .....		8½
<hr/>		
Coal in lower bench .....	3	9
Partings in lower bench .....	2	9

What is probably the upper bench of the Splash Dam is 32 inches thick on Keen Mountain near Antioch School (location 438, elevation 2,500) and is reported only about 2 feet thick nearby. The lower bench is apparently only about 18 inches in the ridge road about half a mile southeast of the school, though the exposure may not be complete.

DISMAL CREEK BELOW WHITEWOOD.

*General features.*—This region includes the main valley of Dismal Creek itself from its mouth to Whitewood, and the basins of all tributaries of that part of the creek. The principal southern tributaries are Mill, Big, Bill Young, and Burnt Chestnut branches. The chief northern tributaries are Harper Creek and Grapevine, Big, Midway, Long, Hale, Sprucepine, Harry, and Linnecamp branches.

The rocks exposed in this area include those from near the Tiller coal to just above the Clintwood coal, and their character is shown by local sections 21, 22, 23, 26, and 29 (pp. 37-39, 41, and 43). Generalized section 3 (Pl. II) is applicable to all of the area except the part east of Bill Young and Harry branches, where the stratigraphic intervals are close to the smallest ones in generalized section 4. The intervals between coal beds increase, in general, from west to east. The dip of the strata is northwest, except in a few places, and is much steeper east of Long Branch than west of it.

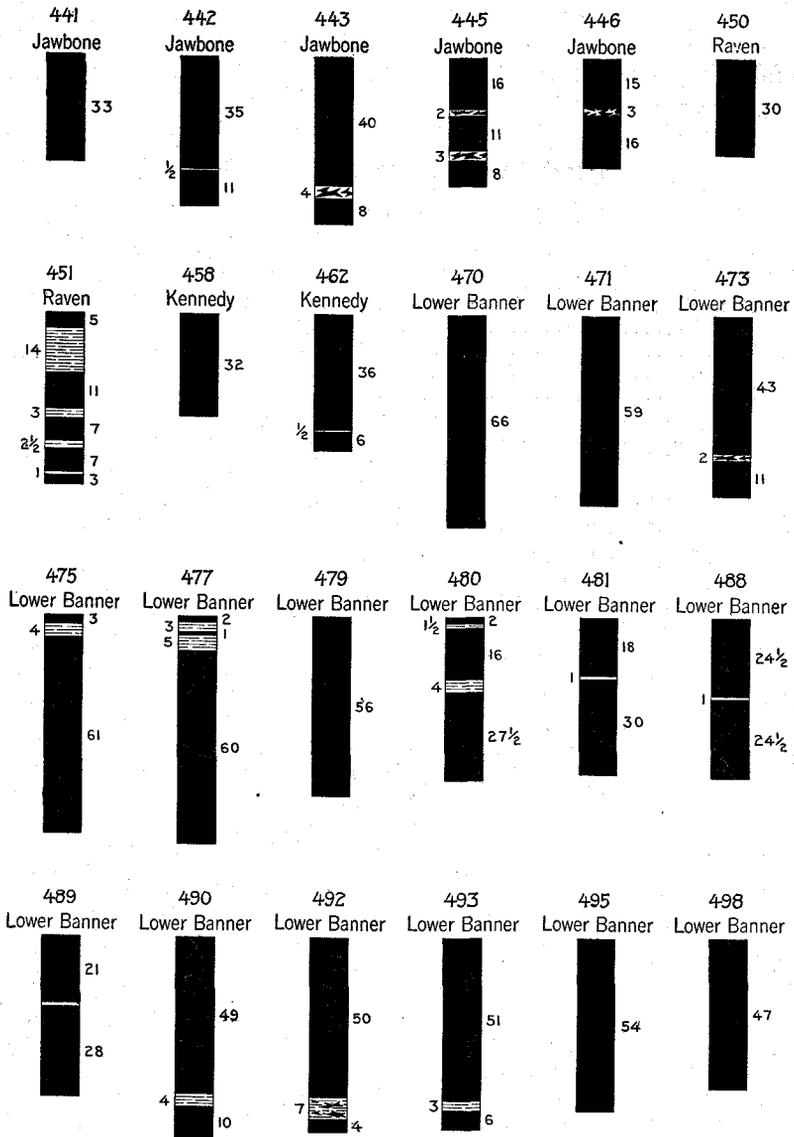


Fig. 16.—Sections of coal beds in the basin of Dismal Creek below Whitewood.

There is a low dome near the head of Grapevine Branch which causes the general northwesterly dip to be interrupted in a small area.

There are probably workable coals in the Lee formation, at least in the eastern part of the region, as explained below. The lowest coal exposed, aside from the thin Tiller bed, is the Jawbone, which is about 2 feet thick near the mouth of Dismal Creek and 3 to 4 feet thick, though impure, in the eastern part of the region. The Kennedy is nearly 3 feet thick along lower Dismal Creek and thinner on the east. The Lower Banner is commercially the most important coal; it is 4 to 5½ feet thick in a fairly large area which will be more fully outlined later, and is commonly less than 3 feet thick elsewhere. The Raven, Big Fork, Upper Banner, Splash Dam, Hagy, Glamorgan, and perhaps two or three higher beds are minable in many places, though less than 3 feet thick practically everywhere and less than 30 inches in most districts. (See figs. 4, 5, 6, 7, and 16.)

*Coals below the Tiller.*—There is no direct information concerning beds that are concealed beneath the surface. The record of the boring on Seng Creek Fork of Dismal Creek (pp. 13-16) is a rough index of the possibilities of the region, as it penetrates the lowest coal that is thought to be workable in this part of Virginia. The top of the boring is approximately at the Tiller horizon, so that the distance from each bed to the Tiller on Seng Camp Fork is the same as its depth in the boring. These intervals, however, decrease to the west and north, so that they are considerably less at Whitewood than in the boring and are several hundreds of feet less at the mouth of Dismal Creek. Most of these coals probably thin to the west, so that minable deposits are less likely to be found at the mouth of the Dismal than farther east.

Coal found in outcrops and borings near Bradshaw, W. Va.,<sup>1</sup> only about 5 miles from the heads of Harry and Linncamp branches of Dismal Creek, also has a bearing on the possibilities of this region. A table showing the thickness of the Lee coals near Bradshaw and their probable interval below the Splash Dam near the head of Slate Creek is given in the detailed description of coal in the Slate Creek basin.

*Tiller and Jawbone coals.*—The lowest coal exposed in this area is the Tiller, which is about 40 to 80 feet below the Jawbone. This bed, however, is probably thin, the Jawbone being the lowest minable coal exposed. The Jawbone is above the level of Dismal Creek from its mouth to Grapevine Branch and from near Dwight to Whitewood. The interval between the

<sup>1</sup>Hennen, R. V., Wyoming and McDowell counties: West Virginia Geol. Survey, 1915.

Jawbone and Splash Dam horizons increases eastward from 685 feet at the mouth of Dismal Creek to 820 feet at Whitewood. There is a thin coal about 40 feet above the Jawbone.

The Jawbone is thick in places and is mined at Whitewood to supply locomotives on the lumber railroad, but bony streaks produce much ash and greatly impair its fuel value. The bed is about 3 to 4 feet thick along Dismal Creek between Dwight and Whitewood, and probably also north and south of this part of the creek to the borders of this region. Along Dismal Creek southwest of Grapevine Branch the bed is only about 2 feet thick.

A stripping on the upper part of Bill Young Branch (location 439, elevation 1,785) shows the Jawbone to be 31 to 40 inches thick, though the lower 20 inches is the only minable part, the upper portion of the bed containing a thick shale lens of irregular thickness. Here, as in most other exposures, the Jawbone roof is a plant-bearing shale. There are 30 inches of coal farther down the branch (location 440, elevation 1,735) and 33 inches at its mouth (location 441, elevation 1,700). A small mine in a hollow east of Burnt Chestnut Branch (location 442, elevation 1,715) is in coal 46 inches thick, exclusive of half an inch of shale 11 inches from the bottom. The roof at this pit is sandstone at least 25 feet thick.

The largest mine in the area is at Whitewood (location 443, elevation 1,840), where the C. L. Ritter Lumber Co. obtains fuel for its locomotives. The main entry extends about 1,500 feet south from the drift mouth. In average section the bed is about 52 inches thick, including 4 inches of bone 8 inches from the base. In places part of the coal is very hard and somewhat bony, and there are several irregular streaks of bone. There is a good sandy shale roof and a shale floor. Analyses of a sample from this mine are given on page 237.

The first of the following sections is reported by d'Inwilliers as found in a pit half a mile east of Loggy Bottom Branch; the second was measured in a small mine a short distance up the branch.

*Jawbone bed near Loggy Bottom School.*

(Location 444, elevation 1,760.)

	Ft.	in.
Coal .....	1	5
Bone .....		1½
Coal .....		10
Bone .....		4
Coal .....		7
<hr/>		
Coal .....	2	10
Partings .....		5½

(Location 445, elevation 1,725.)

	Ft.	in.
Coal .....	1	4
Bone .....		2
Coal .....		11
Bone .....		3
Coal .....		8
<hr/>		
Coal .....	2	11
Partings .....		5

The Jawbone is 34 inches thick, 3 inches in the middle being bony, in a pit beside the road a mile south of Dwight (location 446, elevation 1,564). A few rods west along the road and 38 feet higher is another coal 19 inches thick.

A conspicuous, though thin, pebble-bearing sandstone lies a few feet below the Jawbone along the lower part of Dismal Creek, and a medium-grained sandstone with an irregular base is a few inches to 40 feet above the coal. The coal is 22 inches thick a short distance north of the mouth of Mill Branch (location 447, elevation 1,232) and is about the same elsewhere on this part of the creek. In places the bed is slightly thicker but only part is sufficiently clean to be minable (see local section 21).

*Raven coal.*—The interval between the Raven and Splash Dam horizons is about 530 feet at the mouth of Dismal Creek and at Dwight and 610 feet at Whitewood. One coarse, massive sandstone underlies the Raven, and another is only a short distance above it in most districts. In many places the coal is in two benches a few feet apart and another coal lies 30 to 80 feet higher; locally, however, only one or two of the three beds are present. Both Raven benches and the coal next above them are less than 30 inches thick in most places, though slightly thicker locally.

One bench of the Raven, and perhaps the only one in that district, is reported 22 inches thick in a hollow between Mill and Grapevine branches (location 448, elevation 1,420), and a 21-inch coal is said to be 75 feet above it. What is probably the upper bench of the Raven is 2 feet thick near the mouth of Big Branch (location 449, elevation 1,435) and 30 inches thick 1¼ miles east on Dismal Creek (location 450, elevation 1,515). The lower bench is as follows in a section reported by d'Invilliers as found on Bill Young Branch:

*Lower bench of Raven bed on Bill Young Branch.*

(Location 451, elevation 1,930.)

	Ft.	in.
Coal .....		5
Shale .....	1	2
Coal .....		11
Shale .....		3
Coal .....		7
Shale .....		2½
Coal .....		7
Shale .....		1
Coal .....		3
<hr/>		
Coal .....	2	9
Partings .....	1	8½

The Raven is 25 inches thick near the head of Linncamp Branch (location 452, elevation 2,050), and also on the opposite side of the ridge, in West Virginia (location 452A, elevation 2,040), where it has been called the Lower Douglas coal by Hennen.<sup>1</sup> The same bed is 23 inches thick near stream level on lower Hale Branch (location 453, elevation 1,560), in addition to 4 inches of bone at the top. What is either the Raven or the coal about 40 feet above it is 21 inches thick in pits at the sharp bend of Dismal Creek west of Hale Branch (location 454, elevation 1,514), where conglomeratic sandstone occupies the coal horizon in some places and is 20 feet or more above it in others. About a mile down Dismal Creek (location 455, elevation 1,535) the same bed is about 30 inches thick. The Raven is 20 inches thick farther down the creek, near the mouth of Long Branch (location 456, elevation 1,440).

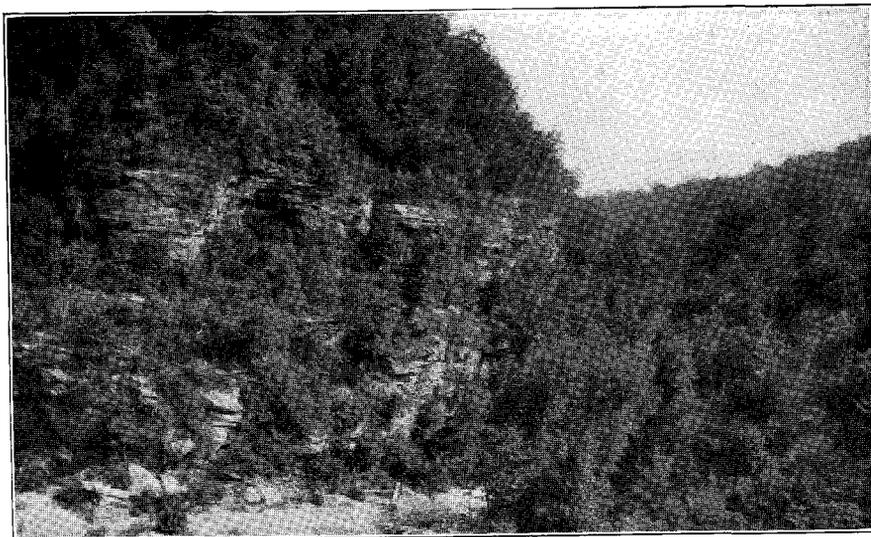
*Kennedy coal.*—Although the Aily coal is present in places it is thin, and the next minable coal above the Raven in this region is the Kennedy. The Kennedy horizon is easily identified in the field because of its position a few feet above a thick pebble-bearing sandstone that makes high, conspicuous cliffs. The roof of the coal is commonly shale, underlying a thick series of shales and thin-bedded sandstones that makes gentle slopes. The interval between the coal and the Splash Dam horizon increases southeastward and is about 340 feet along Dismal Creek between its mouth and Dwight and 400 feet at Whitewood.

The Kennedy is a little less than 3 feet thick in most places along the lower part of Dismal Creek and its tributaries, though it is thinner locally and is as much as 42 inches thick in one pit. Along Dismal Creek and its tributaries east of Hale Branch, the coal is thinner and may not be minable in many places. Little is known about the bed in a large part of the region.

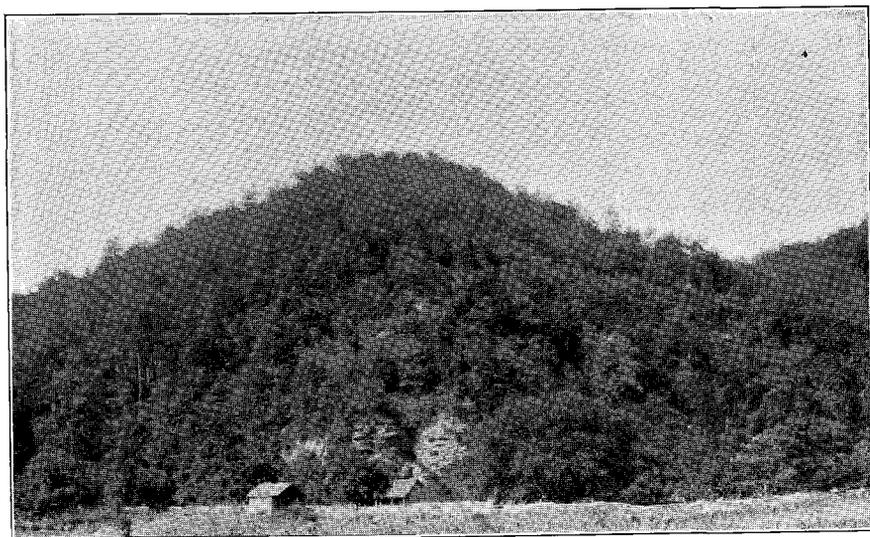
D'Invilliers reports 32 inches of coal in the Kennedy (Harris) bed near the mouth of the Dismal (location 457, elevation 1,605), and Williams states that the bed has the same thickness in a hollow north of Mill Branch (location 458, elevation 1,630). On the upper part of Mill Branch (location 459, elevation 1,725) 28 inches of clean coal are mined a little and the bed may be a few inches thicker.

In a hollow south of Dismal Creek, near the mouth of Long Branch (location 460, elevation 1,660), less than a foot of coal was found in the Kennedy. At the head of Bill Young Branch (location 461, elevation 2,210) the minable coal is only 15 inches thick and is underlain by a foot of interbedded shale, coal, and bone.

<sup>1</sup>Hennen, R. V., Wyoming and McDowell counties: West Virginia Geol. Survey, 1915, p. 519.



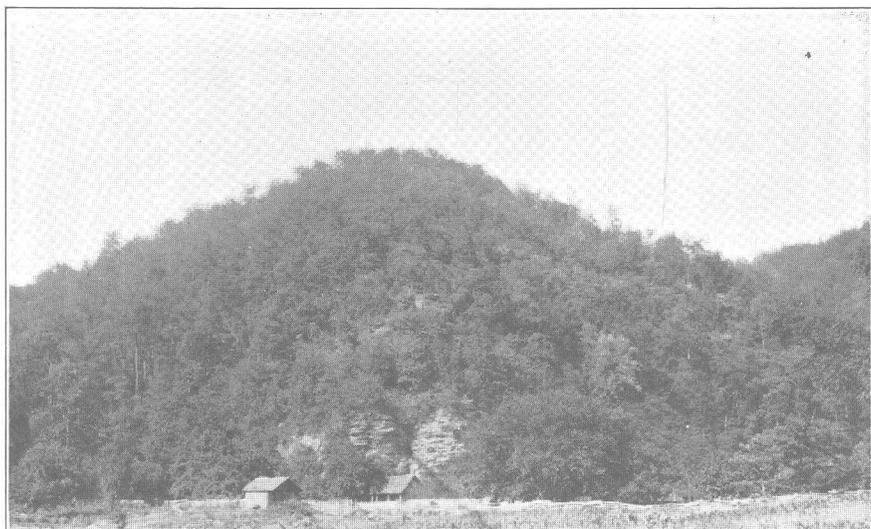
(A) The sandstone underlying the Kennedy coal horizon at the mouth of Grassy Creek.



(B) The sandstones between the Kennedy and Jawbone coals on Dismal Creek at the mouth of Big Branch.



(A) The sandstone underlying the Kennedy coal horizon at the mouth of Grassy Creek.



(B) The sandstones between the Kennedy and Jawbone coals on Dismal Creek at the mouth of Big Branch.

The thickest known deposit in the Kennedy bed of this area is in a pit north of Dismal Creek, a mile southwest of the mouth of Hale Branch (location 462, elevation 1,740), where there are said to be 42 inches of coal, exclusive of half an inch of shale 6 inches from the base. The coal is reported only 18 inches thick on a tributary of Long Branch (location 463, elevation 1,700). Aside from 5 inches of bony shale at the base the bed is only 14 inches thick on the northern Big Branch (location 464, elevation 1,600). On the upper part of Grapevine Branch (location 465, elevation 1,650) the bed is reported 34 inches thick by one authority and 30 inches by another, and is said to include an inch of shale 11 inches from the base. On Harper Creek, near its mouth (location 466, elevation 1,560), the coal is 27½ inches thick and has a roof of shaly sandstone.

*Big Fork coal.*—Blooms of a thin coal bed 40 to 60 feet below the Lower Banner coal and separated from it chiefly by massive sandstone were found in many places, especially in the northern part of the area. The coal is only a foot thick in a hollow north of Mill Branch (near location 458, elevation 1,770). It is reported by d'Invilliers to be 19 inches thick in one pit on Long Branch (location 467, elevation 1,770) and 18 inches in another pit farther up that stream (location 468, elevation 1,750).

*Lower Banner coal.*—The most important bed in the area, the Lower Banner, is a few inches to a few feet above the massive sandstone mentioned as overlying the Big Fork coal and is 150 to 220 feet above the Kennedy coal. The interval between the Lower Banner and Splash Dam horizons increases eastward from 150 feet at the mouth of Dismal Creek and 140 feet near the heads of Grapevine and Long branches to about 175 feet at Bill Young Gap and Whitewood and along Harry and Linncamp branches. The roof is commonly a drab shale.

The Lower Banner is an exceptionally clean bed containing 4 to 5½ feet of coal along parts of Mill, Big, Hale, Long, and Grapevine branches and along Dismal Creek between Long and Hale branches. Elsewhere in this region, including all of the area close to the Slate Creek divide, it is commonly less than 3 feet thick and it is probably less than 2 feet thick along Sprucepine, Harry, and Linncamp branches and near the mouth of Dismal Creek. The thinness of minable coal in at least the northeastern part of the region is due to a splitting of the bed into two benches.

Williams states that the Lower Banner is only 20½ inches thick halfway between the mouth of the Dismal and Mill Branch (location 469). About 1½ miles east of this, on a tributary of Mill Branch (location 470, elevation

1,895), the coal is  $5\frac{1}{2}$  feet thick and contains one or two thin layers of splint coal. Williams states that the coal is 59 inches thick on a southern tributary of Mill Branch farther east (location 471, elevation 1,914), and  $56\frac{1}{2}$  inches in a mine on a northern tributary (location 472, elevation 1,915).

Nearly opposite the mouth of Long Branch (location 473, elevation 1,836) the coal is 56 inches thick, including 2 inches of bone 11 inches from the base. Near the mouth of Big Branch (location 474, elevation 1,860) the bed is reported by d'Inwilliers to be 57 inches thick, including an inch of shale 2 inches from the top. Half a mile farther south (location 475, elevation 1,870) the bed is 68 inches thick, including 4 inches of shale 3 inches from the top. Measurements still farther up the branch, on both sides of the valley, are shown below, the first being reported by d'Inwilliers:

*Lower Banner bed on Big Branch.*

(Location 476, elevation 1,910.)			(Location 477, elevation 1,900.)		
	Ft.	in.		Ft.	in.
Shale.			Shale.		
Coal .....	4	4	Coal .....		2
Shale and coal .....		5	Shale .....		3
			Coal .....		1
Coal .....	4	4	Shale .....		5
			Coal .....	5	
			Coal .....	5	3
			Partings .....		8

Williams states that the coal is 51 inches thick in a pit nearly half a mile southeast of location 476, but thins to only 35 inches near the head of Big Branch. He measured 5 feet of clean coal in the first tributary of Dismal Creek east of Big Branch (location 478) and d'Inwilliers reports 56 inches of coal about a mile east of the mouth of Big Branch (location 479, elevation 1,925). The following two reported measurements are from pits a mile and less farther northeast; it is possible that the second section is a short distance west of the location assigned to it.

*Lower Banner bed southwest of Dwight.*

(Location 480.)			(Location 481, elevation 1,965.)		
	Ft.	in.		Ft.	in.
Coal .....		2	Coal .....	1	6
Shale .....		$1\frac{1}{2}$	Shale .....		1
Coal .....	1	4	Coal .....	2	6
Shale .....		4			
Coal .....	2	$3\frac{1}{2}$	Coal .....	4	
			Parting .....		1
Coal .....	3	$9\frac{1}{2}$			
Partings .....		$5\frac{1}{2}$			

The coal is thought to be rather thin along the streams which head near Antioch School, though it was not found between the pits just mentioned and Burnt Chestnut Branch. D'Invilliers, however, report 58 inches of clean coal near Bill Young Gap. He also says that the same thickness of coal was seen farther east, near the head of the main fork of Bill Young Branch, but that the bed also contained 11 inches of shale 28 inches from its base and 2 inches more 6 inches from its base. The upper coal bench thins out or separates farther from the lower to the northeast, so that only the lower bench, consisting of 25 inches of coal, appears at the head of the main fork of Burnt Chestnut Branch (location 482, elevation 2,390). This bench is 28 inches thick at the head of the left fork of the same stream (location 483, elevation 2,400), and is said to be even thinner a short distance northwest.

The coal is probably less than 2 feet thick nearly everywhere on the northern tributaries of Dismal Creek east of Hale Branch, and has been found in only a few places. At the head of a western tributary of lower Harry Branch (location 484) a bed that is probably the Lower Banner, but may be the Big Fork, consists of  $1\frac{1}{2}$  feet of coal and a shale parting in the middle. The Lower Banner includes 22 inches of coal, in addition to 2 inches of shale and bone 5 inches from the top, on a tributary of Left Fork of Sprucepine Branch (location 485, elevation 2,040). North of this, near the head of Left Fork (location 486, elevation 1,975), the Lower Banner is reported to be about  $1\frac{1}{2}$  feet thick.

Between Hale and Long branches and along most of those two streams the Lower Banner is thick. At the side of the road on the upper part of Hale Branch (location 487, elevation 1,860) there is a pit in which the coal is said to be only 25 inches thick. Farther down Hale Branch (location 488, elevation 1,920) the bed is reported to be 50 inches thick, including an inch of shale in the middle. On a tributary which joins the branch near its mouth (location 489, elevation 1,935) the bed is also 50 inches thick, including an inch of shale 21 inches from the top. Half a mile southwest of this, on a tributary of Dismal Creek (location 490, elevation 1,895), a small mine utilizes 49 inches of clean coal, and a lower coal bench 10 inches thick is reported to underlie a 4-inch shale parting. A mile south, on a point at a sharp bend in the creek (location 491, elevation 1,920), the bed is said to be 4 feet thick, including half an inch of shale  $1\frac{1}{2}$  feet from the top.

The following sections show the nature of the bed along Long Branch. As most of the pits had fallen shut when visited, all measurements except the third are taken from private reports.

*Lower Banner bed on Long Branch.*

(Location 492, elevation 1,810.)			(Location 493, elevation 1,870.)		
	Ft.	in.		Ft.	in.
Coal .....	4	2	Coal .....	4	3
Bone and shale .....		7	Shale .....		3
Coal, bony .....		4	Coal .....		6
	<hr/>			<hr/>	
Coal .....	4	6	Coal .....	4	9
Parting .....		7	Parting .....		3
(Location 494, elevation 1,765.)			(Location 495, elevation 1,835.)		
	Ft.	in.		Ft.	in.
Coal .....	1	9	Coal .....	4	6
Sandstone .....		2½		<hr/>	
Coal .....	1	8	Coal .....	4	6
	<hr/>			<hr/>	
Coal .....	3	5			
Parting .....		2½			

The coal thins westward and is reported only 20 inches thick on Left Fork of Long Branch, nearly a mile from its mouth, and 17 inches on Midway Branch. Williams, however, measured 34 inches near the mouth of Midway Branch (location 496, elevation 1,745). D'Inwilliers gives the thickness as 16 inches on the upper part of Grapevine Branch (location 497, elevation 1,830), 34 inches on Dismal Creek about half a mile southwest of the mouth of Grapevine Branch, and 18 inches on the left fork of upper Harper Creek. Williams found 47 inches of clean coal about half a mile west of the mouth of Grapevine Branch (location 498, elevation 1,780). Crawford states that the coal is 4 feet thick about halfway up Grapevine Branch and 3 feet or more on the right fork of upper Harper Creek.

*Coals above the Lower Banner.*—Although there are a number of coals above the Lower Banner, they have been prospected or utilized in very few places in this area, and none of them appears to be minable in more than small areas. They will be described briefly, beginning with the lowest.

The Upper Banner coal, between the Lower Banner and Splash Dam beds, is present in at least the eastern part of the area. It is probably very thin except, possibly, near West Virginia. It is thought to be about 15 inches thick at the head of Harry Branch, and is reported somewhat

doubtfully as 3 feet thick in two pits on a tributary of upper Linncamp Branch (location 499; elevation 2,555; and location 500, elevation 2,570), where it is more than 100 feet below the Splash Dam horizon and may be an upper bench of the Lower Banner.

The character of the Splash Dam coal on Keen Mountain has been described in connection with the coal resources of the Contrary Creek basin. No complete measurements were obtained elsewhere in this region. The coal is in two or more benches separated by shale and is probably minable locally.

The Hagy coal was found in a few places. It is about 150 feet above the Splash Dam, lying upon the first thick sandstone above the latter coal. The Hagy will probably be found as a bed 1 to 3 feet thick in most of the area north of Dismal Creek, and is in two benches of doubtful thickness on Keen Mountain. A caved pit on this bed at the head of Hale Branch (location 501, elevation 2,105) appears to be in thin coal, but may possibly be where the first of the following measurements, both reported by d'Invilliers, was made. The second of these measurements is on the upper part of Long Branch.

*Hagy (?) bed on Hale and Long branches.*

(Location 501 ?)		(Location 502.)	
	Ft. in.		Ft. in.
Coal .....	1 6	Coal .....	2 2
Shale .....	1 1	Shale .....	1 1
Coal .....	1 6	Coal .....	1 1
	<hr/>	Shale .....	8 8
Coal .....	3 3	Coal .....	3 3
Parting .....	1 1		<hr/>
		Coal .....	2 6
		Partings .....	9 9

Two pits in the Hagy at the head of the northern Big Branch (locations 503 and 504, elevation 1,975) show 17 and 20 inches of coal, respectively.

The Glamorgan coal, at the base of the Wise formation and 330 to 360 feet above the Splash Dam horizon, occupies only small outliers on the tops of the ridges in the northwestern part of the area and on Keen Mountain. It has a thick coarse sandstone below it and another, conglomeratic in places, 50 feet or less above it. The coal is very irregular in thickness. It is reported 30 inches thick at the head of Grapevine Branch (location 505, elevation 2,205), of which 2 feet were visible when the exposure was visited. A short distance north and northeast the bed is 40 inches thick

(see description of Slate Creek basin). At the head of Big Branch (location 506, elevation 2,130) 15 inches of coal were seen and 7 inches more reported.

Blooms of the Blair and Eagle beds were seen on the ridge tops at the heads of Grapevine and Big branches, but the thickness of the coals is not known. The Clintwood coal crops out in very small areas on the highest lands at the heads of Big and Long branches.

#### DISMAL CREEK ABOVE WHITEWOOD, INCLUDING LAUREL FORK.

*General features.*—This region includes the basins of upper Dismal Creek and all tributaries which enter it at or above Whitewood. The principal tributaries are Laurel, Seng Camp, and Jones forks, the chief subsidiaries of which are Hurricane, Spring, Benny, Jewell, Bearwallow, Johnny, and Peak branches. Brushytop Fork and Aily, Mill, and Betsey branches enter Dismal Creek directly. The valleys are sparsely inhabited, most of the houses being on the ridges. Whitewood is a lumber camp with a fairly large sawmill from which lumber is shipped over a narrow-gauge railroad across Sandy Ridge to Doran, a village on the Norfolk and Western Railway. This railroad could not be used for coal transportation because of steep grades at the head of Hurricane Branch.

The rocks exposed are all in the Norton formation, including those from about 150 feet below the Tiller coal to 100 feet above the Splash Dam coal. Their characteristics are shown in local sections 23, 24, 25, and 26 (pp. 39-41), and in generalized section 4 (Pl. II). The general dip is to the northwest and west, and ranges from 50 feet per mile near Whitewood to 300 feet per mile along most of Sandy Ridge.

As outlined in more detail below, the Lee formation may contain several minable coal beds which are below the surface in this area. A number of coal beds are exposed, the thickest of these deposits being near Sandy Ridge and the head of Dismal Creek. The most important bed is the Raven, though the thickest coal deposit is in the united Tiller and Jawbone beds.

The lowest exposed coal is the Tiller, which contains less than 2 feet of coal. The next higher coal, the Jawbone, is 3 to 6 feet thick, but its quality is poor because of bony streaks and layers. Along Dismal Creek near Jones Fork and in neighboring territory the Tiller and Jawbone beds unite and include 4 to 7 feet of coal interbedded with shale and bone. The principal bench of the Raven bed is less than 30 inches thick near Whitewood, and 2 to 3½ feet thick in the southern part of the Laurel Fork

basin and under House and Brushytop ridges. The two Raven benches unite at the heads of Laurel, Seng Camp, and Jones forks and Dismal Creek to form an excellent coal deposit 4 to 5 feet thick. The Aily, Kennedy, Big Fork, Upper Banner, and Splash Dam beds are thin in a

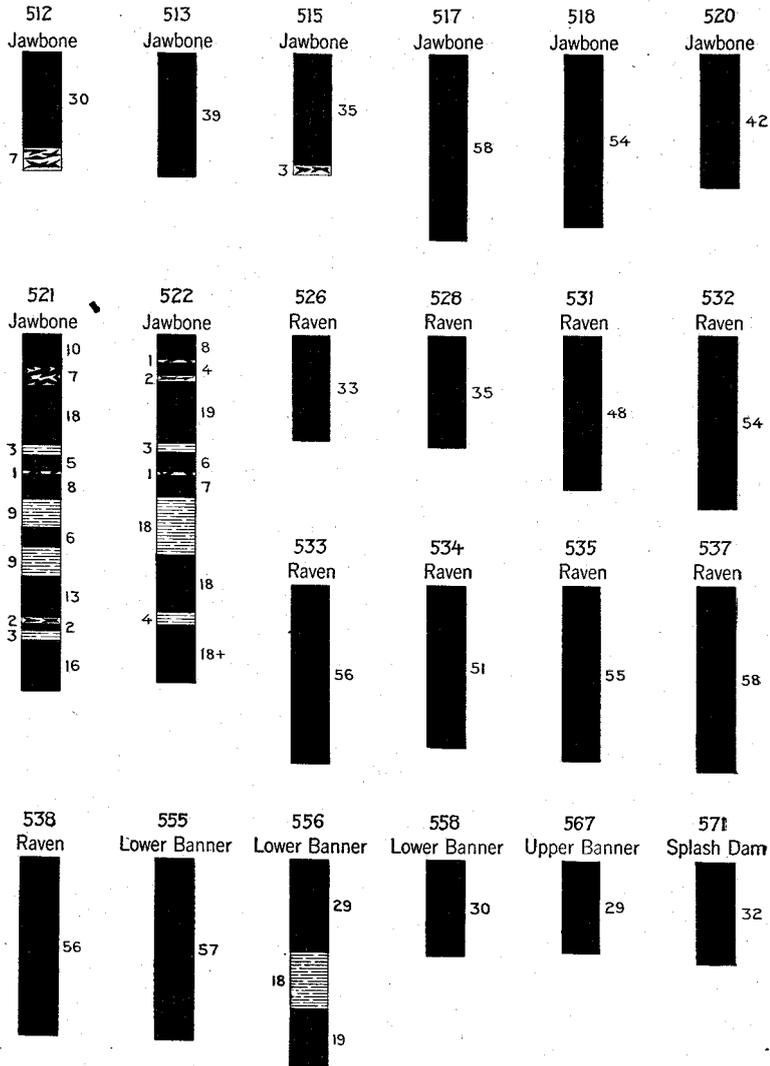


Fig. 17.—Sections of coal beds in the basin of Dismal Creek above Whitewood.

large part of the region and as much as 3 feet thick in places. The Lower Banner bed is 4 to 5 feet thick west of Hurricane Branch, where its acreage is not great, and is split into two benches farther east and northeast. (See figs. 4, 5, 6, 7, and 17.)

*Coals below the Tiller.*—No workable coals were found in the small area that contains exposures of rocks below the Tiller horizon and it is not likely that there are any workable deposits between the Tiller and the base of the Norton formation. One boring has been made in the area, on the upper part of Seng Camp Fork, and its record (see p. 13) indicates that some coals in the Lee formation may be workable in places. The top of this boring is close to the Tiller horizon and the bottom is probably below the lowest horizon at which minable coal exists. Explorations in neighboring parts of West Virginia have thrown additional light on the possibilities of the Lee coals in the Dismal Creek region. The following table shows the thicknesses of coal, exclusive of partings, in the Seng Camp boring, and also along and near Dry Fork between Bradshaw and Canebrake, W. Va., as shown by numerous exposures and borings less than 6 miles from the Virginia boundary:<sup>1</sup>

*Mirable coal in Lee formation.*

Name.	Seng Camp Fork boring.			Dry Fork district, W. Va.
	Depth. Feet.	Interval below Splash Dam horizon. Feet.	Thickness. Feet.	Approximate thickness. Feet.
Lower Seaboard .....	538	1,408	1 $\frac{1}{2}$	1 to 3 $\frac{1}{2}$
Unnamed bed .....	595	1,465	$\frac{3}{4}$	1 to 2 $\frac{1}{2}$
Upper Horsepen .....	691	1,561	2	1 to 2
Middle Horsepen .....	749	1,619	2 $\frac{1}{3}$	$\frac{1}{2}$ to 6
War Creek .....	867	1,737	5 $\frac{1}{2}$ or 9 $\frac{1}{2}$	1 to 4 $\frac{1}{2}$
Lower Horsepen .....	946	1,816	$\frac{1}{4}$	$\frac{1}{2}$ to 2
No. 9 Pocahontas.....	1,062	1,932	$\frac{2}{3}$	$\frac{1}{4}$ to 5
No. 6 Pocahontas.....	1,295	2,165	1	0 to 2
No. 4 Pocahontas.....	1,372	2,242	$\frac{1}{3}$	0 to 6
No. 3 Pocahontas.....	1,466	2,336	2	0 to 6

<sup>1</sup>Hennen, R. V., Wyoming and McDowell counties: West Virginia Geol. Survey, 1915.

There are several coals not listed above, but they are thin both in the Seng Camp boring and on Dry Fork, so that little can be expected of them in the Dismal Creek basin. The above table indicates clearly, however, that a few Lee coals are probably thicker in parts of the upper Dismal Creek basin than in the Seng Camp boring. Three beds that contain little coal in this boring—the Upper, Middle, and Lower Seaboard coals—are sufficiently thick to be mined for shipment a few miles farther south, at Seaboard in Tazewell County, where they come to the surface.

*Tiller and Jawbone coals.*—The interval between the Jawbone and Splash Dam horizons is about 850 feet along Sandy Ridge and 800 to 830 feet elsewhere in the region. The Tiller coal is commonly less than 50 feet below the Jawbone and separated from it chiefly by coarse sandstone, though in one district the two coals are virtually united. The roof of the higher coal is commonly shale. In places there is a thin coal bed about 30 feet above the Jawbone.

The Tiller bed probably includes only about 2 feet of coal where separated from the Jawbone. In the same districts the Jawbone is commonly 3 to 4 feet thick, though as much as 5 to 6 feet thick in part of the district south of the upper part of Laurel Fork. Along Dismal Creek near Jones Fork, in a district of unknown extent, the Tiller and Jawbone are separated by only a few inches or feet of shale, forming one bed containing  $4\frac{1}{2}$  to 7 feet of coal and many layers of shale and bone. The value of the Jawbone bed is greatly impaired everywhere by irregular layers of bone and bony coal.

The Tiller is clean and 22 inches thick in a small pit on Spring Branch of Laurel Fork (location 507, elevation 2,070), where it is about 25 feet stratigraphically below the Jawbone coal. The bed may be slightly thicker under Sandy Ridge, south of Laurel Fork. On a branch of Seng Camp Fork (location 508, elevation 2,080) the coal is 18 inches thick. Near the head of the fork (location 509, elevation 2,255) a pit in the same bed shows 25 inches of coal. This pit is only 20 feet from the deep drill hole previously mentioned and is about 3 feet below its top. An error in the topographic mapping makes both appear to be too low in elevation on the geologic map.

The Tiller is badly split by shale partings in places, as shown by the following sections, the first near the head of Bearwallow Branch of Jones Fork and the second on Dismal Creek between Aily and Knob branches. It may be that neither section includes all of the bed.

*Tiller bed near Bearwallow Knob.*

(Location 510, elevation 2,250.)

	Ft.	in.
Sandstone .....	2	
Coal .....		6
Shale .....		1
Coal .....	1	1
Shale .....		10
Coal .....		3
Shale .....	5?	
Coal ? .....		
<hr/>		
Coal .....	1	10
Partings .....		11

(Location 511, elevation 2,010.)

	Ft.	in.
Sandstone .....	20	
Coal .....		6
Shale .....		8
Coal .....		10
Shale, dark .....	1	1
Coal .....		7+
<hr/>		
Coal .....	1	11+
Partings .....	1	9

The Jawbone coal is 37 inches thick in a small mine in a hollow near Whitewood (location 512, elevation 1,850), the lower 7 inches being bone. A mine which formerly supplied fuel for the railroad, near the mouth of Hurricane Branch (location 513, elevation 1,910), is in 39 inches of coal containing irregular bony streaks. In a hollow a mile farther up Hurricane Branch (location 514, elevation 1,940) the Jawbone is said to be nearly 4 feet thick, including streaks of bone, and 30 feet above it there is a 21-inch coal bearing nodules of iron pyrites. Exposures in neighboring drainage basins indicate that the Jawbone is 3 to 4 feet or more thick along the upper part of Hurricane Branch and under Sandy Ridge near the head of that stream.

On Laurel Fork just above the mouth of Hurricane Branch (location 515, elevation 1,930) the Jawbone is 38 inches thick and fairly clean except for 3 inches of bone at the base. One mile farther southeast, behind a house at the mouth of a large tributary (location 516, elevation 1,985), the coal is reported to be about 6 feet thick and very bony. Near the head of the same tributary (location 517, elevation 2,055) a large pit is said to have been in 58 inches of coal, in part bony; an error in the topographic mapping causes this pit to appear at too high an elevation on the geologic map. The average thickness of the Jawbone under Sandy Ridge between Hurricane Branch and the head of Laurel Fork is probably close to 4 feet, including bone.

On Spring Branch of Laurel Fork (location 518, elevation 2,090) the Jawbone is  $4\frac{1}{2}$  feet thick, but is interlaminated with streaks of bone. The bed about 30 feet higher, stratigraphically, is opened farther up the branch (location 519, elevation 2,110), where it is 2 feet thick and has 2 inches or less of shale three inches from the top.

Campbell<sup>1</sup> states that the bed here called the Jawbone is 46 inches thick, including four 1-inch shale partings, on Lick Branch, a southern tributary of Dismal Creek between Sugar Cove Branch and Seng Camp Fork. Near the head of Seng Camp Fork (location 520, elevation 2,290) the Jawbone is 42 inches thick. An error in the topographic mapping makes this pit appear to be too low in elevation on the geologic map.

The Tiller and Jawbone beds are so close together along Dismal Creek above Seng Camp Fork that they form in places one very thick but dirty bed. Campbell<sup>2</sup> gives the first two of the following measurements from pits on opposite sides of the creek near the mouth of Jones Fork. The third and fourth measurements were made by Davidson about half a mile farther up Dismal Creek.

*Tiller and Jawbone beds on Dismal Creek near Jones Fork.*

(From Tazewell folio.)

	Ft.	in.		Ft.	in.
Coal .....		10	Coal .....		8
Shale .....		4	Bone .....		4
Coal .....	1		Coal .....	1	6
Shale .....	1	1	Shale .....		6
Coal .....	1	3	Coal .....	1	1
Shale .....		3	Clay .....	1	2
Coal .....	1	8	Coal .....		7
			Clay .....		5
Coal .....	4	9	Coal .....	1	1
Partings .....	1	8	Shale .....	1	1
			Coal .....	1	1
			Coal .....	5	11
			Partings .....	3	6

(Location 521, elevation 1,990.)

	Ft.	in.
Shale .....	10	
Coal .....		10
Coal, bony .....		7
Coal .....	1	6
Shale .....		3
Coal .....		5
Bone .....		1
Coal .....		8
Shale .....		9
Coal .....		6
Shale .....		9
Coal .....	1	1
Bone .....		2
Coal .....		2
Shale .....		3
Coal .....	1	4
Coal .....	7	1
Partings .....	2	3

(Location 522, elevation 1,970.)

	Ft.	in.
Shale .....	15	
Coal .....		8
Bone .....		1
Coal .....		4
Bone .....		2
Coal .....	1	7
Shale .....		3
Coal .....		6
Bone .....		1
Coal .....		7
Shale .....	1	6
Coal .....	1	6
Shale .....		4
Coal .....	1	6+
Coal .....	6	8+
Partings .....	2	5

<sup>1</sup> Campbell, M. R., U. S. Geol. Survey, Tazewell Folio (No. 44), fig. 29, 1898.

<sup>2</sup> Idem., figs. 27, 28.

Three feet of the upper, or Jawbone, part of this thick coal are visible in a partially caved pit opposite the mouth of Seng Camp Fork (location 523, elevation 1,990).

Very little is known concerning the nature of the Jawbone bed under the district near the head of Dismal Creek. North of the Dismal between the pits just mentioned and Whitewood, the Jawbone and Tiller probably separate, the former being 3 to 4 feet thick and the latter thinner.

*Raven coal.*—The Raven bed is 150 to 200 feet above the Jawbone coal. It is about 610 feet below the Splash Dam horizon at Whitewood and 660 feet below it along Sandy Ridge. Along most of Laurel Fork and its tributaries the coal is in two benches a few feet or inches apart, but these unite to form one bed in most other parts of the region. The roof of the coal is commonly shale, and there is a coarse pebble-bearing and cliff-making sandstone a few inches to 50 feet above the coal. In places a thin coal appears between this sandstone and the Raven. A moderately coarse sandstone lies just below the Raven.

The Raven bed is mined extensively near Raven and Jewell in Tazewell County, the Jewell operations extending under Sandy Ridge and the head of Laurel Fork of Dismal Creek. At Jewell the bed mined contains an average of nearly 4 feet of coal and also partings of rash and clay a few inches thick. Northeast of this, under Sandy, Jewell, Redoak, and Norton ridges and probably near Peapatch, the coal is 4 to 5 feet thick and partings are absent nearly everywhere. West and northwest of the Jewell mines the partings thicken so as to separate the coal into two benches, only the upper one of which is minable. This upper bench is 2 to 3½ feet thick in the basins of Hurricane Branch and upper Laurel Fork. Near Whitewood and along Betsey Branch the coal is probably less than 30 inches thick.

A pit in a hollow at the mouth of Hurricane Branch of Laurel Fork (location 524, elevation 2,075) shows 28 inches of clean coal in the Raven bed. A faint coal bloom shows about 20 feet higher and the base of the conglomeratic sandstone is 20 feet above the bloom. The conglomerate rests directly on the Raven a mile south (location 525, elevation 2,070), where the coal is 18 to 24 inches thick. This coal is underlain with 2 feet of shale containing coaly lenses, under which there is said to be a foot more of coal. The upper bench of the Raven is probably 2½ to 3½ feet thick farther south in the basin of Hurricane Branch, but it has not been prospected. Small mines which supply the lumber railroad about a mile south of the head of Hurricane are in the Raven bed where it is 30 to 39 inches thick.

On Laurel Fork, nearly opposite the mouth of Benny Branch (location 526, elevation 2,220), the upper bench of the Raven is 33 inches thick and directly under conglomeratic sandstone. At least 80 feet of sandstone also shows below the coal. The upper bench is reported to be 37 inches thick in a pit three-fourths of a mile southeast of Brown School (location 527, elevation 2,380), and is said to be separated from a 14-inch lower bench by 38 inches of shale. Within less than a mile east of this prospect three other openings are said to have shown 31 to 36 inches of coal in the upper bench, 14 inches in the lower bench, and only about 19 inches of shale in the parting.

The workings of the Jewell Ridge Coal Corporation mines at Jewell extend under Sandy Ridge and the head of Laurel Fork. Considerable coal is mined and shipped south down Big Creek to Richlands and the Clinch Valley division of the Norfolk and Western Railway. The coal is somewhat irregular in thickness because of rolls in the roof and floor, horse-backs, etc., but the following two sections measured where samples were taken (see p. 238 for analyses) are fairly typical. The parting between the two coal benches consists of interlaminated rash, coal and clay only a few inches thick, so that both coal benches can be easily mined as one. The coal rests on sandstone in many places and is overlain with a few inches of "draw slate."

*Raven bed near head of Laurel Fork in Jewell Ridge mine No. 1.*

	Ft.	in.		Ft.	in.
Coal .....	2	6	Coal .....	2	8
Rash .....		1	Rash .....		1
Coal .....		4	Coal .....		2
Rash and clay .....		5	Rash and clay .....		3
Coal .....	1		Coal .....		10
	3	10	Coal .....	3	8
Partings .....		6	Partings .....		4

On a northern tributary of Laurel Fork, less than a mile northeast of Brown School (location 528, elevation 2,335) coal 35 inches thick is mined a little and 18 inches more are said to underlie a parting which is probably sufficiently thick to make the lower coal bench unavailable. The upper bench is reported to be a little more than 3 feet thick on Spring Branch (location 529, elevation 2,285).

A small pit near the head of Seng Camp Fork (location 530, elevation 2,485) is in coal 32 inches thick and the entire bed is reported on good authority to consist of 54 inches of coal and 3 inches of clay, the parting

being slightly thinner than in the Jewell Ridge mines. All partings are absent from the upper Jones Fork basin and the bed is in fine condition for mining. A pit on the east side of Jewell Ridge (location 531, elevation 2,430), separated from an overlying thick coarse sandstone by 5 or 10 feet of drab shale, is said to be in clean coal about 4 feet thick. The coal is reported to be 54 inches thick at the head of Jones Fork (location 532, elevation 2,640), and 56 inches about half a mile northeast (location 533, elevation 2,560). There are 51 inches of hard, bright coal on a spur south of Bearwallow Branch (location 534, elevation 2,505), with 10 or 15 feet of shale between it and the overlying sandstone cliff. The Raven evidently thickens slightly to the east, for less than half a mile east of Bearwallow post-office it is 5½ feet thick, including 8 inches of clay.

The Raven is evidently also thick in a considerable area north of Jones Fork. It consist of at least 55 inches of clean coal near the mouth of Aily Branch (location 535, elevation 2,210). It is reported to be 58 inches thick in two pits farther up Dismal Creek (location 536, elevation 2,285, and location 537, elevation 2,310), and is 56 inches thick at the head of the creek, nearly due north of Bearwallow Knob (location 538, elevation 2,400).

No measurements of the Raven were obtained north of Dismal Creek in this region. The bed probably thins to the northwest, as it is only 25 inches thick in a pit on Middle Fork of Bradshaw Creek, W. Va. (location 452A) a mile north of the head of Linncamp Branch.

*Aily coal.*—About halfway between the Raven and Kennedy coals and between two thick conglomeratic sandstones there is a coal which may be persistent but could be found in only a few places. Blooms indicate that it is thin in most districts and thickens slightly to the east. On Bearwallow Branch of Jones Fork (location 539, elevation 2,520) the coal is 27 inches thick and full of shale films. A remarkable sandstone parting 3 to 6 inches thick and containing many large rounded quartz pebbles overlies this coal bench and separates it from 4 inches more of coal. One mile southeast of this, in Tazewell County, the Aily is 31 inches thick and sulphurous, and 1½ miles northeast of Bearwallow post-office, in West Virginia, the coal is 28 inches thick, including 3 inches of rash near the middle.

*Kennedy coal.*—The Kennedy is 400 feet below the Splash Dam horizon and 210 to 260 feet above the Raven bed, the larger interval prevailing near Sandy Ridge. The coal lies a short distance above a cliff-making sandstone that forms the top of a thick series of coarse conglomeratic sand-

stones called by Campbell the Dismal conglomerate lentil. It is very easy to recognize this rock in any part of the field. The roof of the coal is drab sandy shale in many places and a thin argillaceous sandstone in others.

No complete exposures of the Kennedy were found in this area except near Sandy Ridge. Pits in the Contrary Creek and Bill Young Branch basins indicate that the coal may be as much as 3 feet thick under parts of the ridge west of Hurricane Branch and that it is thinner farther north, in the district west of lower Laurel Fork. Practically nothing is known about the thickness of the bed north of Dismal Creek and in adjoining parts of West Virginia, though it is probably less than 30 inches. The thickness near Sandy Ridge is about  $1\frac{1}{2}$  to 3 feet, the bed thinning to the northeast.

An exposure in Tazewell County, less than a mile southeast of Wolfpen Knob, indicates that the Kennedy may be at least 3 feet thick under parts of Sandy Ridge near the head of Hurricane Branch. Near the head of Calf Hollow (location 540, elevation 2,655) the bed is about 3 feet thick, probably including a few inches of clay. Several pits  $1\frac{1}{4}$  miles and less east of this, a short distance south of the top of Sandy Ridge, show the coal to be in two benches separated by 4 to 8 inches of clay and rash, the upper coal bench being 18 to 26 inches thick and the lower about 5 inches. The Kennedy is 27 inches thick in a small mine under the Sandy Ridge road near the head of Laurel Fork (location 541, elevation 2,890) and perhaps a few inches thicker in a similarly situated pit 800 feet east. Blooms of a thin coal 25 feet above the Kennedy show at many places in the wagon road in this vicinity.

The Kennedy is 23 inches thick a short distance west of the junction of Big Fork and Sandy ridges (location 542, elevation 2,835). In one pit on the east side of Big Fork Ridge (location 543, elevation 2,620) the coal is 20 inches thick and in another (location 544, elevation 2,710) it is 19 inches. A pit on the west side of Jewell Ridge (location 545, elevation 2,665) shows the coal to be 2 feet thick. There may be a few inches more of coal under a shale parting in these last four pits but it is probably not available for mining.

The measurements at four pits on the northwest side of Sandy Ridge within  $1\frac{1}{2}$  miles of Bearwallow post-office are given on page 176. In this vicinity and elsewhere in the region many houses are situated on the benches formed by the Kennedy bottom-rock, and pits are opened near them for household use.

*Kennedy bed on Sandy Ridge southwest of Bearwallow.*

(Location 546, elevation 2,865.)			(Location 547, elevation 2,795.)		
	Ft.	in.		Ft.	in.
Shale .....	10		Shale.		
Coal .....	1	8	Coal .....	1	6
Shale .....	1	2	Shale .....		0-7
Coal .....		3	Coal .....		0-3
(Location 548, elevation 2,810.)			(Location 549, elevation 2,835.)		
	Ft.	in.		Ft.	in.
Shale .....	3		Shale .....	2	
Coal .....	2		Coal .....	1	10

The Kennedy shows in a caved pit behind the store at Bearwallow and in the road a few rods north of it.

*Big Fork coal.*—A thin coal 25 feet above the Kennedy has been mentioned, and there is another thin bed, underlain by a moderately thick sandstone, about 100 feet above the Kennedy. These two are not minable in this area, but the next higher coal, the Big Fork, is locally 1½ to 3 feet thick, and, though impure, is used for domestic purposes where it crops out near houses. This coal is 50 to 80 feet below the Lower Banner coal and is separated from it chiefly or entirely by coarse massive sandstone which contains pebbles near Bearwallow Knob.

The Big Fork bed is reported to be at least 2 feet thick at the head of the first western tributary of Laurel Fork, west of Whitewood. Blooms were seen on Sandy Ridge, but the bed was not found elsewhere west of Big Fork Ridge in this area, though undoubtedly present.

In a pit on the west side of Big Fork Ridge (location 550, elevation 2,770) the coal is 26 inches thick, the upper half being dirty. The average thickness in a pit on the east side of the ridge (location 551, elevation 2,880) is 29 inches, including bony streaks, and is about the same under the knob at the junction of Big Fork and Sandy ridges (location 552, elevation 2,960). On the east side of Jewell Ridge (location 553, elevation 2,770) the upper division of the bed is 18 inches of coal with many shale streaks, the middle division is a foot of interbedded coal and shale, and the base is 6 inches of clean coal. The Big Fork coal shows in many caved pits and road blooms on both Big Fork and Jewell ridges.

The Big Fork coal crops out in the road along the county line at several places southwest of Bearwallow and near Bearwallow Knob and blooms were also found on the ridges northwest of the knob. The only complete measurement made in this part of the area, however, was one of 19 inches near Toliver School (location 554, elevation 2,830).

*Lower Banner coal.*—The Lower Banner is a few feet or inches above the coarse sandstone mentioned as overlying the Big Fork coal. It is about 200 feet above the Kennedy and 175 feet below the Splash Dam horizon. It occupies only rather small areas near the ridge tops. The roof is commonly drab shale. In much of the area the coal is split into two beds by shale.

On the ridge west of Hurricane Branch of Laurel Fork the Lower Banner is a fine clean bed 4 to 5 feet thick. Elsewhere the coal is in two benches, each less than 3 feet thick.

The thickest bench of the Lower Banner is said to be only 15 inches thick on the ridge a mile west of Whitewood and is only 25 to 28 inches thick near the heads of Lauders Branch. Probably because two benches of coal unite to the south, the minable coal is about 4 feet thick on the south side of Little Hurricane Branch basin and 5 feet thick a mile farther south. A local mine at the head of Cove Branch (location 555, elevation 2,630) is in 57 inches of coal which is clean except for two shale streaks near the top and 2 inches of bony coal near the middle. The coal is clean and 5 feet thick near Wolfpen Knob, but is split by 18 inches of shale one mile north-east (location 556, elevation 2,755), the coal above the shale being 29 inches thick and that below it 19 inches thick.

Near the head of Spring Branch, on Big Fork Ridge (location 557, elevation 2,795), the Lower Banner is said to be about 3 feet thick. It is reported on good authority to be 30 inches thick less than a mile west, on a spur of the same ridge (location 558, elevation 2,735).

A pit in this bed near Bearwallow Knob (location 559, elevation 2,930) is in coal only 17 inches thick, and it is 22 inches thick about half a mile northwest (location 560, elevation 2,850). The coal is 19 inches thick  $1\frac{1}{2}$  miles north of the knob, under the road on the state line (location 561, elevation 2,880). Other pits in West Virginia, less than a mile northwest of Peapatch (location 562, elevation 2,680, and location 563, elevation 2,670) are in coal 18 inches thick. In this district there is a very thin split off the Lower Banner 30 feet and less above the lower bench. This upper bench is reported by Hennen<sup>1</sup> to be 10 inches thick and only a foot above the lower in a pit a few yards north of the end of House Ridge (location 564, elevation 2,650), but only the lower bench, consisting of coal 16 inches thick, could be found by Davidson in 1914.

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<sup>1</sup>Hennen, R. V., Wyoming and McDowell counties: West Virginia Geol. Survey, 1915, p. 484.

*Upper Banner coal.*—The Upper Banner is only a few feet below a coarse massive sandstone that underlies the Splash Dam coal. It is a very thin coal in most of this region, but is 2 feet thick in places and nearly 3 feet thick in very small areas. It is possible, however, that all of the exposures correlated with the Upper Banner in the following paragraph may be an upper bench of the Lower Banner.

The coal is 21 inches thick at a spring on Redoak Ridge (location 565, elevation 2,840). There are numerous blooms in this bed on the ridges near the headwaters of Dismal Creek, but no other complete exposures. Two openings on Brushytop Ridge (location 566, elevation 2,650, and location 567, elevation 2,593) show coal 29 inches thick with a roof of thin shale under sandstone. Farther south on this ridge the Upper Banner is only 16 inches thick in one pit (location 568, elevation 2,655) and 19 inches in another (location 569, elevation 2,645).

*Splash Dam coal.*—A few feet below the Splash Dam bed is a thick coarse sandstone that contains pebbles in places and forms the top of Bearwallow Knob and other high points on a few ridges. The Splash Dam, therefore, has very little acreage in this region.

Very little is known about this coal south of Dismal Creek, though it is probably in two or more thin or moderately thick benches. According to measurements by Davidson the bed has a 20-foot sandy shale cap a few yards north of the end of House Ridge (location 570, elevation 2,820) and is in two benches separated by a 15-inch shale parting, the upper coal being about 8 inches thick and the lower 15 inches. At the north end of Brushytop Ridge, at Height, the two benches are 15 feet apart and the lower (location 571, elevation 2,780) is said to contain 32 inches of coal without partings.

#### SLATE CREEK.

*General features.*—The basin of Slate Creek and all its tributaries is a long, narrow area extending east from Grundy to the boundary of West Virginia. Most of the inhabitants live in the valleys in the western part of the region and on the ridges in the eastern part. For several years freight and passengers have been carried on the Big Sandy and Cumberland railroad from Devon, West Virginia, to Matney on Slate Creek, and the road has been recently extended to Grundy. An extension along Slate Creek east of Matney is utilized chiefly in lumbering operations. The railroad is narrow-gauge and its gradient across the divide between Slate and Knox creeks is too steep to permit the shipping of the large quantities of coal that could be mined in the region.

The rocks exposed in the region include those from a short distance below the Raven coal to about 150 feet above the Campbell Creek coal. The characteristics of most of these rocks are shown in local sections 29, 30, 35, and 37 (pp. 43, 48, and 49), and in generalized section 3 on Plate II. The larger intervals in generalized section 1 are applicable to the rocks exposed at the head of Mill Creek and along northern tributaries of Slate Creek farther west. The strata dip, in general, northwest at 50 to 400 feet per mile, the gradient being least in the northern half of the region and greatest near the head of Slate Creek.

The region contains some commercially important coal deposits, though the best beds are confined to rather small areas high in the hills north of lower Slate Creek. (See figs. 4, 5, 6, 7, and 18.) The lowest outcropping coal is the Raven, and, as mentioned later, the Jawbone and some lower beds may be sufficiently thick for shaft mining in places, especially in the eastern part of the region.

The Kennedy supplies Grundy and many houses along Slate Creek with fuel, but is only 2 to 3 feet thick in most places. The Splash Dam bed includes several shale partings and  $1\frac{1}{2}$  to  $3\frac{1}{2}$  feet of coal along lower Slate Creek and its tributaries, and is probably minable farther east except where split into several widely separated benches. The Hagy is clean and about 2 to 3 feet thick where found. The Glamorgan is 2 to  $3\frac{1}{2}$  feet thick in places. The Blair contains more than 6 feet of coal locally, but also includes thick partings. The Eagle includes 3 to 5 feet of coal and only thin partings north of lower Slate Creek. The Clintwood is clean and about 5 feet thick where found. The Raven, Aily, Big Fork, Lower Banner, and Upper Banner coals are known to be present in parts of the region, but are commonly only 2 feet or less thick.

*Coals below the Raven.*—No coals lower than the Raven appear at the surface in this region. The highest of the coals which are everywhere concealed beneath the surface is the Jawbone, which is 2 to  $4\frac{1}{2}$  feet thick, including thin layers of shale and bone, on the waters of Bradshaw Creek in West Virginia, a short distance from the heads of Slate Creek. The Jawbone of Virginia is the same as the Iaeger seam of the upper Bradshaw Creek basin of West Virginia. This coal is probably as much as 4 feet thick under parts of upper Slate Creek and its tributaries, but it probably thins to the west and is impure where thick. The Jawbone is 175 feet below the Raven at the head of Slate Creek and about 125 feet below it at Grundy. The interval between the Jawbone and Splash Dam horizons decreases westward from 725 feet at the head of Slate Creek to about 575 feet at Grundy.

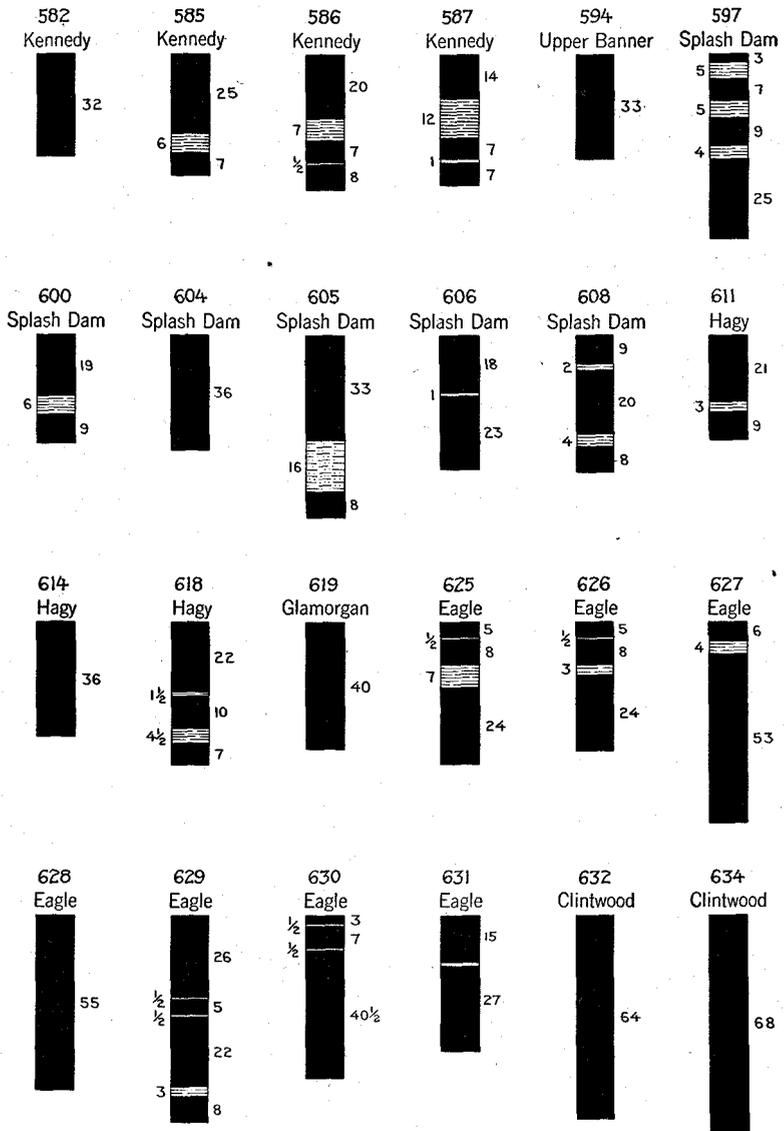


Fig. 18.—Sections of coal bcds in the Slate Creek basin.

Exposures and borings in the Bradshaw, West Virginia, district, 3 to 8 miles from the head of Slate Creek, show several minable beds in the Lee formation.<sup>1</sup> Conclusions based upon these are incorporated in the following table, though it must be recognized that the intervals given are subject to error:

*Mifiable beds in the Lee formation.*

Name.	Probable interval below Splash Dam horizon near head of Slate Creek. Feet.	Approximate thickness in Bradshaw, W. Va., district. Feet.
Lower Seaboard .....	1,090	1 to 3
.....	1,170	1 to 3
Upper Horsepen .....	1,220	1 to 2
Middle Horsepen .....	1,330	2 to 4
War Creek .....	1,450	1½ to 4
Lower Horsepen .....	1,490	2½
No. 9 Pocahontas .....	1,550	1½
No. 6 Pocahontas .....	1,740	¼ to 2
No. 4 Pocahontas .....	1,850	0 to 6
No. 3 Pocahontas .....	1,920	0 to 2½

There is a general tendency for Lee coals to thin to the west and north, so that the chances for finding workable coal by drilling are much less near Grundy than in the eastern part of the Slate Creek basin. The thickness of Lee and Norton shales and sandstones also decreases notably to the northwest, so that the interval between any of the Lee coal beds and the Splash Dam horizon is probably several hundred feet less at Grundy than at the head of Slate Creek.

*Raven coal.*—The Raven is above the level of Slate Creek only near Grundy, where it is 450 feet below the Splash Dam, and in a small area near the head of the creek, where it is 550 feet below the Splash Dam. The coal is only about 2 feet thick.

<sup>1</sup> Hennen, R. V., Wyoming and McDowell counties: West Virginia Geol. Survey, 1915.

The coal is 26 inches thick at the mouth of Breeden Branch (location 572, elevation 1,940). The bed has about the same thickness about 2 miles east and 2 miles northeast in the upper Bradshaw Creek basin of West Virginia, where it has been called the Lower Douglas coal by Hennen.

On the lower part of Slate Creek the Raven is 18 inches thick nearly opposite the mouth of Booth Branch (location 573, elevation 1,190), at least 17 inches at the mouth of Mill Branch (location 574, elevation 1,145), and 21 inches in a small sandstone quarry in the eastern part of Grundy (location 575, elevation 1,101).

*Aily coal.*—Although it is probably present as a thin bed in the small area in which its horizon is above the surface on upper Slate Creek, the Aily coal was found only along lower Slate Creek, where it is about 60 feet above the Raven. The coal is 20 inches thick in pits on both sides of Slate Creek at the mouth of Stonecoal Branch (location 576, elevation 1,280), and the same near the mouth of Elkins Creek (location 577, elevation 1,240). It is 19 inches thick near the mouth of Enochs Branch (location 578, elevation 1,220) and near the mouth of Mill Branch (location 579, elevation 1,174).

*Kennedy coal.*—A coarse massive sandstone which makes conspicuous ledges along nearly all of Slate Creek lies only a few feet below the Kennedy coal and serves as a marker for its position. This coal is 290 feet below the Splash Dam and about 100 feet above the Aily at Grundy. The distance below the Splash Dam increases eastward to 320 feet at Rife and 400 feet at the head of Slate Creek. The Kennedy is used for household purposes at a number of places between Grundy and Matney, the average thickness being about 28 inches and the maximum 42 inches, exclusive of partings. The coal was not found east of Matney, though probably present as a thin or moderately thick bed. The roof is commonly drab shale.

Though not well exposed, the Kennedy appeared to be about 3 feet thick in one pit at Grundy (location 580, elevation 1,260). It is not so thick elsewhere near town, and is only 28 inches in a small mine half a mile farther southeast (location 581, elevation 1,325) and 32 inches in a mine nearly opposite the mouth of Davis Hollow (location 582, elevation 1,265). The coal is 29 inches thick a short distance west of Booth Branch (location 583, elevation 1,350). A shale parting appears farther east, as shown by the following sections, the first on Lick Branch and the second on Whiteoak Branch. It is possible that neither of these measurements include all of the bed.

*Kennedy bed on Lick and Whiteoak branches.*

(Location 584, elevation 1,445.)			(Location 585, elevation 1,430.)		
	Ft.	in.		Ft.	in.
Shale .....	5		Shale .....	30	
Coal .....	1	1	Coal .....	2	1
Shale .....		1	Shale .....		6
Coal .....		7	Coal .....		7
<hr/>			<hr/>		
Coal .....	1	8	Coal .....	2	8
Parting .....		1	Parting .....		6

A lower coal bench was found still farther east, as shown by the following two sections, the first reported by d'Invilliers from a pit about half a mile west of Matney and the second measured on the lower part of Smith Branch:

*Kennedy bed near Matney.*

(Location 586, elevation 1,460.)			(Location 587, elevation 1,435.)		
	Ft.	in.		Ft.	in.
Coal .....	1	8	Coal .....	1	2
Shale .....		7	Shale .....	1	
Coal .....		7	Coal .....		7
Shale .....		1½	Shale .....		1
Coal .....		8	Coal .....		7
<hr/>			<hr/>		
Coal .....	2	11	Coal .....	2	4
Partings .....		7½	Partings .....	1	1

In a pit half a mile southwest of Enochs Branch (location 588, elevation 1,330), and in another pit south of it, the coal is 23 inches thick. A short distance up Mill Branch (location 589, elevation 1,300) the coal is 28 inches thick in one pit and 22 inches in another near it. Less than half a mile southwest (location 590, elevation 1,285) the thickness is 33 inches, but it is only 25 inches near the mouth of Davis Hollow (location 591, elevation 1,260).

*Lower Banner coal.*—The interval between the Lower Banner and Splash Dam beds is about 100 feet at Grundy and increases eastward to 130 feet at Rife, 150 feet on Mullins Branch, and 175 feet at the head of Slate Creek. The Lower Banner lies upon a sandstone bottom-rock that is rather thin and inconspicuous at its exposures near Grundy, but is thicker and a better ledge-maker farther east. The Big Fork coal is probably present in places as a thin bed underlying this sandstone.

Although the Lower Banner is thick along parts of Grapevine, Hale, and Long branches of Dismal Creek, it is thought to be thin in most of the

Slate Creek basin. It is said to be only 7 inches thick at Grundy and 20 inches thick on Enochs Branch. An exposure of coal 23 inches thick near Joshua Day School at the head of Slate Creek (location 592, elevation 2,300) is mapped as Lower Banner but is probably the Big Fork bed.

*Upper Banner coal.*—The Upper Banner is about halfway between the Lower Banner and Splash Dam beds and is overlain by a coarse massive sandstone which separates it from the Splash Dam. It is thought to be thin in nearly all of the Slate Creek basin, though locally moderately thick near West Virginia. The bed has a sandstone roof and is 15 inches thick near Joshua Day School (location 593, elevation 2,440). The average thickness is about 33 inches in a pit at the head of Breeden Branch, close to the State boundary (location 594, elevation 2,425), but the bed is irregular because of an uneven roof. This exposure may be an upper bench of the Lower Banner, and a one-foot coal bed which crops out about 35 feet above it may be the true Upper Banner. Nearly 2 miles north of this pit, in West Virginia (location 595, elevation 2,245), the coal is 23 inches thick. It is said to be 18 inches thick on Enochs Branch.

*Splash Dam coal.*—A coarse massive sandstone which underlies the Splash Dam bed is a strong ledge-maker on narrow spurs, but does not crop out conspicuously where low down in valleys. In most places the Splash Dam coal is in two or more benches separated from one another by a few inches or feet of shale. The minable parts of the bed aggregate  $1\frac{1}{2}$  to  $3\frac{1}{2}$  feet thick where measurements were obtained; but exposures are so scarce and partings so irregular in both thickness and occurrence that very little is known about the real value of the bed. Practically nothing is known about the Splash Dam in the eastern third of the Slate Creek basin; it is said to contain little minable coal in West Virginia, a short distance from the head of Blackey Fork.

The Splash Dam is reported 3 feet thick, probably including some shale partings, in a pit under the path at the head of Booth Branch (location 596, elevation 1,780). The first of the following two sections shows the full bed in a hollow south of Slate School; the second section is on the right fork of Meetinghouse Branch, south of Rife, and is probably only one of two or more benches:

*Splash Dam bed near Slate School and Rife.*

(Location 597, elevation 1,690.)		(Location 598, elevation 1,860.)	
	Ft. in.		Ft. in.
Shale.		Shale.	
Coal .....	3	Coal .....	6
Shale .....	5	Shale .....	1
Coal .....	7	Coal .....	6
Shale .....	5	Shale .....	1
Coal .....	9	Coal .....	6
Shale .....	4		
Coal .....	2 1	Coal .....	1 6
		Partings .....	2
Coal .....	3 8		
Partings .....	1 2		

A lower bench of the Splash Dam is 18 inches thick on Woosley Branch (location 599, elevation 1,885). Considerable bloom, indicating several feet of coal, is visible 15 feet above the lower bench and is separated from it by shale. In a pit on Upper Rockhouse Branch (location 600, elevation 1,790) the bed consists of 19 inches of coal at the top, 6 inches of shale below it, and 9 inches of coal at the bottom. The bed is reported to be 28 inches thick a short distance southwest of Smith Branch on Slate Creek (location 601, elevation 1,720), and about 2 feet thick on the right fork of Stonecoal Branch (location 602, elevation 1,665). On the main fork of Stonecoal Branch (location 603, elevation 1,630) the bed is 29 inches thick, including a 3-inch shale parting 9 inches from the base. An upper bench about 30 feet higher and 17 inches thick has been opened a short distance up the branch. The lower bench is 3 feet thick and is clean except for a few knife-edge partings in a small mine on Mill Creek, 1½ miles from its mouth (location 604, elevation 1,587). The first of the following sections was made in a small mine on Elkins Creek, 2 miles from its mouth, and the second in a mine at the head of Stillman Hollow:

*Splash Dam bed on Elkins Creek and in Stillman Hollow.*

(Location 605, elevation 1,533.)		(Location 606, elevation 1,600.)	
	Ft. in.		Ft. in.
Shale .....	7	Shale.	
Coal .....	2 9	Coal .....	1 6
Sandstone and clay ..	1 4	Shale .....	1
Coal .....	8	Coal .....	1 11
Coal .....	3 5	Coal .....	3 5
Parting .....	1 4	Parting .....	1

Coal 29 inches thick, excluding a clay streak 18 inches from the top, was measured on the south side of a western tributary of Enochs Branch

(location 607, elevation 1,555) and nearly the same section was seen on the north side of the hollow; it is reported, however, that the entire bed is 42 inches thick in the vicinity. The following section was made in Davis Hollow, near its mouth:

*Splash Dam bed in Davis Hollow.*

(Location 608, elevation 1,530.)

	Ft.	in.
Shale, light drab, sandy .....	5	
Coal .....		9
Shale .....		2
Coal .....	1	8
Shale .....		4
Coal .....		8
Coal .....	3	1
Partings .....		6

*Hagy coal.*—The Hagy is a few feet above a moderately thick sandstone and is 110 feet above the Splash Dam horizon at Grundy, 135 feet above it at Matney, and 130 to 160 feet above it farther east. The coal is commonly clean and is about 2' to 3 feet thick in most places. The roof is shale.

No complete measurements were obtained south of Slate Creek. Timbers in a caved pit on the right fork of Meetinghouse Branch, south of Rife (location 609, elevation 2,025), indicate a bed about 3 feet thick, probably including some shale in partings.

Hennen<sup>1</sup> states that his Lower War Eagle coal, the same as the Hagy of Virginia, is about 3 feet thick on the ridge road northwest of the head of Mullins Branch (location 610, elevation 2,450). Near Paynesville, W. Va., near one of the heads of Blackey Fork of Mullins Branch (location 611, elevation 2,210), the same bed is 33 inches thick, including a 3-inch shale parting 9 inches from the base. The coal appears to be only about 2 feet thick in a caved pit in what is probably the Hagy on a tributary of Kennedy Branch (location 612, elevation 2,270). The Hagy is 31 inches thick at the head of Nighway Branch (location 613, elevation 2,170) and 3 feet thick on Orchard Branch (location 614, elevation 2,075). A pit on Woosley Branch (location 615, elevation 2,055) is in 29 inches of coal, and a neighboring natural exposure (location 616, elevation 2,055) shows at least 34 inches. The coal is 32 inches thick on Payne Branch (location 617, elevation 1,980). It is thicker near Elkins School, as shown by the following section:

<sup>1</sup>Wyoming and McDowell counties: West Virginia Geol. Survey, 1915, p. 456.

*Hagy bed on Elkins Creek.*

(Location 618, elevation 1,690.)

	Ft.	in.
Shale, blue.		
Coal .....	1	10
Shale .....		1½
Coal .....		10
Shale .....		4½
Coal .....		7
		-----
Coal .....	3	3
Partings .....		6

The Hagy is said to consist of 40 inches of coal and 8 inches of shale on the lower part of Enochs Branch.

*Glamorgan coal.*—The lower boundary of the Wise formation on the geologic map is practically the same as the Glamorgan outcrop, as the coal is only a few feet higher. The Glamorgan is 300 to 360 feet above the Splash Dam horizon, the interval increasing irregularly to the south and southeast. It is irregular in thickness and has been opened in only a few places. It appears to be clean and is about 2 to 3½ feet thick where measured. There is a thin coal 50 to 100 feet below the Glamorgan in the central and eastern parts of the Slate Creek basin.

A small mine at the head of Lick Branch (location 619, elevation 2,175) is in coal 40 inches thick. The Glamorgan is at least 30 inches thick, and probably more, in a caved pit half a mile east (location 620, elevation 2,160). An opening at the head of the left fork of Lick Branch (location 621, elevation 2,030) shows an upper 8-inch coal layer separated from a thicker lower bench by 16 inches of shale, and is probably in the Glamorgan.

The only complete measurement of the Glamorgan obtained north of Slate Creek was one of 27 inches in Davis Hollow, 1½ miles northeast of Grundy (location 622, elevation 1,810).

*Blair coal.*—No complete measurements of the Blair coal, which lies about halfway between the Glamorgan and Eagle beds, were obtained in this region.

A caved pit on upper Elkins Creek (location 623, elevation 1,870) was reported to be in coal 3 feet thick, but it is not known whether the exposure was complete or whether it included shale partings.

A bloom which was seen on a western tributary of lower Enochs Branch was prospected afterward and is reported by W. B. Crawford to be as follows:

*Blair bed on lower Enochs Branch.*

(Near location 631, elevation 1,880.)

	Ft.	in.
Coal .....	1	6
Clay .....		3½
Coal .....	1	
Clay .....		2
Coal .....		8
Clay .....	1	3½
Coal .....	3	3
<hr/>		
Coal .....	6	5
Partings .....	1	9

*Eagle coal.*—The Eagle coal is 110 to 185 feet above the base of the Wise formation and 425 to 490 feet above the Splash Dam horizon. In the area north of Slate Creek and west of Upper Rockhouse Branch the bed commonly includes 3 to 5 feet of coal and a few partings that are not seriously detrimental. It is probably thinner in other parts of the region.

No exposures of the Eagle were obtained south of Slate Creek or in the eastern part of the region, where the bed is confined to small areas on ridge tops. A measurement of only 21 inches at the head of Butt Branch of Knox Creek indicates that the bed is thin northeast of Matney. The following sections show that the bed is thick northwest of Matney, the first being on Smith Branch, the second and third on upper Stonecoal Branch, and the fourth near the head of Mill Creek.

*Eagle bed on Smith and Stonecoal branches and Mill Creek.*

(Location 624, elevation 2,055.)

	Ft.	in.
Coal .....		5
Shale .....		½
Coal .....		7½
Shale .....		3
Coal .....	1	8½
<hr/>		
Coal .....	2	9
Partings .....		3½

(Location 625, elevation 2,045.)

	Ft.	in.
Coal .....		5
Shale .....		½
Coal .....		8
Shale .....		7
Coal .....	2	
<hr/>		
Coal .....	3	1
Partings .....		7½

(Location 626, elevation 2,030.)

	Ft.	in.
Coal .....		5
Shale .....		½
Coal .....		8
Shale .....		3
Coal .....	2	
<hr/>		
Coal .....	3	1
Partings .....		3½

(Location 627, elevation 2,025.)

	Ft.	in.
Coal (reported) ...		6
Shale .....		4
Coal .....	4	5
<hr/>		
Coal .....	4	11
Parting .....		4

The Eagle is 55 inches thick and contains only knife-edge partings on a western fork of Mill Creek (location 628, elevation 2,035). The first of the following sections was measured at the head of the right fork of Elkins Creek; the second is reported by Crawford from the head of the main fork and is either at or near the location assigned to it below:

*Eagle bed on Elkins Creek.*

(Location 629, elevation 2,020.)			(Location 630 (?), elevation 1,940.)		
	Ft.	in.		Ft.	in.
Coal .....	2	2	Coal .....	3	
Shale .....		½	Clay .....		½
Coal .....		5	Coal .....		7
Shale .....		½	Clay .....		½
Coal .....	1	10	Coal .....	3	4½
Shale .....		3			
Coal .....		8	Coal .....	4	2½
			Partings .....		1
Coal .....	5	1			
Partings .....		4			

The Eagle was also seen in a small mine in a western tributary of Enochs Branch (location 631, elevation 1,965), where the bed is 43 inches thick, including an inch of shale 15 inches from the top.

*Clintwood and higher coals.*—The Clintwood coal is 100 feet or less above the Eagle and is separated from it chiefly by a massive sandstone which makes a strong bench just below the higher coal. The coal is clean and about 5 feet thick, at least in the western half of the region, but underlies only somewhat small areas on the ridge tops. No higher coal has been opened, though the Campbell Creek is probably about 250 feet above the Clintwood in small areas near the heads of Mill and Elkins creeks and neighboring streams.

The Clintwood consists of clean coal 64 inches thick near the head of Lick Branch (location 632, elevation 2,300). J. H. Stinson of Grundy reports finding 67 inches of coal at the head of Mill Creek, about 20 feet above the level of a neighboring pit in the Eagle. This bed is probably the Clintwood, though the interval between it and the Eagle is much less than it is elsewhere. The Clintwood is said to be 58 inches thick near the head of Enochs Branch (location 633, elevation 1,995) and a partial exposure of 4 feet of clean coal was seen in a caved pit there. The coal is 68 inches thick on a western tributary of lower Enochs Branch (location 634, elevation 2,050).

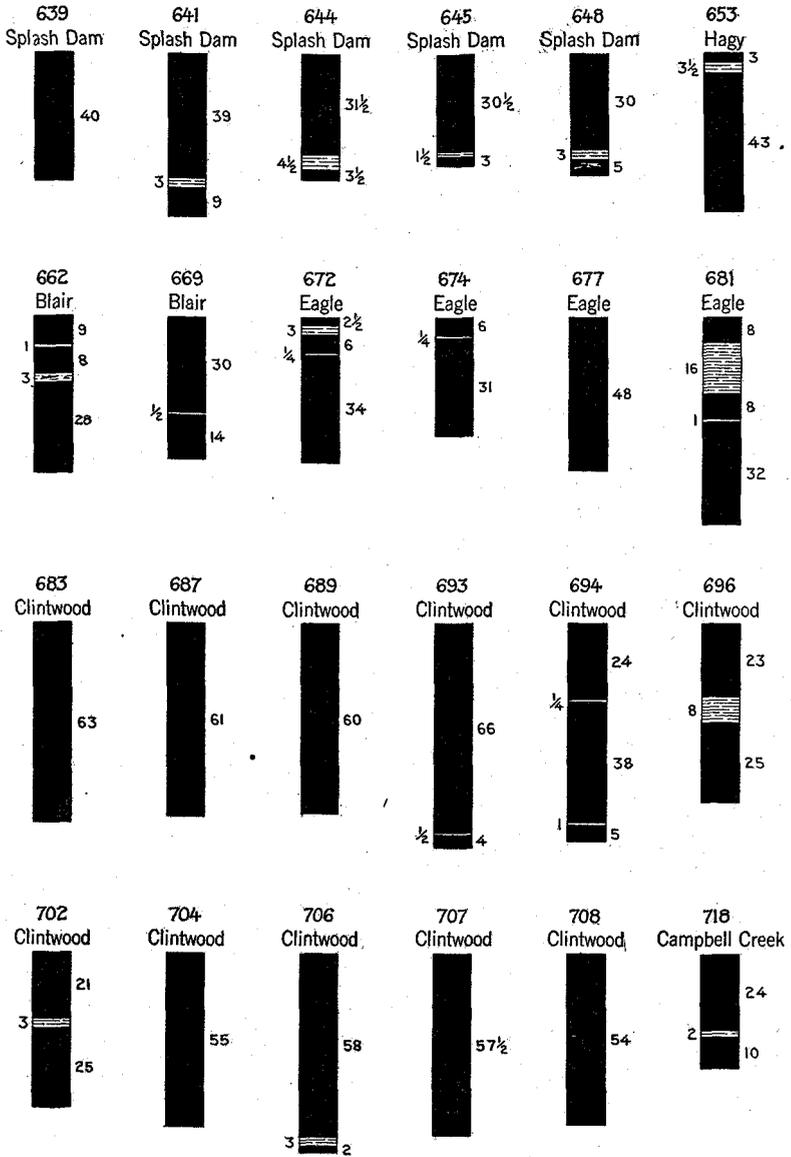


Fig. 19.—Sections of coal beds in the basins of Looney, Linn Camp, Home, and Rocklick creeks.

## LOONEY, LINN CAMP, HOME, AND ROCKLICK CREEKS.

*General features.*—This region consists of the basins of the four largest creeks which enter Levisa Fork northwest of Grundy. The coal resources along the small neighboring tributaries of the Levisa, including Stilton Creek, have been discussed under the heading "Levisa Fork and small tributaries northwest of Grundy." The rocks exposed include those from a few feet below the Raven coal to those about 400 feet above the Cedar Grove coal, and their characteristics are shown by local sections 12, 30, 31, 32, 33, and 34 (pp. 30 and 43-47), and by generalized section 1 on Plate II. The general dip of the region, interrupted only by small local anticlines and synclines, is northwest at 25 to 125 feet per mile.

The region is rich in coal resources (see figs. 4, 5, 6, 7, and 19), especially the basin of Rocklick Creek, where the thick coals of the Wise formation are sufficiently low to underlie considerable territory. Nothing is known about coals that are everywhere below the surface, though all or most of them are thought to be too thin to justify deep shaft mining.

The Raven, Aily, and Kennedy coals are only about 2 feet thick, so that the Splash Dam is the lowest known coal of much economic importance. The Splash Dam contains 2½ to 4 feet of minable coal, as well as several shale partings. The Hagy coal is probably 2 to 4 feet thick in part of the region and lacking elsewhere. The Glamorgan is 1½ to 3 feet thick. The Blair consists of 6 feet or less of minable coal and many shale partings in the southern part of the region, and is thinner and cleaner along Rocklick Creek. The Eagle contains 2½ to 4 feet of minable coal. The Clintwood is clean and about 5 feet thick in most of the region, though split by a shale parting along the upper part of Rocklick Creek and in part of the Home Creek basin. The Campbell Creek is 2½ to 5 feet thick along the Kentucky line and is probably minable elsewhere, though its acreage is small. Nothing is known as to the thickness of four or more coals which are probably present above the Campbell Creek in small areas, though at least two of them are probably thick.

*Raven and Aily coals.*—The lowest outcropping coal in the region is the Raven, which is a short distance above water level at the mouth of Looney Creek. The Aily bed is 60 to 90 feet higher and is above the surface for about a mile on lower Looney Creek and only a few feet above stream level at the mouth of Linn Camp Creek. Each coal is less than 2 feet thick, and is described more fully in the section devoted to the coal resources of Levisa Fork and small tributaries northwest of Grundy.

*Kennedy coal.*—The horizon of the Kennedy is well marked by a massive ledge-making sandstone bottom-rock, the top of which is 290 feet below the Splash Dam bed on Looney Creek, 270 feet on Linn Camp and Home creeks, and 240 feet at the mouth of Rocklick Creek. The coal is above the surface only along the lower courses of these creeks, and is only about 2 feet thick.

The Kennedy was not found on Looney or Linn Camp creeks, but is 24 to 34 inches thick in neighboring parts of the Levisa Fork Valley (see locations 121, 122, 124, and 125). The coal is 19 inches thick in two pits on Home Creek (locations 635 and 636, elevation 950), and there is a 4-inch coal layer 3 to 8 feet below the upper bench. A bloom near Big Rock (location 637, elevation 935) is said to be in a bed about 2 feet thick.

*Splash Dam coal.*—Both the Lower Banner and the Upper Banner coals appear only as blooms of what seem to be very thin beds in this region, and the Big Fork coal is probably absent. It is possible that the Lower Banner is about 2 feet thick beneath the surface near the heads of the main creeks, but the first minable outcropping coal above the Kennedy is in the Splash Dam bed, which is exposed a few feet above a ledge-making sandstone along the lower parts of the principal streams. This bed consists of several shale partings and 2½ to 4 feet of minable coal. The roof is commonly drab shale containing fossil leaves.

A short distance southeast of Looney Creek School (location 638, elevation 1,470) the Splash Dam is 32 inches thick, including 2 half-inch shale partings 6 and 13 inches, respectively, below the top. A small mine half a mile farther southeast (location 639, elevation 1,480) is in clean coal 40 inches thick. D'Invilliers states that the coal is 30 inches thick on Left Fork of Looney Creek (location 640, elevation 1,475). A thin lower coal bench probably lies a few inches or feet below all of these openings.

The first of the following two sections is from a pit on the lower part of Linn Camp Creek and the second is from a small mine near Linn Camp School:

*Splash Dam bed on Linn Camp Creek.*

(Location 641, elevation 1,295.)		(Location 642, elevation 1,404.)	
	Ft. in.		Ft. in.
Shale.		Sandstone.	
Coal .....	3 3	Coal .....	2 7
Shale (reported) ....	3 3	Shale (reported) ....	6 6
Coal (reported) ...	9 9	Coal (reported) ...	9 9
Coal .....	4 4	Coal .....	3 4
Parting .....	3 3	Parting .....	6 6

The principal bench of the Splash Dam is 34 inches thick on Home Creek, nearly opposite the mouth of Nanny Branch (location 643, elevation 1,220). The same bench and a thin one below it are shown in the following sections in openings about 2 miles farther east:

*Splash Dam bed on Home Creek.*

(Location 644, elevation 1,295.)			(Location 645, elevation 1,310.)		
	Ft.	in.		Ft.	in.
Shale.			Shale.		
Coal .....	2	7½	Coal .....	2	6½
Shale .....		4½	Shale .....		1½
Coal .....		3½	Coal .....		3
	<hr/>			<hr/>	
Coal .....	2	11	Coal .....	2	9½
Parting .....		4½	Parting .....		1½

The principal coal bench is 31 inches thick nearly half a mile west of Home Creek School (location 646, elevation 1,345), and 34 inches thick opposite the school (location 647, elevation 1,360). The same bench is 30 inches thick on Elswick Fork (location 648, elevation 1,340), and a lower 5-inch layer of bony coal is separated from it by 3 inches of shale. The first of the following sections is reported to have been found on Benns Branch, and the second was measured on Nanny Branch:

*Splash Dam bed on Benns and Nanny branches of Home Creek.*

(Location 649, elevation 1,225.)			(Location 650, elevation 1,225.)		
	Ft.	in.		Ft.	in.
Coal .....	2	6	Coal .....		2
Shale .....		7	Shale .....	2	8
Coal .....		4	Coal .....	2	5
	<hr/>		Shale .....		½
Coal .....	2	10	Coal .....		10
Parting .....		7		<hr/>	
			Coal .....	3	5
			Partings .....	2	8½

The only complete measurement of this bed obtained in the Rocklick Creek basin was on Right Fork (location 651, elevation 1,140), where an upper 34-inch coal bench is exposed and is separated by an 18-inch shale parting from a lower coal bench said to be 18 inches thick.

*Hagy coal.*—The Hagy horizon is 60 to 170 feet above the Splash Dam and overlies a sandstone that crops out conspicuously in places. The coal itself was found only in the Rocklick Creek basin, and as a very thin bed at one place on Linn Camp Creek, though it is probably present in some

other parts of the region as a bed 2 to 4 feet thick. It is possible, however, that the coal is lacking and its place taken by sandstone in most of the Home and Linn Camp basins and part of the Looney Creek basin. A bloom was seen on Right Fork of Rocklick Creek, nearly opposite the mouth of Watts Branch (location 652, elevation 1,260), and the coal was said by residents to be 18 inches thick. The following complete section was measured one-fourth mile north of Big Rock:

*Hagy bed near Big Rock.*

(Location 653, elevation 1,240.)

	Ft.	in.
Shale.		
Coal .....	3	
Shale .....	3	½
Coal .....	3	7
	<hr/>	
Coal .....	3	10
Parting .....		3½

*Glamorgan coal.*—The Glamorgan is only a few feet above the Gladeville sandstone, so that its line of outcrop is approximately the same as that of the base of the Wise formation. The interval between the coal and the Splash Dam horizon decreases to the northwest and ranges from 330 feet along upper Looney Creek to about 250 feet along Rocklick Creek. The Glamorgan is about 1½ to 3 feet thick and has few or no shale partings.

The Glamorgan is reported to be 2 feet thick in two pits near the head of Looney Creek (location 654, elevation 1,755; location 655, elevation 1,735).

The coal is said to be 20 inches thick on Elswick Fork of Home Creek (location 656, elevation 1,595) and about 3 feet thick in one pit on the upper part of Left Fork of Home Creek (location 657, elevation 1,510). Nearer the head of Left Fork (location 658, elevation 1,515) an opening shows only 18 inches of coal. The bed is reported to be only 13 inches thick at the head of Benns Branch (location 659, elevation 1,475).

The Glamorgan is said to be about 30 inches thick on Rocklick Creek opposite the mouth of Jacks Branch (location 660, elevation 1,365), and is probably thicker near the head of the creek.

*Blair coal.*—The Blair is 25 to 95 feet above the Glamorgan. It is a thick bed in the basins of Looney, Linn Camp, and Home creeks containing coal layers aggregating as much as 6 feet thick in places, but also including many shale partings. The bed is thinner in the Rocklick Creek basin and contains fewer partings.

Several caved pits in the Blair were seen in the Looney Creek basin, but the only available measurements are the following, the first being from Feds Camp Branch, the second from nearly 1½ miles farther northwest, and the third from Left Fork:

*Blair bed in Looney Creek basin.*

(Location 661, elevation 1,865.)			(Location 662, elevation 1,825.)		
	Ft.	in.		Ft.	in.
Coal .....	1		Coal .....		9
Shale .....		3	Shale .....		1
Coal .....		11	Coal .....		8
Shale .....		7	Shale, bony .....		3
Coal .....		6	Coal .....	2	4
Shale .....		2			
Coal .....		4½	Coal .....	3	9
Shale, bony .....		2	Partings .....		4
Coal (reported) ..	2	7			
Coal .....	5	4½			
Partings .....	1	2			

(Location 663, elevation 1,815.)

	Ft.	in.
Coal .....	1	2
Rash .....		¼
Coal .....		10
Shale .....		6
Coal .....		10
Bone .....		2
Coal .....		10
Shale .....		4
Coal (reported) ..	2	7
Coal .....	6	3
Partings .....	1	¼

A caved pit in the Blair at the head of Linn Camp Creek (location 664, elevation 1,790) appears to be in a bed about 4 feet thick, including shale partings.

The first of the following sections in the Home Creek basin is from Licklog Branch, and is not complete either at top or bottom; the second is from the head of Left Fork, and the lower part may not be exact.

*Blair bed in Home Creek basin.*

(Location 665, elevation 1,700.)

	Ft.	in.
Coal .....		6+
Shale .....	1	
Sandstone .....	1	6
Coal .....		2
Sandstone .....		3
Coal .....	1	
Bone .....		4
Coal .....		8+
<hr/>		
Coal .....	2	4+
Partings .....	3	1

(Location 666, elevation 1,600.)

	Ft.	in.
Coal .....	2	8
Shale .....		2
Coal .....		2
Shale (reported) ...		8
Coal (reported) ...		?
<hr/>		
Coal .....	2	10+
Partings .....		10

On a tributary of Rocklick Creek,  $1\frac{1}{4}$  miles east of Upper Rocklick School (location 667, elevation 1,525) the Blair is about 3 feet thick. On Lee Branch of Rocklick (location 668, elevation 1,440) the coal exposed is 21 inches thick, exclusive of an inch of shale 15 inches from the top, and it is possible that there is more coal below. On Feds Creek, in Kentucky, half a mile north of the head of Dicks Branch of Rocklick (location 669, elevation 1,360), the Blair is  $44\frac{1}{2}$  inches thick and contains only half an inch of shale.

*Eagle coal.*—The next coal above the Blair is the Eagle, which is 95 to 140 feet above the base of the Wise formation and 340 to 470 feet above the Splash Dam horizon in this region, both intervals increasing from northwest to southeast. The Eagle commonly lies only a few feet below a massive cliff-making sandstone. It has few shale partings and contains  $2\frac{1}{2}$  to 4 feet of minable coal.

The Eagle contains 34 inches of minable coal near the head of Looney Creek, as shown by the following section:

*Eagle bed near head of Looney Creek.*

(Location 670, elevation 1,905.)

	Ft.	in.
Sandstone, under shale .....	2	
Shale .....		4
Coal .....		$1\frac{1}{2}$
Shale .....	1	9
Coal .....		2
Shale .....	2	4
Coal .....	2	10
<hr/>		
Coal .....	3	$1\frac{1}{2}$
Partings .....	4	1

The bed is reported to be about 4 feet thick  $1\frac{1}{4}$  miles farther west (location 671, elevation 1,870) and this may be all coal without partings.

The following measurement from a pit 50 feet above the Blair coal was obtained in the Linn Camp Creek basin:

*Eagle bed half a mile south of Linn Camp School.*

(Location 672, elevation 1,820.)

	Ft.	in.
Sandy shale, under sandstone cliff .....	30	
Coal .....		2½
Shale .....		3
Coal .....		6
Shale .....		¼
Coal .....	2	10
<hr/>		
Coal .....	3	6½
Partings .....		3¼

The first of the following four sections was obtained near the head of Home Creek, and the other three on the eastern branch of Left Fork:

*Eagle bed in Home Creek basin.*

(Location 673, elevation 1,850.)

	Ft.	in.
Coal .....	2	1
Rash .....	6	
Shale .....	3	4
Coal .....	3	9
<hr/>		
Coal .....	5	10
Parting .....	3	10

(Location 674, elevation 1,665.)

	Ft.	in.
Coal .....		6
Clay .....		¼
Coal .....	2	7
<hr/>		
Coal .....	3	1
Parting .....		¼

(Location 675, elevation 1,690.)

	Ft.	in.
Coal .....		6
Clay .....		⅛
Coal .....	2	3
<hr/>		
Coal .....	2	9
Parting .....		⅛

(Location 676, elevation 1,690.)

	Ft.	in.
Coal .....		6
Clay .....		⅛
Coal .....	2	2½
<hr/>		
Coal .....	2	8½
Parting .....		⅛

The coal was reported to be 4 feet thick in a caved pit on a small tributary of Left Fork of Home Creek (location 677, elevation 1,630) and almost that much is still visible. It is reported 3 or 4 feet thick in a large caved pit on Bennis Branch (location 678, elevation 1,585).

On Rocklick Creek, east of Jacks Branch (location 679, elevation 1,475), the coal is 37 inches thick and has a drab shale roof. It is said to

be 33 inches thick in a pit above the road farther up the creek (location 680, elevation 1,510), the roof being a thin shale grading to sandstone at top. The following is reported by d'Invilliers to have been measured in a small northern tributary of the lower part of Rocklick Creek:

*Eagle bed 1 mile north of Big Rock.*

(Location 681, elevation 1,535.)

	Ft.	in.
Sandstone .....	75	
Coal .....		8
Shale .....	1	4
Coal .....		8
Shale .....		1
Coal .....	2	8
Coal .....	4	
Partings .....	1	5

The Eagle is only 2 feet thick on the path from Dicks Branch of Rocklick to Feds Creek, in Kentucky (location 682, elevation 1,417).

*Clintwood coal.*—The Clintwood coal, which is known to prospectors as the Feds Creek seam in this region, is a thick and important bed. It is 130 feet or less above the Eagle coal and is separated from it by the massive, cliff-making sandstone mentioned as overlying the Eagle. This sandstone crops out conspicuously and forms benches a few feet below the Clintwood horizon. The average thickness of coal is close to 5 feet in most districts and shale partings are lacking or are mere streaks. In the eastern part of the Rocklick Creek basin and along some of the northern tributaries of Home Creek a shale parting in the middle of the bed reduces the thickness of minable coal to only 2 or 3 feet. The roof is commonly a shale which is the base of a thick series of shales and thin-bedded sandstones.

The Clintwood is clean and 63 inches thick at a natural exposure on Feds Camp Branch of Looney Creek (location 683, elevation 2,020). It is 51 inches thick, including half an inch of shale 17 inches from the base, about a mile north (location 684, elevation 1,970), and is reported to be 5 feet thick in another pit near the head of Looney Creek (location 685, elevation 2,015). It is 62 inches thick on New Wolfpen Branch (location 686, elevation 2,020).

At the head of a stream which empties into Linn Camp Creek near the school (location 687, elevation 1,983) the coal is clean and 61 inches thick. It is 56 inches thick a short distance northeast (location 688, elevation 1,980), and 5 feet thick near the head of Linn Camp Creek (location 689, elevation 1,920).

A small mine is in 55 inches of clean coal near the head of Home Creek (location 690, elevation 1,910). The coal is said to be only 2 feet thick near the heads of both branches of Left Fork (location 691, elevation 1,800, and location 692, elevation 1,735), probably because the bed is split into two benches by shale and only one bench was found. For the same reason the coal is reported to be only 3 feet thick at the head of Bennis Branch. Crawford, however, states that the bed is 76½ inches thick at the head of Nanny Branch and that it is clean except for a 2-inch clay parting 45 inches from the base. It is known to be clean and about 5 feet thick in the ridge between Nanny and Harper branches.

Four of the following five sections show a parting in the middle of the bed which is sufficiently thick to impair the value of the coal along the eastern part of the Right Fork of Rocklick Creek. It is probably this parting that has split the Clintwood into two parts at the heads of Bennis Branch and Left Fork of Home Creek. The third of these sections is based on reports that may not be exact.

*Clintwood bed in basin of Right Fork of Rocklick Creek.*

(Location 693, elevation 1,600.)

	Ft.	in.
Coal .....	5	6
Shale .....		½
Coal .....	4	
	-----	
Coal .....	5	10
Parting .....		½

(Location 694, elevation 1,620.)

	Ft.	in.
Coal .....	2	
Rash .....		¼
Coal .....	3	2
Shale .....		1
Coal .....		5
	-----	
Coal .....	5	7
Partings .....		1¼

(Location 695, elevation 1,675.)

	Ft.	in.
Coal .....	2	
Shale (reported) .....	2	
Coal (reported) .....	2	
	-----	
Coal .....	4	
Parting .....	2	

(Location 696, elevation 1,625.)

	Ft.	in.
Coal .....	1	11
Clay .....		8
Coal .....	2	1
	-----	
Coal .....	4	
Parting .....		8

(Location 697, elevation 1,590.)

	Ft.	in.
Coal .....	1	10
Rash .....		½
Coal .....	2	7
	-----	
Coal .....	4	5
Parting .....		½

The same parting is 8 inches thick in a small mine less than half a mile east of Upper Rocklick School (location 698, elevation 1,545), the coal above it being 22 inches thick and that below it 27 inches thick. The coal in a mine one-fourth mile east (location 699, elevation 1,555) is 38 inches thick. Still farther east, on a large southern tributary of Rocklick Creek (location 700, elevation 1,650), the Clintwood is said to be only 18 inches thick, probably because only one bench was found. At the head of Rocklick Creek (location 701, elevation 1,635) the coal is said to be about 3 feet thick, and it is probably about the same elsewhere in the vicinity. On Dicks Branch (location 702, elevation 1,520) the coal is in two benches separated by 3 inches of shale, the upper bench being 21 inches thick and the lower bench 25 inches. The parting thins out to the southwest, so that the bed is clean coal 50 inches thick on Old Field Branch (location 703, elevation 1,540), 55 inches thick on Grassy Spring Branch (location 704, elevation 1,520), and 50 inches thick in the next valley southwest (location 705, elevation 1,580). Half a mile northwest of the mouth of Right Fork (location 706, elevation 1,610) the minable bench is clean and 58 inches thick, and a 2-inch coal layer is said to underlie a 3-inch parting.

The Clintwood coal has been extensively prospected along Feds Creek in Kentucky by the Kentland Coal and Coke Co. Only those measurements which throw the most light on the thickness of the bed in neighboring parts of Virginia will be specifically mentioned here. One opening on the right fork of Laurel Fork of Feds Creek (location 707, elevation 1,495) is in 57½ inches of coal, and another on the same stream (location 708) is in coal 54 inches thick. The bed is slightly thicker short distances northwest and northeast of location 708, but is only 42 inches thick at the head of main Laurel Fork (location 709). It is 46 inches thick at the head of Miller Fork of Feds Creek (location 710). Coal 44 inches thick was found on the upper part of Right Fork of Feds Creek (location 711, elevation 1,470). In two pits short distances northeast (location 712, elevation 1,475, and location 713) the coal is only 2 feet thick, probably because the bed is split into two coal benches by a shale parting and only one bench was found.

*Campbell Creek and higher coals.*—The Campbell Creek coal lies in the midst of a thick series of sandstones and occupies only small areas on the ridge tops. It is 180 to 250 feet above the Clintwood coal and 630 to 780 feet above the Splash Dam horizon, both intervals being smallest near Kentucky and greatest along Looney Creek. Little is known about the

Campbell Creek in this region, though it is a thick and important coal in neighboring parts of Kentucky. The bed is said to be 6 feet thick, including shale partings, in a pit 1½ miles east of Upper Rocklick School (location 714, elevation 1,920), though the report could not be verified.

Coal in the Campbell Creek bed is reported to be 5 feet thick on State Line Branch of Levisa Fork and 43 inches thick on the left fork of Hackney Creek, 1¼ miles west of the head of Grassy Spring Branch of Rocklick Creek. It is only about 3 feet thick near the Virginia line in the Feds Creek basin and the upper part commonly contains interlaminated bony streaks ("laminated coal"). The bed is said to be 31½ inches thick on the right fork of Laurel Fork of Feds Creek (location 715), including 4 inches of "laminated coal" and half an inch of shale. It is reported to be 3 feet thick at the head of Laurel Fork (location 716). The following are measurements in pits at the head of Feds Creek:

*Campbell Creek bed at head of Right Fork of Feds Creek, Ky.*

(Location 717, elevation 1,690.)

(Locations 718 and 719.)

	Ft.	in.		Ft.	in.
Bone .....		2	Coal .....	2	
Shale .....	1	6	Shale .....		2
Coal .....	1	9	Coal .....		10
Shale .....		4			
Coal .....		10	Coal .....	2	10
		<hr/>	Parting .....		2
Coal .....	2	7			
Parting .....		4			

Coal blooms 40 feet and 140 feet (Alma) above the Campbell Creek were seen in the road at the head of Feds Creek, but the thickness of the beds is unknown. The Lower Cedar Grove coal, which is about 205 feet above the Campbell Creek, and the Cedar Grove coal, 280 feet above the same seam, are probably present near the head of Rocklick Creek but they underlie only small areas. There are probably also a few coals above the Cedar Grove in the same high area.

PAWPAW CREEK, RACE FORK, LESTER FORK, AND NEIGHBORING PARTS OF KNOX CREEK.

*General features.*—This region consists of the western slopes of Knox Creek valley between Hurley and the Kentucky boundary and the basins of all tributaries which enter that part of the main stream from the west. The rocks exposed range from a few feet below the Kennedy coal to about

400 feet above the Cedar Grove coal. Their characteristics are shown by local sections 33, 34, 35, 36, and 40 (pp. 46-48 and 51), and by generalized section 2 on Plate II. The general dip is to the northwest at an average rate of about 70 feet per mile.

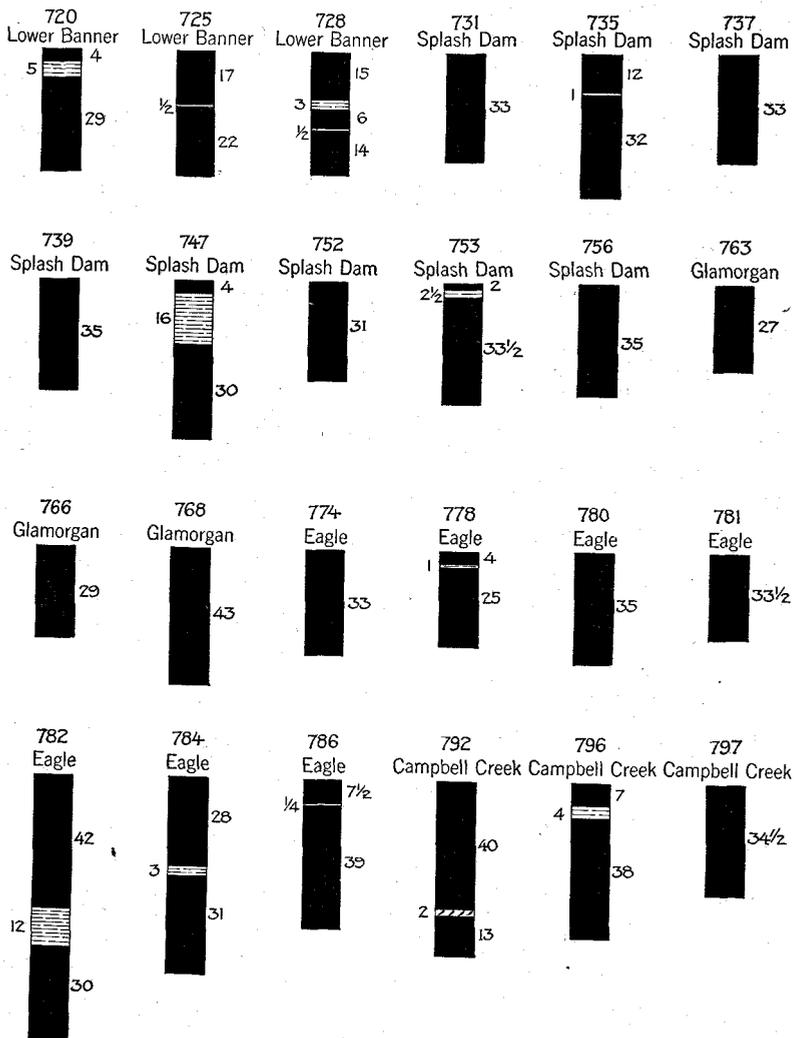


Fig. 20.—Sections of coal beds in the basins of Pawpaw Creek, Race Fork, and Lester Fork.

The region contains some thick and valuable outcropping coals (see figs. 4, 5, 6, 7, and 20), especially the Eagle, Campbell Creek, and other beds in the lower part of the Wise formation. There are also many moderately thick beds which furnish local supplies and could be profitably mined for shipping purposes. No coal was found at the lowest coal horizon exposed, the Kennedy. The Lower Banner and Splash Dam coals are about 2 to 3 feet thick, and the Hagy may equal them locally. The Glamorgan and Blair beds were identified with certainty only in the Pawpaw Creek basin, where they are 2 to 3½ feet thick, but they are probably present elsewhere. The Eagle is 2 to 3 feet thick in the Pawpaw basin and 3 to 6 feet thick elsewhere. The Clintwood is about 2½ feet thick in the Pawpaw basin, but may be as much as 5 feet thick in part of the Lester Fork district. The Campbell Creek contains 3 to 6 feet of coal near the Kentucky boundary and underlies only small areas elsewhere. Several higher coals are undoubtedly present, but have only small acreages.

Transportation for freight and passengers is furnished by the Big Sandy and Cumberland Railroad, which runs up Knox Creek from its junction with the main line of the Norfolk and Western at Devon. This road is now utilized chiefly for lumbering purposes, but it could be made available for shipping coal from all parts of the region by comparatively inexpensive alterations and additions.

No drilling has been done to determine the character of coals below the Kennedy, none of which reaches the surface. The Jawbone coal, if sufficiently pure, may be minable under the Lester Fork basin, where it is probably 550 to 600 feet below the Splash Dam horizon. Other coals in the lower part of the Norton formation are probably thin. A summary of the thicknesses of coals in the Lee formation near Bradshaw, W. Va., and their distances below the Splash Dam at the head of Slate Creek is given in the description of coal in the Slate Creek basin (p. 181). Because of the general tendency of these lower coals to thin to the northwest it is probable that they are too thin for profitable shaft mining in this part of the Knox Creek basin, though only deep drilling can definitely determine the facts. The intervals between coal beds also decrease to the northwest, so that they are considerably less along Lester Fork than at the head of Slate Creek and less along Pawpaw Creek than on Lester Fork. All or most of the Pocahontas coals are probably absent from the northern part of the region, as the lower part of the Lee formation was not deposited there.

*Kennedy coal.*—The sandstone which lies a few feet below the Kennedy horizon crops out low down in the valley of Knox Creek between Bee Branch and Hurley and along the lower part of Lester Fork, but the coal itself was not seen. The Kennedy is probably very thin nearly everywhere, though possibly about 2 feet thick under the head of Lester Fork. It is about 300 feet below the Splash Dam horizon at the head of Lester Fork, 250 feet at Hurley, and 200 feet at Kelsa.

*Lower Banner coal.*—The sandstone a few feet below the Lower Banner is above the surface low down in the deeper valleys and is about 100 feet below the Splash Dam horizon. The coal is 2 to 3 feet thick in most places, commonly including thin layers of shale or bone.

Three openings on the north side of Pawpaw Creek valley, near the mouth of Left Fork, show 29 inches of coal in the Lower Banner; the pit farthest east (location 720, elevation 1,035) shows an additional 4 inches of coal which is separated from the lower bench by a 5-inch shale layer and is overlain by 10 feet of drab shale. The bed in three pits a short distance north is as in the first of the following sections. The second section was measured opposite the mouth of Swan Fork, and the third and fourth about a mile southwest of Kelsa.

*Lower Banner bed on Pawpaw Creek.*

(Location 721, elevation 1,000.)		(Location 722, elevation 1,005.)	
	Ft. in.		Ft. in.
Shale .....	10	Shale .....	10
Coal, bony .....	6	Coal .....	2
Bone .....	½	Rash .....	1
Coal .....	1 8	Coal .....	2 6
Coal .....	2 2	Coal .....	2 8
Parting .....	½	Parting .....	1
(Location 723, elevation 1,025.)		(Location 724, elevation 1,035.)	
	Ft. in.		Ft. in.
Shale .....	2	Sandstone .....	3
Coal .....	4	Coal .....	4
Shale .....	3	Shale .....	5-10
Coal .....	2+	Coal .....	2 4
Coal .....	2 4+	Coal .....	2 8
Parting .....	3	Parting .....	5-10

The Lower Banner is 39½ inches thick in a small mine at Kelsa (location 725, elevation 995), including a thin streak of bone near the middle.

No complete measurement was obtained on Race Fork, but the upper part of the bed is shown in the first section below. The second section is from a small mine on Knox Creek, near the mouth of Race Fork.

*Lower Banner bed on and near Race Fork.*

(Location 726, elevation 1,110.)		(Location 727, elevation 1,070.)	
	Ft. in.		Ft. in.
Coal .....	4	Coal .....	1 5
Shale .....	3½	Shale .....	3
Coal .....	1+	Coal .....	1 2
<hr/>		<hr/>	
Coal .....	1 4+	Coal .....	2 7
Parting .....	3½	Parting .....	3

The first of the following sections was measured on Knox Creek near the mouth of Pounding Mill Creek, and the second on a tributary of Lester Fork, 1½ miles south of Hurley.

*Lower Banner bed near Hurley and on Lester Fork.*

(Location 728, elevation 1,115.)		(Location 729, elevation 1,155.)	
	Ft. in.		Ft. in.
Sandstone .....	10	Sandstone .....	20
Coal .....	1 3	Coal, dirty .....	4
Shale .....	3	Coal, good .....	1 8
Coal .....	6	Bone and shale.....	5
Shale .....	½	Coal .....	11
Coal .....	1 2	<hr/>	
Coal .....	2 11	Coal .....	2 11
Partings .....	3½	Parting .....	5

*Splash Dam coal.*—The first conspicuous sandstone ledge above the Lower Banner underlies the Splash Dam coal, which has been opened for local use in many places and which has a long outcrop in the lower part of all the principal valleys. The coal is probably in two or more benches separated by several feet of shale, but commonly only the thicker bench has been opened. This bench contains 20 to 44 inches of minable coal, the average being a little less than 3 feet, and includes thin shale partings in places. The roof is commonly a few feet of shale under moderately coarse sandstone.

The Splash Dam coal is 22 inches thick in the hollow off Knox Creek, northeast of Kelsa (location 730, elevation 1,055). It is 33 inches thick on a tributary of Mill Creek of Pawpaw (location 731, elevation 1,085),

and there are also two 4-inch coal layers in the roof shale. The coal is 27 inches thick opposite the mouth of Left Fork of Pawpaw (location 732, elevation 1,125), and has the same thickness farther up the main fork (location 733, elevation 1,075). At Pawpaw Post-Office it is 21 inches thick (location 734, elevation 1,085). Nearly opposite the mouth of Swan Fork (location 735, elevation 1,090) the bed is 45 inches thick, including an inch of bone a foot from the top.

The coal is 39 inches thick on Left Fork of Pawpaw Creek, half a mile from its mouth (location 736, elevation 1,120), and 33 inches thick opposite a store a short distance up the stream (location 737, elevation 1,135). Between the store and the mouth of Balls Fork (location 738, elevation 1,100) the bed is 34½ inches thick, including two very thin streaks of bone. No bone was noted at the mouth of Hunts Fork (location 739, elevation 1,110), where the coal is 35 inches thick. There is a little bone at the base of the 32-inch bed on Abners Fork (location 740, elevation 1,170). Pits on Left Fork between Abners and Balls forks (locations 741 and 742, elevation 1,115) are in coal 29 inches thick, including a little bone at the base, and the bed is practically the same on Balls Fork (location 743, elevation 1,140) and on Left Fork near its mouth (location 744, elevation 1,115). In the first hollow south of the mouth of Left Fork (location 745, elevation 1,125) the Splash Dam is in two benches about 15 feet apart, the upper coal being 25 inches thick and the lower 20 inches, including an inch of bone in the middle.

The following sections were measured in the southern part of the Race Fork basin, the first being on Bearwallow Branch, the second opposite the mouth of Left Fork, and the third a short distance north of the mouth of Hurricane Fork.

*Splash Dam bed on upper Race Fork.*

(Location 746, elevation 1,250.)

	Ft.	in.
Shale .....	8	
Coal .....		4
Shale .....		10
Coal .....	2	6
Bone .....		5+
	<hr/>	
Coal .....	2	10
Parting .....		10

(Location 747, elevation 1,303.)

	Ft.	in.
Shale .....	5	
Coal .....		4
Shale .....	1	4
Coal .....	2	6
	<hr/>	
Coal .....	2	10
Parting .....	1	4

(Location 748, elevation 1,293.)

	Ft.	in.
Coal .....		5
Shale .....		4
Coal .....	2	1
Shale, reported thin .....	?	?
Coal, reported .....	?	?
<hr style="width: 50%; margin-left: auto; margin-right: 0;"/>		
Coal .....	2	6+
Partings .....		4+

A caved pit on Left Fork of Race Fork (location 749, elevation 1,350) appears to be in a bed  $2\frac{1}{2}$  or 3 feet thick. A stripping in the hollow between Low Gap Branch and Bear Hollow (location 750, elevation 1,225) is in coal 35 inches thick and under 3 feet of shale that is overlain by sandstone.

Two feet of coal is exposed on Knox Creek opposite the mouth of Guess Fork (location 751, elevation 1,230), but this is not the full thickness of the Splash Dam here. A small mine nearly half a mile farther south (location 752, elevation 1,245) is in coal 31 inches thick, under a 10-foot shale cap.

On upper Pounding Mill Creek (location 753, elevation 1,252) the coal is  $33\frac{1}{2}$  inches thick, in addition to a 2-inch layer  $2\frac{1}{2}$  inches above the thick bench.

The Splash Dam coal is 27 inches thick on Lester Fork, half a mile west of the mouth of Left Fork (location 754, elevation 1,310). A caved pit near the head of Lester Fork (location 755, elevation 1,395) is probably the same opening in which d'Invilliers reports a bed 33 inches thick, including an inch of shale 1 inch from the top and 2 inches of shale 16 inches from the base. On upper Left Fork of Lester Fork (location 756, elevation 1,415) the Splash Dam is 35 inches thick and without partings.

*Hagy coal.*—The top of the sandstone which underlies the Hagy horizon is 80 to 135 feet above the Splash Dam in this area, but the only opening found in the coal is on Pounding Mill Creek (location 757, elevation 1,340), where only part of the bed was exposed. Blooms were seen in several places, however, and the coal may be 2 or 3 feet thick locally. A coal exposure on the upper part of Brushy Fork of Left Fork of Lester Fork, reported by Crawford to be 38 inches thick, is either the Hagy or the Splash Dam.

*Glamorgan coal.*—The horizon of the Glamorgan coal, which lies only a few feet above the base of the Wise formation, is part way up the slopes

of most valleys, 230 to 320 feet above the Splash Dam horizon. The coal itself was seen only in the Pawpaw Creek basin and may be absent from parts of the region. It is about  $2\frac{1}{2}$  to  $3\frac{1}{2}$  feet thick in most of the basin of Left Fork and about 2 to  $2\frac{1}{2}$  feet thick in the rest of the Pawpaw Creek area. In a few places the coal is in two benches separated by 35 feet or less of shale.

A few rods north of the State line on Mill Branch of Pawpaw Creek (location 758, elevation 1,275) the Glamorgan is 28 inches thick. In a caved pit on Swan Fork (location 759, elevation 1,300) the coal appears to be at least  $2\frac{1}{2}$  feet thick. In two pits in Kentucky, the first half a mile west of Pawpaw Post-Office (location 760, elevation 1,255) and the second three-quarters of a mile farther southwest (location 761, elevation 1,250), the coal is 26 inches thick. These pits are in the lower bench of the Glamorgan, for the upper bench has been opened and abandoned a short distance southeast of location 761, where the lower bench, 27 inches thick, is still utilized (location 762, elevation 1,260). The coal is also 27 inches thick in a small mine on Pawpaw Creek about a mile southwest of Pawpaw Post-Office (location 763, elevation 1,290).

The Glamorgan is somewhat thicker on Left Fork of Pawpaw Creek. It is said to be 3 feet thick in a hollow near the mouth of Balls Fork (location 764, elevation 1,335), though only half that much was uncovered when the opening was visited. Coal 34 inches thick was seen near the head of Drakes Fork (location 765, elevation 1,350). The same bed is 29 inches thick on upper Hunts Fork (location 766, elevation 1,330). It is said to be 42 inches thick at the mouth of Joes Hollow (location 767, elevation 1,372). It is known to be 43 inches thick in one pit near the mouth of Abners Fork (location 768, elevation 1,370) and 33 inches thick in another pit a short distance north. The coal is only 26 inches thick in a pit on Balls Fork (location 769, elevation 1,425).

*Blair coal.*—The Blair horizon is 60 to 100 feet above the base of the Wise formation. The coal itself is exposed in very few places and is easily confused with the Eagle bed, which is not far above it. Little is known, therefore, concerning the characteristics of the Blair, and it may be that it is a fairly thick bed in several localities in which it has not been identified. A report that the coal is 40 inches thick in a pit on the principal left branch of Abners Fork, in the Pawpaw basin (location 770, elevation 1,510), appears to be correct. An imperfect exposure at the head of Left Fork of Lester Fork (location 771, elevation 1,840) is about 2 feet thick.

A pit nearly a mile northeast of this, on the west side of Brushy Fork Valley, may be in the Blair and is reported by Crawford to be 43 inches thick, including a 6-inch shale parting.

*Eagle coal.*—The Eagle underlies a massive, cliff-making sandstone and is 90 to 185 feet above the base of the Wise formation and 340 to 460 feet above the Splash Dam horizon, both intervals increasing to the southeast from a minimum near the Kentucky boundary to a maximum at the heads of Lester Fork. The coal is clean and 2 to 3 feet thick in the Pawpaw Creek basin. The bed includes  $3\frac{1}{2}$  to 6 feet of coal in much of the part of the region which lies southeast of the main stream of Race Fork, and is minable even where it contains a rather thick shale parting. It is particularly valuable in the southern part of the Lester Fork basin, where partings are thin or absent.

The Eagle is 30 or 40 inches thick on upper Mill Creek, in Kentucky (location 772, elevation 1,335), and 31 inches thick at the head of Swan Fork of Pawpaw Creek (location 773, elevation 1,385). Another pit in the Swan Fork basin, a few rods south of the State line (location 774, elevation 1,390), is in 33 inches of coal. A Kentucky opening about half a mile north of Pawpaw Post-Office (location 775, elevation 1,370) shows coal 31 inches thick. Three openings in Kentucky, near the road along the upper part of Pawpaw Creek, indicate the nature of the bed in neighboring parts of Virginia; the opening farthest west (location 776, elevation 1,350) is in 21 inches of coal, the one next east (location 777, elevation 1,345) is in  $27\frac{1}{2}$  inches, and the one farthest east (location 778, elevation 1,355) is in 29 inches, excluding an inch of shale 4 inches from the top.

The Eagle appears to be about the same in a caved pit near the head of Hunts Fork of Left Fork of Pawpaw Creek (location 779, elevation 1,445) as it is farther down the same stream (location 780, elevation 1,455), where it is 35 inches thick and without shale partings. No openings were found near the head of Left Fork, but the coal is thought to be about 3 feet thick there. It is  $33\frac{1}{2}$  inches thick in a drift at the head of the chief western branch of Balls Fork (location 781, elevation 1,545). No openings have been made in the Eagle near Kelsa or along Knox Creek between Hurley and the Kentucky boundary.

Although the Eagle is probably a minable bed in most of the Race Fork basin, the only measurement obtained is one made between Low Gap Branch and Bear Hollow and given as the first of the following sections. The second section is near the head of Pounding Mill Branch and may not represent the average thickness for this locality.

*Eagle bed on Race Fork and Pounding Mill Creek.*

(Location 782, elevation 1,585.)			(Location 783, elevation 1,640.)		
	Ft.	in.		Ft.	in.
Shale .....	10		Rash .....		2
Coal .....	3	6	Coal, hard .....		10
Shale .....	1		Rash .....		1/4
Coal .....	2	6	Coal .....	2	2
	<hr/>			<hr/>	
Coal .....	6		Coal .....	3	
Parting .....	1		Parting .....		1/4

The Eagle is thought to be thick in most of the Lester Fork basin, but exposures are few. The first of the following sections is near the head of Wolfpen Branch, the second is in the first valley south of Calfpenn Hollow, the third is at the head of Left Fork, and the fourth is on the divide between Left Fork and Brushy Fork.

*Eagle bed in Lester Fork basin.*

(Location 784, elevation 1,760.)			(Location 785, elevation 1,815.)		
	Ft.	in.		Ft.	in.
Rash .....		2	Sandstone .....	10	
Coal .....	2	4	Coal .....		4
Shale .....		3			
Coal .....	2	7	Coal .....		4
	<hr/>			<hr/>	
Coal .....	4	11			
Parting .....		3			
	<hr/>			<hr/>	
	<hr/>			<hr/>	
(Location 786, elevation 1,940.)			(Location 787, elevation 1,950.)		
	Ft.	in.		Ft.	in.
Shale .....	10		Sandstone .....	25	
Coal .....		7 1/2	Rash .....		1
Shale .....		1/4	Coal .....		1 1/2
Coal .....	3		Shale .....		1
Coal, bony .....		3	Coal .....	3	7
	<hr/>			<hr/>	
Coal .....	3	10 1/2	Coal .....	3	8 1/2
Parting .....		1/4	Parting .....		1

*Clintwood coal.*—The next higher coal, the Clintwood, is separated from the Eagle by a cliff-making sandstone commonly about 100 feet thick. This coal is 180 to 250 feet above the base of the Wise formation and 430 to 530 feet above the Splash Dam horizon, both intervals being least in the Pawpaw Creek basin and greatest in the southern part of the Lester Fork basin. As indicated by measurements in neighboring areas the coal is probably about 5 feet thick in at least the southern part of the Lester Fork basin and may be minable in many other localities. This is merely conjecture, however, as the only openings found in the entire area were

three caved pits in the Pawpaw Creek basin, in each of which the coal was reported to be  $2\frac{1}{2}$  feet thick. One of these pits is in Kentucky near the head of Pawpaw Creek (location 788, elevation 1,495), another is on the first right-hand branch of Left Fork (location 789, elevation 1,560), and the third is at the head of Left Fork (location 790, elevation 1,625).

*Campbell Creek coal.*—Along the Kentucky boundary the Campbell Creek is about 190 feet above the Clintwood, 400 feet above the base of the Wise formation, and 650 feet above the Splash Dam horizon. All three intervals are about 50 feet greater near Left Fork of Pawpaw Creek. Elsewhere in the region the coal occupies only very small areas on the highest parts of the ridges and has not been prospected. The three intervals increase to the southeast and are probably 100 to 150 feet greater at the head of Lester Fork than along the State line. The bed contains about 4 to 6 feet of coal in pits in Kentucky near the State boundary and is undoubtedly thick in some neighboring parts of Virginia. The only measurement obtained in Virginia is one of about 3 feet in a pit on Hunts Fork.

The coal is said to be 4 feet thick in a pit, now caved, on upper Mill Creek (location 791, elevation 1,655). It is 55 inches thick near the head of Swan Fork (location 792, elevation 1,670), including 2 inches of rash 13 inches from the base. On Grassy Fork of Pawpaw Creek,  $1\frac{1}{3}$  miles southwest of Pawpaw Post-Office (location 793, elevation 1,590), the coal is in two benches separated by 7 inches of shale, the upper bench being 45 inches thick and the lower 30 inches thick. What may be only the upper bench, 46 inches thick, shows in two pits farther southwest (location 794, elevation 1,610, and location 795, elevation 1,630). In another pit near the head of Pawpaw Creek (location 796, elevation 1,640) the bed is 49 inches thick, including 4 inches of shale 7 inches from the top, and no lower bench appears to be present.

The only Campbell Creek opening found in Virginia in this region is at the head of Hunts Fork of Left Fork of Pawpaw Creek (location 797, elevation 1,740), where the coal is  $34\frac{1}{2}$  inches thick.

*Higher coals.*—Several coal beds higher than the Campbell Creek probably underlie small areas on the highest ridges, but have not been found. In the Pawpaw Creek basin, the only part of the region in which they underlie areas sufficiently large to be of commercial importance, the thickest of these coals are probably about 140 feet (Alma), 205 feet (Lower Cedar Grove), and 280 feet (Cedar Grove), respectively, above the Campbell Creek horizon.

## KNOX CREEK AND TRIBUTARIES SOUTHEAST OF HURLEY.

*General features.*—This area consists of the basins of main Knox Creek above Hurley and of all its tributaries, the chief of which are Straight, Right, Whiteoak, and Laurel forks, and Butt, Christian Camp, Hoover Camp, Long Bottom, and Lick branches. The chief industry is lumbering, centering in the mills and lumber camps at Hurley and Blackey. The railroad up Knox Creek and Right Fork, though now narrow-gauge and used chiefly in lumbering operations, could be easily converted into a coal carrier.

The rocks exposed in the region range from a short distance below the Kennedy coal horizon to about 100 feet above the Campbell Creek coal. Their characteristics are shown in local sections 29, 36, 37, and 38 (pp. 43 and 48-50), and in generalized sections 2 and 3 on Plate II. In general the intervals between coal beds decrease from southeast to northwest. The general dip is to the northwest at an average rate of about 100 feet per mile.

The region contains several moderately thick outcropping coals (see figs. 4, 5, 6, 7, and 21), the best of which is the Eagle. The lowest coal exposed, the Kennedy, is thin. The Lower Banner, Splash Dam, and Hagy

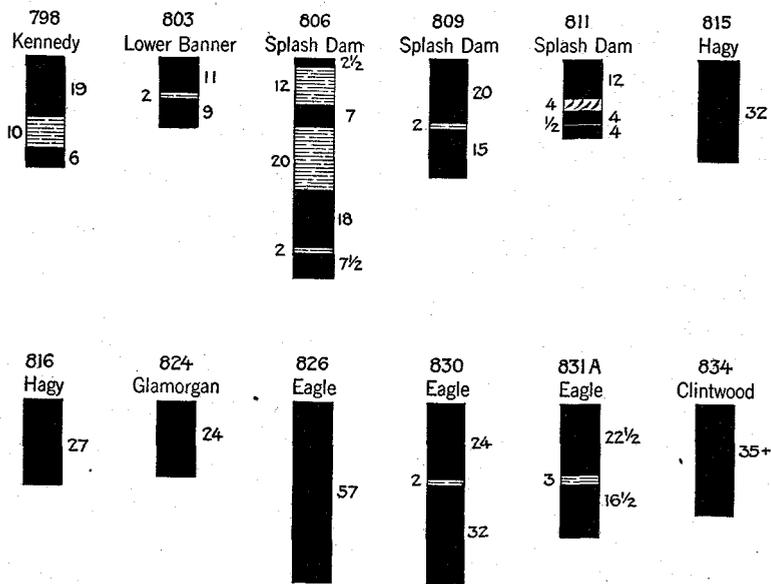


Fig. 21.—Sections of coal beds in the basin of Knox Creek, southeast of Hurley.

are 2 to 3 feet thick in most localities. Little is known about the Glamorgan, Blair, and Clintwood beds, though they are probably minable in many areas. The Eagle contains 3 to 5½ feet of coal except in the extreme southeastern portion of the region. It could supply large quantities of fuel, though its acreage is small. The Campbell Creek bed has been eroded from nearly all of the region.

Only the drill can determine whether there are valuable coals below the Kennedy. Borings on the lower part of Meethouse Fork in West Virginia, only a few miles from the Virginia boundary, are said to show 4½ feet of coal in a bed that may be the Raven.<sup>1</sup> The Raven is less than 200 feet below the Kennedy in the upper Knox Creek region and is probably not thick under large areas. The Jawbone coal, if sufficiently pure, is probably minable under at least the headwaters of Knox Creek, where it is 300 or 350 feet below the Kennedy horizon. Some coals in the Lee formation are fairly thick near Bradshaw, W. Va., as shown by a summary given in the detailed description of coal in the Slate Creek basin. These coals have a general tendency to thin to the northwest, however, so that many of them are probably thinner under the upper Knox Creek basin than near Bradshaw. The intervals between each of these coals and the Splash Dam horizon have been given for the head of Slate Creek in the same summary. These intervals also decrease northwestward, however, and are less near Paynesville than at the head of Slate Creek and considerably less near Hurley than at Paynesville.

*Kennedy coal.*—The sandstone underlying the Kennedy coal outcrops low down in the principal valleys, and is 250 feet below the Splash Dam horizon at Hurley, 300 feet below it at Blackey, and 330 feet below it at the head of Knox Creek. The coal bed itself was found in very few places in this area and probably contains less than 2 feet of workable coal nearly everywhere, though it may be about 30 inches thick near the head of Knox Creek. It may be absent locally.

Where the railroad crosses the outcrop of the Kennedy coal on Right Fork (location 797A, elevation 1,485) the coal is in two benches nearly 10 feet apart, the upper being 15 inches thick and the lower containing only 9 inches of coal split by a 6-inch shale parting. On Blackey Fork of Right Fork (location 798, elevation 1,401) the coal is in two benches

<sup>1</sup> Hennen, R. V., Wyoming and McDowell counties: West Virginia Geol. Survey, p. 294, 1915. Hennen correlates this coal with his Iaeger bed, but it is probably higher than the Iaeger of the upper Bradshaw Creek district, which is the same as the Jawbone of Virginia.

separated by 10 inches of shale, the upper bench being 19 inches thick and the lower bench 6 inches thick.

A few pits on Slaunch Fork in West Virginia indicate the nature of the Kennedy under the State line ridge. These exposures are correlated by Hennen with the Lower Douglas bed of West Virginia.<sup>1</sup> The coal in one pit (location 799, elevation 1,465) was reported about 3 feet thick. In a pit about a mile farther downstream (location 800, elevation 1,385) the bed is 23 inches thick, including an inch of shale 7 inches from the base. Pits still farther downstream, near the mouth of Arrow Branch (see descriptions of locations 835 and 836) are in slightly thicker coal.

*Lower Banner coal.*—The Lower Banner bed, which is 100 to 150 feet below the Splash Dam horizon, probably contains 2 or 3 feet of coal in most places, though poor exposures make this uncertain. Coal 2 feet thick is exposed half a mile southeast of Hurley (location 801, elevation 1,145) and more coal, probably 3 or 4 inches thick, is concealed beneath stagnant water in the pit. The bed is reported to be 40 inches thick in another pit on Knox Creek, 1½ miles northwest of Blackey (location 802, elevation 1,140), but the imperfect exposure seen indicated only about 30 inches. The first of the following sections was measured by the railroad track near the head of Right Fork; the second is an incomplete and very poor exposure on Schoolhouse Branch, near Hurley.

*Lower Banner bed on Right Fork and Schoolhouse Branch.*

(Location 803, elevation 1,600.)		(Location 804, elevation 1,120.)	
	Ft. in.		Ft. in.
Shale .....	2	Shale .....	5
Coal .....	11	Coal .....	5
Shale .....	2	Shale .....	½
Coal .....	5	Coal .....	9
Coal, bony .....	4	Shale .....	2
	<hr/>	Coal .....	5+
Coal .....	1 8	Coal .....	1 7+
Parting .....	2	Partings .....	2 ½

*Splash Dam coal.*—As in neighboring areas, the Splash Dam coal is in two or more benches separated by shale commonly 15 to 35 feet thick, though it is rare for more than one bench to be workable or to be exposed in any one locality. Both benches usually include several shale and bone

<sup>1</sup>Hennen, R. V., Wyoming and McDowell counties: West Virginia Geol. Survey, pp. 514-515, 1915. The bed he has called Lower Douglas along Slaunch Fork is the equivalent of the one called Douglas in at least part of the upper Bradshaw Creek district.

partings. The thickness of coal and the position and thickness of partings are very irregular. The aggregate thickness of minable coal appears to range from about 1½ to 3 feet.

A natural exposure of the Splash Dam half a mile southeast of Hurley (location 805, elevation 1,245) shows coal 26 inches thick. A pit about one-fourth mile farther southeast is in the following:

*Splash Dam bed three-fourths mile southeast of Hurley.*

(Location 806, elevation 1,275.)

	Ft.	in.
Shale, sandy .....	5	
Coal, splint .....		2½
Shale .....	1	
Coal .....		7
Shale .....	1	8
Coal .....	1	6
Shale .....		2
Coal .....		7½
Coal .....	2	11
Partings .....	2	10

What is probably only the upper and thinner bench of the Splash Dam, about 30 feet above the lower bench, is 16 inches thick on upper Straight Fork (location 807, elevation 1,535). The same bench is 17½ inches thick, including two thin bone layers, a little more than a mile southeast, on a western tributary of Right Fork (location 808, elevation 1,700). Near the head of Right Fork the upper bench is about 30 feet above the lower and is only about 6 inches thick. The lower bench shows beside the railroad track (location 809, elevation 1,762) as a bed 37 inches thick, including 2 inches of shale 15 inches from the base.

A partial exposure of what seemed to be coal about 2 feet thick was seen on a western tributary of Butt Branch (location 810, elevation 1,720). No other exposures were found in the basin of main Knox Creek above Blackey except the following on a fork of Lick Branch:

*Splash Dam bed one and three-fourths miles northeast of Blackey.*

(Location 811, elevation 1,370.)

	Ft.	in.
Shale, sandy .....	5	
Coal .....	1	
Rash .....		4
Coal .....		4
Shale .....		½
Coal .....		4
Coal .....	1	8
Partings .....		4½

On Laurel Fork, nearly  $2\frac{1}{2}$  miles northeast of Blackey (location 812, elevation 1,310), 15 inches of coal which shows at the Splash Dam horizon is only part of the bed.

*Hagy coal.*—The Hagy coal is 95 to 160 feet above the Splash Dam in this area and is commonly  $1\frac{1}{2}$  to 3 feet thick. Another coal bed 3 feet or less thick, associated with shale containing marine shells, is present locally about 115 feet above the Hagy.

The Hagy is thin in the railroad gap at the head of Right Fork (location 813, elevation 1,910), containing only 15 inches of coal. An exposure of 2 feet of coal on an eastern tributary of Blackey Fork (location 814, elevation 1,810) is probably only part of the bed. On Stonecoal Branch of Right Fork (location 815, elevation 1,595) the coal is  $3\frac{1}{2}$  inches thick.

The Hagy was not found along Knox Creek near Hurley and Blackey, but is opened at several places along the headwater tributaries of Knox Creek. The coal is 27 inches thick on a tributary of Butt Branch (location 816, elevation 1,875). It is as follows at the head of the right fork of Christian Camp Branch:

*Hagy bed on Christian Camp Branch.*

(Location 817, elevation 1,965.)

	Ft.	in.
Shale .....	20	
Coal .....	1	10
Shale .....		$2\frac{1}{2}$
Coal .....		9
Shale (reported) .....		6
Coal (reported) .....		4
	<hr/>	
Coal .....	2	11
Partings .....		$8\frac{1}{2}$

Exposures previously described at locations 611, 613, 614, 615, 616, and 617 in the Slate Creek basin show that the coal has a general thickness of  $2\frac{1}{2}$  to 3 feet near the heads of Christian Camp Branch and Knox Creek. A bloom 2 feet thick 1,500 feet west of Paynesville (location 818, elevation 2,130) probably marks a coal bed several inches thicker. A partial exposure 15 inches thick in West Virginia,  $1\frac{1}{5}$  miles northwest of Paynesville (location 819, elevation 2,020), is said to be part of a 3-foot coal bed. There are about 2 feet of coal in a caved pit at the head of Farlow Branch (location 820, elevation 1,830). The coal is  $20\frac{1}{2}$  inches thick at the head of a tributary of Slauch Fork, across the State line ridge from the head

of Whiteoak Fork of Knox Creek (location 821, elevation 1,740), and is the same thickness at the head of Right Fork of Guess Fork (see description of location 854).

The coal about 115 feet above the Hagy was seen in only two pits. One pit is on a branch of Right Fork, three-fourths of a mile northwest of the railroad gap (location 822, elevation 1,970), where the bed is 3 feet thick but includes 9 inches of shale 3 inches from the base, so that the minable portion is only 2 feet thick. The other pit is on upper Laurel Fork, about 2 miles north of Blackey (location 823, elevation 1,525), and shows coal 35 inches thick.

*Glamorgan coal.*—The horizon of the coal near the base of the Wise formation is 280 to 360 feet above the Splash Dam bed. The coal itself, however, may be absent from part of the region and was measured only at the head of Butt Branch of Knox Creek (location 824, elevation 2,150), where it is 2 feet thick.

*Blair and Eagle coals.*—The Eagle is 80 to 160 feet above the base of the Wise formation and 400 to 490 feet above the Splash Dam horizon. The Blair is 40 feet or more lower. As the Eagle lies only a few feet below a thick massive sandstone and there is also some sandstone a short distance above the Blair, it is often very difficult to determine which bed is seen in poor exposures. The Eagle is a thick and valuable bed, though underlying only the higher parts of the ridges. The minable coal commonly aggregates about 3 to 5½ feet in thickness, being in one bench in some localities and split by a thin or moderately thick shale parting in others. The bed is thinner near the head of Butt Branch. No complete measurements of the Blair coal were obtained, though it is possible that one or two of the sections correlated with the Eagle should be assigned to the Blair.

The Eagle is especially valuable near Blackey and along Straight Fork. In a hollow three-fourths mile northwest of Blackey (location 826, elevation 1,790) the coal is clean and 57 inches thick. It is reported to be 5 feet thick in a caved pit on a western tributary of Straight Fork (location 827, elevation 1,895). Clean coal 40 inches thick, which is said to be only part of the bed, was seen farther south on this ridge (location 828, elevation 1,960). The nature of the bed on the ridge east of Blackey is shown by the following two sections. The second section was measured on Stonecoal Branch in the W. M. Ritter Lumber Co. mine, which supplies fuel for locomotives and for lumber camps and houses along the railroad. The

coal comes down in large blocks, shooting readily off the solid because of a foot of soft clay beneath it and a thin parting near its middle. The loaded cars are hauled along the ridge for half a mile by mules and are lowered by gravity to a tippie beside the railroad.

*Eagle bed 1 mile southeast of Blackey.*

(Location 829, elevation 1,975.)			(Location 830, elevation 1,925.)		
	Ft.	in.		Ft.	in.
Sandstone .....	90		Sandstone .....	100	
Coal .....	2	3	Coal .....	2	
Shale .....		10	Shale .....		2
Coal .....	3	2	Coal .....	2	8
Coal .....	5	5	Coal .....	4	8
Parting .....		10	Parting .....		2

An opening at the head of a southern tributary of Knox Creek, in the same small body of coal at the Ritter mine (location 831, elevation 1,960) is said to be in a bed 54 inches thick. The bed is 42 inches thick on the ridge south of Dam Branch of Knox Creek (location 831A, elevation 2,168), including 3 inches of shale 16½ inches from the base. An opening in what is probably the Eagle at the head of Butt Branch (location 832, elevation 2,310) shows only 21 inches of coal.

The only measurement obtained north of Knox Creek is the following, seen about 2 miles northeast of Blackey:

*Eagle bed near head of Laurel Fork.*

(Location 833, elevation 1,755.)			Ft.	in.
Sandstone.				
Coal .....			10	
Shale .....			1	1
Coal (reported) .....			2	
Coal .....			2	10
Parting .....			1	1

*Clintwood and higher coals.*—The Clintwood coal is above the Eagle and is separated from it by a massive sandstone about 100 feet thick. This coal occupies only small areas on parts of some ridges and was found opened only in a pit 3,300 feet west of the railroad gap, at the head of a tributary of Right Fork (location 834, elevation 2,200), where 35 inches of coal was seen in what is probably only a partial exposure.

The Campbell Creek coal is present only on the divide between Knox Creek and Guess Fork, where it is about 200 feet above the Clintwood and occupies outliers too small to be of commercial importance.

#### GUESS FORK AND AREA NORTH OF IT.

*General features.*—This region consists of the basins of Guess Fork, Upper, Middle, and Lower Elk creeks, Greenbrier Creek, Long Branch, and several smaller streams. It includes all of Buchanan County east of Knox Creek and north of the divide between Guess Fork and Knox Creek. Part of the region is near the main line of the Norfolk and Western Railway. Coal from the Knox Creek basin could be shipped by making alterations in the lumber railroad along Knox Creek, spurs from which extend up Guess Fork and Lower Elk Creek.

The rocks exposed range from a few feet below the Kennedy coal horizon to about 200 feet above the Cedar Grove coal. Their characteristics are shown in local sections 38, 39, 40, 41, and 42 (pp. 50-52), and in generalized section 2 on Plate II. As in other parts of the county, most of the intervals between coal beds decrease from southeast to northwest. The general dip is northwest at 30 to 150 feet per mile.

The region contains exposures of several moderately thick coals and of some that are exceptionally thick (see figs. 4, 6, 7, and 22). The Kennedy is thin or absent. The Lower Banner is probably 3 feet thick locally and thinner in most places. The Splash Dam contains 2 to 3 feet of minable coal, more or less. The Haggy is commonly thin. Little is known about the Glamorgan, Clintwood, and Powellton, though they are probably minable locally. The Eagle includes 2½ to 4 feet or more of coal. The Campbell Creek is in two benches, one containing 2 to 3 feet and the other 3½ to 5 feet of minable coal in most localities. The Alma is about 2½ feet thick. The Lower Cedar Grove is 9 feet thick in one pit, in addition to very thin partings, but may be thinner locally. The Cedar Grove is a remarkable bed containing about 15 feet of coal and several partings. Unfortunately, the Campbell Creek and higher coals underlie only small areas on the high ridges.

No drilling has been done to test beds which are below the Kennedy coal and do not reach the surface in this area. The probable character of these deposits is much the same along upper Guess Fork as in the upper Knox Creek region, though the chances of finding workable coals are smaller and the intervals between coals are less. A boring near Panther, W. Va., was continued to a depth of 712 feet below the Kennedy without

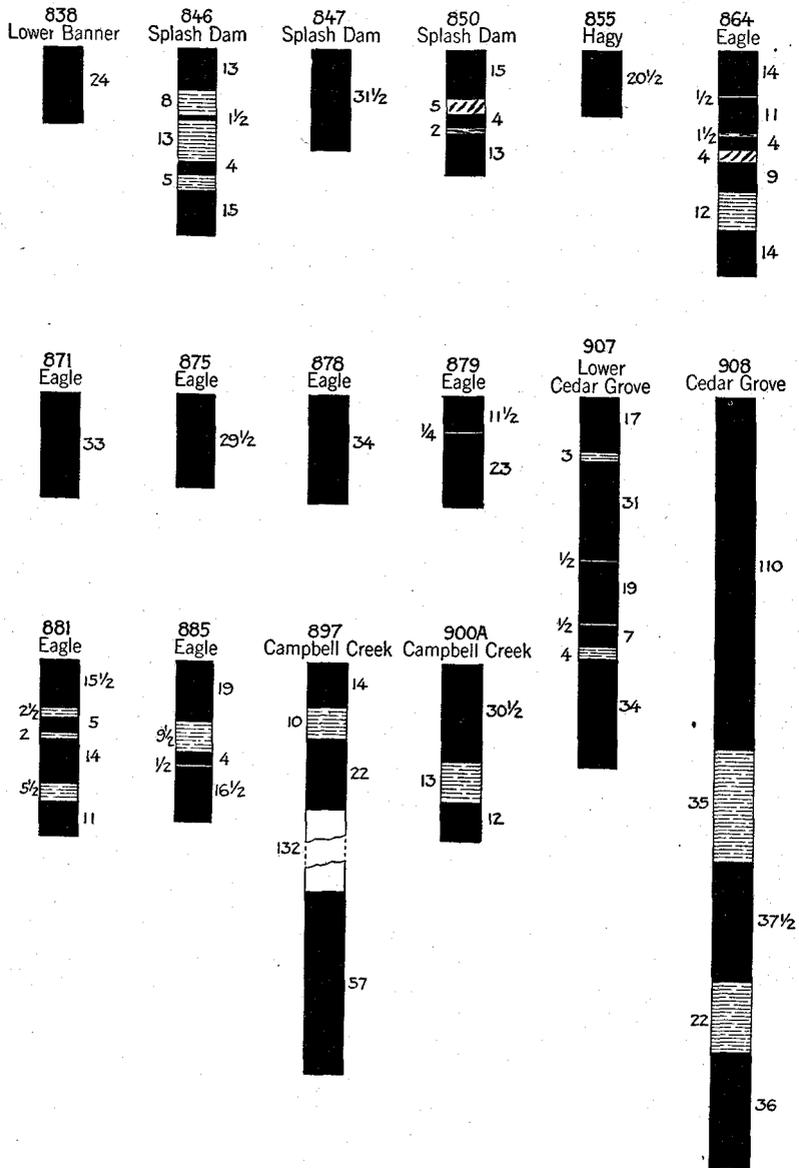


Fig. 22.—Sections of coal beds in the basin of Guess Fork and in the area north of it.

penetrating minable coals. The Raven (Lower Douglas) coal, however, where exposed 90 feet below the Kennedy and 20 feet above the top of this boring, is 4 feet thick, though very dirty.<sup>1</sup> It is probable that all or most of the Pocahontas coals are absent from the northern part of the region, as the lowest part of the Lee formation was never deposited there.

*Kennedy coal.*—The interval between the Kennedy and Splash Dam horizons ranges from 200 feet near Kelsa to about 300 feet at the head of Guess Fork. The Kennedy horizon of this region, however, is above the surface only along part of Knox Creek and lower Guess Fork. No coal was found and the bed, if present, is probably very thin along the outcrop. It may be thicker under the head of Guess Fork, as two pits on a neighboring part of Slauch Fork in West Virginia (location 835, elevation 1,380, and location 836, elevation 1,355) are in 2½ feet of workable coal.

A coal found at Wharncliffe, W. Va. (location 837, elevation 850) is probably the Big Fork bed, a short distance above the Kennedy. It is 1 to 3 feet thick in this exposure, being irregular because of the uneven under surface of the thick sandstone overlying it.

*Lower Banner coal.*—The coal which is about 100 feet below the Splash Dam horizon was not found within the limits of the region under consideration, though its horizon is plainly marked by the thick massive sandstone which underlies it and which makes great cliffs along Tug Fork near War Eagle and Alnwick. It is 2 feet thick in a pit on Knox Creek one-fourth mile north of the State boundary (location 838, elevation 885), though less than a foot thick in other exposures in the vicinity. Exposures already mentioned at locations 725, 727, and 728, on the west side of Knox Creek valley, show coal 2½ to 3¼ feet thick and indicate that the bed is minable in at least part of this region.

*Splash Dam coal.*—The Splash Dam outcrop is a few feet above a massive sandstone in the lower parts of all the principal valleys. The coal is in two or three benches separated by several feet of shale and it is often difficult to ascertain which bench is represented by an exposure. The thickest bench commonly contains an aggregate thickness of 2 to 3 feet of coal split by several thin shale or bone partings.

In the Guess Fork basin the Splash Dam coal is more than 2 feet thick on Staggerweed Creek (location 839, elevation 1,285) and about

<sup>1</sup> Hennen R. V., Wyoming and McDowell counties: West Virginia Geol. Survey, pp. 88-89, 1915.

2 feet thick on Lick Branch (location 840, elevation 1,370). Five openings near the heads of Trace, Trap, Greenbrier, and Road forks, in West Virginia, indicate the character of the bed near the heads of both main branches of Guess Fork. On Trace Fork (location 841, elevation 1,440) it is 31½ inches thick, including three streaks of bone and shale. It is only 15 inches thick on a branch of Trap Fork (location 842, elevation 1,430),<sup>1</sup> and 20 inches thick on the main stream (location 843, elevation 1,340). It is reported to include 32 inches of minable coal on Greenbrier Fork (location 844, elevation 1,300), but only 14 inches were found on a branch of Road Fork (location 845, elevation 1,225).<sup>2</sup> The openings on Trap and Road forks may not be in the thickest bench. A measurement near the mouth of Sycamore Fork of Guess Fork follows:

*Splash Dam bed on Sycamore Fork of Guess Fork.*

(Location 846, elevation 1,220.)

	Ft.	in.
Shale, sandy .....	10	
Coal .....	1	1
Shale .....		8
Coal .....		1½
Shale .....	1	1
Coal .....		4
Shale .....		5
Coal .....	1	3
Coal .....	2	9½
Partings .....	2	2

The coal is clean and 31½ inches thick on Knox Creek near the Kentucky boundary (location 847, elevation 985). No other openings were found east of the railroad between this exposure and Hurley, but pits mentioned elsewhere at locations 730, 731, 751, and 752, west of the railroad, indicate that the average thickness of coal may be about 2½ feet in both districts.

The following three sections were measured on Upper Elk Creek, the first at the mouth and the others nearly 1 and 2 miles, respectively, up the stream:

<sup>1</sup> Op. cit., p. 465. This bed is called the Glenalum Tunnel coal in West Virginia.

<sup>2</sup> Idem., pp. 464-465.

*Splash Dam bed on Upper Elk Creek.*

(Location 848, elevation 1,000.)

	Ft.	in.
Shale, sandy .....	5	
Coal .....	1	6
Shale .....		$\frac{3}{4}$
Coal .....	1	11
<hr/>		
Coal .....	3	5
Parting .....		$\frac{3}{4}$

(Location 849, elevation 1,040.)

	Ft.	in.
Shale .....	3	
Coal .....	1	4
Shale .....		$\frac{1}{2}$
Coal .....		$5\frac{1}{2}$
Bone .....		$\frac{1}{4}$
Coal .....	1	4
Shale (reported) ..	5	
Coal (reported) ..	1	6
<hr/>		
Coal .....	3	$1\frac{1}{2}$
Partings .....		$\frac{3}{4}$

(Location 850, elevation 1,077.)

	Ft.	in.
Sandstone .....	10	
Coal .....	1	3
Rash .....		5
Coal .....		4
Bone .....		2
Coal .....	1	1
<hr/>		
Coal .....	2	8
Partings .....		7

On Middle Elk Creek, half a mile from its mouth (location 851, elevation 975) the bed exposed is 33 inches thick, including 7 inches of shale 9 inches above the base.

No complete measurements were obtained along Tug Fork and its tributaries in the War Eagle district, though the bed was reported to be 32 inches thick, including partings, in a caved pit on Long Branch, 3,500 feet east of the mouth of South Fork. Hennen<sup>1</sup> found only 18 inches of minable coal on Bull Creek (location 852, elevation 1,130), south of the pit just mentioned. At the east portal of the new Glenalum Junction, W. Va., tunnel (location 853, elevation 840) an aggregate thickness of  $31\frac{1}{2}$  feet of coal is distributed through 30 feet of shale and sandstone in layers that are so thin and irregular as to be practically worthless.<sup>2</sup>

*Hagy coal.*—The Hagy is 90 to 140 feet above the Splash Dam horizon and is less than 2 feet thick in most localities. The coal found about 115 feet above the Hagy in a neighboring part of the Knox Creek basin (see description of location 823) was seen in only one caved pit in this region.

The Hagy coal is  $20\frac{1}{2}$  inches thick near the head of Right Fork of Guess Fork (location 854, elevation 1,665) and about a mile farther north

<sup>1</sup> Op. cit., p. 464.

<sup>2</sup> Hennen, R. V., and Reger, D. B., Logan and Mingo counties: West Virginia Geol. Survey, p. 135, 1914.

(location 855, elevation 1,575). It is only 15 inches thick near the head of Left Fork of Guess Fork (locations 856 and 857, elevation 1,430) and about a mile farther north, on Road Fork in West Virginia (location 859, elevation 1,400). Hennen<sup>1</sup> found the coal on Greenbrier Fork, east of Road Fork (location 858, elevation 1,415), to be in two benches separated by 6 inches of shale, the upper bench being 11 inches thick and the lower about 19 inches thick.

The Hagy is only 11 inches thick on Long Branch, 3 miles southwest of War Eagle (location 860, elevation 1,155), the upper 4 inches being cannel. Either this is merely the upper bench or the bed is thinner than elsewhere in the district, for it contains 29 inches of minable coal in West Virginia, 1½ miles northeast of War Eagle (location 861, elevation 1,185), where it is known as the Lower War Eagle seam.<sup>2</sup>

*Glamorgan coal.*—The horizon of the Glamorgan coal is close to the base of the Wise formation and is 210 to 340 feet above the Splash Dam, the interval being smallest on Tug Fork and greatest at the head of Guess Fork. No complete measurements of the coal were obtained in this region and it is not probable that it is a thick bed. Hennen<sup>3</sup> states that the bed is 4½ feet thick, including 8 inches of shale, half a mile east of Mohawk, W. Va. (location 863, elevation 1,440).

*Blair and Eagle coals.*—The Eagle is 300 to 360 feet above the Splash Dam between Upper Elk Creek and Tug Fork and 400 to 450 feet above it near the head of Guess Fork, the interval increasing from north to south. The Blair bed, which is between the Glamorgan and the Eagle, was not identified with certainty in this region, though it is undoubtedly present in places. As the Eagle lies only a few feet below a very thick and massive sandstone and there is also some sandstone a short distance above the Blair, it is very difficult to differentiate the two coals where only one is exposed. In the following discussion, therefore, some of the pits assigned to the Eagle are probably in the Blair, though all are tentatively correlated with the Eagle.

In the greater part of this region the Eagle contains an aggregate of 2½ to 3 feet of workable coal, split in places by thin shale or bone partings

<sup>1</sup>Hennen, R. V., Wyoming and McDowell counties: West Virginia Geol. Survey, p. 455, 1915.

<sup>2</sup>Hennen, R. V., and Reger, D. B., Logan and Mingo counties: West Virginia Geol. Survey, p. 89, 1914.

<sup>3</sup>Hennen, R. V., Wyoming and McDowell counties: West Virginia Geol. Survey, p. 87, 1915. This coal is called the Cedar in West Virginia.

that detract from its value locally. In some localities the thickness of workable coal is 4 feet or more. The bed is fairly high in the hills but includes ample acreage for large mining operations. The Eagle is of particular interest because it is one of the beds extensively mined near War Eagle and at Mohawk, W. Va., where it is known locally as the Middle War Eagle. Chemical analyses of samples from these mines are given elsewhere (p. 240).

No measurements were obtained south of Guess Fork in this region, but the section already given for location 833 on Laurel Fork is applicable to part of it. The bed is thick but includes many partings on the divide between the two main benches of Guess Fork, as shown by the following section and by a similar one seen in a pit 1,000 feet farther west.

*Eagle bed on Left Fork of Guess Fork.*

(Location 864, elevation 1,700.)

	Ft.	in.
Sandstone, massive .....	3	
Coal .....	1	2
Bone .....		1½
Coal .....		11
Bone .....		1½
Coal .....		4
Rash .....		4
Coal .....		9
Shale .....	1	
Coal .....	1	2
	-----	
Coal .....	4	4
Partings .....	1	6

Hennen<sup>1</sup> states that the bed is 40 inches thick at the head of Greenbrier Fork of Panther Creek (location 865, elevation 1,740), including 6 inches of shale 14 inches from the base. The following four measurements on a branch of upper Road Fork of Bull Creek also indicate the nature of the coal under the divide north of Left Fork of Guess Fork.<sup>2</sup> There is a 16-inch coal 20 to 40 feet above the thicker coal in this locality.

<sup>1</sup> Op. cit., p. 422.

<sup>2</sup> The first section (location 866) was measured by Hennen, op. cit., p. 425, who considers it to be the Bens Creek (Blair) coal. The present writer, however, believes it may be the Eagle and the thin coal above it the Eagle "A" coal of West Virginia.

*Eagle bed near head of Road Fork of Bull Creek.*

(Location 866, elevation 1,580.)

	Ft.	in.
Coal .....		1
Shale .....		7
Coal .....	1	11
Shale .....		2
Coal .....		3
Shale .....		1
Coal .....		9
<hr/>		
• Coal .....	3	
Partings .....		10

(Location 868, elevation 1,585.)

	Ft.	in.
Shale .....	5	
Coal .....	1	9
Shale .....		8
Coal .....		2
Clay .....		1
Coal .....		10
<hr/>		
Coal .....	2	9
Partings .....		9

(Location 867, elevation 1,585.)

	Ft.	in.
Coal .....	1	7
Shale .....		3½
Coal .....		10½
<hr/>		
Coal .....	2	5½
Parting .....		3½

(Location 869, elevation 1,580.)

	Ft.	in.
Shale .....	3	
Coal .....	1	7
Shale .....	1	1
Coal .....		2½
Shale .....		1
Coal .....		8
<hr/>		
Coal .....	2	5½
Partings .....	1	2

The coal is 29 inches thick at the head of a southern tributary of Upper Elk Creek (location 870, elevation 1,430). It is 33 inches thick in one pit near the head of the creek (location 871, elevation 1,440), 28½ inches thick in another pit (location 872, elevation 1,450), and 33½ inches in a third (location 873, elevation 1,465), each exposure showing an inch or less of shale 7 to 9 inches from the top of the coal. It is 30½ inches thick on one small northern tributary near Upper Elk School and 33 inches thick on another (locations 874 and 874A, elevation 1,385).

The coal is 29½ inches thick on a southern tributary of Middle Elk Creek, nearly a mile from the State boundary (location 875, elevation 1,380). In the next deep valley north of this creek the coal is 35 inches thick in a pit in Virginia (location 876, elevation 1,270) and 30 inches thick in a pit in Kentucky (location 877, elevation 1,260). On Lower Elk Creek, close to the State boundary (location 878, elevation 1,300), it is 34 inches thick.

The following two sections were measured on opposite sides of Greenbrier Creek valley:

*Eagle bed on Greenbrier Creek, one and three-fourths miles southwest of War Eagle.*

(Location 879, elevation 1,295.)

	Ft.	in.
Shale .....	15	
Coal .....		11½
Rash .....		¼
Coal .....	1	11
<hr/>		
Coal .....	2	10½
Parting .....		¼

(Location 880, elevation 1,315.)

	Ft.	in.
Shale .....	10	
Coal .....		11
Shale .....		½
Coal .....		6
Shale .....		¼
Coal .....	1	6½
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Coal .....	2	11½
Partings .....		¾

The two following measurements were made in the Long Branch basin between South Fork and Alnwick:

*Eagle bed on Long Branch, southwest of Alnwick.*

(Location 881, elevation 1,430.)

	Ft.	in.
Shale .....	6	
Coal .....	1	3½
Shale .....		2½
Coal .....		5
Shale .....		2
Coal .....	1	2
Shale .....		5½
Coal .....		11
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Coal .....	3	9½
Partings .....		10

(Location 882, elevation 1,400.)

	Ft.	in.
Shale .....	15	
Coal .....	1	3½
Shale .....		3
Coal .....		5½
Shale .....		¼
Coal .....	1	4½
Shale .....		6½
Coal .....	1	1
<hr/>		
Coal .....	4	2½
Partings .....		9¾

There is a partial exposure of 2 feet of coal on South Fork of Long Branch (location 883, elevation 1,345). Three sections farther south in the same basin follow:

*Eagle bed in part of Long Branch basin.*

(Location 884, elevation 1,380.)

	Ft.	in.
Shale .....	5	
Coal .....	1	½
Shale .....		1½
Coal .....	1	8
<hr/>		
Coal .....	2	8½
Parting .....		1½

(Location 885, elevation 1,415.)

	Ft.	in.
Shale .....	2	
Coal .....	1	7
Shale .....		9½
Coal .....		4
Shale .....		½
Coal .....	1	4½
<hr/>		
Coal .....	3	3½
Partings .....		10

(Location 886, elevation 1,410.)

	Ft.	in.
Shale .....	5	
Coal .....	1	6
Shale .....		11
Coal .....	2	
Shale .....	1	6½
Coal .....		10½
Coal .....	4	4½
Partings .....	2	5½

Exposures in the Bull Creek basin in West Virginia indicate the nature of the bed under part of the State line ridge. The first of the following sections was made by Hennen<sup>1</sup> near the head of Bull Creek; the Eagle "A" coal shows about 25 feet higher in this locality, but is of no value. The second section was measured 1 mile farther northeast; the Blair coal shows about 30 feet lower and is reported to be 18 inches thick.

*Eagle bed in upper Bull Creek basin.*

(Location 887, elevation 1,455.)

	Ft.	in.
Coal .....		11
Shale .....		8
Coal .....	2	
Shale .....	3	
Coal .....	1	
Coal .....	3	11
Partings .....	3	8

(Location 888, elevation 1,450.)

	Ft.	in.
Shale .....	10	
Coal .....	1	11
Shale .....		1½
Coal .....		3
Shale .....	1	1
Coal .....		10
Coal .....	3	
Partings .....	1	2½

A caved pit in the Eagle was found in the first western tributary of Bull Creek above the mouth of Bee Branch (location 889, elevation 1,470) and was reported to be 6 feet thick, including partings. The Blair is about 35 feet below the Eagle in this hollow and is said to be 2 feet thick.

The Eagle is a thick bed in large mines in neighboring parts of West Virginia, as shown by the following sections by Hennen.<sup>2</sup> The first section was measured at the Mohawk mine at Mohawk, the others at the Papoose, Mephisto, and Margaret mines on upper Turkey Creek.

<sup>1</sup> Op. cit., p. 423.<sup>2</sup> Supplementary coal report, West Virginia Geol. Survey, vol. 2 (A), pp. 327-329, 1908.

*Eagle bed at shipping mines near Mohawk and War Eagle.*

(Location 890, elevation 1,530.)

	Ft.	in.
Coal .....	1	8
Shale .....		1
Coal .....	3	4
Shale .....		5
Coal .....		6
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Coal .....	5	6
Partings .....		6

(Location 891, elevation 1,430.)

	Ft.	in.
Coal .....		3
Bone .....		1
Coal .....	2	5
Shale .....		3
Coal .....	3	2½
Shale .....		6
Coal .....		4
<hr/>		
Coal .....	6	2½
Partings .....		10

(Location 892, elevation 1,431.)

	Ft.	in.
Coal .....	2	2
Shale .....		5
Coal .....	3	5
Shale .....		6
Coal .....		4
<hr/>		
Coal .....	5	11
Partings .....		11

(Location 893, elevation 1,404.)

	Ft.	in.
Coal .....	1	3½
Shale .....		½
Coal .....	1	½
Shale .....		½
Coal .....	2	9
<hr/>		
Coal .....	5	1
Partings .....		1

*Clintwood and Powellton coals.*—The Clintwood horizon lies 55 to 110 feet above the Eagle and is separated from it chiefly by a coarse, cliff-making sandstone. The Powellton is probably about 55 feet higher. Several blooms of the Clintwood were seen, but no complete measurements of either the Clintwood or the Powellton were obtained. Both beds were found by Hennen<sup>1</sup> half a mile east of Mohawk, W. Va., where the Clintwood (location 894, elevation 1,650) contains 28 inches of minable coal and the Powellton (location 896, elevation 1,703) is 46 inches thick, including a 4-inch parting near the middle.

*Campbell Creek coal.*—The Campbell Creek is 550 to 650 feet above the Splash Dam horizon in most of the region, though the interval increases to 680 feet at the head of Left Fork of Guess Fork. The coal underlies only the higher parts of the ridges and has been prospected in only a few places. It is in two benches a few feet to 50 feet or more apart, the interval between them being very irregular. The lower bench probably contains 3½ to 5 feet of workable coal in most localities, and the upper bench an aggregate of about 2 to 3 feet. The Campbell Creek bed is mined

<sup>1</sup>Wyoming and McDowell counties: West Virginia Geol. Survey, p. 87, 1915. The Clintwood of Virginia is the Matewan coal of West Virginia.

for shipping purposes in the War Eagle district, about 2 miles from the Virginia border, where it is known locally as the Upper War Eagle coal.

The lower bench, 57 inches thick, is mined a little at the head of Upper Elk Creek and the complete bed is reported on good authority to be as in the first of the following sections. The second section was measured across the ridge at the head of a branch of Bull Creek, where the upper and lower benches are exposed in separate pits; the interval between the two benches is given on the authority of the West Virginia Geological Survey.<sup>1</sup>

*Campbell Creek bed near head of Upper Elk Creek.*

(Location 897, elevation 1,720.)			(Location 898, elevation 1,730.)		
	Ft.	in.		Ft.	in.
Coal .....	1	2	Coal .....	1	1½
Shale .....		10	Shale .....		11
Coal .....	1	10	Coal .....	1	8
Shale .....	3		Interval .....	8	
Coal .....	1		Coal .....		10
Shale .....	7		Shale .....	7	3
Coal .....	4	9	Coal .....	3	11

The two benches are farther apart on Maria Branch, the next tributary of Bull Creek north of location 898. The following section shows the upper bench near the head of the stream:

*Upper bench of Campbell Creek bed on Maria Branch of Bull Creek.*

(Location 899, elevation 1,765.)		
	Ft.	in.
Shale .....	3	
Coal .....		10½
Shale .....		3½
Coal .....	1	5
Shale (reported) .....	3	9
Coal (reported) .....		5

Less than half a mile southeast (location 900, elevation 1,715) the lower bench consists of 43 inches of clean coal and the upper bench is reported to be 3 feet or more thick in a caved pit about 45 feet higher.

A pit at the head of South Fork of Long Branch (location 900A, elevation 1,595) shows 30½ inches of coal at the top and 12 inches at the bottom, separated by a shale parting 13 inches thick. Where mined in the

<sup>1</sup>Op. cit., p. 396. Mr. Hennen correlates this bed with the Alma coal, but investigations in neighboring parts of Virginia indicate that it is the Campbell Creek.

War Eagle, W. Va., district, only 1 to 2 miles from the Virginia boundary, the Campbell Creek coal is 4 to 6½ feet thick and shale partings are very thin or absent. The principal mines are the War Eagle (location 901, elevation 1,656), the Margaret No. 2 (location 902, elevation 1,635), and the Star (location 903, elevation 1,610).<sup>1</sup>

*Alma coal.*—The Alma is about 160 feet above the lower bench of the Campbell Creek. The coal was reported to be 31 inches thick and about 50 feet below the Lower Cedar Grove coal at the head of Pounding Mill Branch. The same bed is 29 inches thick at the head of Maria Branch of Bull Creek (location 904, elevation 1,885). A partial exposure about 50 feet below this shows at least 20 inches of coal in what may be the Little Alma, a bed not commonly of commercial importance.

*Lower Cedar Grove coal.*—A bed about 210 feet above the lower bench of the Campbell Creek corresponds to the Lower Cedar Grove coal of West Virginia. It is thick but underlies areas only slightly larger than those outlined on the geologic map for the Cedar Grove bed, which is 70 to 115 feet higher than the Lower Cedar Grove.

A pit at the head of Middle Elk Creek (location 905, elevation 1,860) shows coal in two benches separated by 26½ inches of shale, the upper bench being 37 inches thick and the lower bench more than 25 inches thick. This exposure may possibly be in a slip from a higher outcrop.

The first of the following sections was measured at the head of Lower Elk Creek and is not complete at either top or bottom. The second section is from the head of Pounding Mill Branch, 2 miles southwest of War Eagle.

*Lower Cedar Grove bed on Lower Elk Creek and Pounding Mill Branch.*

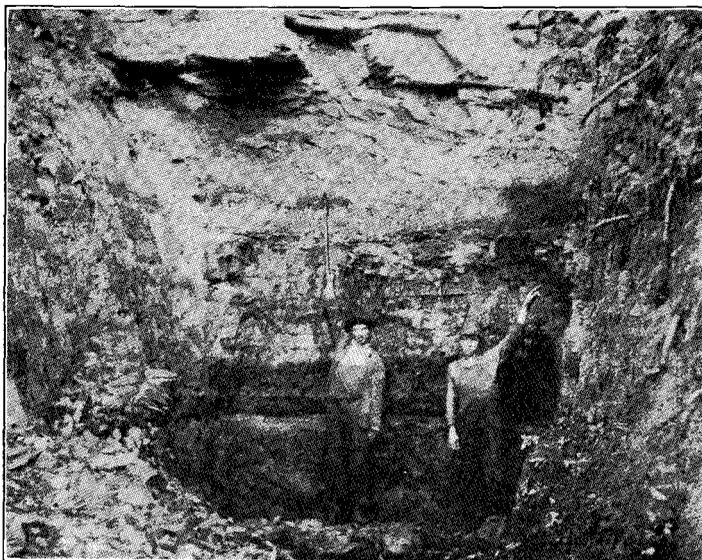
(Location 906, elevation 1,840.)

	Ft.	in.
Coal .....	2+	
Shale .....	1	4
Coal .....		7
Coal, bony .....		2
Coal .....	1	
Shale .....		2
Coal .....		2½
Shale .....		4½
Coal .....	1+	
<hr/>		
Coal .....	3	1½+
Partings .....	1	10½

(Location 907, elevation 1,775.)

	Ft.	in.
Coal .....	1	5
Shale .....		3
Coal .....	2	7
Bone .....		½
Coal .....	1	7
Bone .....		½
Coal .....		7
Clay .....		4
Coal .....	2	10
<hr/>		
Coal .....	9	
Partings .....		8

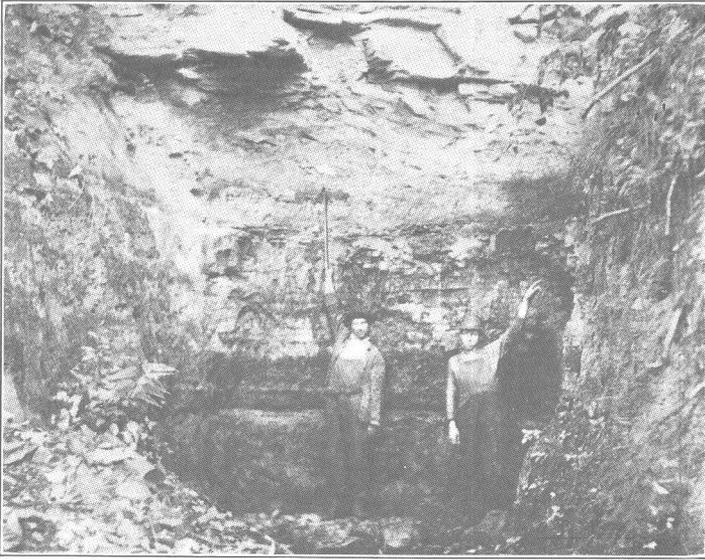
<sup>1</sup> Hennen, R. V. and Reger, D. B., Logan and Mingo counties: West Virginia Geol. Survey, pp. 666-667, 1914.



(A) Lower Cedar Grove coal at head of Pounding Mill Branch (location 907).



(B) Cedar Grove coal in State Line Ridge near head of Upper Elk Creek (location 909).



(A) Lower Cedar Grove coal at head of Pounding Mill Branch (location 907).



(B) Cedar Grove coal in State Line Ridge near head of Upper Elk Creek (location 909).

samples from adjoining counties, however, are all from mines only a few miles from Buchanan County that are actively working in coal similar to that of Buchanan County in all essential particulars.

In taking a sample of coal for analysis every effort was made to procure fresh, unweathered coal that would represent as nearly as possible the product of the mine. The bed was faced up and carefully cleaned for a distance of three feet or more on each side of the point selected for sampling, special care being taken to remove all loose fragments of "slate" from the roof and deposited powder smoke from the coal. A uniform cut, of sufficient size to yield about 6 pounds of coal for each foot of thickness of the bed, was then made from roof to floor. All partings or binders more than three-eighths of an inch thick and all concretions or "sulphur-balls" having a maximum diameter greater than 2 inches and a thickness of more than half an inch were excluded from the sample. The material thus obtained was crushed until it would pass through a half-inch mesh and was then thoroughly mixed and reduced by quartering until about 4 pounds remained. The product was placed in a galvanized-iron can, sealed in the mine with adhesive tape, and mailed as soon as possible to the laboratory.

As soon as received at the laboratory the coal was taken from the can, weighed, and allowed to dry at a temperature slightly above normal until its weight became practically constant. It was then reweighed, the difference in weight being the air-drying loss. Because the coal is more stable and more easily handled in the air-dried form, it was analyzed in this condition and the results given under form B. Forms A, C, and D were calculated from form B. Form A represents the coal as it is collected. Form C represents the theoretical condition of the coal if all the moisture were removed, and form D if both moisture and ash were removed.



*Analyses of coal samples from mines in and near Buchanan County—Contd.*

BED, MINE, LOCATION.	Laboratory No.	Air-drying loss.	Form of analysis.	Proximate.				Ultimate.				Heating Value.						
				Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.				
															2.3	17.1	72.0	8.6
Same (face of first right butt-entry, of left entry 2).....	14471	1.5	A	2.3	17.1	72.0	8.6	0.66	.....	.....	.....	.....	.....	.....	.....	.....		
			B	.8	73.1	8.7	.67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
			C	.....	17.5	73.7	8.3	.68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
			D	.....	19.2	80.8	.....	.75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Same (composite of samples 14468-14471).....	14472	1.5	A	2.2	17.3	71.6	8.88	.64	4.84	80.36	1.29	4.49	.....	.....	.....	.....		
			B	.8	17.5	72.7	9.02	.65	4.23	81.58	1.31	3.21	.....	.....	.....	.....	.....	
			C	.....	17.7	73.2	9.08	.65	4.18	82.20	1.33	2.87	.....	.....	.....	.....	.....	
			D	.....	19.5	80.5	.....	.71	4.60	90.41	1.45	2.83	.....	.....	.....	.....	.....	
LOWER SEABOARD BED. No. 1 mine at Coalidan, 4 1/2 miles north of Richlands, Tazewell Co., Va. (main straight entry, 2,000 feet S. 30° E. of drift mouth).	4304	2.4	A	8.0	25.8	66.5	4.6	1.70	.....	.....	.....	.....	.....	.....	.....	.....		
			B	.7	26.4	68.2	4.7	1.74	.....	.....	.....	.....	.....	.....	.....	.....	.....	
			C	.....	26.6	68.6	4.8	1.75	.....	.....	.....	.....	.....	.....	.....	.....	.....	
			D	.....	28.0	72.0	.....	1.84	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Same (room 12, off left entry 3, 1,600 feet east of drift mouth).	4305	1.9	A	2.6	24.5	68.4	4.5	1.35	.....	.....	.....	.....	.....	.....	.....	.....		
			B	.7	24.9	69.8	4.6	1.38	.....	.....	.....	.....	.....	.....	.....	.....	.....	
			C	.....	25.1	70.3	4.6	1.39	.....	.....	.....	.....	.....	.....	.....	.....	.....	
			D	.....	26.3	73.7	.....	1.46	.....	.....	.....	.....	.....	.....	.....	.....	.....	
UPPER SEABOARD BED. No. 6 1/2 mine of Seaboard, 3 miles north of Richlands, Tazewell Co., Va. (face of third right, 800 feet south of mine mouth).	25760	2.0	A	3.0	28.7	62.7	5.59	.65	4.88	81.48	1.37	6.08	.....	.....	.....	.....		
			B	1.0	29.3	64.0	5.70	.66	4.75	83.12	1.40	4.37	.....	.....	.....	.....	.....	
			C	.....	29.6	64.6	5.76	.67	4.69	83.96	1.41	3.51	.....	.....	.....	.....	.....	
			D	.....	31.4	68.6	.....	.71	4.98	89.09	1.50	3.72	.....	.....	.....	.....	.....	
Same (face of second left, 700 feet southeast of mine mouth).	25761	2.1	A	3.1	29.4	60.8	6.71	.50	5.26	79.19	1.33	7.01	.....	.....	.....	.....		
			B	1.1	30.0	62.1	6.85	.51	5.14	80.86	1.36	5.28	.....	.....	.....	.....	.....	
			C	.....	30.3	62.8	6.93	.52	5.07	81.76	1.37	4.35	.....	.....	.....	.....	.....	
			D	.....	32.6	67.4	.....	.56	5.45	87.83	1.47	4.67	.....	.....	.....	.....	.....	
Same (composite of Nos. 25760 and 25761).....	25762F	2.0	A	3.1	29.0	61.8	6.10	.58	5.03	80.04	1.38	6.87	.....	.....	.....	.....		
			B	1.1	29.6	63.0	6.23	.59	4.91	81.69	1.41	5.17	.....	.....	.....	.....	.....	
			C	.....	29.9	63.8	6.30	.60	4.83	82.63	1.42	4.22	.....	.....	.....	.....	.....	
			D	.....	31.9	68.1	.....	.64	5.15	88.18	1.52	4.51	.....	.....	.....	.....	.....	

*Analyses of coal samples from mines in and near Buchanan County—Contd.*

BED, MINE, LOCATION.	Laboratory No.	Air drying loss.	Form of analysis.	Proximate.				Ultimate.					Heating Value.							
				Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.						
TILLER BED. No. 201 or "Slope mine" of the Clinchfield Coal Corporation at Hurricane, Russell Co., Va. (main entry, 4,900 feet N. 30° W. of slope).	18239	1.0	A	1.8	31.4	60.3	6.5	0.52	.....	.....	.....	.....	.....	.....	.....	7,880	14,180			
			B	.8	31.8	60.9	6.5	.53	.....	.....	.....	.....	.....	.....	.....	.....	7,960	14,330		
			C	.....	32.0	61.4	6.6	.53	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,025	14,440	
			D	.....	34.3	65.7	.....	.57	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,150	15,460	
	Same (1,200 feet N. 64° W. of slope and 800 feet west of main entry).	18240	1.8	A	2.5	31.9	59.5	6.1	.44	.....	.....	.....	.....	.....	.....	.....	.....	7,820	14,070	
				B	.8	32.4	60.6	6.2	.45	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,960	14,330
				C	.....	32.7	61.1	6.2	.45	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,020	14,430
				D	.....	34.9	65.1	.....	.48	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,555	15,400
	Same (right heading, 2,600 feet N. 20° W. of slope and 800 feet from main entry).	18241	1.9	A	2.4	32.5	58.4	6.7	.49	.....	.....	.....	.....	.....	.....	.....	.....	7,790	14,020	
				B	.6	33.1	59.5	6.8	.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,940	14,290
				C	.....	33.3	59.8	6.9	.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,985	14,380
				D	.....	35.7	64.3	.....	.54	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,575	15,440
Same (composite of 18239, 18240, and 18241).....	18242	1.6	A	2.2	31.9	59.4	6.50	.46	5.11	79.69	1.04	7.20	7.840	14,110	.....	.....	7,840	14,110		
			B	.6	32.5	60.3	6.60	.47	5.02	80.94	1.06	5.91	7,960	14,330	.....	.....	7,960	14,330		
			C	.....	32.7	60.7	6.65	.48	4.98	81.48	1.06	5.86	8,015	14,430	.....	.....	8,015	14,430		
			D	.....	35.0	65.0	.....	.50	5.33	87.28	1.14	5.75	8,585	15,460	.....	.....	8,585	15,460		
TILLER BED. "East mine" of Big Town Hill Creek Coal Corporation, 1½ miles northwest of Richlands, Tazewell Co., Va. (room 1, off main heading, 450 feet northeast of entrance).	25763	2.1	A	3.0	30.5	59.0	7.49	.62	5.00	77.96	1.36	7.57	7,670	13,310	.....	.....	7,670	13,310		
			B	.9	31.2	60.3	7.65	.63	4.87	79.62	1.39	5.84	7,835	14,100	.....	.....	7,835	14,100		
			C	.....	31.4	60.9	7.72	.64	4.81	80.34	1.40	5.09	7,905	14,230	.....	.....	7,905	14,230		
			D	.....	34.1	65.9	.....	.69	5.21	87.06	1.52	5.52	8,570	15,420	.....	.....	8,570	15,420		
Same (face of main heading, 400 feet N. 30° E. of entrance).	25764	1.5	A	2.4	31.3	57.5	8.86	.47	4.96	77.23	1.32	7.16	7,500	13,570	.....	.....	7,500	13,570		
			B	.9	31.8	58.3	9.00	.48	4.86	78.43	1.34	5.80	7,620	13,710	.....	.....	7,620	13,710		
			C	.....	32.1	58.8	9.08	.48	4.81	79.11	1.35	5.17	7,685	13,890	.....	.....	7,685	13,890		
			D	.....	35.3	64.7	.....	.53	5.29	87.01	1.48	5.69	8,450	15,210	.....	.....	8,450	15,210		
Same (composite of 25763 and 25764).....	25765F	1.8	A	2.7	30.9	58.1	8.30	.59	4.99	77.39	1.35	7.38	7,590	13,640	.....	.....	7,590	13,640		
			B	.9	31.5	59.2	8.45	.60	4.88	78.82	1.37	5.88	7,720	13,800	.....	.....	7,720	13,800		
			C	.....	31.8	59.7	8.53	.61	4.82	79.51	1.39	5.14	7,785	14,020	.....	.....	7,785	14,020		
			D	.....	34.7	65.3	.....	.67	5.27	86.93	1.52	5.61	8,510	15,320	.....	.....	8,510	15,320		

*Analyses of coal samples from mines in and near Buchanan County—Contd.*

BED, MINE, LOCATION.	Laboratory No.	Air-drying loss.	Form of analysis.	Proximate.				Ultimate.				Heating Value.				
				Moisture.		Fixed carbon.	Ash.	Subbur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.		
				Volatile matter.	Moisture.											
JAWBONE BED, "West mine" of Big Town Hill Creek Coal Corporation, 1½ miles northwest of Richards, Tazewell Co., Va. (face of 9th heading, off 4th right, 1,700 feet N. 45° W. of entrance). Same (face of first left, 1,400 feet west of entrance)..... Same (composite of 25757 and 25758).....	25757	1.2	A	1.9	31.1	53.8	13.13	0.48	4.68	73.57	1.34	6.80	7,210	12,980		
			B	.8	31.5	54.4	13.28	.49	4.60	74.43	1.36	5.84	7,500	13,140		
			C	.....	54.9	53.02	51.7	13.39	.....	5.17	7.353	73.02	1.37	5.97	7,353	13,240
			D	.....	36.7	63.3	.....	.57	5.26	86.62	1.38	5.97	.....	.....	8,480	15,280
	25758	1.3	A	2.2	30.7	57.0	10.05	.47	5.04	76.95	1.43	6.06	7,525	13,550		
			B	.9	31.2	57.7	10.18	.48	4.96	77.97	1.45	4.97	7,625	13,730		
			C	.....	31.4	58.3	10.28	.48	4.90	78.69	1.46	4.19	7,695	13,850		
			D	.....	35.0	65.0	.....	.54	5.46	87.71	1.63	4.66	.....	.....	8,575	15,440
	25759F	1.2	A	2.1	31.1	55.3	11.55	.48	4.91	75.18	1.39	6.49	7,370	13,260		
			B	.8	31.5	56.0	11.70	.49	4.88	76.12	1.41	5.45	7,460	13,430		
			C	.....	31.8	56.4	11.79	.49	4.78	76.76	1.42	4.76	7,525	13,540		
			D	.....	36.0	64.0	.....	.56	5.42	87.02	1.61	5.39	.....	.....	8,580	15,350
19224	1.7	A	2.4	19.5	64.7	13.4	.71	.....	.....	.....	.....	.....	7,310	13,160		
		B	.6	19.9	65.8	13.7	.72	.....	.....	.....	.....	.....	.....	7,440	13,390	
		C	.....	20.1	66.2	13.7	.73	.....	.....	.....	.....	.....	.....	.....	7,460	13,480
		D	.....	23.2	76.8	.....	.85	.....	.....	.....	.....	.....	.....	.....	8,680	15,680
25630	2.0	A	3.2	32.1	58.3	6.4	.57	.....	.....	.....	.....	.....	.....	7,840	14,110	
		B	1.2	32.7	59.5	6.6	.58	.....	.....	.....	.....	.....	.....	.....	8,000	14,400
		C	.....	33.1	60.2	6.7	.59	.....	.....	.....	.....	.....	.....	.....	8,095	14,570
		D	.....	35.5	64.5	.....	.63	.....	.....	.....	.....	.....	.....	.....	8,680	15,620
25631	1.9	A	2.9	31.8	60.3	5.0	.67	.....	.....	.....	.....	.....	.....	8,000	14,400	
		B	1.0	32.4	61.5	5.1	.68	.....	.....	.....	.....	.....	.....	.....	8,160	14,630
		C	.....	32.7	62.1	5.2	.69	.....	.....	.....	.....	.....	.....	.....	8,240	14,830
		D	.....	34.5	65.5	.....	.73	.....	.....	.....	.....	.....	.....	.....	8,690	15,640
25632	2.0	A	2.9	32.0	59.4	5.73	.63	.....	.....	.....	.....	.....	.....	8,000	14,400	
		B	.9	32.7	60.6	5.85	.64	.....	.....	.....	.....	.....	.....	.....	8,065	14,510
		C	.....	33.0	61.1	5.90	.65	.....	.....	.....	.....	.....	.....	.....	8,135	14,650
		D	.....	35.1	64.9	.....	.69	.....	.....	.....	.....	.....	.....	.....	8,650	15,560

RAVEN BED, Raven Red Ash mine of the Raven Red Ash Coal Co. at Red Ash, Tazewell Co., Va. (face of air course to 10th cross-heading, 3,000 feet northeast of No. 1 drift mouth).  
Same (face of air course to No. 3 main heading, 2,600 feet north of No. 3 drift mouth).  
Same (composite of 25630 and 25631).....

*Analyses of coal samples from mines in and near Buchanan County—Contd.*

BED, MINE, LOCATION.	Laboratory No.	Air-drying loss.	Form of analysis.	Proximate.				Ultimate.					Heating Value.						
				Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.					
RAVEN BED. No. 1 mine of the Jewell Ridge Coal Corporation at Jewell, Tazewell Co., Va. (2d right, off main entry, 1,900 feet N. 60° E. of mine entrance).	25651	3.1	A	3.7	25.9	64.9	5.5	0.70	.....	.....	.....	.....	.....	.....	7,960	14,380			
			B	.7	26.8	66.9	5.6	.72	.....	.....	.....	.....	.....	.....	.....	8,210	14,780		
			C	.....	26.9	67.4	5.7	.73	.....	.....	.....	.....	.....	.....	.....	.....	8,265	14,880	
			D	.....	28.5	71.5	.....	.77	.....	.....	.....	.....	.....	.....	.....	.....	8,765	15,780	
Same (No. 6 main entry, 3,700 feet northeast of mine entrance).	25652	2.5	A	3.1	25.9	65.0	6.0	.79	.....	.....	.....	.....	.....	.....	.....	7,985	14,380		
			B	.6	26.6	66.7	6.1	.81	.....	.....	.....	.....	.....	.....	.....	.....	8,190	14,750	
			C	.....	26.7	67.1	6.2	.82	.....	.....	.....	.....	.....	.....	.....	.....	8,240	14,880	
			D	.....	28.5	71.5	.....	.87	.....	.....	.....	.....	.....	.....	.....	.....	8,785	15,810	
Same (composite of 25651 and 25652).....	25653	2.8	A	3.4	25.3	65.6	5.69	.73	5.16	80.98	1.29	6.15	.....	.....	.....	7,980	14,360		
			B	.6	26.0	67.5	5.85	.75	4.99	83.30	1.33	3.78	.....	.....	.....	8,205	14,770		
			C	.....	26.2	67.9	5.89	.76	4.96	83.80	1.33	3.26	.....	.....	.....	8,255	14,860		
			D	.....	27.8	72.2	.....	.81	5.27	89.05	1.41	3.46	.....	.....	.....	8,775	15,790		
KENNEDY BED, Honaker Lumber Company mine at Drill, Russell Co., Va. (450 feet northeast of drift mouth).	19484	0.8	A	2.1	32.4	58.7	6.8	1.01	.....	.....	.....	.....	.....	.....	.....	.....	.....		
			B	1.3	32.6	59.2	6.9	1.02	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
			C	.....	33.1	60.0	6.9	1.03	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
			D	.....	35.5	64.5	.....	1.11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
KENNEDY BED, Sandy Ridge Coal and Coke Company mine, ¾ mile south of Drill, Russell Co., Va. (south drift in room of main entry, 150 feet north of entrance).	19528	1.8	A	3.2	33.1	57.7	6.0	.96	.....	.....	.....	.....	.....	.....	.....	.....	.....		
			B	1.4	33.7	58.5	6.1	.98	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
			C	.....	34.2	59.6	6.2	.99	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
			D	.....	36.4	63.6	.....	1.06	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Same (north drift, 170 feet S. 70° W. of entrance).....	22345F	3.5	A	4.7	30.8	59.4	5.14	.96	5.43	78.93	1.40	6.74	.....	.....	.....	7,760	13,960		
			B	1.2	31.9	61.6	5.33	1.00	5.22	81.18	1.45	5.82	.....	.....	.....	.....	8,040	14,470	
			C	.....	32.3	62.3	5.39	1.01	5.15	82.17	1.47	4.81	.....	.....	.....	.....	8,140	14,650	
			D	.....	34.1	65.9	.....	1.07	5.44	86.86	1.56	5.09	.....	.....	.....	.....	8,600	15,480	
LOWER BANNER BED, No. 55 mine of the Clinchfield Coal Corporation at Wilder, Russell Co., Va. (900 feet S. 60° W. of No. 3 opening).	18243	2.4	A	3.1	33.7	57.3	5.9	.79	.....	.....	.....	.....	.....	.....	.....	7,860	14,150		
			B	.8	34.5	58.7	6.0	.81	.....	.....	.....	.....	.....	.....	.....	.....	8,050	14,490	
			C	.....	34.8	59.1	6.1	.82	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,115	14,600
			D	.....	37.0	63.0	.....	.87	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,640	15,560

*Analyses of coal samples from mines in and near Buchanan County—Contd.*

	Laboratory No.	Air-drying loss.	Form of analysis.	Proximate.				Ultimate.					Heating Value.		
				Moisture.		Volatile matter.	Fixed carbon.	Ash.	Subsur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.
				A	B										
BED, MINE, LOCATION.	18244	1.6	A	2.4	34.6	57.3	5.7	0.83	.....	.....	.....	.....	.....	7,945	14,300
				.8	35.2	38.3	5.7	.84	.....	.....	.....	.....	.....	8,075	14,540
				.....	35.5	38.7	5.8	.85	.....	.....	.....	.....	.....	8,140	14,600
				.....	37.6	62.4	.....	.90	.....	.....	.....	.....	.....	8,645	15,560
Same (1,300 feet N. 35° W. of No. 2 opening).....	18245	2.0	A	2.7	33.7	57.9	5.7	.78	.....	.....	.....	.....	.....	7,920	14,200
				.8	34.4	59.0	5.8	.80	.....	.....	.....	.....	.....	8,080	14,540
				.....	34.7	59.5	5.8	.80	.....	.....	.....	.....	.....	8,145	14,600
				.....	36.8	63.2	.....	.85	.....	.....	.....	.....	.....	8,660	15,570
Same (composite of 18243, 18244, and 18245).....	18246	2.0	A	2.7	33.8	57.7	5.78	.83	5.27	79.33	1.29	7.50	.....	7,915	14,250
				.7	34.5	58.9	5.90	.85	5.15	80.98	1.32	5.85	.....	8,075	14,530
				.....	34.8	59.3	5.94	.85	5.11	81.55	1.33	5.22	.....	8,135	14,650
				.....	37.0	63.0	.....	.90	5.43	86.70	1.41	5.56	.....	8,650	15,570
UPPER BANNER BED, No. 6 mine of the Clinchfield Coal Corporation at Wilder, Russell Co., Va. (3,000 feet S. 71° W. of No. 1 drift mouth).	18235	2.4	A	3.3	35.7	55.0	6.0	.55	.....	.....	.....	.....	.....	7,760	13,970
				1.0	36.6	56.3	6.1	.56	.....	.....	.....	.....	.....	7,945	14,310
				.....	37.0	56.8	6.2	.57	.....	.....	.....	.....	.....	8,080	14,450
				.....	39.4	60.6	.....	.61	.....	.....	.....	.....	.....	8,555	15,400
Same (room 5, about 1,250 feet S. 35° E. of No. 3 drift mouth).	18236	2.4	A	3.2	35.4	55.1	6.3	.59	.....	.....	.....	.....	.....	7,760	13,970
				.9	36.3	56.4	6.4	.60	.....	.....	.....	.....	.....	7,945	14,300
				.....	36.6	56.9	6.5	.61	.....	.....	.....	.....	.....	8,020	14,430
				.....	39.1	60.9	.....	.65	.....	.....	.....	.....	.....	8,575	15,440
Same (4,000 feet S. 10° W. of No. 3 drift mouth).....	18237	2.4	A	3.3	35.1	56.9	4.7	.50	.....	.....	.....	.....	.....	7,925	14,270
				.9	36.0	58.3	4.8	.51	.....	.....	.....	.....	.....	8,115	14,610
				.....	36.3	58.8	4.9	.52	.....	.....	.....	.....	.....	8,195	14,750
				.....	38.2	61.8	.....	.55	.....	.....	.....	.....	.....	8,615	15,510
Same (composite of 18235, 18236, and 18237).....	18238	2.4	A	3.3	35.1	55.9	5.71	.55	5.37	78.72	1.37	8.28	.....	7,820	14,080
				1.0	35.9	57.2	5.85	.56	5.23	80.62	1.40	6.34	.....	8,010	14,420
				.....	36.3	57.8	5.91	.57	5.17	81.44	1.42	5.49	.....	8,095	14,570
				.....	38.5	61.5	.....	.61	5.49	86.55	1.51	5.84	.....	8,600	15,490

*Analyses of coal samples from mines in and near Buchanan County—Contd.*

BED, MINE, LOCATION.	Laboratory No.	Air-drying loss.	Form of analysis.	Proximate.				Ultimate.					Heating Value.	
				Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.
SPLASH DAM BED, Oliver Elswick local mine near Big Rock, Buchanan Co., Va. (60 feet N. 70° E. from opening).	19735F	2.0	A	3.4	28.2	61.4	6.98	0.67	5.09	78.30	1.53	7.48	7,670	13,810
			B	1.4	28.8	62.7	7.12	.68	4.97	79.90	1.56	5.77	7,830	14,090
			C	.....	29.2	63.6	7.23	.69	4.88	81.06	1.58	4.56	7,940	14,290
			D	.....	31.4	68.6	.....	.74	5.26	87.37	1.70	4.98	8,560	15,410
SPLASH DAM BED, C. C. Owens local mine, 1 mile northeast of mouth of Russell Prater Creek, Dickenson Co., Va., (75 feet east of mine mouth).	17751	1.8	A	2.3	29.4	62.2	6.1	.76	.....	.....	.....	.....	.....	.....
			B	1.0	29.7	63.0	6.2	.77	.....	.....	.....	.....	.....	.....
			C	.....	29.9	63.6	6.3	.78	.....	.....	.....	.....	.....	.....
			D	.....	31.6	67.9	.....	.83	.....	.....	.....	.....	.....	.....
Same (25 feet south of sample 17751).....	17752	1.6	A	2.5	29.2	63.2	5.1	.80	.....	.....	.....	.....	.....	.....
			B	.9	29.7	64.2	5.2	.81	.....	.....	.....	.....	.....	.....
			C	.....	29.9	64.8	5.3	.82	.....	.....	.....	.....	.....	.....
			D	.....	31.6	68.4	.....	.87	.....	.....	.....	.....	.....	.....
EAGLE BED, Papoose mine of the War Eagle Coal Co., 1½ miles northeast of War Eagle, Mingo Co., W. Va., (5th left, off main straight entry, 600 feet from mine mouth).	17476	1.4	A	2.8	31.5	61.1	4.6	1.39	.....	.....	.....	.....	7,905	14,230
			B	1.4	32.0	62.0	4.6	1.41	.....	.....	.....	.....	8,020	14,430
			C	.....	32.4	62.9	4.7	1.48	.....	.....	.....	.....	8,140	14,650
			D	.....	34.0	66.0	.....	1.50	.....	.....	.....	.....	8,535	15,330
Same (heading No. 5 drift, 1,200 feet from mine mouth).....	17477	1.9	A	3.3	31.0	60.4	5.3	1.14	.....	.....	.....	.....	7,765	13,980
			B	1.4	31.6	61.5	5.5	1.16	.....	.....	.....	.....	7,915	14,240
			C	.....	32.1	62.4	5.5	1.18	.....	.....	.....	.....	8,030	14,450
			D	.....	33.9	63.1	.....	1.25	.....	.....	.....	.....	8,500	15,300
EAGLE BED, Mephisto mine of War Eagle Coal Co., 2 miles northeast of War Eagle, Mingo Co., W. Va. (heading of second left air course, 500 feet from mine mouth).	17478	1.9	A	3.3	30.9	58.9	6.9	1.11	.....	.....	.....	.....	7,630	13,830
			B	1.5	31.5	60.0	7.0	1.13	.....	.....	.....	.....	7,830	14,090
			C	.....	32.0	60.9	7.1	1.15	.....	.....	.....	.....	7,950	14,310
			D	.....	34.4	65.6	.....	1.24	.....	.....	.....	.....	8,555	15,400
EAGLE BED, Papoose and Mephisto mines (composite of 17476, 17477, and 17478).	17479F	1.7	A	3.1	31.4	59.9	5.60	1.18	5.12	79.51	1.60	6.99	7,805	14,050
			B	1.4	32.0	60.9	5.70	1.20	5.02	80.90	1.63	5.55	7,945	14,300
			C	.....	32.4	61.8	5.78	1.22	4.98	82.09	1.65	4.33	8,060	14,510
			D	.....	34.4	65.6	.....	1.29	5.23	87.12	1.75	4.61	8,555	15,400

*Analyses of coal samples from mines in and near Buchanan County—Contd.*

BED, MINE, LOCATION.	Laboratory No.	Air-drying loss.	Form of analysis.	Proximate.				Ultimate.				Heating Value.				
				Moisture.	Volatile matter.	Fixed carbon.	Ash.	Substn.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.		
EAGLE BED. Local mine of the Yellow Poplar Lumber Company, 2 miles northeast of Mart, Dickenson Co., Va. (Main drift, 200 feet from mouth).	17743	1.7	A	2.8	31.6	58.2	7.4	1.45	.....	.....	.....	.....	.....	7,685	13,840	
			B	1.1	32.2	59.1	7.6	1.47	.....	.....	.....	.....	.....	.....	7,815	14,070
			C	.....	32.5	59.8	7.7	1.49	.....	.....	.....	.....	.....	.....	7,965	14,230
			D	.....	33.2	64.8	.....	1.61	.....	.....	.....	.....	.....	.....	8,965	15,410
Same (220 feet N. 85° E. of mine mouth).....	17744	1.8	A	2.0	32.4	58.4	6.2	1.62	.....	.....	.....	.....	.....	7,795	14,080	
			B	1.2	33.0	59.5	6.3	1.65	.....	.....	.....	.....	.....	.....	7,885	14,280
			C	.....	33.4	60.2	6.4	1.67	.....	.....	.....	.....	.....	.....	8,080	14,460
			D	.....	35.7	64.3	.....	1.78	.....	.....	.....	.....	.....	.....	8,975	15,440
EAGLE BED. Blackey mine of the W. M. Ritter Lumber Company near Blackey, Buchanan Co., Va. (450 feet east of main entrance).	19883	3.2	A	4.1	31.7	61.2	2.98	1.07	5.96	80.91	1.51	8.17	8.035	14,470	14,470	
			B	.9	32.7	63.3	3.08	1.11	5.17	83.88	1.96	5.60	8,301	14,940	8,301	
			C	.....	33.1	63.8	3.11	1.12	5.22	84.33	1.87	4.75	8,375	15,080	8,375	
			D	.....	34.1	65.9	.....	1.16	5.23	87.04	1.62	4.90	8,645	15,560	8,645	
Same (325 feet S. 80° E. of main entrance).....	19884	2.7	A	3.5	31.9	60.9	3.73	1.48	5.32	80.89	1.53	7.05	7,995	14,890	7,995	
			B	.8	32.8	62.6	3.83	1.52	5.16	83.14	1.57	4.78	8,215	14,790	8,215	
			C	.....	33.1	63.0	3.87	1.53	5.11	83.84	1.59	4.06	8,285	14,920	8,285	
			D	.....	34.4	65.6	.....	1.59	5.32	87.22	1.65	4.22	8,620	15,520	8,620	
CAMPBELL CREEK BED. War Eagle mine of the War Eagle Coal Co., 2 miles northeast of War Eagle, Mingo Co., W. Va. (1st room to right, off main entry, 200 feet from entrance).	17475F	.8	A	2.4	32.8	60.5	4.30	7.4	5.06	79.82	1.53	8.55	7,955	14,320	7,955	
			B	1.6	33.1	61.0	4.33	7.5	5.01	80.45	1.54	7.92	8,015	14,430	8,015	
			C	.....	33.6	62.0	4.41	7.6	4.91	81.78	1.57	6.57	8,160	14,670	8,160	
			D	.....	35.2	64.8	.....	.80	5.14	85.55	1.64	6.87	8,525	15,860	8,525	
CEDAR GROVE BED. Red Jacket, Jr., Coal Co. mine, 4 miles northeast of Matewan, Mingo Co., W. Va. (room 15 on left, off main entry, 1,200 feet from mine mouth).	17483	1.3	A	3.0	34.7	58.9	3.4	.66	.....	.....	.....	.....	.....	7,920	14,250	
			B	1.7	35.1	59.7	3.5	.67	.....	.....	.....	.....	.....	.....	8,025	14,440
			C	.....	35.7	60.8	3.5	.68	.....	.....	.....	.....	.....	.....	8,165	14,700
			D	.....	37.0	63.0	.....	.70	.....	.....	.....	.....	.....	.....	8,460	15,230

An examination of the analyses in the preceding table leads to very favorable conclusions as to the purity and value of the coals. Steaming, producer-gas, coking, and other tests made by the United States Geological Survey on run-of-mine samples from the Upper Banner bed near Coeburn, and from the Jawbone bed at Virginia City<sup>1</sup> showed that the coals in this general region rank high for commercial purposes. Field coking tests made by the author in Buchanan County and many private tests in the same area indicate that high-grade coke can be made from the product of almost any coal bed in the area. When the supplies of other coking coals become depleted, this region will assume an important position in supplying the increasing demands of the steel industry for coke.

The following table of averages of the analyses in the preceding table will simplify their study and afford a basis for comparison with other fields. The first form given for each bed (line A) is the average for the samples "as received" and most nearly represents the condition of the coal as it leaves the mine. The second form (line D) is the average on the "pure coal basis," made by theoretically excluding the moisture, ash, and sulphur from the proximate analysis and recalculating the volatile matter and fixed carbon to total 100 per cent. The second form does not represent the actual condition of the coal at any time and should be used only in a comparative study of the qualities and ranks of the coals.

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<sup>1</sup> Hinds, Henry, Coal resources of the Clintwood and Bucu quadrangles, Virginia: Virginia Geol. Survey Bull. 12, pp. 187-193, 1916.



from a Russell County district in which the bed has been subjected to some crushing. The slight inferiority of the Splash Dam coal, as indicated by sample 19735F, is probably due to the inclusion of some of the very thin clay films that characterize that bed in that sample, and possibly also to the fact that that sample was obtained from a small country mine in which the coal was slightly weathered, though the percentage of oxygen in that sample does not suggest weathering.

#### Comparison with other fields.

A comparison of the analyses of coals from the Clintwood and Bucu quadrangles presented in the foregoing tables with those representing the principal mining districts of West Virginia makes it evident that the coals of the region studied above the Lee are equal to the highest rank of the Kanawha coals of southern West Virginia, namely, those along the easternmost border of the Kanawha field, while the coals in the Lee correspond with those in a rather narrow zone along the border of the Pocahontas and New River coal fields. The coals of this region average slightly higher in rank than the coals in the region immediately northwest of Pine Mountain in Pike and Letcher counties, though neither this difference nor its effects on the B. t. u. value are well marked. Farther west, both in Kentucky and West Virginia, the coals fall off in rank and calorific value and in most areas are more impure, so that, on the whole, the coals of Buchanan County have a marked advantage as to ash and sulphur content.

The Pocahontas and New River coals are distinctly above the coals of this part of the Virginia region in rank, being 5 to 15 per cent higher in fixed carbon, and are in general their equal in lowness of ash and sulphur content, while, as is to be expected, their more advanced rank gives them somewhat greater B. t. u. values. Also, the New River and Pocahontas coals are coked with less loss of volatile matter. On the other hand, for household use and for export to markets intolerant of great quantities of slack or fine coal, most of the Virginia coals, which have not been so crushed and made friable by the dynamic forces that gave the Pocahontas and New River coals their higher rank, have a distinct advantage on account of the larger proportion of lump coal which may even permit grading by sizes with smaller waste in dust or slack. The Virginia coal especially commends itself as a reasonably high rank, high heat value, low ash, and low sulphur lump coal for export, as well as for domestic use.

Compared with the Tennessee coals these coals, on account of the higher rank resulting from the more advanced elimination of volatile matter, have

a greater calorific value and are lower in ash and sulphur content. Generally the coals of the same rank contain larger proportions of sulphur to which is usually added a higher ash. In the areas of extraordinarily low ash coals, like Campbell and Claiborne counties in Tennessee, the rank of the coals is so low as to give them a calorific value perceptibly under that of the Virginia coals, in which, moreover, the sulphur is nearly everywhere smaller in amount.

The coals of Alabama vary greatly in quality. In some localities the fuel is clearly of higher rank and heating power than that of the Virginia area, though nearly everywhere higher sulphur is found in the former. In general the Alabama coals are higher in ash and are inferior in rank and calorific value to the coals of Buchanan County.

As compared with the Oklahoma coal field as a whole the Virginia coal possesses marked advantages in rank, purity, and heat value. Even toward the eastern border of the Oklahoma field, in which direction the rank of the coals rises above that of the Virginia fuel, the consequent calorific advantage is at most points neutralized by higher ash and sulphur. On the other hand, most of the Oklahoma localities showing lower ash have coals of rank so much lower as to make them of lower calorific value also. Passing eastward into Arkansas, the Paleozoic coals are all of higher rank; but, except at a few points in the semibituminous area, the greater ash and sulphur contents seem to give them inferior heat values. It remains to be seen whether in an export trade the friability of the purest of the Arkansas semibituminous coal will offset its advantages in rank and heat value.

As compared with the coals of the other Mississippi Valley states, including Illinois, Indiana, and western Kentucky, the Virginia coals are distinctly superior, being of considerably higher rank, generally lower in ash, almost everywhere lower in sulphur, and much higher in calorific value. The differences in the latter, which often exceed 2,000 B. t. u.'s in favor of the Virginia coal, will possibly be found, in some foreign market that is partial to lump coal, to be pitted against the larger percentages of cubical and stronger lump in the coals of the upper Mississippi Valley.

Even the best coals of Ohio are so much lower in fixed carbon, i. e., in rank, as hardly to equal the Virginia coals in heat value, and the Ohio coals are higher in sulphur and in ash.

The coals of the Potomac and Georges Creek-Frostburg basins in western Maryland are clearly much higher in rank, but their heat value is reduced by their higher ash and sulphur content. The coals in the southern part of the Potomac basin and neighboring region of West Virginia are

locally clearly superior in purity and heat value to the Buchanan County coals. These high-rank coals yield a larger proportion of fine coal or slack in the run-of-mine product. The same is true of the high-grade coals of the so-called "Clearfield region" of Clearfield, Cambria, Blair, and Somerset counties in Pennsylvania, particularly the Windber district. Nevertheless, it is interesting to note that, though not nearly so high in rank and in calorific value, the Virginia coals compare advantageously in moisture, sulphur, and ash.

The Virginia coals concerned in this study seem to compare most closely, in rank, heat value, ash, and moisture content, in the northern Appalachian region, with the low ash and low sulphur coals of the Fairmont district in northern West Virginia and in the Uniontown-Connellsville zone of Pennsylvania. Their low ash, low moisture, and abnormally low sulphur content give these Virginia coals an advantage over those in northwestern West Virginia and in western Pennsylvania, toward the western borders of which the lower fixed carbon is attended in general by lower calorific values.

From a single test made at the experimental plant formerly conducted by the United States Geological Survey, it would seem that the Upper Banner coal of the Coeburn district of southwestern Virginia, and the Connellsville coal are closely comparable and apparently nearly equal for coking and furnace use. Further tests should precede final conclusions as to the relative coking value of coals from these two regions. The Virginia and Connellsville coals are similar in the rather large amount of volatile matter contained, about 35 per cent, pure coal basis, suggesting their value for by-product coking.

The samples, analyses of which are presented in the foregoing tables, contain promise of a fuel output of great purity and value. In fact, the expectation seems fully justified that there will be developed in Buchanan County many mines in which the coal will contain about 60 per cent fixed carbon; will run under 3 per cent of moisture, 6 per cent of ash, and .9 per cent of sulphur; and will contain over 14,000 B. t. u.'s as it is loaded in the cars. Most of this will make a good coke.

## PRODUCTION.

### Amount of ultimately available coal.

Actual mining operations in Europe have shown that coal of lower grade than that in southwestern Virginia can be profitably mined from beds only 14 inches thick and at depths greater than any to which it would be necessary to shaft for any bed in Buchanan County. The tonnages in the table on page 248, therefore, include all beds or parts of beds in which there is 14 inches or more of minable coal, but do not include thinner beds or parts of beds that could not be mined profitably because of the position and thickness of partings or because of other factors. The calculations are based on an estimate of 1,800 tons per acre for each layer of coal 1 foot thick.

Although very carefully prepared these estimates are necessarily only approximations. The figures for coals in the Lee formation and for those in the lower part of the Norton in the northern half of the county are most likely to be in error, as little is known concerning the thicknesses of the beds. The calculated totals, though enormous, are thought to be very conservative estimates. The amount of coal already mined or made unavailable for mining is so very small that it is negligible, being considerably less than one-hundredth of one per cent of the total original tonnage.

Of the grand total of 12,032,700,000 tons only about 70 per cent could be recovered under even the most favorable mining conditions, leaving about 8,400,000,000 tons as a possible production. At the rate of consumption of bituminous coal in 1916, a banner year, this county could supply all of the United States for nearly seventeen years. It should be emphasized, however, that much of this coal is in beds that are too thin or too far beneath the surface to be profitably mined and sold in competition with coal from the more cheaply mined beds now being exploited in the Appalachian coal fields. Beds that can not be used to-day, however, are certain to be of value at some time in the future.

### Mining operations.

At present no Buchanan County mines produce coal for shipment to other regions, though similar coals in neighboring areas are mined and shipped in great quantities. Part of one large mine of the Jewell Ridge Coal Corporation at Jewell extends under Sandy Ridge and the head of Laurel Fork of Dismal Creek, mining for shipment some Buchanan County

*Amount of minable coal in Buchanan County, Virginia.*

Coal bed.	North of lat. 37° 15' and west of long. 82° 00".		North of lat. 37° 15' and east of long. 82° 00".		South of lat. 37° 15' and west of long. 82° 00".		South of lat. 37° 15' and east of long. 82° 00".	
	Acres.	Tons.	Acres.	Tons.	Acres.	Tons.	Acres.	Tons.
<b>Wise formation:</b>								
Cedar Grove .....	632	8,100,000	96	2,500,000				
Lower Cedar Grove .....	710	6,400,000	115	1,700,000				
Campbell Creek .....	8,219	59,400,000	1,768	19,800,000	30	200,000		
Clintwood .....	30,198	215,000,000	7,600	34,200,000	2,300	9,400,000		
Eagle .....	35,100	222,100,000	9,167	59,600,000	3,170	24,200,000		
Blair .....	45,700	253,600,000	11,600	34,800,000	5,800	34,000,000		
Glamorgan .....	56,292	253,300,000	14,154	51,400,000	8,640	30,700,000	80	200,000
Other coals .....		30,000,000		15,000,000				
<b>Norton formation:</b>								
Hagy .....	65,000	284,800,000	24,000	86,400,000	30,000	117,000,000	3,200	7,700,000
Splash Dam .....	88,654	505,300,000	31,974	95,900,000	37,700	154,500,000	7,200	27,300,000
Lower Banner .....	49,000	174,000,000	35,000	126,300,000	28,300	94,800,000	11,184	92,500,000
Kennedy .....	85,000	263,500,000	41,000	133,500,000	70,900	313,800,000	24,762	106,600,000
Raven .....	80,000	240,000,000	34,000	126,000,000	85,400	297,600,000	38,000	190,200,000
Jawbone .....	37,500	112,500,000	40,000	220,000,000	85,600	317,800,000	50,050	270,000,000
Other coals .....		360,000,000		205,000,000		798,000,000		420,000,000
<b>Lee formation:</b>								
All coals .....	112,587	1,160,000,000	62,953	918,000,000	90,224	1,272,000,000	56,000	1,176,000,000
Totals .....	112,587	4,148,000,000	62,953	2,130,100,000	90,224	3,464,100,000	56,000	2,290,500,000

Total minable coal in Buchanan County, 12,032,700,000 tons.

coal that is usually credited to Tazewell County because the mine mouth is in the latter area. A small mine at Blackey and one at Whitewood produce coal for use in locomotives on logging railroads. Other mines in the county operate only during the winter months and are very small drifts which produce only a few tons for use in neighboring houses. The total production of the county is, therefore, exceedingly small.

The outlook for the future is very bright, for large production will follow the construction of coal-carrying railroads. Most of the coal under and near Sandy Ridge can be taken out through mine mouths on the south side of the ridge and could be shipped over short spurs or extensions of present spurs to the Clinch Valley division of the Norfolk and Western Railway or to the Dumps Creek branch of the Carolina, Clinchfield & Ohio Railway. Coal shipments could be made from other parts of the county over branch lines from railroads now operating in adjoining counties in Virginia, West Virginia, and Kentucky. As mentioned in another part of this report these branch lines could be constructed to nearly all parts of the region without prohibitive expense, provided coal-mining operations were planned on a large scale.

The market supplied by Buchanan County coal will, of course, depend largely on the outlets afforded by railroads yet to be constructed. Coal-carrying lines to the south would furnish an outlet to the Virginia seaboard by way of the Norfolk and Western Railway, or to Charleston and the growing markets of the southeastern states by way of the Carolina, Clinchfield & Ohio Railway. Coal-carrying lines to the north or east from the northeastern part of the county would reach both the Virginia seaboard and the Middle West. Lines to the west to the new extension of the Carolina, Clinchfield & Ohio Railway on Russell Fork or to the northwest down Levisa Fork to the Big Sandy division of the Chesapeake & Ohio Railway would reach the Middle West or the southeastern states. All of these routes would cause the coal to meet the competition of coal of nearly equal or slightly superior quality and with slightly shorter hauls. Mention of the relative quality of Buchanan County coal and its probable competitors has been made on preceding pages. The competition, though keen, would not prevent the profitable exploitation of this field, for the rapid exhaustion of the most cheaply mined beds in other areas is constantly increasing their mining costs.

Mining conditions are good. The coal beds are only gently inclined, so that electric haulage may be employed, and advantage may usually be taken of the dip in order to secure natural drainage. Most of the coal beds

lie above the levels of the principal streams, and may be entered by drifts. Gas is not likely to be troublesome. The underclays of the coal bed are commonly so hard and sandy that heaving and squeezing will not be common in mine workings, and the mine roofs will be of kinds of rock that are not particularly hard to support. The supply of mine timber is notably abundant, and water for power plants and camps can be obtained with little trouble.

# THE FORESTS OF BUCHANAN COUNTY, VIRGINIA

By W. G. SCHWAB

## LOCATION AND AREA.

Buchanan is one of the border counties of the extreme southwestern section of the State. It is bounded on the northwest by Pike County, Kentucky, on the northeast by McDowell County, West Virginia, on the southwest by Dickenson County, Virginia, and on the south and southeast by Russell and Tazewell counties, Virginia.

Dividing Ridge cuts it off from Clinch Valley on the southeast, and from West Virginia on the northeast. Two logging railroads now cross these mountains.

The natural outlet for the greater part of the county is northwest into Kentucky and West Virginia through the Cumberland Mountains by way of Knox Creek and Levisa River. For the western section of the county the natural outlet is southwestward into Dickenson County by way of Russell Prater, Russell Fork, etc.

The area of the county is 324,480 acres, or 507 square miles, as given by the Federal and State Geological Surveys.

## TOPOGRAPHY AND DRAINAGE.

*The topography* is exceedingly rough and broken. The valleys are very narrow, with extremely steep slopes and sharp ridges. There are few roads following the main ridges, except in the southwestern portion of the county, where the ridges are broader.

In elevation the land varies from approximately 900 feet on Levisa Fork and Knox Creek to 3,000 feet on the high mountains. Differences in elevation of 800 to 1,200 feet, within a mile, are quite common.

*Drainage.*—Levisa River with its various tributaries, Levisa Prater, Dismal and Slate creeks, Knox Creek, Indian Creek, and the eastern drainage of Russell Fork, are the principal streams. They are all tributaries of Big Sandy River, which flows into Ohio River at Catlettsburg, Kentucky.

### POPULATION.

Grundy, the county-seat, is situated on Levisa Fork at the junction of Slate Creek. It has a population of 250. The population of the entire county is approximately 12,000.

### TRANSPORTATION.

Until recently there was no railroad, incorporated as a common carrier, in the county, but now a narrow-gauge road, "The Big Sandy and Cumberland," connects Grundy, the county-seat, with the Norfolk and Western Railroad at Devon, West Virginia. The road traverses Slate Creek to Matney, thence across the ridge to the head of Knox Creek, thence down Knox Creek to the West Virginia line.

This has been of immense benefit to the people of the county. Its chief use at present is for the transportation of logs to the mills and lumber from the mills to the main line.

There are other railroads used for logging purposes only. The location of these, however, is only temporary.

### INDUSTRIES.

The county is "undeveloped." The entire surface is underlain with valuable coal deposits, which are just beginning to be developed. Lumbering is the principal industry. A large per cent of the residents work in the lumbering operations, and hardly sufficient crops are raised to serve the local needs.

### LAND OWNERSHIP.

The land is chiefly in small holdings, running from a few up to 500 acres. There are also about five tracts of 1,000 acres each, four tracts of from 3,500 to 14,000 acres each, and one tract of about 16,000 acres.

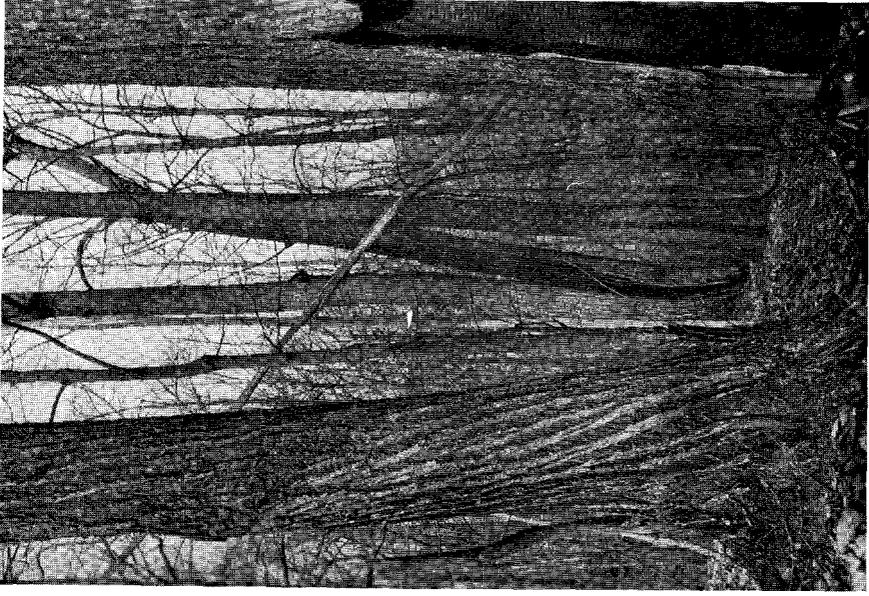
### LAND VALUES.

Cut-over land is valued at from \$2.00 to \$10.00 per acre, the average price being \$5.00. This is exclusive of the coal rights, which are valued at from \$5.00 to \$20.00 or more per acre.

In the past, land titles have been very uncertain in the county, but this condition is rapidly being improved.



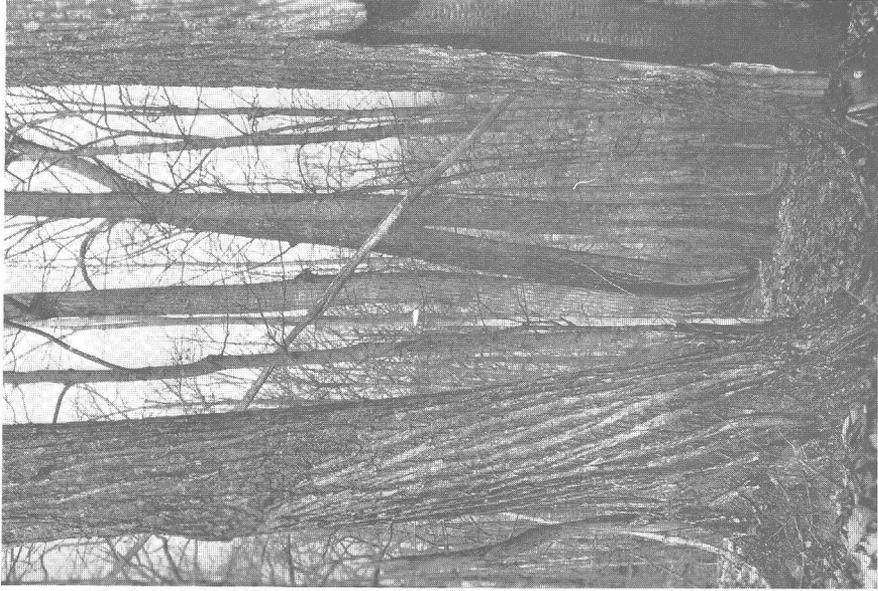
(A) Abandoned field seeding up to yellow poplar.



(B) Ridge type—A pure stand of virgin growth chestnut on upper slope. Note fire scars due to forest fires in this type. Head of Looney Creek.



(A) Abandoned field seeding up to yellow poplar.



(B) Ridge type—A pure stand of virgin growth chestnut on upper slope. Note fire scars due to forest fires in this type, Head of Looney Creek.

## LAND CLEARINGS.

Eighty per cent of Buchanan County is true forest land and should always remain forested. Some of the land now being cut over will be cleared for farming, but there will not be much increase in the amount of cleared land, because this will be offset by the abandonment of land already cleared.

Extreme care must be taken in farming the steep slopes, which, under present methods, "wear out" after from five to seven years of cultivation. It is possible to cultivate the lower, more moderate slopes indefinitely, if proper care is taken to avoid "washing" (erosion), and one of the most important factors is to see that the upper slopes are well forested, in order that they may retain the moisture during wet periods rather than shed it in immediate "run-off," which must necessarily "wash" the cleared slopes below.

*The forest trees of commercial importance in Buchanan County.*

(Arranged approximately in the order of their commercial importance.)

<i>Common Name.</i>	<i>Scientific Name.</i>
Chestnut oak .....	<i>Quercus prinus.</i>
White oak .....	<i>Quercus alba.</i>
Yellow poplar .....	<i>Liriodendron tulipifera.</i>
Chestnut .....	<i>Castanea dentata.</i>
Red oak .....	<i>Quercus rubra.</i>
Hickory .....	<i>Hicoria.</i>
Basswood or "lin" .....	<i>Tilia Americana.</i>
Beech .....	<i>Fagus Americana.</i>
Cucumber .....	<i>Magnolia acuminata.</i>
Buckeye .....	<i>Aesculus octandra.</i>
White ash .....	<i>Fraxinus Americana.</i>
Hard or sugar maple .....	<i>Acer saccharum.</i>
Black walnut .....	<i>Juglans nigra.</i>
Black oak .....	<i>Quercus velutina.</i>
Scarlet oak .....	<i>Quercus coccinea.</i>
Hemlock .....	<i>Tsuga canadensis.</i>
Red or soft maple .....	<i>Acer rubrum.</i>
White elm .....	<i>Ulmus Americana.</i>
Black locust .....	<i>Robinia pseudacacia.</i>
White walnut .....	<i>Juglans cinerea.</i>
Red gum .....	<i>Liquidambar styraciflua.</i>
Shortleaf pine .....	<i>Pinus echinata.</i>
Scrub pine .....	<i>Pinus Virginiana.</i>
Pitch pine .....	<i>Pinus rigida.</i>
Red cedar .....	<i>Juniperus Virginiana.</i>

## DISTRIBUTION OF SPECIES.

The dominant species are not the same on different watersheds. This is due partly to differences in elevation, but chiefly to differences in soil.

The original stand of poplar ran much heavier in Buchanan than in Dickenson County, while white oak forms a larger percentage of the forest stand in the latter county, and produces a higher grade of lumber. On the drainage of Garden Creek white oak predominates, while on Dismal there is more chestnut oak than white oak. The poplar alone, on Dismal and Slate creeks, averaged approximately 2,000 board feet per acre for the entire watersheds. Most of the remaining stand was rock oak and chestnut, with only a small per cent of white oak. The chestnut oak always occurs at elevations of from 2,000 feet up, on the sandy soils. On the clay soils in the southwestern part of the county white oak predominates and runs to the ridge tops. There is approximately three times as much rock oak as white oak cut in the county.

In general, the distribution of species is as follows: On the lowest elevations, along streams, hemlock is the most important commercial species. Higher up, beech, black walnut, and buckeye come in. Then white oak, red oak, cucumber, poplar, etc. Near the ridge tops, chestnut, and, finally, chestnut oak on the ridges.

#### CHESTNUT-BARK DISEASE.

A large per cent of the present stand is chestnut, and this is one of the valuable trees. It grows rapidly, sprouts well from the stumps, and produces valuable timber.

The Chestnut Blight or Bark Disease (*Endothia parasitica*), a fungous disease which has been causing widespread destruction to the chestnut in the northeastern states, and which has already killed or infected much chestnut in northern Virginia, has not reached the southwestern part of the State, so far as is known at the present time (1917).

#### FOREST TYPES.

There are three distinct forest types, namely, the Ridge type, the Slope type, and the Cove type. A bottom or stream type might also be described, but this covers only a narrow strip along the larger streams, and is not commercially important.

*Ridge type.*—This type covers approximately 67,000 acres, or 21 per cent of the entire county. As the name indicates, this type is confined to the ridges, usually occupying the driest soils. The distinctive trees of this type are the rock or chestnut oak (*Quercus prinus*) and the chestnut. The



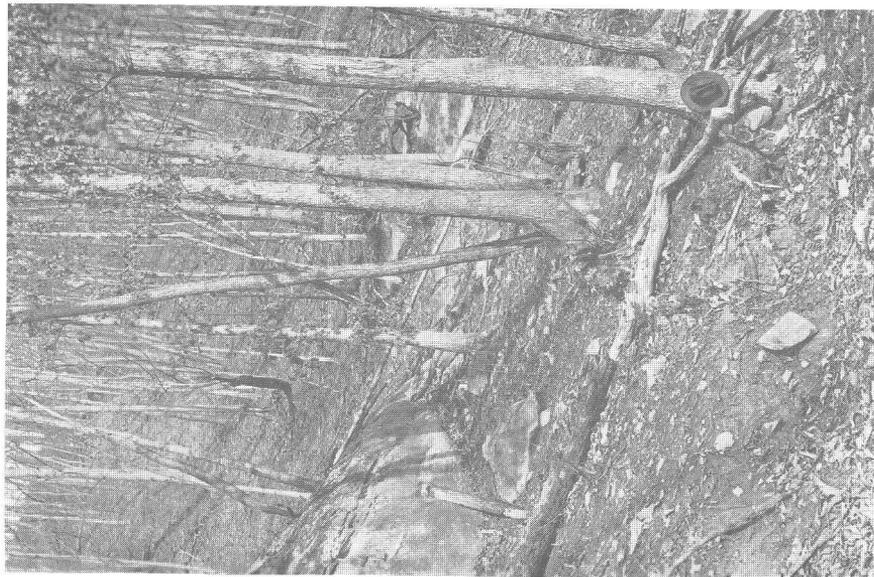
(A) Ridge type—A pure stand of virgin chestnut oak. On ridge top, head of "Six and twentymile Branch."



(B) Slope type—A young stand of white oak. Fires have destroyed all the leaf litter. Hurricane Branch.



(A) Ridge type—A pure stand of virgin chestnut oak. On ridge top, head of "Six and twentymile Branch."



(B) Slope type—A young stand of white oak. Fires have destroyed all the leaf litter. Hurricane Branch.

latter only occurs in pure stands on the lower ridges and near the ridge tops on the higher ridges. It also occurs in mixture with the chestnut oak. White oak, scarlet oak, and hickory are also common trees in this type.

The type is typical of the sandy soils and dry ridges, where the white oaks and other species cannot compete with the rock oak under the poor moisture conditions.

On the slopes the rock oak and chestnut develop long boles from 30 to 60 feet in length, with diameters of from 20 to 35 inches—the chestnut often getting much larger than this. On the driest ridges the trees are usually short-boled with large crowns. Often a 12- or 16-foot log is all that can be utilized, and many of the trees are of no commercial value whatever.

*Slope type.*—This type includes the forest on the slopes and benches. It covers approximately 153,000 acres, or 47 per cent of the entire county, and is the predominant forest type. It could be divided into many subtypes where exposure, soil conditions, etc., favor the development of one species rather than another.

White oak (*Quercus alba*) is the most important tree in this type, and reaches its best development on the benches, where the soil is deep and fertile. Southern exposures and clay soils also favor the development of this species. It is because of the clay soils that there is so much more white oak in the southwestern part of the county. In this section of the county white oak extends to the ridge tops. On northern slopes more chestnut, basswood, and mixed oaks are found in this type.

The important species of the type are: White oak, red oak, black oak, chestnut oak, chestnut, beech, hard maple, buckeye, hickory, hemlock, basswood, and elm. Black locust, scrub or spruce pine, pitch pine, and red cedar also occur, but these form a negligible part of the stand.

*Cove type.*—This type covers approximately 45,454 acres, or 14 per cent of the area of the county.

Yellow poplar (Tulip poplar—*Liriodendron tulipifera*) is the characteristic tree of the type. It reaches the largest size of any tree in southwest Virginia, and for many years was, with the exception of black walnut, the most valuable.

Basswood or lin, hickory, white oak, cucumber tree, white ash, black walnut, beech, etc., are the other species commonly found with the poplar.

This type occupies the heads of the ravines. The poplar reaches its maximum development in the coves flowing southward.

Trees from three to five feet in diameter with a height of from 120 to 150 feet are still common in the virgin stands, and trees from 10 to 12 feet in diameter with a height of 200 feet were found in the original stands.

Toward the head of the coves the poplar gives way to chestnut oak and other oaks, and it is here that the chestnut oak reaches its best development.

*Bottom type.*—This covers but a small percentage of the entire forest area, and has been thrown with the Cove and Slope types in the percentage estimate. It usually comprises a very narrow strip from 10 to 100 feet wide along the larger streams.

Commercially, hemlock is the most valuable tree. Other species commonly found in the type are: Yellow poplar, cucumber, black walnut, black gum, buckeye, red or sweet gum, soft maple, red or river birch, black birch, beech, and sycamore.

Commercially it is unimportant, because it covers a very limited area and contains many inferior species.

*Table showing portion of Buchanan County in the different forest types and classes of forest.*

Class of forest	Ridge type Acres	Slope type Acres	Cove type Acres	TOTAL Acres	Per cent of forest area	Per cent of total area
Virgin with poplar . . . . .	668	2,461	983	4,112	1.5	1.3
Virgin without poplar . . . . .	35,427	75,552	16,387	127,366	48.0	39.2
Cut-over . . . . .	31,108	74,848	28,084	134,040	50.5	41.3
Total forest area . . . . .	67,203	152,861	45,454	265,518	100	81.8
Cleared land . . . . .				58,962		18.2
Total . . . . .				324,480		100

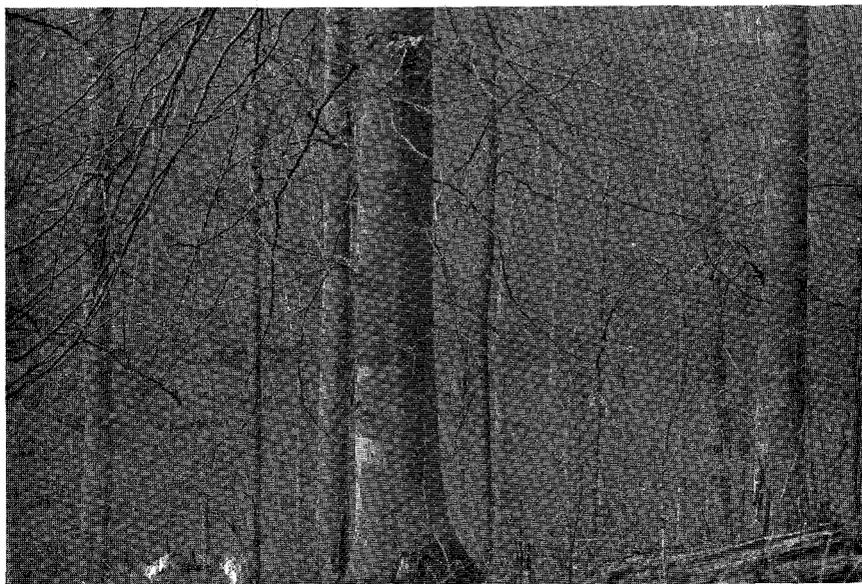
#### DISTRIBUTION OF FORESTS.

Buchanan County is essentially a timber section, and, because of the steep slopes, will always be so. Of the entire area 18.2 per cent is cleared and 81.8 per cent is in forest cover.

Much of the land classed as "cleared" has been abandoned because of the immense amount of erosion on the steep slopes. The cleared land occurs



(A) Ridge type—High Dry Ridge; Chestnut Oak and Scarlet Oak the principal species. Timber scrubby and unmerchantable. Guess Fork of Knox Creek.



(B) Slope type—Beech on lower slopes. Six and twentymile Branch.



(A) Ridge type—High Dry Ridge; Chestnut Oak and Scarlet Oak the principal species. Timber scrubby and unmerchantable. Guess Fork of Knox Creek.



(B) Slope type—Beech on lower slopes. Six and twentymile Branch.

chiefly along lower slopes and streams, although a small per cent of the broader ridges in the southwestern part of the county are also cleared. Nearly all of the upper slopes and narrow ridges are timbered.

On the steepest slopes, as well as where there are cliffs and rock outcrops, the forest extends to the stream bottoms. Many of the gentler slopes are also wooded.

### CLASSES OF FOREST.

The forests may be separated into three classes, as follows, based upon the extent to which they have been cut over:

(1) *Virgin with poplar*.—This includes all land having the original forest growth, with the possible exception of the black walnut, most of which was cut 30 years ago; 4,112 acres, or 1.3 per cent of the county, still contains the original forest stand (excepting black walnut).

Estimating an average stand of 6,000 board feet per acre, the present stand of timber in this class of forest is approximately 24,672,000 board feet.

(2) *Virgin without poplar*.—This includes all the land where only the virgin yellow poplar has been removed. It covers 127,366 acres, or 39.2 per cent of the entire county.

Much of the timber used for building purposes was poplar, but this amount is negligible compared with the immense amounts rafted annually for the last 30 years.

Excepting the upper half of Dismal and Slate creeks, practically all of the Levisa Fork drainage contains the original forest of oaks.

The "Virgin without poplar" class will average 4,000 board feet per acre over large areas; 127,366 acres, at 4,000 board feet per acre, makes the present stand of timber in this class approximately 509,464,000 board feet.

(3) *Cut-over*.—All land from which the virgin timber has been cut is thrown into this class. Some of it, cut-over twenty or more years ago, now contains merchantable timber. Most of it, however, has been burned and contains little saw timber. This class covers 134,040 acres, or 41.3 per cent of the county.

In general, it includes the Buchanan County drainage of Russell Fork, all of Knox Creek, the upper half of Dismal Creek (excepting the extreme headwaters), and the upper half of Slate Creek.

Some stands, cut-over 20 years ago, are now being timbered a second time and will cut 3,000 feet per acre. Second-growth stands will not produce the higher grades of timber in short rotations, but the increased number of trees per acre will make them yield as much lumber as the present stands of virgin timber. Most of it, however, has been held back by fires, and contains little or no merchantable material.

Where fires have not occurred the timber reproduces well after being cut-over, but much of the timber has been removed only within the last 10 years to supply the large mills. Consequently, the timber on the cut-over lands will average little—not more than 500 feet per acre. 134,040 acres, at 500 board feet, makes an approximate stand of 67,020,000 board feet.

*Table showing distribution of different classes of land and forest by number of acres on the different watersheds.*

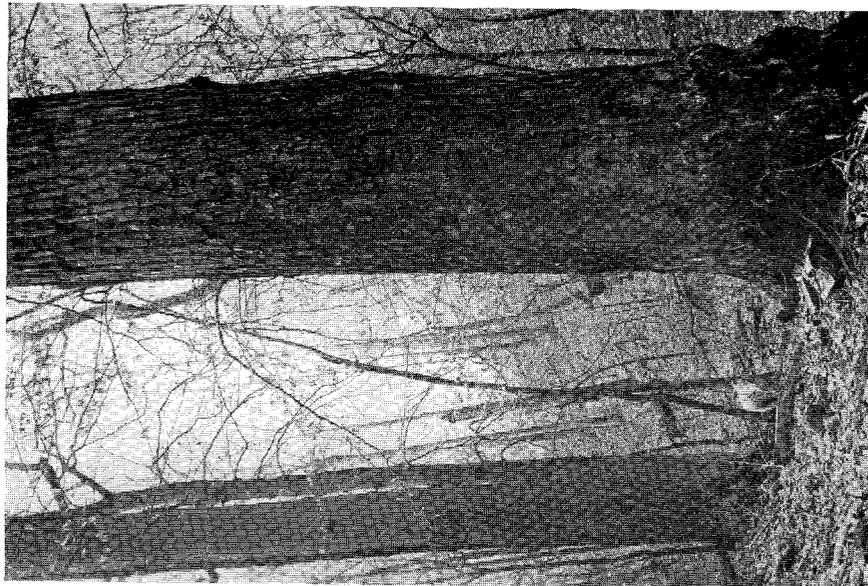
Watershed	Virgin without poplar	Virgin with poplar	Cut over	Cleared	Total
Slate Creek .....	11,631	32	11,630	4,508	26,656
Dismal Creek .....	21,810	2,208	25,167	10,624	59,809
Garden Creek .....	15,305	.....	.....	4,687	19,992
Prater Creek .....	12,918	93	.....	2,937	15,948
Rest of Levisa Fork.....	58,752	1,107	.....	12,313	72,172
Total for Levisa Fork....	120,416	3,438	36,797	35,069	194,577
Russell Fork .....	4,588	674	45,586	13,202	64,050
Knox Creek .....	414	.....	49,832	10,345	60,591
Tug Fork .....	1,948	.....	2,968	346	5,262
Total .....	127,366	4,112	134,040	58,962	324,480
Per cent of total.....	39.2	1.3	41.3	18.2	100.0

*Estimate of the present stand of timber in Buchanan County, Virginia.*

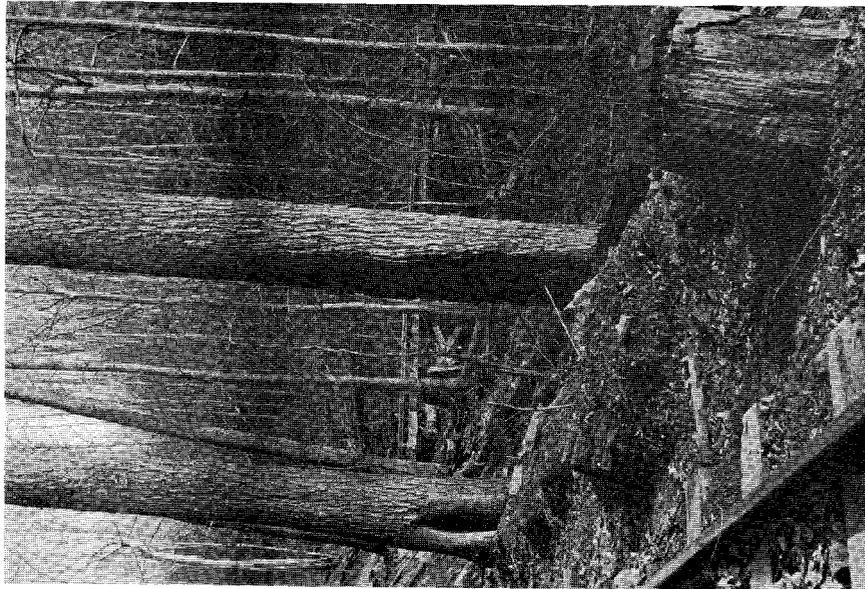
Class of forest	Acres	Average stand per acre Board feet	Total stand Board feet
Virgin with poplar .....	4,112	6,000	24,672,000
Virgin without poplar .....	127,366	4,000	509,464,000
Cut-over .....	134,040	500	67,020,000
Total.....	265,518		601,156,000

Total forest area, 265,518 acres.

Total estimated present stand of merchantable timber, 601,156,000 board feet.



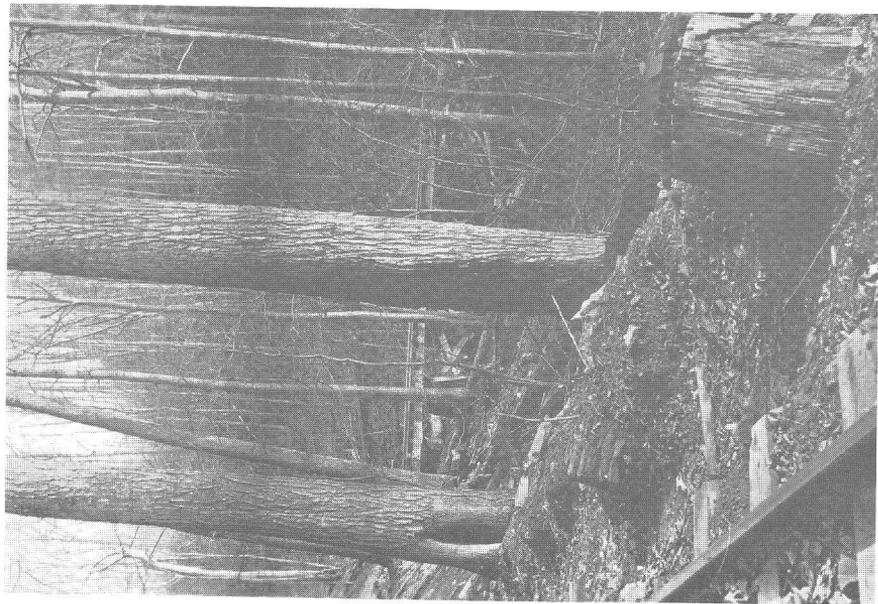
(A) Cove type—Yellow poplar trees, 5½ feet in diameter and 150 feet tall. Virgin forest. Looney Creek. Note the sheep.



(B) Red oak and poplar in cove type. Burned by repeated forest fires. Note fire scar partially grown over on oak. Hurricane Branch.



(A) Cove type—Yellow poplar trees, 5½ feet in diameter and 150 feet tall. Virgin forest. Looney Creek. Note the sheep.



(B) Red oak and poplar in cove type. Burned by repeated forest fires. Note fire scar partially grown over on oak. Hurricane Branch.

### METHODS OF LUMBERING IN THE PAST.

Until about 20 years ago, before the present logging railroads were built, the black walnut and yellow poplar were almost the only timbers cut, and they were cut to only a small extent. As in all southwest Virginia, most of the black walnut was cut and hauled to a railroad previous to the cutting of the poplar. Later, with the advent of the automobile industry, the demand for yellow poplar increased tremendously, and logs were hauled from 12 to 20 miles to the railroad or river. The high prices made it profitable to haul the timber long distances. This made poplar logging the chief industry during the period from about 30 to about 10 years ago. The logs were cut, barked, and floated out during the winter and spring freshets.

Poplar and cucumber were practically the only trees rafted, although later the white oak was frequently rafted with the poplar. The light weight of the latter would help to keep the white oak afloat. Basswood floats, but sap-stains too badly to be rafted.

Ten years ago several thousand rafts were shipped annually. They were taken to Catlettsburg, Kentucky, where they were manufactured into lumber. These rafts brought in a large annual income, which accounts for the wealth of many of the residents of Buchanan County to-day.

A large head of water was often secured by building splash dams. Many poplar logs were sent down Dismal Creek and Levisa River, and rafts are still sent down the latter. When splash dams were used the logs were floated without being rafted. Now, all logs floated out are rafted, with from 20,000 to 30,000 board feet per raft.

They are tied up until high water or "tide" comes, when they are floated to Catlettsburg, Kentucky, where they are sold. Levisa is the only stream now used for rafting, approximately 150 rafts being sent out annually.

During the period of poplar lumbering, which started about 30 years ago, all but a small per cent of the original yellow poplar was cut. Approximately 4,000 acres, or 1.3 per cent of the county, still contains the virgin poplar, but most of this will be cut in the near future.

One tract of approximately 1,100 acres, which still contains the original poplar, will average 10,000 board feet per acre.

### PRESENT METHODS OF LUMBERING.

The chief method of lumbering now carried on in the county is by means of large mills, using logging railroads for transportation of the logs to the mill and the lumber from the mill to the market. This necessitates large expenditures for improvements, including the mills, the railroads, the houses for the employees at the mills, and the logging camps. These camps are constructed of portable houses, which can be moved on flat cars when the operation is completed, or, to use the local term, "cut out."

Much of the stumpage is purchased in small tracts of from 100 to 500 or 1,000 acres, and an operating company endeavors to get all the timber on a watershed, if possible. Within 15 years all the present operations will be "cut out," if conducted in the usual way, and the original growth left will consist only of the occasional patches which the present owner refused to sell. This does not mean, however, that it is advisable for small owners to hold their timber when their section or watershed is "operated." The removal of the logging railroad makes the marketing of timber on lumbered watersheds impossible, except where it can be floated out or cut for local needs.

The usual diameter limit in the purchase contract is 12 inches on the stump. The landowner sometimes sells to a higher diameter limit, or makes exemption of a certain species, such as white oak or poplar, or sells these only to a diameter limit of 16 or 18 inches, while the other species are sold to 12 inches.

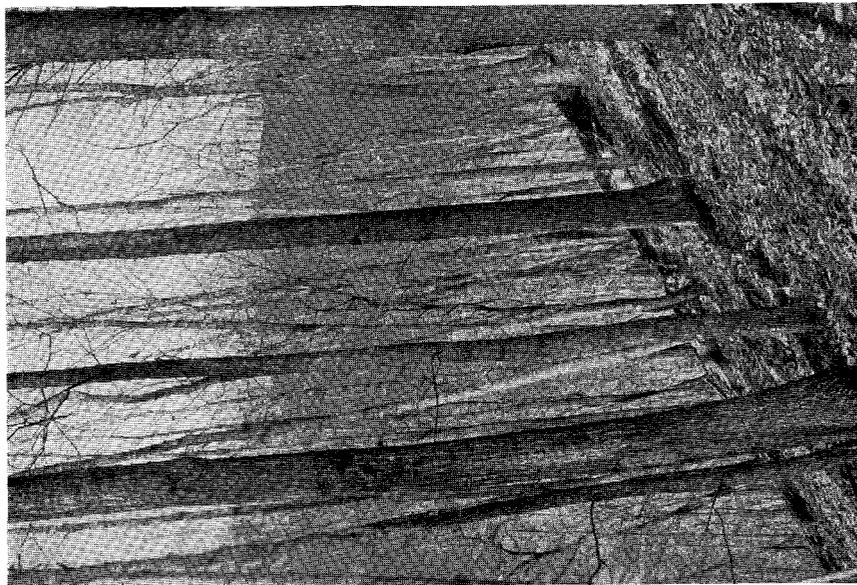
The very steep slopes make it impossible to handle logs and fell trees as carefully as in more rolling country, and, when released, logs often shoot down the steep slopes several hundred feet to the bottom of the ravine. The numerous clearings along the lower slopes make it practical to "shoot" the logs, uninterrupted, from the upper slopes to the bottom in many places. Obviously, much young growth is destroyed when the logs go through it, but this cannot be avoided.

There are at present four single-band mills and one triple-band mill (the latter being located at Putnam in Russell County, but sawing timber cut entirely in Buchanan County), and about 25 portable mills operating in the county.

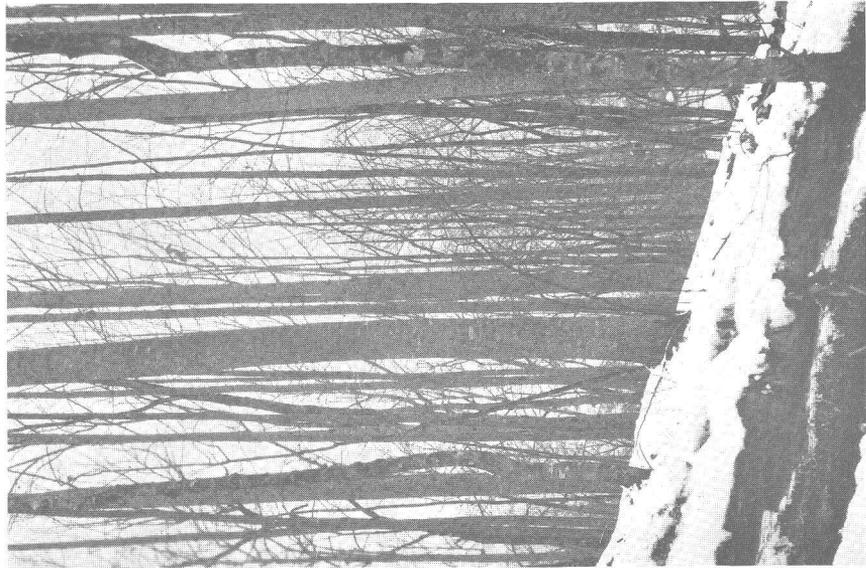
Most of the portable mills operate only part of the year, cutting from 2,000 to 5,000 board feet per day. The band mills cut about 30,000 feet per band daily.



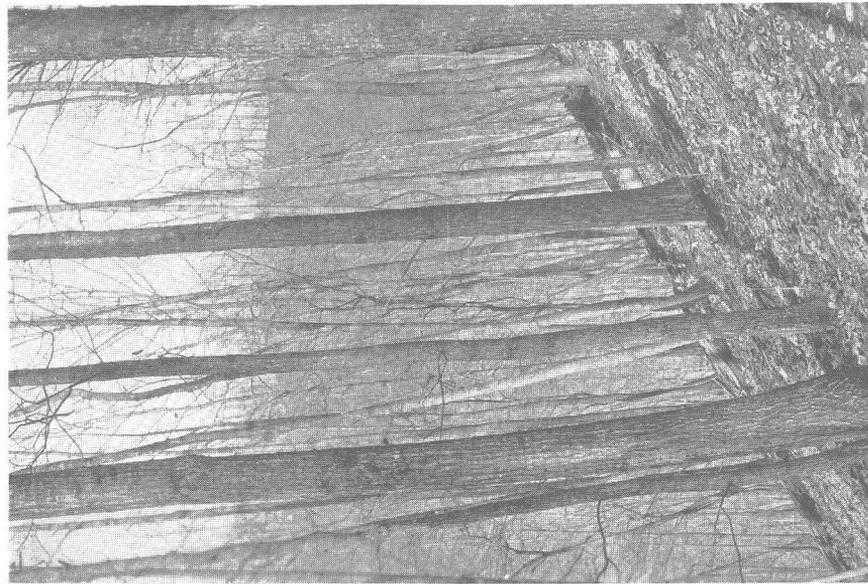
(A) Young growth poplar. Staggerweed Creek. Virginia poplar cut 15 years ago.



(B) Mixed oak and chestnut, young growth. Slope type. Sandy ridge. Lumbered 20 year ago.



(A) Young growth poplar. Staggerweed Creek. Virgin poplar cut 15 years ago.



(B) Mixed oak and chestnut, young growth. Slope type. Sandy ridge. Lumbered 20 year ago.

*Table showing number of mills classified according to their annual cut.*

Mills cutting 25,000,000 board feet per year .....	1
“ “ 9,000,000 “ “ “ “ .....	4
“ “ 1,200,000 “ “ “ “ .....	1
“ “ 900,000 “ “ “ “ .....	1
“ “ 600,000 “ “ “ “ .....	7
“ “ 300,000 “ “ “ “ .....	10
<b>Total number of mills .....</b>	<b>24</b>
Mills doing only custom sawing, etc., not included.	
24 mills—annual cut .....	<i>Board feet</i> 80,400,000
Poplar floated out .....	3,600,000
<b>Total annual cut .....</b>	<b>84,000,000</b>

*Table showing the per cent of cut of various species.*

Based on six months' run in the northern part of the county.	
Poplar .....	33.1
Basswood .....	3.5
White oak .....	43.4
Red oak .....	3.6
Chestnut .....	8.0
Ash .....	.4
Other species .....	8.0
<b>Total .....</b>	<b>100.0</b>

White oak includes 60 per cent rock oak; “others” include buckeye, beech, maple, etc.

On Dismal (eastern part of county) the present cut runs 60 per cent white oak, of which 35 per cent is true white oak and 25 per cent chestnut oak. In the extreme southern part of the county chestnut oak predominates, but is of poor quality compared with that in other sections of the county.

### THE MARKETS FOR LUMBER.

There are no wood-using industries in the county, and all lumber is shipped out. The best quartered oak and poplar go to the northeast; cheaper grades are shipped to the mining sections and westward. Previous to the beginning of the war in 1914, 20 or 30 per cent of the cut was exported. This has now been absorbed by the increased home demand.

**ROCK-OAK BARK.**

Rock-oak bark, which is very valuable for its tannin, and worth at present from \$11.00 to \$12.50 per cord or ton on the car, is utilized by only one company operating in the county.

The exceedingly steep slopes, the location of this species on the ridges, and the use of narrow-gauge railroads (making it necessary to transfer to other cars on the main line), are probably the chief drawbacks to the utilization of this valuable product. Approximately one ton of bark could be secured per thousand feet of timber cut, and so it may be roughly estimated that 2,200 tons are wasted annually.

**CHESTNUT EXTRACT-WOOD.**

The steep slopes and lack of shipping facilities make it unprofitable at present to utilize chestnut logs and defective timber for extract-wood, although this would be worth \$4.00 or \$5.00 per cord on the car.

**STUMPAGE VALUES.**

There are two ranges of stumpage prices in the county, because the timber now manufactured on Dismal Creek is taken across Sandy Ridge to the Clinch Valley division of the Norfolk and Western Railway to be shipped. This lumber has a westward freight rate of approximately \$1.20 per M board feet higher than that from Knox Creek. Hence market conditions makes it necessary to pay a lower price for stumpage in this section.

Timber is bought either by the tree, the "boundary" (tract), or by the thousand board feet. The following were the stumpage values in May, 1917:

*Dismal Creek.*

Species.	Price paid per M board feet on the stump.
White oak .....	\$ 4.00
Rock or chestnut oak .....	3.00
Chestnut .....	2.00
Poplar .....	6.00
Cucumber } .....	to
Ash (black) } .....	10.00
Basswood } .....	3.00
Hickory } .....	2.50
Hemlock .....	2.50
Birch .....	2.00
Sugar or hard maple } .....	2.00
White walnut } .....	2.00
Soft maple } .....	2.00
Beech } .....	1.00
Buckeye } .....	1.00
Black gum } .....	1.00



(A) Levisa Fork—Yellow poplar logs to be made into rafts and floated to Catlettsburg, Ky. Note the two rafts in the river.



(B) Logs "balhooting" off slopes into the bottoms, ready to be hauled to the logging railroad.



(A) Levisa Fork—Yellow poplar logs to be made into rafts and floated to Catlettsburg, Ky. Note the two rafts in the river.



(B) Logs "ballhotted" off slopes into the bottoms, ready to be hauled to the logging railroad.

The stumpage prices on Levisa, Knox, and Slate creeks are approximately \$1.00 higher than these figures.

### FOREST FIRES.

Whether the permanent forest land of Buchanan County remains the source of a constant supply of timber depends entirely upon protection from forest fires. In many sections of the county fires burn every few years, occasionally over several thousand acres. The southern slopes and dry ridges burn most frequently. The coves are usually so moist that fires spread in them very slowly and do comparatively little damage, except in very dry seasons.

The effect of forest fires is not so evident in stands of original-growth hardwoods, because they do not become so hot, and because old timber is far less susceptible to damage by fires than young timber, due to the thicker bark of the old timber. But the immense amount of brush left after lumbering makes conditions such that fires become extremely hot, with the inevitable result that all the young growth is killed or badly injured when burned over.

Recently lumbered land worth \$4.00 or \$5.00 per acre before being burned is not worth more than \$2.00 or \$3.00 after being burned, as far as its value for producing a future crop of timber is concerned.

Since fires have done serious damage to the forests in the past, and since there is danger of their increasing in frequency and severity, because of lumbering and the building of new railroads (as the coal resources are developed), it is very important that coöperative action be taken to secure fire protection. Whether 200,000 acres of surface in the county shall be productive or be worse than worthless depends directly upon such action. The landowners may coöperate to secure fire protection (preferably through an Association) or the county itself may make appropriations for this purpose in the interests of all citizens of the county. The Federal Government, through the U. S. Forest Service, and the State Government, through the State Forester, are able and eager to coöperate in this matter with any local agency, as is now being done successfully in the adjoining county of Dickenson.

### REPRODUCTION AND RATE OF GROWTH OF YOUNG STANDS.

Reproduction is good throughout the county, wherever soil and moisture conditions are reasonably favorable. The rate of development of young

growth in the various situations is in the following order: First, most rapid in the coves; second, on the lower slopes; third, on the upper slopes; fourth, on the ridges; and, fifth, on the old fields. Natural reproduction from seeds on old fields is very slow, and there are few old fields in the county on which such reproduction is taking place satisfactorily.

Unless protected from forest fires the young trees will grow very slowly. But if given such protection, the writer estimates that where conditions are favorable for the development of young growth the present cut-over areas will have a stand of 3,000 or 4,000 board feet per acre within from 25 to 40 years.

### THE FUTURE OF THE FORESTS.

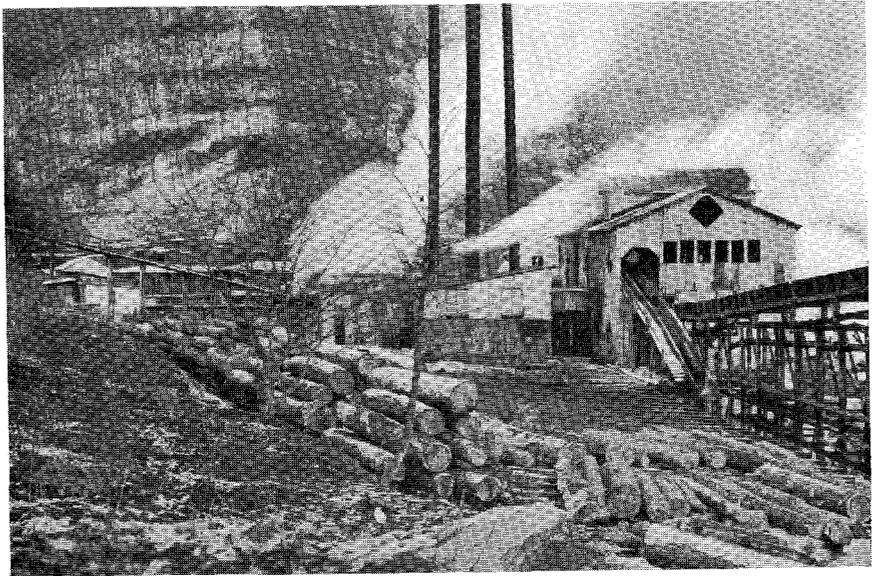
Since the county is located at the headwaters of Big Sandy River, a branch of Ohio River, it is most important that the forest cover on the slopes be maintained, because of its immense protective value in regulating the flow of water in these rivers.

The preservation of the forest in good growing condition is also most important from the standpoint of the utilization of the products of the forest. The development of the extensive coal resources of the county will require an immense amount of timber in the form of ties, mine props, etc., and a conservative forest policy should be adopted at once by all owners of coal lands.

The forest is now threatened by forest fires, which have done considerable damage in the county, and will inevitably do a tremendously greater amount of damage unless there is adopted organized protection against them. Such fires have in some cases elsewhere destroyed more timber than has been destroyed by lumbering, and, unless they are guarded against, will inevitably prevent a second crop of timber from developing, except in small patches where the soil is constantly moist. The forests are also threatened by the present methods of lumbering. The present general practice of cutting all valuable trees down to 12 inches in diameter, while trees of larger sizes of the less valuable species are left, inevitably results in an increased proportion of the less valuable trees in the future stands, and thereby greatly reduces the value of the future forests. Cutting to such a low diameter limit also postpones for many years the time at which another valuable crop can be cut.



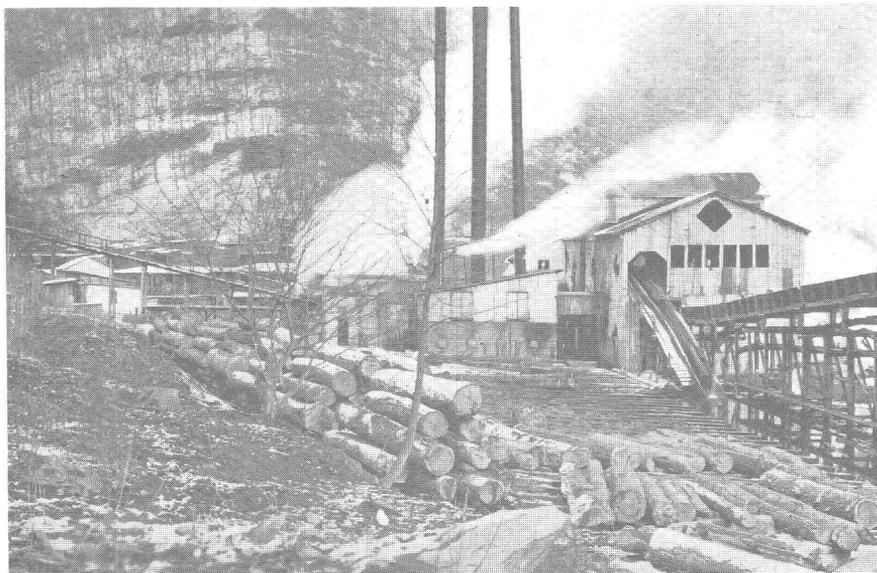
(A) After logging. Guess Fork. Note remaining young growth.



(B) Single band, hardwood mill at Hurley. Daily capacity, 30,000 board feet.  
Note train of logs to the left; log pond to the right.



(A) After logging. Guess Fork. Note remaining young growth.



(B) Single band, hardwood mill at Hurley. Daily capacity, 30,000 board feet.  
Note train of logs to the left; log pond to the right.

**THE NECESSITY OF MORE CONSERVATIVE CUTTING.**

When the poplar operations described under the heading "The Methods of Lumbering in the Past" (page 259) were carried on many of the owners sold only the trees 18 inches and over in diameter, measured inside the bark on the stump. This amounted practically to a "selection" cutting, and ordinarily left a good stand of young growth and seed-trees, and is the reason why the present forests from which the poplar was cut a few years ago are in fairly good condition. On the other hand, in the present operations, trees of the valuable species are usually cut to a diameter limit of 12 inches. This low limit is entirely to the disadvantage of the owner. Trees from 12 to 16 inches in diameter are increasing more rapidly in volume than at any other stage in their growth. It also costs more per thousand board feet (in fact, as between different sizes of logs, in some cases nearly twice as much) to cut and manufacture logs under 16 inches in diameter than larger logs. Since the average log in a tree is much smaller than the diameter of the tree near its base it follows that the cost of cutting and manufacturing logs from trees under 16 inches in diameter is out of all proportion to that of cutting and manufacturing logs from trees over 16 inches in diameter per thousand board feet of lumber secured. Consequently, the operator cannot afford to pay as high a price per thousand board feet for small trees. Small logs also produce only the lower grades of lumber, which sell at a low price compared with the higher grades secured from larger logs. It is evident that 12 inches (and even 14 inches) is too low a diameter limit, for the following reasons: (1) It robs the forest stand of its most productive timber, the growing capital; (2) it costs much more per thousand board feet to log and manufacture small trees; (3) they produce principally the lower and cheaper grades of lumber when manufactured; (4) the amount of lumber contained in small trees is very small, and the owner secures little more in the case of the forests of Buchanan County by selling the trees to a diameter limit of 12 inches than he would if he sold to 16 inches; (5) the owner could cut over his forest stand again within 10 or 20 years if it were only cut to a diameter limit of 16 inches, whereas if he cuts to a limit of 12 inches he will be obliged to wait 30 or 40 years for another cut; and (6) by cutting more conservatively the forest would not be cleared, therefore the soil would not dry out so quickly, the danger of fires would be decreased, and conditions would be more favorable for the growth of young timber.

The least valuable species, namely, beech, buckeye, soft maple, and black gum, should be cut to as small sizes as can be profitably utilized, but for all valuable species the present diameter limit removes the timber before it is financially mature.<sup>1</sup> It should not be less than 16 inches on the stump, and perhaps 18 inches in the case of the most valuable species, namely, poplar, oak, basswood, cucumber, and ash. It is evident that cutting the beech and other poor species to a lower diameter than the better species will considerably increase the percentage of the better species in the next cut.

An exception must be made to the recommended diameter limit of 16 inches in the case of stands in which the use of this limit would leave practically no thrifty trees below 16 inches in diameter. Openings should never be made larger than half an acre in area. To avoid this an occasional seed-tree should be left. There should be left at least two or three seed-trees per acre, well distributed through any openings. These seed-trees should be of the best species, poplar, oak, basswood, cucumber, or ash, but need not be large, valuable trees. They should be only average-sized trees, with well-developed crowns, capable of scattering numerous seeds and of living until the next cut.

#### **HOW THE LUMBER INDUSTRY CAN BE MADE A PERMANENT BUSINESS.**

The cost of erecting a large mill makes a 15- or 20-year "run" necessary for profitable operation. The operating companies have, therefore, before building the large mills, bought up enough standing timber to give them a 15- or 20-year "run" under the present conditions. At the end of the 15- or 20-year period they will be obliged under the present conditions to abandon the operation. It is evident, therefore, that this method of operation involves a large charge for deterioration. If cutting were done only to a 16-inch diameter limit in the case of the more valuable trees, and to as low a limit as would be profitable in the case of the less valuable trees, the companies which have now provided timber enough for a 15- or 20-year "run" could, at the end of that period, begin cutting again in the part first cut over, and could continue on this basis indefinitely, assuming that the cut-over land will receive reasonably good protection from fire.

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<sup>1</sup> A tree is not financially mature until its rate of growth has declined so much that it no longer exceeds or equals the accepted rate of interest on the present stumpage value of the tree.

This statement is conservative, as is shown by the following figures: The average stand of timber in Buchanan County is 4,000 or 5,000 board feet per acre, which requires approximately 35,000 acres of such timber for the full run of a single-band mill with an annual capacity of 9 million board feet. There are approximately 265,000 acres of land now in forest or brush in Buchanan County. Assuming that 20 per cent of this land may still be cleared, there remains a minimum of 211,000 acres of permanent forest. This is a very conservative figure, since 20 per cent added to the present clearings would make 38 per cent of the area of the county cleared, which is hardly a possibility because of the very steep slopes.

Two hundred and eleven thousand (211,000) acres of forest at 35,000 acres per mill would make a full run for six single-band mills, and there are seven bands securing their lumber in the county to-day. Cutting to a conservative limit, making possible a cut every 20 years, would give these mills an indefinite run. To be very conservative and allow for a slightly decreased cut in the present operations, due to a 16-inch diameter limit instead of a 12-inch diameter limit, it would be possible to discount these figures 50 per cent, and still allow a constant run for three mills with a total annual cut of 27 million board feet. Based on the assumed permanent area of forest land, 211,000 acres, this would require an annual growth of only 128 board feet per acre, which is very low, since good management of timber land will easily produce an annual growth of 300 board feet per acre.

It is evident, therefore, that if the sound business principles of forestry are applied and the forests are protected from fire, they can be made to yield a large permanent annual cut of timber, which will be a source of much revenue to the people of the county, and will be indispensable when the coal resources are developed; but that in the absence of fire protection and good management the forests will inevitably deteriorate and become practically nothing but a barren waste.

#### SUMMARY.

(1) *Location and area.*—Buchanan County is situated in the extreme southwestern part of the State. Its area is 324,480 acres, or 507 square miles.

(2) *Topography and drainage.*—The topography is exceedingly rough and broken. The valleys are very narrow, the slopes extremely steep, and the ridges sharp.

The principal streams are Levisa River, with its various tributaries, and part of Russell Fork. These streams are tributaries of Big Sandy River, which flows into Ohio River.

(3) *Transportation*.—There is no standard-gauge railroad in the county, but there has been recently constructed a narrow-gauge road connecting Grundy, the county-seat, with the Norfolk and Western Railroad, at Devon, West Virginia.

(4) *Population*.—The population of the county is about 12,000. Grundy, the county-seat, has about 250 people.

(5) *Industries*.—The county is “undeveloped.” The entire surface is underlain with valuable coal deposits, which are beginning to be developed. Lumbering is the principal industry. Hardly sufficient crops are raised to serve the local needs.

(6) *Land ownership*.—The land is chiefly in small holdings, from a few up to 500 acres. The largest single tract covers about 16,000 acres.

(7) *Land values*.—Cut-over land is valued at from \$2.00 to \$10.00 per acre, the average price being \$5.00. This is exclusive of the coal rights, which are valued at from \$5.00 to \$20.00 or more per acre.

(8) *Land clearings*.—Only 18.2 per cent of the land is cleared at present. Only slightly more than this should ever be cleared, because the slopes are so steep that cleared fields soon “wash” and “wear out” under ordinary methods of cultivation.

(9) *Important trees*.—Rock oak or chestnut oak and yellow poplar are the most important trees. Others are white oak, chestnut, red oak, and other hardwoods. Evergreens are of no importance.

(10) *Forest types*.—The forest may be divided into three types—ridge, slope, and cove—the occurrence of each being indicated by its name. There are characteristic species composing each.

(11) *Extent of past cutting*.—The forest may be divided into three classes based on the extent to which it has been cut over, namely: (a) Virgin with poplar, 1.3 per cent of the area of the county; (b) Virgin without poplar, 39.2 per cent of the area of the county; (c) Cut-over, 41.3 per cent of the area of the county. (The remaining 18.2 per cent is cleared land.)

(12) *Stand of timber*.—The total stand of merchantable timber in the county is estimated to be 600 million board feet.

(13) *Methods of lumbering in the past.*—During the period from about 30 to about 10 years ago black walnut logs were hauled long distances to railroads, and poplar and cucumber logs were floated in great numbers down the streams to Catlettsburg, Kentucky. Almost all of the original yellow poplar has been cut for this purpose. Some white oak logs were also floated with the poplar by means of rafts.

(14) *The present methods of lumbering.*—Lumbering is conducted at present chiefly by large mills and logging railroads, each operation being necessarily confined to one watershed and the operators endeavoring to purchase all the timber on that watershed. The stumpage is usually purchased in small tracts and usually all trees are sold above a diameter limit of 12 inches on the stump. If the business continues to be conducted in this way all the present operations will be cut out within 15 years.

(15) *Present annual cut.*—There are at present 24 mills of various sizes (not including those doing only custom sawing) cutting timber from the county. The present annual cut of the mills is about 80 million feet and about 4 million feet of poplar are floated out, a total annual yield of about 84 million feet. The principal species cut are white oak (including rock oak) and poplar.

(16) *The market for lumber.*—There are no wood-using industries in the county and all lumber is shipped outside. Chestnut-oak bark and chestnut extract-wood are not utilized.

(17) *Stumpage values.*—The average stumpage values on Dismal Creek in the spring of 1917 were as follows: Poplar, cucumber, and ash, from \$6.00 to \$10.00 per thousand feet; white oak, \$4.00; rock or chestnut oak, basswood, and hickory, \$3.00; hemlock, \$2.50; chestnut, birch, sugar or hard maple, soft maple, and white walnut, \$2.00; beech, buckeye, and black gum, \$1.00. Due to more favorable location with respect to transportation, the stumpage prices on Levisa, Knox, and Slate creeks are about \$1.00 higher than the above figures.

(18) *Forest fires.*—In many sections of the county forest fires burn every few years, occasionally being of large extent. They are particularly severe following lumbering, and will inevitably become so severe following the present intensive lumbering operations as to prevent the growth of another stand of timber of any value, unless action is taken to prevent them. There is at present no organized protection, although coöperation on the part of the Federal and State governments is available and has been offered.

(19) *Reproduction and rate of growth of young stands.*—Reproduction is good where conditions are favorable, and, if protected from forest fires, it is estimated that the present cut-over areas will have a stand of 3 or 4 thousand board feet per acre within from 25 to 40 years.

(20) *The future of the forests.*—The maintenance of the forests in thrifty condition is important for the regulation of the flow of water in Big Sandy and Ohio rivers, and also as a source of needed wood products, both for the general market and also especially for local use when the coal resources of the county are developed.

The forests are now threatened by forest fires, control of which is absolutely necessary, and by cutting the valuable species to too small sizes, which will decrease the percentage of valuable species in the succeeding forests, and will postpone by about 20 years the time when the forests can be cut again (even if protected from fire).

(21) *The necessity of more conservative cutting.*—It is very bad policy for an owner to sell trees of the most valuable species (poplar, oak, basswood, cucumber, and ash) to as small sizes as 12 inches. The limit should be not less than 16 inches. The less valuable species should be sold to as small sizes as are merchantable.

Cuttings should never be so heavy as to leave openings larger than half an acre in area, even if it is necessary to leave trees about 16 inches in diameter. Such seed-trees should be two or three to the acre, well distributed through any openings, and should be of the best species, thrifty, with developed crowns, but of only medium size.

(22) *The lumber industry can be made a permanent business.*—There are at present seven large mills manufacturing timber cut in the county, all of which, under the present methods of operation, will be obliged to go out of business after 15 or 20 years, when their present operations are "cut out." But if the cut-over forests are protected from fire, and cutting is done in the way described above, it is a conservative statement to say that the timber will grow so fast that these mills will be able to get timber enough from the same land to run indefinitely. If the forests are not protected from fire and managed according to the sound business principles of forestry they will inevitably deteriorate until they are practically worthless for any purpose.

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TOPOGRAPHIC MAP  
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BUCHANAN COUNTY  
VIRGINIA

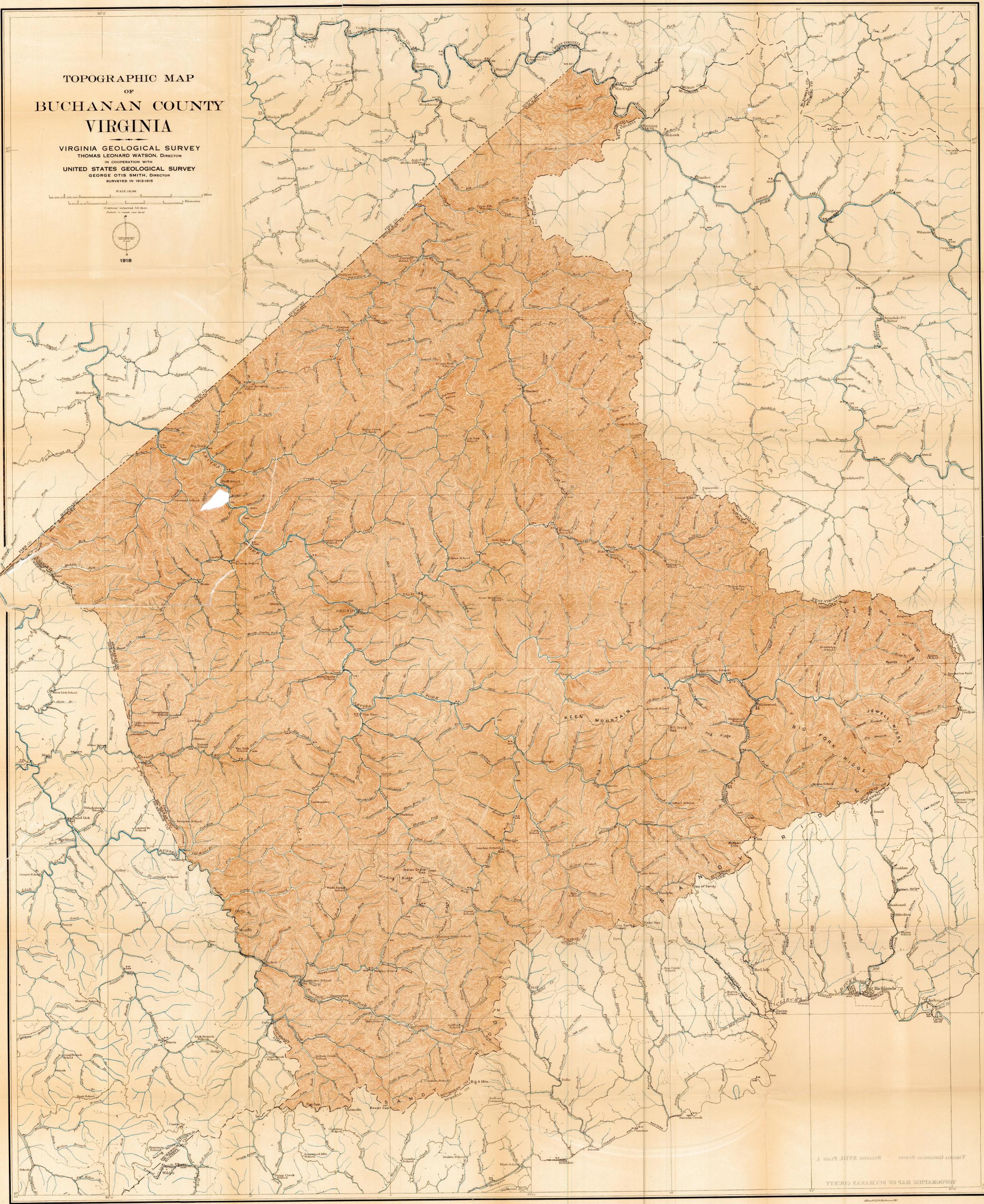
VIRGINIA GEOLOGICAL SURVEY  
THOMAS LEONARD WATSON, DIRECTOR  
IN COOPERATION WITH  
UNITED STATES GEOLOGICAL SURVEY  
GEORGE OTIS SMITH, DIRECTOR  
SURVEYED IN 1913-1915

SCALE 1:62,500  
Miles  
Kilometers

Contour Interval 50 Feet  
Feet or more near base



1918



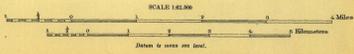
TOPOGRAPHIC MAP OF BUCHANAN COUNTY  
RICHMOND, VIRGINIA  
1918

VIRGINIA GEOLOGICAL SURVEY  
**GEOLOGIC MAP**  
 OF  
**BUCHANAN COUNTY**  
**VIRGINIA**

BY  
 HENRY HINDS, T. K. HARNSBERGER, C. A. DAVIDSON,  
 AND C. M. BAUER

1918

Surveyed in 1913-1916  
 in cooperation with the U. S. Geological Survey



**EXPLANATION**

- Wise formation  
 (sandstone and shale, including  
 the Clinch, Clinch, and  
 Clinch shales, and other  
 shales)
- Glasgow formation  
 (at top) and  
 Norton formation  
 above Kennedy coal bed  
 (sandstone and shale, including  
 the Clinch, Clinch, and  
 Clinch shales, and other  
 shales)
- Norton formation  
 below Kennedy coal bed  
 (sandstone and shale, including  
 the Clinch, Clinch, and  
 Clinch shales, and other  
 shales)
- Lee formation  
 (sandstone, shale, and coal)
- Unconsolidated  
 formations  
 (clay, sand, gravel, and  
 other loose materials)
- Martinsburg  
 (shale, sandstone, and  
 other rocks)
- Rockwood formation  
 (sandstone and shale)
- Clinch sandstone  
 (thin portion)
- Flye sandstone  
 (sandstone and shale)
- Faults
- Coal outcrops  
 (see list below)
- Structure contours  
 showing elevation of  
 Clinch Dam coal bed  
 from above sea level.  
 (Contour interval 50  
 feet)
- Shipping coal mine  
 with text reference  
 number.
- Small local coal mine  
 or prospect with  
 text reference number.
- Diamond drill  
 prospect hole with  
 text reference number.

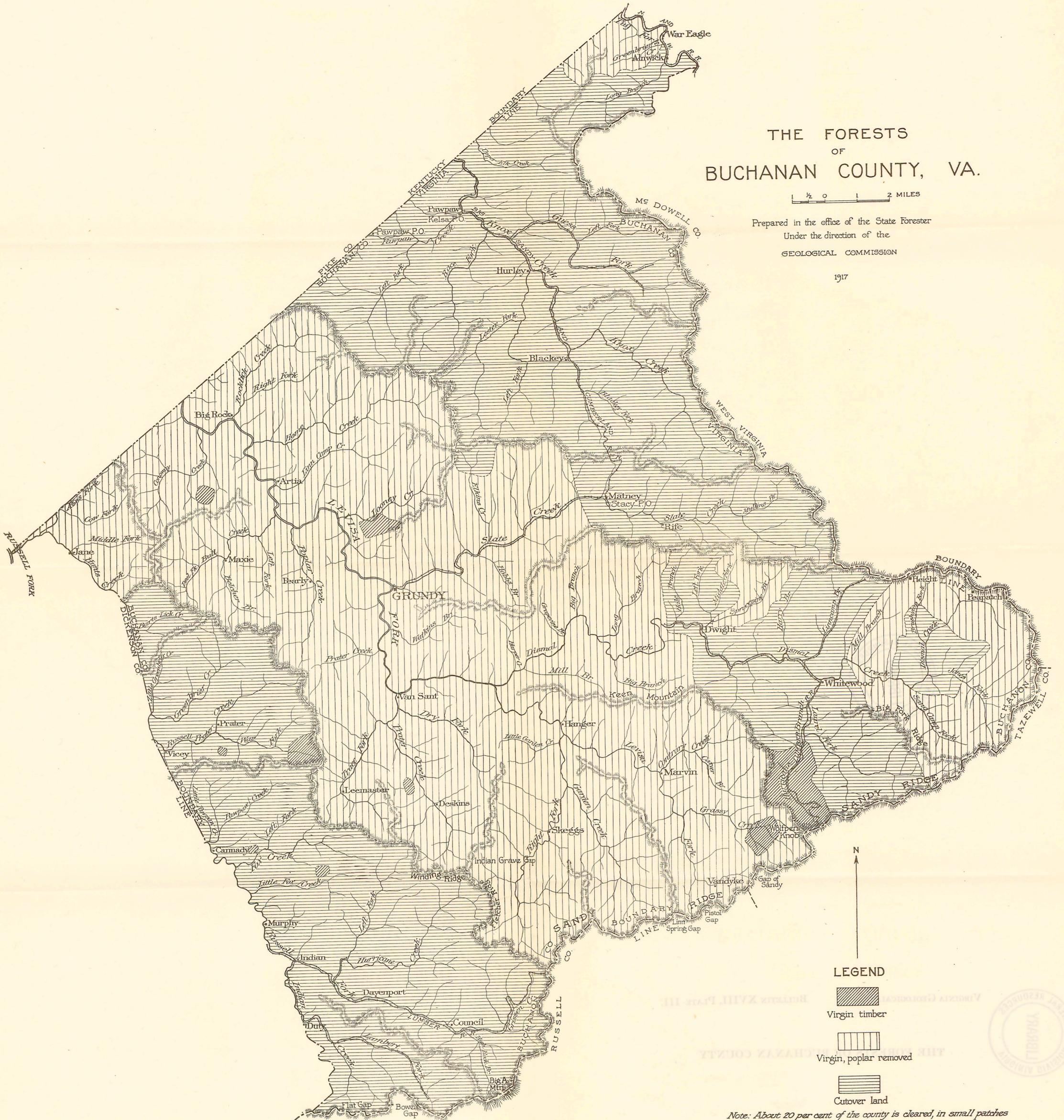
- 12—Cedar Grove
- 13—Campbell Creek
- 14—Clintonwood
- 15—Dingle
- 16—Bishop Dam
- 17—Upper Banner
- 18—Lower Banner
- 19—Kennedy
- 20—Bacon
- 21—Jackson
- 22—Tiller

# THE FORESTS OF BUCHANAN COUNTY, VA.

1/2 0 1 2 MILES

Prepared in the office of the State Forester  
Under the direction of the  
GEOLOGICAL COMMISSION

1917



## LEGEND

-  Virgin timber
-  Virgin, poplar removed
-  Cutover land

Note: About 20 per cent of the county is cleared, in small patches