VIRGINIA GEOLOGICAL SURVEY
UNIVERSITY OF VIRGINIA
THOMAS LEONARD WATSON, PH. D.
DIRECTOR

Bulletin No. XXI

The Geology and Coal Resources of Dickenson County, Virginia

BY

ALBERT W. GILES

PREPARED IN CO-OPERATION WITH THE
UNITED STATES GEOLOGICAL SURVEY

CHARLOTTESVILLE
UNIVERSITY OF VIRGINIA
1921

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LETTER OF TRANSMITTAL

VIRGINIA GEOLOGICAL SURVEY,
UNIVERSITY OF VIRGINIA,
CHARLOTTESVILLE, September 1, 1921.

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. XXI of the Virginia Geological Survey Series of Reports, a manuscript and illustrations of a report entitled "The Geology and Coal Resources of Dickenson County, Virginia," by Professor Albert W. Giles.

This report, prepared by the Virginia Geological Survey in coöperation with the United States Geological Survey, is the fifth one of a series of detailed reports published by the Virginia Geological Survey on the coal resources of southwest Virginia, under coöperative agreement of the State and Federal Surveys, and the third one of the county reports. It is accompanied by topographic and geologic maps of Dickenson County.

Dickenson County has an enormous quantity of bituminous coals of great purity and value, the development of which should add much to the wealth of Virginia. It is my opinion that this report will be extensively consulted and will greatly aid in the development of the vast coal resources of the county.

Respectfully submitted,

THOMAS L. WATSON,
Director.

THE GEOLOGY AND COAL RESOURCES OF DICKENSON COUNTY, VIRGINIA

By Albert W. Giles.

INTRODUCTION

Location and importance of the county.—Dickenson County is in southwest Virginia (see Fig. 1), and is bounded on the north by Pike County, Kentucky, on the northeast by Buchanan County, Virginia, on the east by Buchanan and Russell counties, Virginia, on the southeast and south by Russell and Wise counties, Virginia, on the west by Wise County, Virginia, and on the northwest by Pike County, Kentucky.

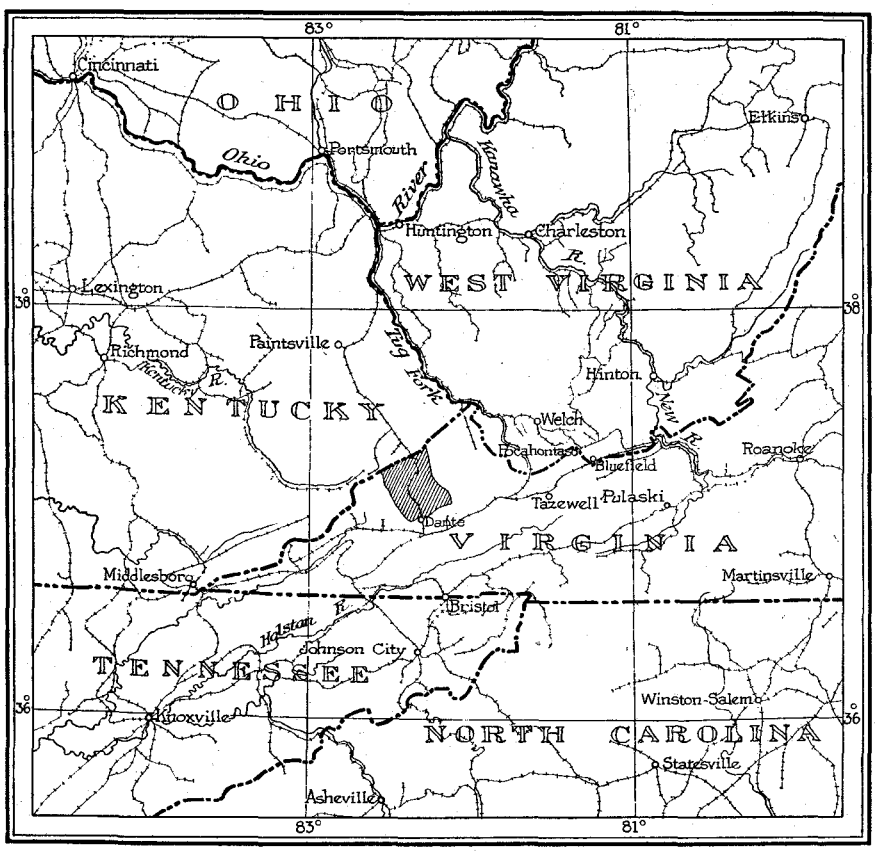

Fig. 1.—Index map showing the location of Dickenson County (shaded area).

The area of the county is 332.2 square miles, or 212,600 acres, computed from recent topographic maps of the United States and Virginia Geological Surveys. The county is composed of the following topographic quadrangles: Bucu, Carterton, Clintwood, Coeburn, Hurley, Pound, and Regina. Nearly all of the Clintwood quadrangle lies within the boundaries of the county, and 54 square miles of the county are contained in the Bucu quadrangle. About 17 square miles of the Regina quadrangle are in Dickenson County, 8 square miles of the Coeburn, and 22 square miles of the Pound. About one-quarter of a square mile of the Hurley and about one-tenth of a square mile of the Carterton quadrangles are embraced within the confines of the county.

The primary purpose of the geological survey which constitutes the basis of this report was to obtain detailed information of the extensive coal resources that the county was known to contain. The geology of that part of the county not having a direct bearing on the coal beds has received secondary consideration. The county lies on the southeast border of the central part of the great Appalachian coal field and contains in beds of 14 inches or more in thickness, about 6,900,000,000 tons of high-grade, coking bituminous coal. This great resource of coal is practically untouched. Until recently the only mines were small, furnishing coal for purely local consumption. At the present time large operations are in progress in several places in the county, and the coal is being shipped over the Carolina, Clinchfield and Ohio Railway, recently constructed through the central part of the county.

Method of geologic work.—The western part of Dickenson County included in the Pound quadrangle was surveyed geologically by Charles Butts[1] in 1912.

During 1913 and 1914 Henry Hinds[2] and T. K. Harnsberger surveyed the larger part of the county in preparation for their report on the coal resources of the Clintwood and Bucu quadrangles.

The geological work was completed during the summer of 1919 by Albert W. Giles and C. K. Wentworth who surveyed the southern part of the county included in the recently published map of the Coeburn quadrangle.

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

[2] Hinds, Henry, The coal resources of the Clintwood and Bucu quadrangles, Virginia: Va. Geol. Survey Bull. XII, 1916.

The expense of both the geologic and topographic work has been shared by the Virginia Geological Survey and the United States Geological Survey. The Virginia Geological Survey was represented in the geologic work by Mr. Harnsberger and the author and the United States Geological Survey by Messrs. Butts, Hinds, and Wentworth. David White, Chief Geologist of the United States Geological Survey, had general supervision of the work, and added materially to its value by his identification of fossil plants and critical examination of coal analyses. During the summer of 1919 George H. Ashley of the United States Geological Survey spent a week in the field with C. K. Wentworth and the author, and he has contributed largely of his time and experience in furthering the field work and in the preparation of this report.

The earlier geological work of Hinds and Harnsberger was done at the same time as a detailed coöperative topographic survey in charge of J. I. Gayetty, and the topographic corps rendered valuable aid in determining the location and elevation of a number of coal openings and exposures. By this method the geologists had available many more instrumentally determined elevations than appear on the printed maps, but were handicapped in making locations by the lack of completed and adjusted topographic sketching.

During the summer of 1919 the author had the advantage of the published topographic maps of the United States Geological Survey in the completion of the geological work and in the general geologic reconnaissance of the county.

Geologic profiles were made of all roads and paths and all reported coal openings were visited, but it was soon seen that the lack of well-defined stratigraphic markers, the heavily timbered condition of the country, the rarity of natural coal exposures, and structural irregularities made additional work necessary. Sections 400 to 800 feet long were, therefore, measured at intervals of half a mile to a mile up the sides of all the principal valleys. The elevations of the principal exposures were usually read both in going up and coming down, and the barometer was frequently checked at stadia stations to correct errors arising from variations in atmospheric pressure. It may be confidently asserted that the work was more detailed than any other that has been conducted by public geological surveys in the coal fields of the Appalachian region.

Acknowledgments.—In the preparation of this report W. D. Tyler of the Clinchfield Coal Corporation has again permitted the use of the engineering records of his office. He has furnished the logs of many diamond-

drill holes (Pls. IX and X), maps of accurate transit surveys of coal outcrops, and measurements of thickness of coal beds in hundreds of prospect pits. These data were available for the most important parts of the Russell Fork drainage basin, and for all of the Clinch River drainage basin within the county. Outcrop maps and coal measurements, chiefly in the Levisa Fork drainage basin, were furnished by E. V. d'Invilliers and J. B. Dilworth, and by Charles Catlett.

The only publication describing the geology and coal resources of the county is the result of a hurried reconnaissance survey by R. W. Stone in the Russell Fork area,[1] and this has been drawn upon for several coal measurements. The Tazewell and Bristol folios of the U. S. Geological Survey, by M. R. Campbell, describing adjacent areas on the east and south, respectively, have been of material assistance.

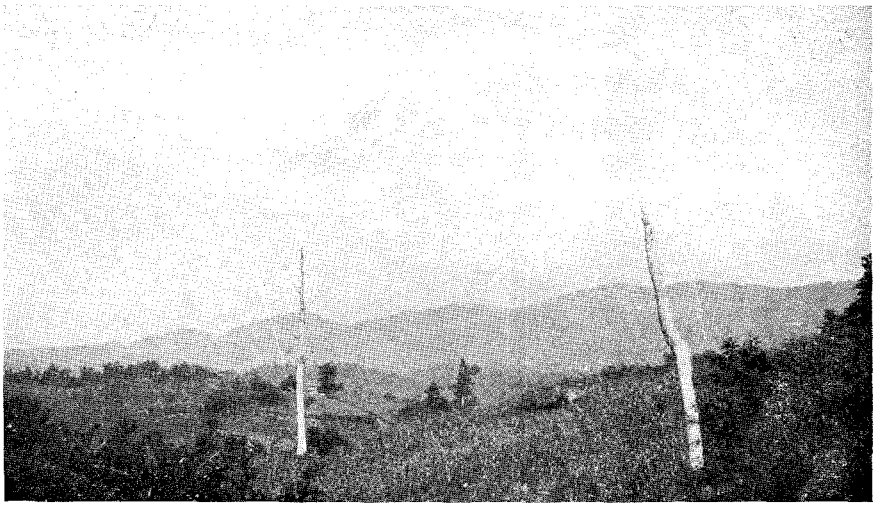
GEOGRAPHY.

TOPOGRAPHIC FEATURES.

Land surface.—The region represents a plateau surface deeply and maturely dissected by streams. It is so extremely rugged that it may be designated as mountainous. Flat lands even a few acres in extent are rare and valley slopes, though not precipitous, are nearly everywhere very steep. The principal water courses are only a few miles apart and are separated by ridges that rise 500 to 1,000 feet above them. The valleys are deep, narrow, and V-shaped, with little or no flat bottom lands. Some valleys, notably those of Russell Fork and Fryingpan Creek, are remarkably straight for long distances; others, notably those of Pound and Cranesnest rivers, are winding, so that water in the streams travels a long distance between points not far apart. The ridges are steep sided, winding, and very irregular in horizontal outline, with many side spurs. Most of the few small flat areas in the region are on the divides, but by far the greater part of the ridge tops are very narrow. The heights of neighboring ridges are approximately the same in most districts.

The maximum relief of Dickenson County is 2,233 feet, the lowest point being where Russell Fork crosses the State boundary into Kentucky, at an elevation of 904 feet above sea level, and the highest point being the triangulation station on Pine Mountain near Jesse Gap, at an elevation of 3,137 feet. The most conscipuous topographic feature of the county

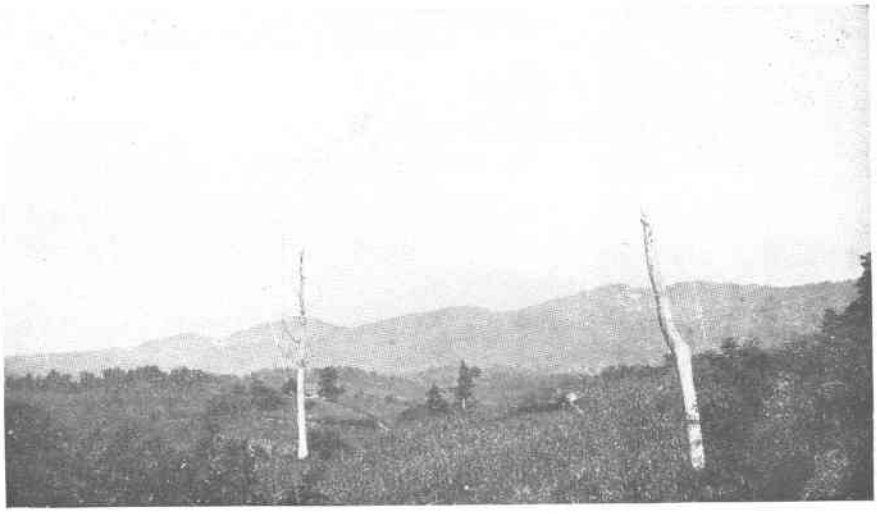
[1] Stone, R. W., Coal resources of the Russell Fork basin in Kentucky and Virginia: U. S. Geol. Survey Bull. 348, 1908.



(A) View of Pine Mountain from ridge near the mouth of Pound River.

(B) View of Pine Mountain looking northwest from Big Ridge.

PLATE III.—VIEWS OF PINE MOUNTAIN.



(A) View of Pine Mountain from ridge near the mouth of Pound River.

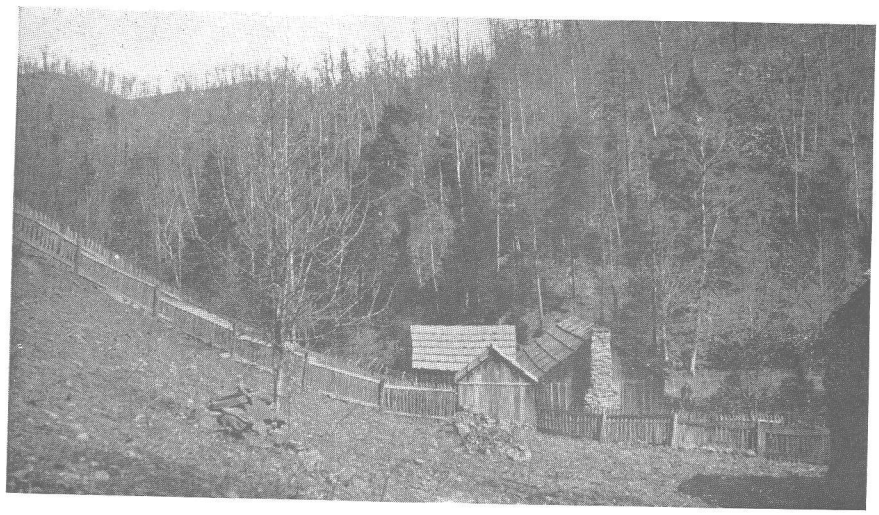
(B) View of Pine Mountain looking northwest from Big Ridge.

PLATE III.—VIEWS OF PINE MOUNTAIN.

(A) View near Lick Creek.

(B) View on Georges Fork.

PLATE IV.—TYPICAL VIEWS OF THE HOMES IN DICKENSON COUNTY WITH THEIR SMALL CLEARINGS.



(A) View near Lick Creek.

(B) View on Georges Fork.

PLATE IV.—TYPICAL VIEWS OF THE HOMES IN DICKENSON COUNTY WITH THEIR SMALL CLEARINGS.

is Pine Mountain, locally known as "Cumberland Mountain." Pine Mountain constitutes the boundary between Virginia and Kentucky, a conspicuous feature from nearly every high point in Dickenson County, with its long, nearly straight, serrated sky-line. It extends from Russell Fork on the northeast into Tennessee on the southwest. The southern slopes of the mountain are long and comparatively gentle, but the northern slopes are very steep and descend a vertical distance of nearly 2,000 feet between the mountain crest and Elkhorn Creek, in Kentucky, a distance of less than 1½ miles.

There are several other ridges that deserve special mention. Sandy Ridge is a conspicuous feature that forms the divide on the north side of the Clinch River drainage basin, closely paralleling or actually forming the Dickenson-Russell counties boundary. It is nearly as high as Pine Mountain. Big Ridge extends from Sandy Ridge northeastward to the mouth of Pound River, forming the divide between Cranesnest and McClure rivers.

The grandest scenic feature of the county is the gorge through Pine Mountain which Russell Fork has carved in its northward flow into Kentucky. The Breaks of Sandy, as the gorge is called, is visited annually by thousands of tourists and campers. The gorge has been utilized in the construction of the Carolina, Clinchfield and Ohio Railway, and an excellent view of its magnificent scenery may be obtained from the car windows of passenger trains on this road.

Drainage.—The streams of Dickenson County are tributary to two great drainage systems. Those on the south side of Sandy Ridge flow into Clinch River, which joins the Tennessee, a river that flows as far south as Alabama and then turns west and north to the Ohio. Streams north of Sandy Ridge are tributary to Russell Fork of the Big Sandy River and reach the Ohio by a direct northerly route. The largest tributaries of Russell Fork are Pound, Cranesnest, and McClure rivers. Only the upper parts of moderately large creeks belonging to the Clinch River drainage system are included in the county.

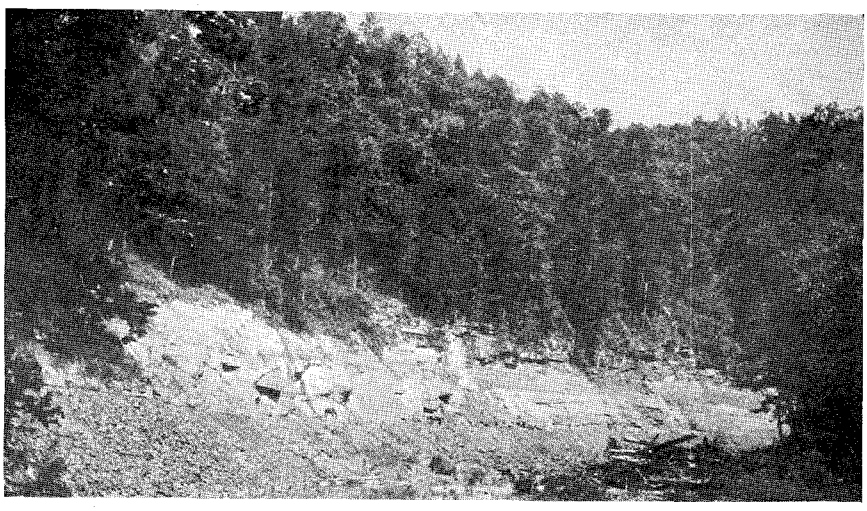
Although even small tributaries contain some running water during most of the year, none of the streams has a very large flow. It is difficult even to utilize rowboats in navigating Russell Fork and Pound River, the largest streams, for any considerable distance, and bridges are considered a luxury rather than a necessity. Logs in large number are floated down the lower part of Russell Fork by means of a splash dam just north of the mouth of Pound River. The rainfall of the region is exceptionally great,

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 relative to the position of a person facing upstream.

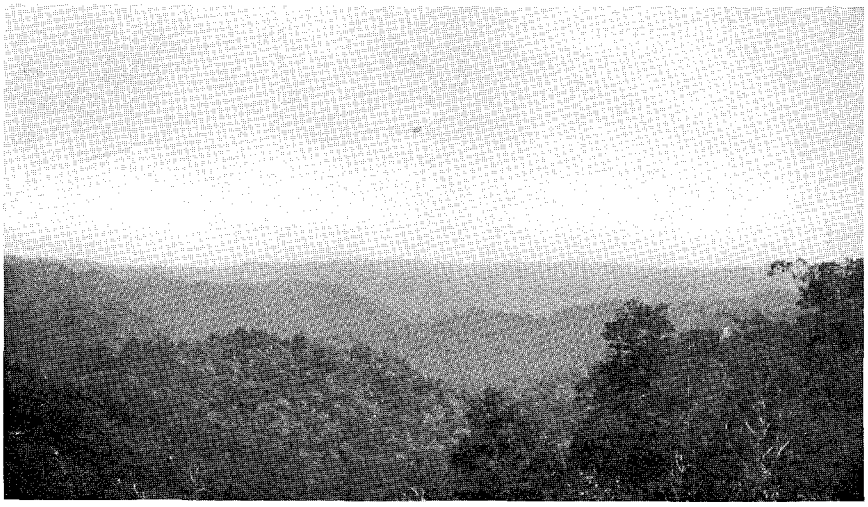
INDUSTRIAL FEATURES.

Settlement.—The original settlers subsisted chiefly by hunting, but now squirrels, rabbits, and birds are the principal wild game. A few wild turkeys are found on the slopes of Pine Mountain, and both wildcats and catamounts are sometimes encountered in this heavily forested district. The county is sparsely populated, the population in 1910 being 9,199. At the present time the county has a population of about 12,000. The impetus recently given to mining by the war, and the establishment of several lumber camps have augmented the population considerably. The chief pursuits are mining, lumbering, and farming. The wealth of the county lies in its coal and lumber resources, rather than in its farming possibilities. The slopes are too steep to be tilled easily and when laid bare of their forest cover are rapidly denuded of their soil. The present farms are small, the chief products being corn, garden truck, oats, and cattle. The forests which cover about 84 per cent of the county will be an important source of revenue for at least another generation, and with proper management should constitute a permanent source of income. The largest town of the county is Moss, a mining camp of the Clinchfield Coal Corporation, built within the past three years. It had a population of about 1800 in September, 1919. Clintwood, the county-seat, located in the west-central part of the county, has a population of about 500. Recently established lumber camps are Fremont and McClure, two miles south of Fremont, both on the Carolina, Clinchfield and Ohio Railway and in the central part of the county. New mining camps in addition to Moss, are Calhoun, Haysi, and Delano, all situated on the railroad.

Accessibility.—That part of the county south of Sandy Ridge has been of easy access to the outside world since the construction of the Clinch River division of the Norfolk and Western Railway many years ago. The part north of Sandy Ridge, however, has been more or less isolated by Sandy Ridge on the south and Pine Mountain on the north, as well as by the hilly character of the entire region. The completion in 1915 of the extension of the Carolina, Clinchfield and Ohio Railway, under Sandy Ridge and down McClure River and Russell Fork, has opened rail communication both to the south and to the north.

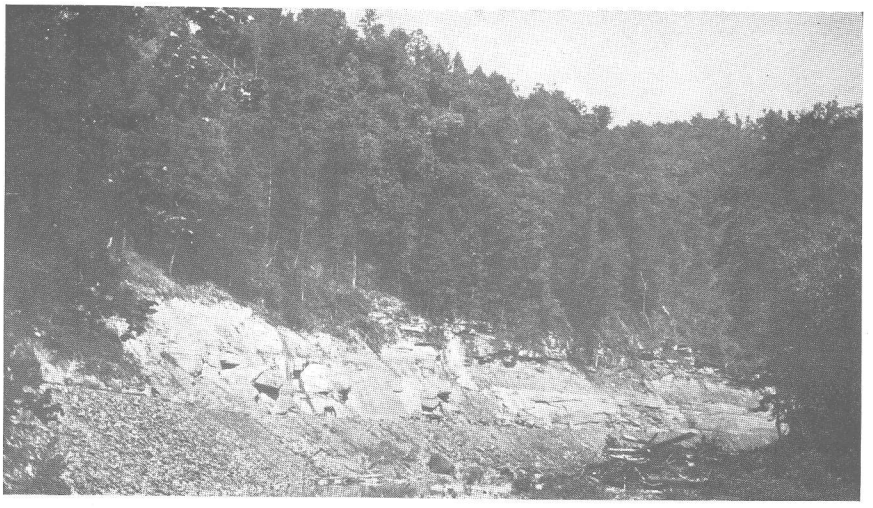


(A) Railway cut 2½ miles southwest of the mouth of McClure River.



(B) Ridges east of the head of Hatchet Branch of McClure River.

PLATE V.—VIEWS SHOWING FOREST CONDITIONS.



(A) Railway cut 2½ miles southwest of the mouth of McClure River.

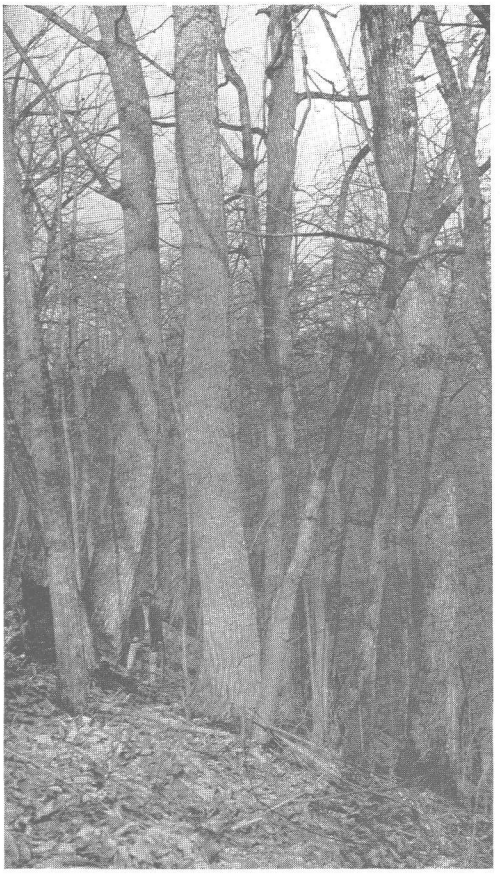
(B) Ridges east of the head of Hatchet Branch of McClure River.

PLATE V.—VIEWS SHOWING FOREST CONDITIONS.

(A) Typical stand of chestnut oak on Big Ridge.

(B) Hemlock trees on Caney Creek.

PLATE VI.—VIEWS ILLUSTRATING THE CHARACTER OF THE FORESTS OF DICKENSON COUNTY.



(A) Typical stand of chestnut oak on Big Ridge.

(B) Hemlock trees on Caney Creek.

PLATE VI.—VIEWS ILLUSTRATING THE CHARACTER OF THE FORESTS OF DICKENSON COUNTY.

Wagon roads are rocky and very steep in places, and the usual method of travel is on horseback. Recently, however, an excellent road with low grades has been constructed from Clintwood southwestward to Darwin and Wise, and southeastward across Bearpen Gap to McClure River. Many of the ridge roads are fairly good, but wind so much that they are commonly less direct than the valley roads.

With the present impetus given to road building in Virginia it is certain that Dickenson County will have shortly several scores of miles of improved roads. It is likely that within a few years Clintwood will be connected by an improved road with Jenkins, Kentucky, on the west, and Grundy, the county-seat of Buchanan County, on the east. It seems probable that a road will be built paralleling the line of the Carolina, Clinchfield and Ohio Railway from Elkhorn City, Kentucky, to Dante, the large mining camp just south of the county line.

Present and future coal production and markets.—Until a few years ago the only coal mined in Dickenson County was taken from small country mines for use in the immediate neighborhood. Recently mine No. 2 of the Clinchfield Coal Corporation at Dante and the Cranesnest mine of the same company near Toms Creek have been driven through Sandy Ridge, and considerable coal is being taken from beneath the surface of the southern portion of Dickenson County. The same company is also operating two large mines at Wilder just across the boundary in Russell County, which have been driven into the coal beds beneath Dickenson County. Moss, the new mining camp of the Clinchfield Coal Corporation, located at the junction of Mill Creek and McClure River, is the center of active mining operations with large production. All of these mines are now producing much coal and have an even greater capacity. They are equipped with electric haulage and are under scientific management that considers the future as well as the present. The smaller camps of Calhoun, Delano, Haysi, etc., are furnishing only a small production.

The total present production, while large, may be greatly augmented, and it is likely that in the next few years new mining camps will be established and much larger operations undertaken.

Expansion of the industry, outside districts now active, will be by the mining of the Upper Banner bed on Squirrel Camp Branch, Mill Creek, and all along McClure River. The thick coal of the Clintwood bed southwest of Clintwood can be reached by a railroad from McClure River under Bearpen Gap and up Cranesnest River, or by one from the Toms Creek field down the Cranesnest, with a long tunnel under Sandy

Ridge. Coals mined on the upper part of Russell Fork and Indian and Fryingpan creeks can be hauled out over a railroad down Russell Fork to the mouth of McClure River, though it is probable that most beds near Sandy Ridge will be reached by mines entering on the south side of that divide.

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 and haulage. 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 beds 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 during most of the year.

The natural market for most of this region is the southeastern states, with their growing industrial centers. The Carolina, Clinchfield and Ohio Railway also offers direct rail communication with Charleston, South Carolina, where huge new coal-loading docks have been constructed with the expectation that the city will become a great shipping point for coal exported to Central and South America, especially through the Panama Canal. Ships destined for those points save more than a day by loading at Charleston instead of the principal coal ports farther north. The Ohio Valley and the Middle West are now reached through direct rail communication over the Carolina, Clinchfield and Ohio and the Chesapeake and Ohio railways, but in this direction the competition of other fields with shorter hauls must be met. Shipments to the East and to the seaboard via the Norfolk and Western Railroad meet competition with high-grade coals that have shorter hauls. Mention of the relative quality of this coal and its probable competitors is made in another part of this report.

(A) Young hemlock trees taking possession of cleared land on Dog Branch.

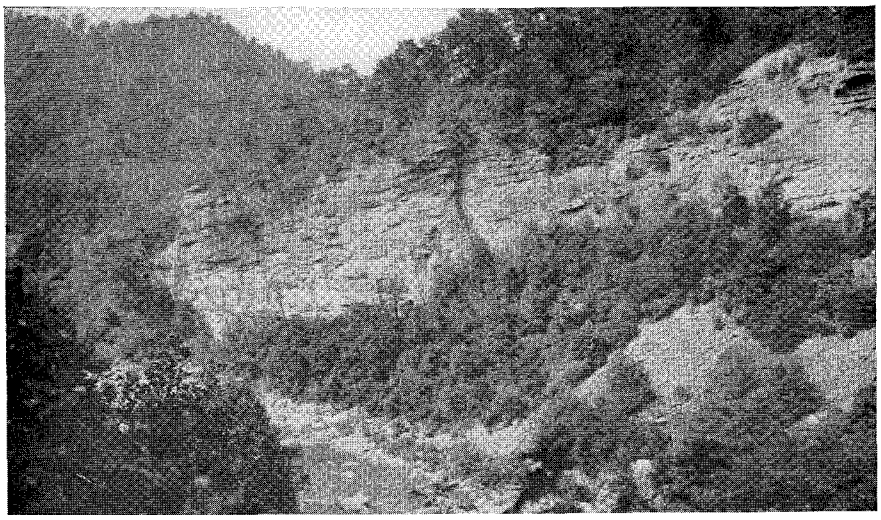
(B) Mature valley carved in the elevated peneplain surface that forms the even sky line. Looking north into the headwaters of McClure River from a point near the extreme southern end of Dickenson County.

PLATE VII.—GENERAL VIEWS IN DICKENSON COUNTY SHOWING MATURE VALLEYS WITH FOREST COVER.

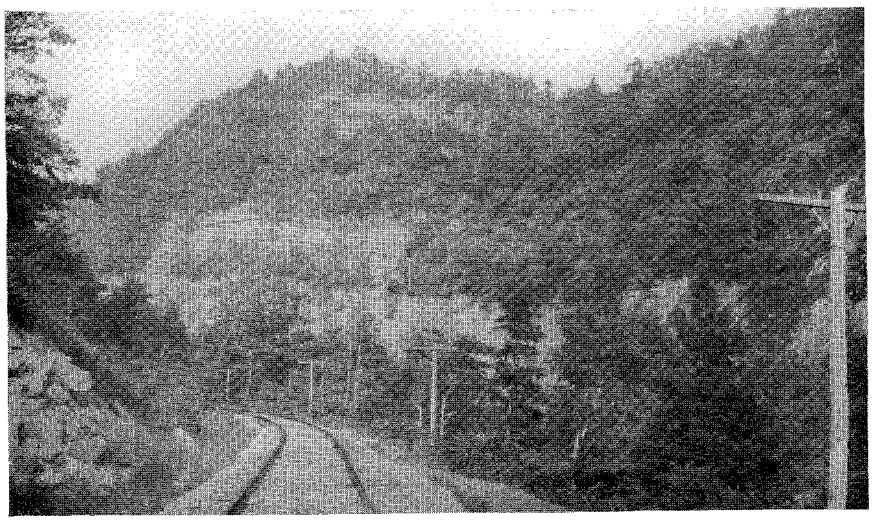
(A) Young hemlock trees taking possession of cleared land on Dog Branch.

(B) Mature valley carved in the elevated peneplain surface that forms the even sky line. Looking north into the headwaters of McClure River from a point near the extreme southern end of Dickenson County.

PLATE VII.—GENERAL VIEWS IN DICKENSON COUNTY SHOWING MATURE VALLEYS WITH FOREST COVER.

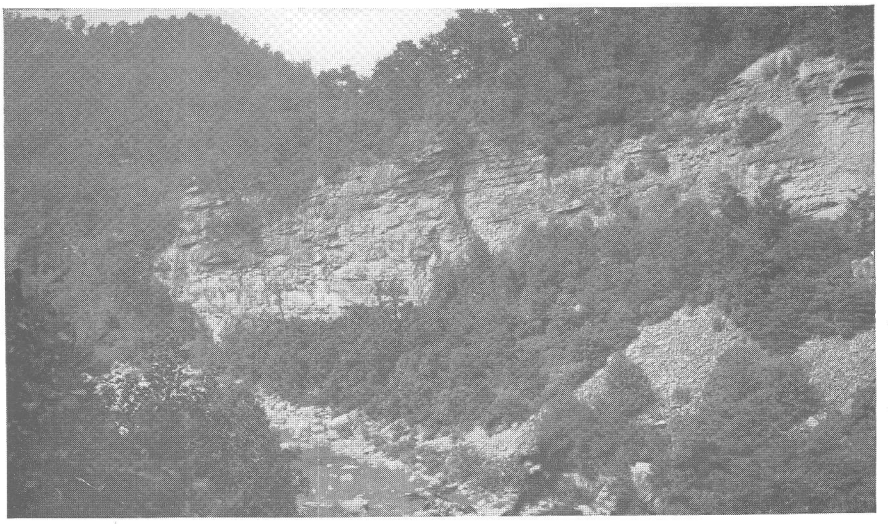


(A) Canyon walls and talus in The Breaks of Sandy.

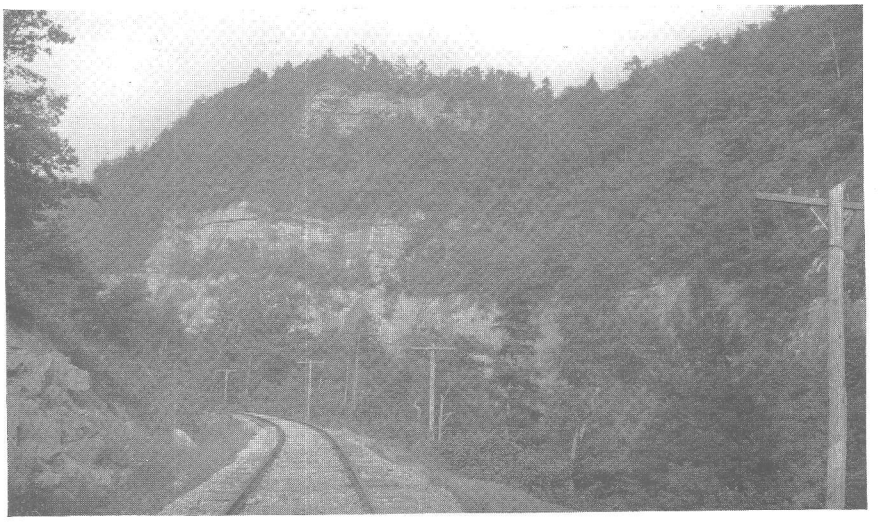


(B) Lee formation in The Breaks of Sandy showing growth of trees on belts of shale.

PLATE VIII.—VIEWS IN THE BREAKS OF SANDY.



(A) Canyon walls and talus in The Breaks of Sandy.



(B) Lee formation in The Breaks of Sandy showing growth of trees on belts of shale.

PLATE VIII.—VIEWS IN THE BREAKS OF SANDY.

GENERAL GEOLOGY

STRATIGRAPHY.

GENERAL STATEMENT.

The rocks exposed in Dickenson County, exclusive of residual soils and small alluvial deposits in the bottoms of the valleys, belong to the Carboniferous system. The Carboniferous system is divided into the Mississippian series below and the Pennsylvanian series above, and each of these series, which are unconformable, is made up of a number of formations that are described below. The Mississippian series does not come to the surface anywhere in the county, but well drillings have revealed its presence beneath the coal-bearing rocks in so many places that it seems certain that it is present under the entire county. The Mississippian probably carries some coal in this county, but its depth beneath the surface and the fact that its coal beds, are so far as known, of a few inches in thickness only, preclude the possibility of profitable mining.

MISSISSIPPIAN SERIES.

Although the Mississippian series is not exposed in the county its character is known from well records and from the study of adjacent areas where it comes to the surface. This series consists of the upper part of the Grainger shale at the base, the Newman limestone near the middle, and the Pennington shale at the top. According to Charles Butts, its thickness in Pine Mountain is 1,700 to 1,800 feet. In the same locality the Mississippian part of the Grainger is composed chiefly of green shale and brownish sandstone with considerable red sandstone in the upper 50 feet, and is 400 to 500 feet thick. The Newman limestone is about 500 feet thick. It is a fossiliferous, bluish gray to dark gray, firm, compact, tough limestone. It is oolitic and thick bedded in the lower half, but thinner bedded and containing only a few oolitic layers in the upper half. It weathers to a dull gray color, becomes cavernous, and yields a typical Karst[1] topography. Both of these formations thin towards the northwest, hence they are much thicker in the southern part of the county than in Pine Mountain.

[1] Karst topography is characterized by sink holes, sinking creeks—creeks that plunge into sink holes, and numerous depressions with no outlets.

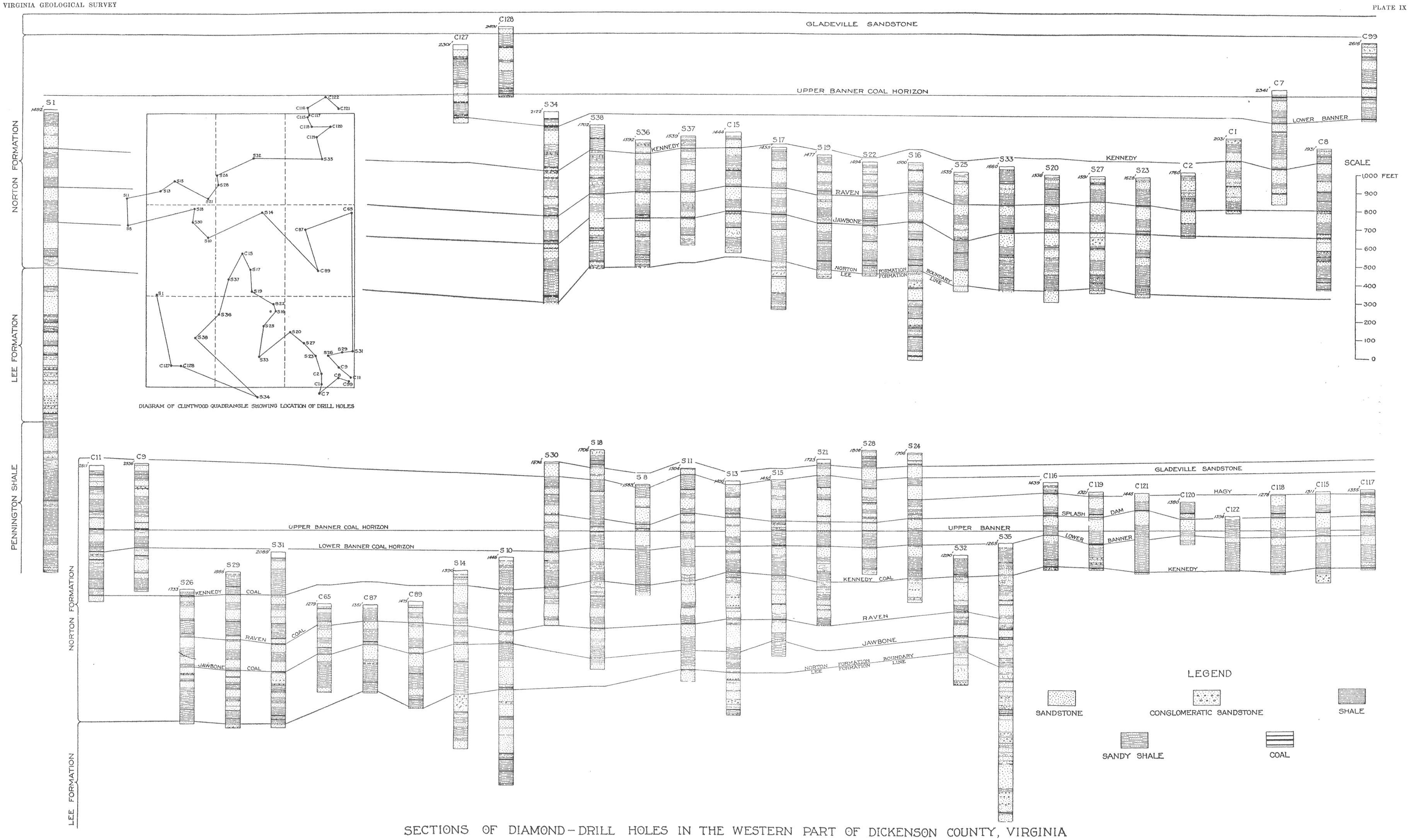
The Pennington shale is about 800 feet thick, and is composed of red, green, and drab shale, thin-bedded, fine-grained green sandstone, and one persistent stratum of resistant siliceous sandstone 100 feet thick. The formation is thicker in the southeastern part of the county than in Pine Mountain. In both this district and Pine Mountain much of the Pennington resembles lithologically most of the Pennsylvanian series, but it is distinguished chiefly by certain beds of red or green hues—colors that are very uncommon in the commercially coal-bearing rocks. Most of the Pennington was penetrated by drill hole S 1 on Cranesnest River (Pl. IX).

PENNSYLVANIAN SERIES.

General statement.

The Pennsylvanian series, in which are all the commercially important coal beds of this county, 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 one or more of 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 field, so that the members of a measured section can rarely be certainly identified by comparing it with another section 5 miles or more distant. In spite of these facts, however, and 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 careful tracing of a number of beds from place to place.

Sandstone constitutes one-third to nearly one-half 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 coarse-grained, stained with iron oxide and containing decomposed feldspars, mica, and other minerals, as well as the much more abundant



SECTIONS OF DIAMOND-DRILL HOLES IN THE WESTERN PART OF DICKENSON COUNTY, VIRGINIA

The records were furnished by the Clinchfield Coal Corporation and bear its serial numbers.
Numbers at upper left hand corners of sections show elevation of surface above sea level.

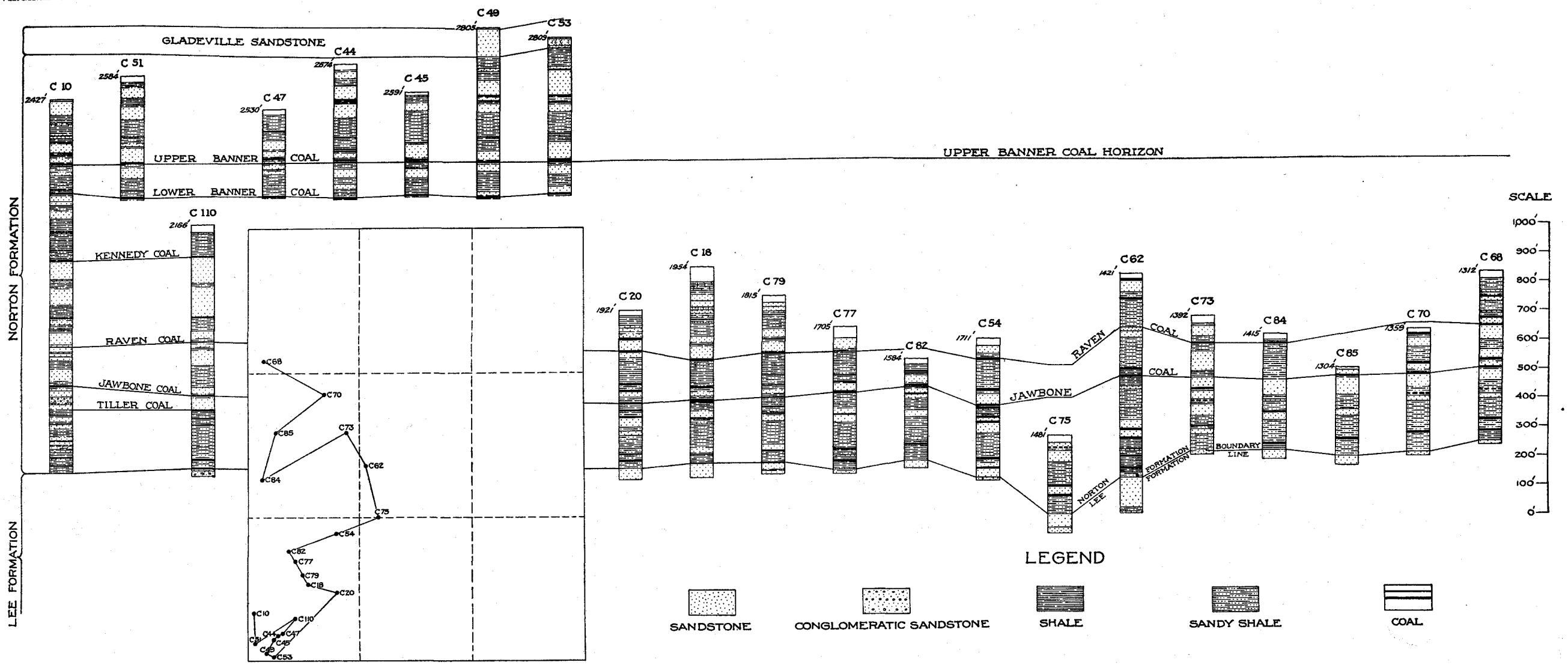


DIAGRAM OF BUCU QUADRANGLE SHOWING LOCATION OF DRILL HOLES

SECTIONS OF DIAMOND-DRILL HOLES IN THE EASTERN PART OF DICKENSON COUNTY

The records were furnished by the Clinchfield Coal Corporation and bear its serial numbers

Numbers at upper left hand corners of sections show elevation of surface above sea level.

quartz grains. Other beds, especially some in the lower part of the series, are gray and contain a large proportion of quartz grains that are firmly held together by siliceous cement. Another type of sandstone that is not very common and is confined to horizons above the Norton 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 in the Lee but not in higher formations. The Gladeville contains pebbles at a few localities. This conglomeratic phase is not persistent in any of the beds, though more common in the Lee and lower half of the Norton than elsewhere.

Most of the shale is very sandy and grades 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 shale is yellowish, and thin beds, commonly those within a few feet of coal beds, are black.

The coal beds will be described 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 shale.

Lee formation.

The Lee formation, named from Lee County, Virginia, is exposed along the upper slopes of Pine Mountain, in the Middle and Left Forks of Cane Creek in the extreme southeastern part of the county. Only a few beds at the top of the formation are at the surface in the latter locality. A nearly complete section is exposed in The Breaks, one drill hole on Cranesnest River (S 1 in Pl. IX) passes through the entire formation, and other borings were continued into the upper part of it.

In the boring on Cranesnest River, a mile south of Darwin, the Lee is 830 feet thick, and consists largely of sandstone, conglomeratic in the lower part, with comparatively thin beds of shale, and several coal beds. In Pine Mountain the formation has probably about the same thickness, and the most conspicuous member is a massive sandstone, 100 to 300 feet thick, that forms the crest of the mountain northeast of Blowing Rock Gap, and high points southwest of the gap that are a short distance south of the divide. This sandstone, which constitutes the base of the Lee, contains many smoothly rounded, white and cream-colored quartz pebbles that weather out and lie on the surface like hailstones. Like most other sandstones

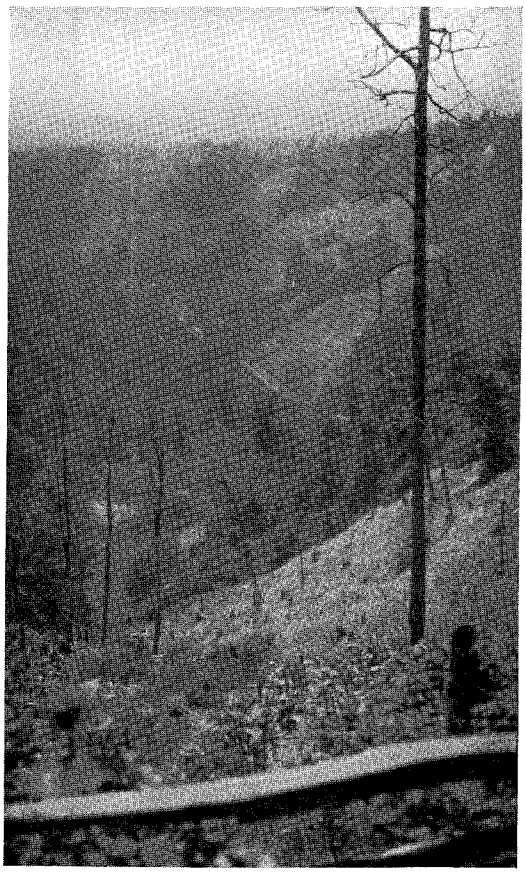
in the formation, this rock is grayish white and composed almost entirely of large clear quartz grains, very firmly cemented with a siliceous cement. As the dips are slightly greater than the mountain slope, successively higher beds are crossed in descending the mountain on the Virginia side. In this county the upper beds of the Lee are not well exposed, but in The Breaks the top of the formation, consisting chiefly of conglomeratic sandstone 400 to 500 feet thick, forms the lower part of the canyon walls. Few coal beds were found in the Lee of this county. In The Breaks a bed 32 inches thick has been mined about one-half mile south of the State line, and two higher beds, each a few inches in thickness, were seen.

A conglomeratic sandstone that forms a low hogback in the lower slope of Pine Mountain in Virginia and the cliff at the top of The Breaks has all the characteristics of Lee sandstones, and has been called the top of the Lee in the reports by Stone and Butts previously mentioned. The work upon which this report is based, confirmed by a study of fossil plants by David White, has shown that this bed is the rock directly beneath the Kennedy coal bed, and that its top is 400 to 550 feet above the top of the Lee.

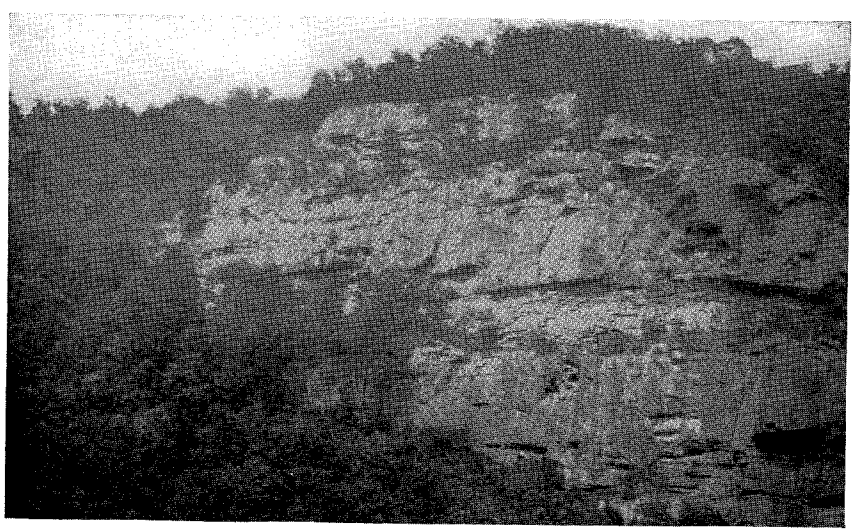
As shown by drill records (Pls. IX and X), at least the upper part of the Lee contains a large proportion of sandstone and conglomerate in that part of Dickenson County about which information is available. In the southeastern part of the county, however, there is more shale, and the standstones appear to be no thicker or more conglomeratic than those in the Norton formation. The exposures on Indian Creek show a coarse, thin sandstone at the top, and a 30-inch coal bed about 50 feet below the top of the formation. The rocks specifically correlated with the Lee by Stone, on Indian and Hurricane creeks and on Russell Fork, are in the lower part of the Norton, as demonstrated by the paleontological evidence.

Norton formation.

The Norton formation, named from Norton in Wise County, forms the greater part of the surface of Dickenson County, outcropping in most districts from the bottoms of the valleys nearly to the tops of the ridges. The thickness of the Norton, obtained at many points by combining drill records (see Pls. IX and X) with outcrop observations, ranges from 920 feet in the northwestern part of the county to approximately 1,460 feet in the southeastern part of the county. The direction in which the greatest thickening takes place is slightly east of south, and all parts of the section are involved in the increase. This feature and the stratigraphic succession

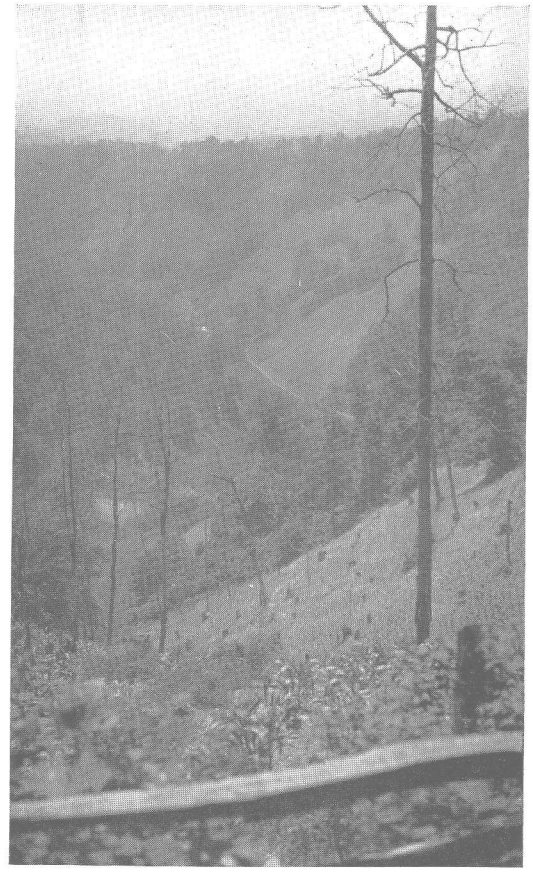


(A) View in the southern part of Dickenson County showing typical mature topography in rocks of the Norton formation.



(B) Vertical walls of a youthful valley—The Breaks of Sandy.

PLATE XI.—VIEWS ILLUSTRATING THE CONTRAST BETWEEN THE LATERAL SLOPES OF VALLEYS IN YOUTH AND IN MATURITY.



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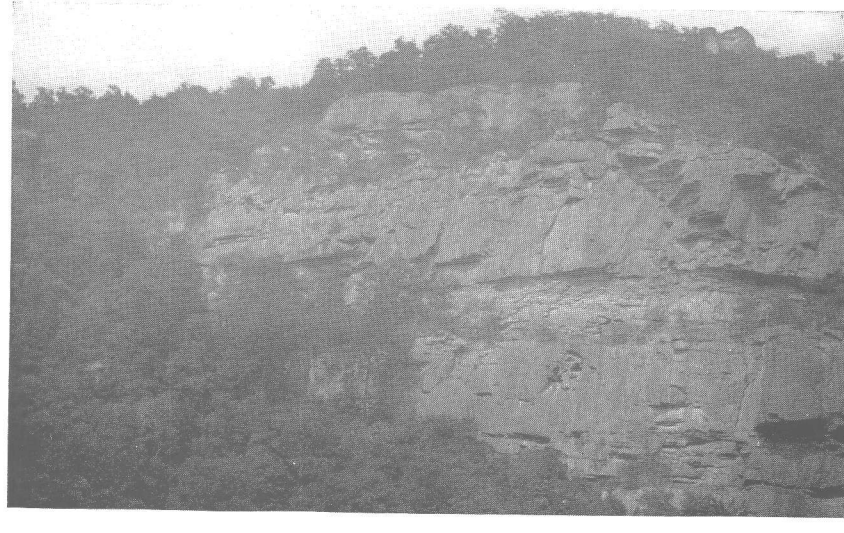

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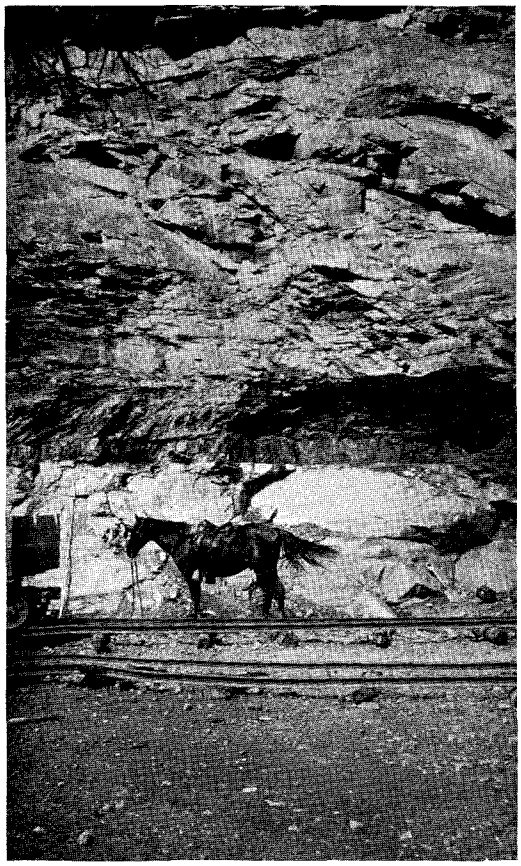
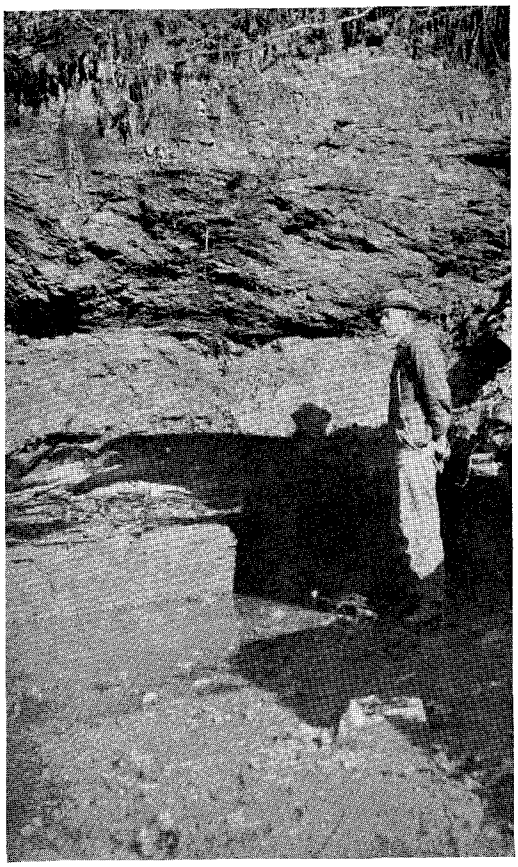
PLATE XI.—VIEWS ILLUSTRATING THE CONTRAST BETWEEN THE LATERAL SLOPES OF VALLEYS IN YOUTH AND IN MATURITY.

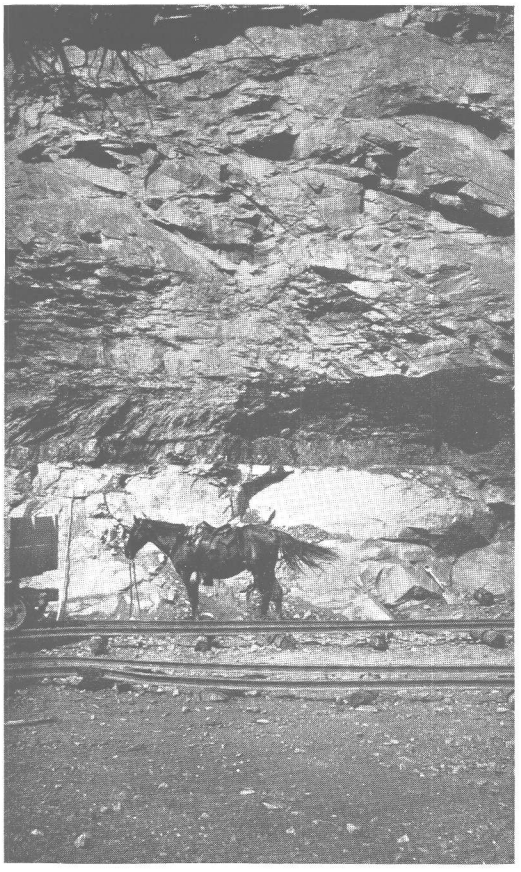


(A) Kennedy coal in railroad cut near the mouth of Roaring Fork.

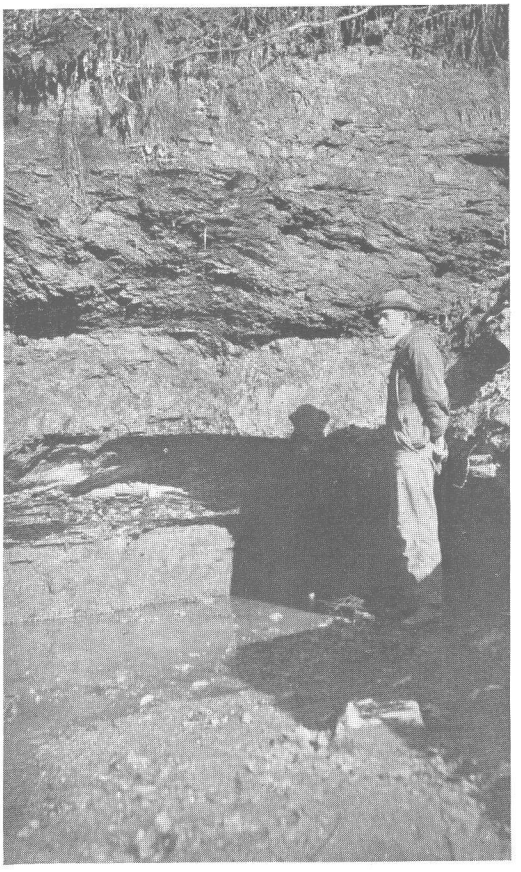


(B) Tiller and Jawbone coal one mile southwest of Duty (location 260).

PLATE XII.—VIEWS OF COAL BEDS SHOWING EFFECT OF MOVEMENT ON BEDDING PLANES.



(A) Kennedy coal in railroad cut near the mouth of Roaring Fork.



(B) Tiller and Jawbone coal one mile southwest of Duty (location 260).

PLATE XII.—VIEWS OF COAL BEDS SHOWING EFFECT OF MOVEMENT ON BEDDING PLANES.

and thickness of intervals is shown by the drill records (Pls. IX and X), the generalized sections (Pl. XIII), and the local sections. The local intervals between coal beds are also mentioned in the detailed descriptions of each drainage basin.

The formation consists chiefly of alternating beds of sandstone and shale, with a number of coal beds, and thin layers of clay in and under some coal beds. Small limestone nodules were found at a very few horizons. Of greatest significance and importance are the coal beds, which will be described later in the section devoted to economic geology. Other beds are most readily described in connection with the coal beds with which they are associated, and that method of treatment will be adopted. Only a few facts of a general nature will be mentioned here.

The most easily identified horizon, considering the field 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 which forms ledges and cliffs, and overlain by nearly 200 feet of shale and thin-bedded, fine-grained sandstone which forms long slopes, its position is usually easy to find. Its usefulness as a stratigraphic marker is increased by the fact that the general northwesterly dip causes it to outcrop for long distances a few hundred feet above the principal streams. Except locally there is a large proportion of sandstone, and more of the coarse-grained type below the Kennedy than above it. The sandstone underlying the Kennedy is 50 to 200 feet thick and contains at least a few pebbles in parts of most districts. This conglomeratic feature is conspicuous only at the foot of Pine Mountain, where the sandstone is gray and siliceous and forms high cliffs. The rock just beneath the Kennedy of the Pine Mountain district has been called the top of the Lee in reports by both Butts and Stone.

Several other sandstone beds are locally conglomeratic and exceptionally coarse and form conscipuous ledges and cliffs. One of these is a gray, quartzose bed that lies between the Tiller and Jawbone coal beds along parts of Indian Creek. This bed resembles certain sandstones in the Lee formation and has been mistaken for them. A similar bed underlies the Tiller coal bed in places. A buff, more arkosic sandstone, about 60 feet thick and with thin layers of pebbles near the base, is a useful marker in all except the northeastern part of the Clintwood quadrangle. This bed is separated from the top of the Norton by shale 60 to 100 feet thick.

Many shale beds are sandy and of the types described as most common in the Pennsylvanian series. The most persistent bed is at the top of the Norton; and it is in part yellowish and not very sandy. Where traced

by Hennen in Mingo and McDowell counties, West Virginia, there is a persistent marine horizon in this shale at which there are invertebrates of a type found also on Keen Mountain in the Bucu quadrangle, between Dismal Creek and Levisa Fork, just east of Dickenson County.

Gladeville sandstone.

The Gladeville sandstone was named from Gladeville, now Wise, the county seat of Wise County, where it is an important stratigraphic marker. In most parts of Dickenson County it is also a useful marker, though no better than several other beds not separately mapped. According to Butts, who traced the bed from its type locality to the Clintwood quadrangle, it is hard, white, and siliceous at Wise, and more arkosic and thinner on the north side of Sandy Ridge. In Dickenson County the Gladeville is 60 to 110 feet thick, is stained brownish by iron, and contains considerable argillaceous matter, mica, and other minerals. Although coarse-grained and thick-bedded to massive, it rarely forms strong cliffs, and readily breaks up on weathering into its constituent grains. In many districts this sandstone forms the upper parts of the principal ridges and many small patches of corn thrive upon it. The formation has its minimum thickness in the northeastern part of the county and is more compact here than elsewhere.

Wise formation.

The Wise formation, named from Wise County, Virginia, differs little in essential particulars from the Norton formation. The Wise is very thick in Wise County west of Dickenson County, but only the lower 750 feet are exposed in Dickenson County. Except near Clintwood and in the western part of the county, the Wise is confined to the upper parts of the ridges and occurs only in small areas in much of the region. The stratigraphic succession and thicknesses of intervals may be ascertained by consulting the generalized sections (Pl. XIII), the local sections, and the detailed descriptions of the rocks in each drainage basin.

The lower 200 feet of the Wise formation contain fine coal beds that will be described in the section devoted to economic geology, and a considerable proportion of sandstone. The resistant sandstone bed noted by Butts just above the Clintwood coal in the Pound quadrangle is a good marker only near Clintwood, being non-resistant or absent elsewhere. West of McClure River, the best marker is a white, firmly cemented, siliceous sandstone that, though not thick, outcrops conspicuously 15 to 60 feet

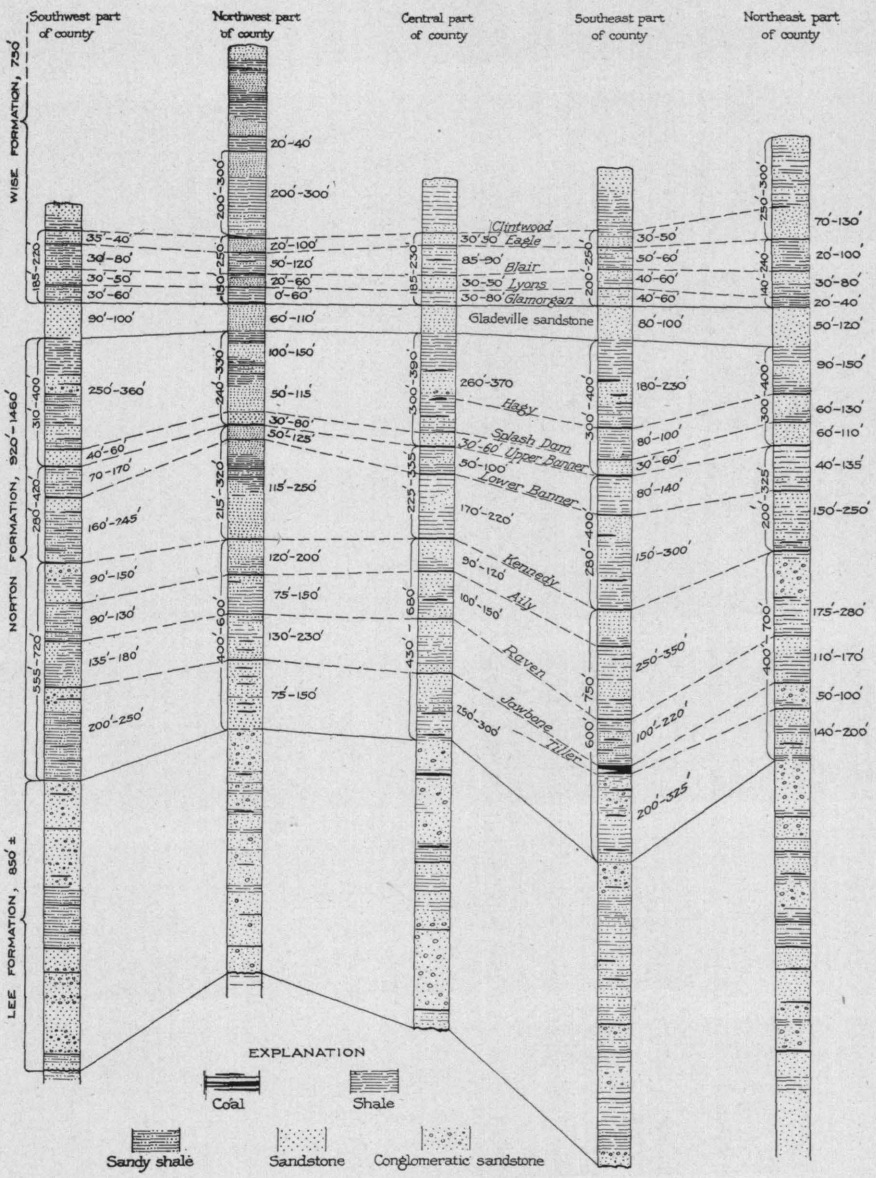


PLATE XIII.—GENERALIZED SECTIONS OF THE PENNSYLVANIAN SERIES IN DICKENSON COUNTY.

NOTE.—Glamorgan has been changed to Dorchester by the State and Federal Geological Surveys.

above the Gladeville. The best marker in other districts is a grayish, resistant sandstone that lies between the Eagle and Clintwood coal beds and forms cliffs 100 feet or less in height. For about 200 feet above the Clintwood coal the sedimentary rocks are chiefly shale, and these are succeeded by thick beds of brownish-buff, medium-grained, non-resistant sandstone, within which there is another coal bed.

QUATERNARY SYSTEM.

Recent series.

ALLUVIUM.

The lower portion of every valley in the county is floored with unconsolidated material, such as sand, clay, and gravel. This material has been washed down from the headwaters of the streams and has come to rest along their lower courses because of loss of velocity due to decreasing gradient. The resulting floodplains are narrow but are nearly everywhere cleared and under cultivation, for their soils are the richest in the county. The largest accumulations of alluvial soils are along McClure and Pound rivers, Lick Creek and Russell Fork.

SOIL.

Essentially all of the soils of Dickenson County are the result of the decay and disintegration of the underlying formations and their character is therefore largely dependent upon the nature of the parent rock. The underlying rocks being chiefly arkosic sandstone and sandy shale the soils are consequently sandy, being chiefly sandy loams. On Sandy Ridge and on other long level-topped ridges the soils are thick and of fair quality, hence many small areas have been cleared and are under cultivation. On the uncleared hillsides the soil may be thick locally and of good quality, although generally mixed with some coarse sandstone debris. When cleared and cultivated the hillsides are rapidly denuded of their soil mantle. For this reason in the course of a few years these clearings are allowed to revert to a forested condition. Because of the steep slopes throughout much of the county and the infertile soils the agricultural possibilities of Dickenson County are severely limited.

CORRELATIONS WITH ADJOINING AREAS.

Plate XIV contains sections showing correlations between the Dickenson County coal beds and the coal beds of adjacent areas. This table is

based essentially on the work of Hinds in Buchanan County and in the Clintwood and Bucu quadrangles. His correlations differ from those previously made chiefly because early ties were necessarily made across the gap formed by Pine Mountain and the Pine Mountain fault, where no direct tracing of beds from one field to the other is possible. The work upon which the Clintwood-Bucu report of Hinds was based was continued so as to include the northern half of Buchanan County to the boundaries of Kentucky and West Virginia, and a tie line was made by him in 1915 from Elkhorn City down Russell Fork, up Marrowbone Creek, and over the Flatwoods to Shelby Creek, where it joined detailed private surveys carried from Jenkins. The results of detailed private surveys in southeastern Pike County, Ky., confirmed the conclusions reached. Correlations were also greatly strengthened by a preliminary examination of fossil plant collections by David White.

There can be no question concerning the accuracy of the identification of the Upper and Lower Banner and Kennedy coal beds in Dickenson County. The position of the Jawbone coal bed and the top of the Lee formation in this county is based upon the stratigraphic distances and somewhat meager lithologic descriptions given by Campbell for neighboring parts of the Bristol quadrangle. If the Jawbone correlation is correct the "so-called Imboden" is the equivalent of the Garden Hole coal bed, and the Raven farther east. The Gladeville sandstone was traced by Butts from its type locality at Wise through the Pound quadrangle to Clintwood. On parts of Sandy Ridge, Campbell has apparently included in his mapping of the Gladeville a thin but conspicuous resistant white sandstone that is separated from the Gladeville of Butts by a moderately thick shale bed.

The identification of horizons above the Norton in this report agree essentially with those made by Butts in the Virginia portion of the Pound quadrangle. His identifications of certain Norton coal beds and of the top of the Lee formation in drill holes S 1, S 13, and S 15, which are in the Clintwood quadrangle, have been slightly changed on the basis of a careful study of outcrops and many drill records east of the Pound quadrangle where the available data concerning the lower two Pennsylvanian formations are exceptionally good. As previously explained, the Lee-like sandstone near the foot of Pine Mountain and at the top of the canyon at The Breaks, naturally considered by both Butts and Stone to be the top of the Lee, is now known to be the stratum lying a few feet below the Kennedy coal bed, near the middle of the Norton formation. This sandstone is the cliff-former upon which Elkhorn City, Ky., is built,

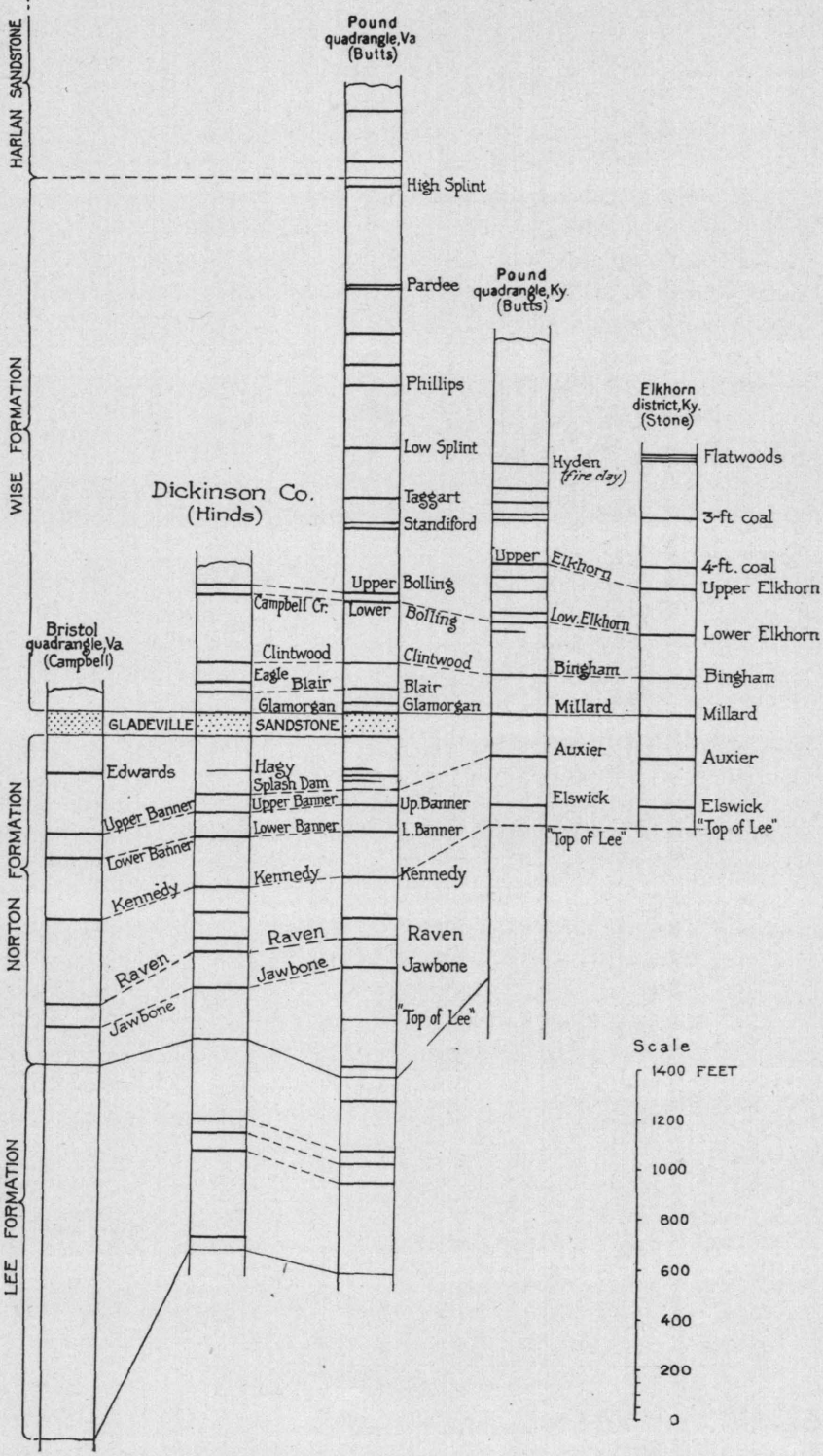


PLATE XIV.—SECTIONS SHOWING CORRELATIONS WITH ADJOINING AREAS

NOTE.—Glamorgan has been changed to Dorchester by the State and Federal Geological Surveys.

and the change in its correlation necessitates an entirely new conception of the stratigraphic position of strata in the Elkhorn district of eastern Kentucky (Pl. XIV).

In recent reports on Mingo and McDowell counties, West Virginia,[1] great cliffs on Tug Fork at and near War Eagle are correlated with the Nuttall sandstone and placed at the top of what is called the "Middle Pottsville or New River group," underlying the "Upper Pottsville or Kanawha group." The top of the Nuttall is a few feet below the Lower Banner coal horizon, and is the same as Campbell's Dotson sandstone. The bed mapped by Campbell as Dotson farther south, in the western and central parts of the Tazewell quadrangle, appears to be slightly higher in the section, probably just above the Upper Banner horizon. The sandstone mapped by Campbell as the Raleigh in the western part of the Tazewell quadrangle is the rock directly beneath the Jawbone coal, and is probably higher than the bed mapped as Raleigh in the eastern part of that quadrangle.

The coal beds called the Eagle and Campbell Creek (No. 2 Gas) by the West Virginia Geological Survey have been traced into Dickenson County and the names retained. The Eagle coal is locally known as the Middle War Eagle and Mohawk on Tug Fork. The Campbell Creek coal is the bed to which the name Lower Bolling was applied in the Pound quadrangle. This coal is locally called the Lower Elkhorn, Lower Marrowbone, Warfield, Freeburn, Burnwell, and Upper War Eagle in Pike County, Kentucky, and Mingo County, West Virginia. The Lower War Eagle coal of Tug Fork is the same as the Hagy of Virginia.

LOCAL SECTIONS.

The following sections are inserted without comment, as it is believed that they are self-explanatory. They have been chosen from among a large number 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 distances between important beds are not in every case the averages for the locality. Corrections that should be made in thicknesses of beds because of dip are indicated for each section; in the column showing intervals the necessary correction for dip has already been made.

[1] 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.

Local Section 1.

On trails from mouth of Jerry Branch of Pound River to spur on west.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Coal (Clintwood), elevation 1,795 feet	....	
Sandstone, buff, coarse, shaly at base	70	
Coal (Eagle), elevation 1,725 feet	....	70
Sandstone, similar to one above	40	
Concealed, probably shale and shaly sandstone, horizon of Blair coal bed near base	55	
Sandstone, white, compact, siliceous	20	
Shale, poorly exposed, horizon of Lyons coal bed near top	45	160
Coal (Dorchester), elevation 1,565 feet	....	
Gladeville sandstone:		
Sandstone, brownish-buff, coarse, weathers granular	70	70
Norton formation:		
Shale, poorly exposed	50	
Sandstone, to river at mouth of Jerry branch	25	75
	375	375

Local Section 2.

From the mouth of Poplar Branch on Cranesnest River southeast along trail to triangulation station.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Sandstone, coarse, brown, cliff-forming	85	
Concealed	5	
Sandstone	5	
Shale, gray, sandy	20	
Concealed	5	120
Gladeville sandstone:		
Sandstone, coarse, brown, arkosic	70	
Concealed, probably Gladeville	20	90
Norton formation:		
Shale, coarse gray, sandy	40	
Sandstone, arkosic, cliff forming	20	
Concealed, probably sandstone chiefly	60	
Sandstone, arkosic, cliff forming	20	
Concealed	5	
Shale	15	
Concealed, probably chiefly arkose	120	
Upper Banner horizon, estimated elevation 1,560 feet	....	280
Concealed	20	
Sandstone, coarse, arkosic	20	
Concealed, chiefly sandstone probably	60	
Lower Banner horizon, estimated elevation 1,460 feet	....	100
Concealed, chiefly sandstone	30	
Sandstone, massive, cross-bedded, dark gray	30	60
	650	650

Local Section 3.

Along road from crest of ridge one-half mile southeast of Clintwood to Cranesnest River. Section too short on account of dip.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Shale, gray	15	
Concealed	5	
Coal bloom (Blair), elevation 1,980 feet	....	20
Sandstone, massive, arkosic	20	
Concealed	10	
Shale, coarse, gray	20	
Coal bloom (Lyons), elevation 1,930 feet	....	50
Shale	10	
Sandstone	10	
Shale	20	
Coal bloom (Dorchester), elevation 1,890 feet	....	40
Concealed	10	10
Gladeville sandstone:		
Sandstone, coarse, arkosic	30	
Concealed	30	
Shale and shaly sandstone	20	
Sandstone	5	85
Norton formation:		
Shale with thin arkosic sandstone	10	
Sandstone, massive, gray, cliff forming	25	
Shale, sandy, coarse	40	
Coal bloom, elevation 1,720 feet	....	115
Shale, sandy, coarse	50	
Coal bloom, elevation 1,670 feet	....	60
Sandstone	5	
Shale	5	
Coal bloom, elevation 1,660 feet	....	10
Shale, gray, sandy	10	
Sandstone, arkosic	10	
Shale, gray, sandy	10	
Sandstone	10	
Coal bloom (Splash Dam), elevation 1,620 feet	....	50
Shale, gray, sandy	10	
Sandstone, massive, arkosic	50	
Coal bloom (Upper Banner), elevation 1,560 feet	....	65
Sandstone, arkosic	40	
Shale and sandstone	25	
Coal bloom, elevation 1,495 feet	....	65
Concealed	5	
Sandstone	5	
Shale	20	
Coal bloom (Lower Banner), elevation 1,465 feet	....	30
Concealed	15	15
	550	615

Local Section 4.

From 1 mile west of Clintwood along road west to Georges Fork.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Sandstone, massive, gray, arkosic	40	
Concealed	10	
Coal bloom (Eagle), elevation 1,820 feet	....	50
Shale	5	
Sandstone, shaly	15	
Coal bloom (Blair), elevation 1,800 feet	....	20
Shale	5	
Sandstone, cross-bedded, siliceous to arkosic	25	
Shale, gray, sandy	60	
Coal bloom (probably Lyons, upper bench), elevation 1,710 feet	....	90
Shale	5	
Coal bloom (probably Lyons, lower bench), elevation 1,705 feet	....	5
Shale	5	
Sandstone, massive	10	
Shale	5	
Coal bloom (Dorchester), elevation 1,685 feet	....	20
Shale	5	5
Gladeville sandstone:		
Sandstone, massive, coarse, arkosic	20	
Sandstone, thin-bedded, gray	25	
Concealed, probably sandstone	10	
Sandstone, shaly and thin-bedded	35	
Sandstone, thin-bedded, arkosic	10	100
	290	290

Local Section 5.

Along road from Pound River opposite mouth of Camp Creek to top of hill one mile north.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Shale, interbedded with thin sandstone	40	
Coal bloom (Clintwood), elevation 1,790 feet	....	40
Shale, with thin sandstones	40	
Concealed	10	
Shale, sandy	20	
Concealed	10	
Shale, sandy	30	
Concealed	5	
Shale, sandy, with sandstone	15	
Concealed	20	
Shale, sandy	80	
Dorchester coal, elevation 1,560 feet	....	230
Shale	5	
Gladeville sandstone:		
Sandstone, coarse, arkosic, cliff-forming	60	65
	335	335

Local Section 6.

From McClure River near Big Branch to Bearpen Gap, thence south on Big Ridge one-half mile.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Sandstone, white, weathers red and granular	45	
Concealed	48	
Sandstone, white, siliceous, compact	22	
Shale, black at base	25	
Coal (Dorchester), elevation 2,078 feet	1	141
Gladeville sandstone:		
Sandstone, light buff, coarse, massive, weathers red and granular	100	100
Norton formation:		
Shale, dark blue and drab, lower part exposed in Bearpen Gap	70	
Sandstone, buff, very coarse, forms cliffs	40	
Shale, blue	20	
Sandstone, similar to one above	40	
Shale and inconspicuous sandstone	70	
Shale, sandy, with 3 coal beds 15 feet apart, and each less than 13 inches thick (Splash Dam)	30	
Sandstone, buff, shaly at top, coarse and massive below	50	
Coal bloom (Upper Banner, upper bench), elevation 1,658 feet	....	320
Shale, sandy, and shaly sandstone	100	
Coal bloom (Lower Banner), elevation 1,558 feet	....	100
Sandstone, buff, coarse to fine	70	
Sandstone, buff, fine-grained, mostly thin-bedded	70	140
	801	801

Local Section 7.

From Bearpen Gap west one mile on Clintwood road.

	Thickness. Feet.	Intervals. Feet.
Norton formation:		
Shale, dark blue and drab in Bearpen Gap	15	
Coal bloom, elevation 1,910 feet	....	15
Shale, same as above	5	
Sandstone, buff, coarse, cliff-forming	50	
Shale, blue	20	
Sandstone, coarse, cross-bedded	25	
Shale	5	
Coal bloom, elevation 1,805 feet	....	105
Sandstone, coarse, arkosic	20	
Shale, sandy	55	
Coal bloom (Splash Dam horizon), elevation 1,730 feet	....	75
Shale	5	
Sandstone, massive, arkosic	5	
Shale	5	
Coal bloom, elevation 1,715 feet	....	15
Shale	5	

Coal bloom, elevation 1,710 feet	....	5
Shale	10	
Sandstone	10	
Shale, with thin sandstone layers	40	
Sandstone, massive, buff	25	
Shale	5	
Coal bloom (Upper Banner), elevation 1,620 feet	....	90
Shale	15	
Sandstone, massive, arkosic	45	60
	365	365

Local Section 8.

From drill hole S 1 on Cranesnest River up road to Hibbitts Gap, thence west to top of ridge near triangulation station. Section 130 feet too short because of dip.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Sandstone, not well exposed	30	
Shale	10	
Coal (Clintwood) and partings, elevation 2,045 feet	8	60
Concealed	15	
Sandstone, white, compact, siliceous	18	
Shale, probably, not well exposed	20	
Coal (Blair), elevation 1,992 feet	....	65
Sandstone, medium- to fine-grained	20	
Shale, apparently, not well exposed	15	
Coal, thin	....	44
Shale	10	
Coal (Lyons), elevation 1,947 feet	....	12
Shale (Dorchester coal horizon near base)	50	60
Gladeville sandstone:		
Sandstone, coarse, friable, fine-grained and thin-bedded at top	85	100
Norton formation:		
Shale	75	
Coal bloom	....	95
Sandstone, coarse-grained, conglomeratic in middle	25	
Coal bloom	....	30
Shale, sandy	15	
Sandstone, coarse-grained	5	
Concealed	5	
Coal	....	30
Shale, sandy	50	
Coal streak	....	60
Shale	15	
Sandstone, coarse-grained at top, medium- to fine-grained below	50	
(Upper Banner coal horizon), elevation 1,572 feet	....	80
Shale	50	
Sandstone, medium-grained	10	
Shale, not well exposed	20	95
	601	731

Section continued in log of drill hole S 1.

Local Section 9.

On Rockhouse Branch from elevation 1601 east to one-fourth mile northeast of road intersection at elevation 2200.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Sandstone, coarse, brown, cross-bedded	60	
Shale, coarse, gray, sandy	30	
Concealed	10	100
Gladeville sandstone:		
Sandstone, massive, coarse, brown, arkosic	110	110
Norton formation:		
Concealed	10	
Sandstone, gray	20	
Shale, gray, sandy	90	
Sandstone, gray	30	
Concealed	5	
Sandstone	5	
Concealed, probably sandstone	15	
Sandstone, massive, cliff-forming	30	
Concealed	5	
Sandstone	10	
Concealed	5	
Shale, sandy, gray	10	
Sandstone, massive, coarse, brown	80	
Concealed	10	
(Upper Banner horizon), estimated elevation 1,750 feet	....	325
Concealed	30	
Sandstone, siliceous	5	
Concealed, probably sandstone	10	
Sandstone, siliceous to arkosic	5	
Concealed, probably arkosic	10	
Sandstone, siliceous	5	
Concealed, probably siliceous sandstone	50	
Shale, sandy	40	155
	690	690

Local Section 10.

From elevation 2718, near county line on Sandy Ridge one and one-fourth miles south-southwest of Greenwood School, along road to the east to Middle Fork, thence north one-fourth mile.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Sandstone, siliceous to arkosic	20	
Concealed	5	
Sandstone	10	
Concealed	5	
Sandstone	20	

	Thickness. Feet.	Intervals. Feet.
Shale, sandy	10	
Sandstone and shale alternating	20	
Concealed	5	
Shale	5	
Coal bloom (Dorchester), elevation 2,620 feet	....	100
Shale	5	
Concealed	15	20
Gladeville sandstone:		
Sandstone	20	
Concealed	30	
Sandstone	10	
Concealed	5	
Sandstone	20	
Concealed	20	105
Norton formation:		
Concealed	30	
Sandstone	5	
Shale	10	
Sandstone and shale alternating	10	
Concealed	20	
Sandstone, arkosic, thick-bedded	20	
Concealed	5	
Sandstone, concretionary, cliff-forming	80	
Concealed	15	
Sandstone, arkosic	25	
Concealed, probably sandstone	25	
Sandstone	5	
Concealed, probably sandstone	10	
Sandstone	5	
Concealed	10	
Sandstone	5	
Shale, sandy, coarse	15	
Sandstone	5	
Concealed	15	
Sandstone	35	
Upper Banner coal, elevation 2,170 feet	....	350
Sandstone	10	
Concealed	10	
Sandstone, coarse, arkosic	40	
Shale, sandy	10	
Sandstone	10	
Shale, coarse, sandy	10	
Sandstone	15	
Shale, coarse	15	
Concealed, Lower Banner horizon, estimated elevation 2,050 feet	....	120
Sandstone, coarse	20	
Shale, sandy, thin	30	
Coal bloom, elevation 2,000 feet	....	50
Concealed	15	
Sandstone, coarse, arkosic	5	20
	765	765

Local Section 11.

From road intersection one-half mile S. S. W. of Cherry Knob School southeast down creek road to main stream flowing eastward to Dante. Section 50 feet too long on account of dip.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Shale, sandy	5	
Coal bloom, elevation 2,820 feet	....	
Shale	5	
Sandstone	5	
Shale	5	
Coal bloom (Dorchester), elevation 2,805 feet	....	
Shale	5	25
Gladeville sandstone:		
Sandstone, red, ferruginous	20	
Sandstone, massive, coarse	95	105
Norton formation:		
Shale, sandy	20	
Coal bloom, elevation 2,620 feet	....	20
Shale	5	
Sandstone	35	
Concealed, probably sandstone	10	
Shale, sandy	30	
Coal bloom, elevation 2,550 feet	....	80
Shale	10	
Sandstone	10	
Shale, gray, sandy, with sandstones	30	
Conglomerate	10	
Shale, sandy, with thin-bedded sandstone	20	
Coal bloom, elevation 2,470 feet	....	80
Shale	10	
Sandstone	10	
Shale, gray, sandy	60	
Sandstone, sandy	10	
Sandstone, argillaceous	5	
Sandstone, arkosic	10	
Shale	10	
Sandstone, brown, arkosic	20	
Concealed	10	
Coal bloom (Splash Dam), elevation 2,310 feet	....	160
Sandstone, coarse, arkosic	25	
Shale, probably	30	
Coal bloom (Upper Banner), elevation 2,250 feet	....	60
Sandstone, coarse, massive	30	
Concealed	20	
Sandstone, massive, cliff-forming	20	
Shale, sandy	40	
Sandstone, arkosic	20	
Concealed	10	
Lower Banner coal, estimated elevation 2,135 feet	....	115
Sandstone, massive, cliff-forming	60	
Shale, argillaceous	20	
Sandstone, coarse	40	
Concealed	50	
Sandstone	30	
Coal bloom (Kennedy), elevation 1,940 feet	....	195
Sandstone	30	
	890	840

Local Section 12.

From road intersection one mile southeast of Austin Gap to Austin Gap and west to top of hill.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Sandstone, massive, cliff-forming	30	
Concealed	40	70
Gladeville sandstone:		
Sandstone, coarse, arkosic	90	90
Norton formation:		
Shale	25	
Sandstone, coarse, brown	30	
Concealed	10	
Shale	15	
Coal bloom, elevation 2,570 feet	....	80
Shale, brown	20	
Sandstone, gray, arkosic	80	
Shale, sandy, coarse	40	
Shale, blocky	25	
Concealed	15	
Shale	10	
Coal bloom (Splash Dam), elevation 2,380 feet	....	190
Sandstone, massive, arkosic	50	
Concealed	10	
Coal bloom (Upper Banner), elevation 2,330 feet	....	50
Sandstone	25	
Shale	20	
Sandstone, coarse, arkosic	30	
Concealed, probably sandstone	30	
Sandstone, coarse, arkosic	20	
Shale	30	
Coal bloom (Lower Banner), elevation 2,170 feet	....	160
Concealed	50	
Sandstone, massive, gray	20	
Concealed, probably shale	40	
Shale	45	
Sandstone	5	
Shale, thin, sandy	5	
Sandstone, coarse	35	
Coal bloom (Kennedy), elevation 1,970 feet	....	200
Shale	10	
Sandstone and shale interbedded	20	
Shale	20	
Sandstone	10	
Concealed	15	
Shale	15	
Sandstone, massive, gray, arkosic	15	105
	950	945

Local Section 13.

Along road from mouth of Roaring Fork northeast to top of ridge. Section 30 feet too long because of dip.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Sandstone, white, weathers reddish, granular, shaly, with ferruginous bands in middle	35	
Coal bloom (Glamorgan), elevation 2,597 feet	....	35
Gladeville sandstone:		
Sandstone, weathers reddish, granular, shaly in part	70	
Sandstone, light to brownish-gray, coarse-grained, massive	65	125
Norton formation:		
Shale, with some sandstone, not well exposed	165	
Sandstone, brownish-gray, in part very coarse, massive	40	
Concealed	10	
Sandstone, thin-bedded, resistant	40	
Sandstone, thin-bedded, and shale	45	
Coal bloom (Splash Dam), elevation 2,162 feet	....	280
Sandstone, very coarse-grained, massive	13	
Sandstone, fine-grained, thin-bedded	15	
Sandstone, coarse-grained	35	
Concealed	25	
Coal (Upper Banner), elevation 2,074 feet	....	88
Concealed	15	
Sandstone, coarse-grained, massive	20	
Concealed	80	
Sandstone, drab, coarse-grained	5	
Coal (Lower Banner), elevation 1,951 feet	3	123
Sandstone, coarse-grained, massive	40	
Sandstone, drab, mostly fine-grained and thin-bedded	135	
Concealed	45	
Shale and sandy shale	20	
Coal bloom (Kennedy), elevation 1,711 feet	....	240
Sandstone, coarse-grained, massive	35	
Concealed	35	
Sandstone, massive	15	85
	1,006	976

Section continued in log of drill hole S 23.

Local Section 14.

Northward along road from mouth of Negro Camp Branch of Road Fork to Carrie, thence one-fourth mile east on Sandy Ridge.

	Thickness. Feet.	Intervals. Feet.
Gladeville sandstone:		
Sandstone, reddish-brown, grades from fine-grained at base to very coarse and with a few small pebbles at top, upper part very resistant to weathering	115	115
Norton formation:		
Shale, with two thin sandstones	100	

	Thickness. Feet.	Intervals. Feet.
Sandstone, coarse and compact, weathers light gray to brown	75	
Concealed	67	
Shale, in part sandy and with some fine-grained, thin-bedded sandstone	45	
Sandstone, coarse at base to fine-grained at top, resistant, forms cliff	45	
Concealed	10	
Coal bloom (Splash Dam), elevation 2,433 feet	....	342
Sandstone, medium-grained, forms conspicuous ledge	30	
Concealed, probably shale	8	
Coal bloom (Upper Banner), elevation 2,395 feet	....	38
Shale, sandy	30	
Sandstone, fine-grained	5	
Concealed	80	
(Lower Banner coal horizon), elevation 2,280 feet	....	115
Sandstone, fine-grained at top, lower part coarse, forms conspicuous cliff	60	
Shale, sandy	12	
Sandstone, fine-grained, forms ledge	20	92
	702	702

Local Section 15.

From Cane Gap southwest along road to top of Sandy Ridge.

	Thickness. Feet.	Intervals. Feet.
Norton formation:		
Sandstone, badly weathered	10	
Shale	30	
Sandstone, fine-grained	15	
Shale	70	
Coal bloom (Kennedy), elevation 2,505 feet	....	125
Sandstone, fine-grained in upper half, coarse below	65	
Coal bloom (Aily ?), elevation 2,440 feet	....	65
Sandstone, fine-grained, shaly in part	60	
Sandstone	95	
Shale	5	
Coal bloom, elevation 2,280 feet	....	160
Shale, with thin sandstone in middle	30	
Concealed	20	
Sandstone, medium-grained	15	
Concealed, some sandstone in lower part	45	
(Raven coal horizon), elevation 2,170 feet	....	110
Sandstone, fairly coarse, compact, massive	30	
Shale	15	
Sandstone, medium-grained	45	
Shale, blue	10	
Shale and fine-grained, shaly sandstone	40	
Sandstone, medium-grained	15	
Shale	15	
Coal bloom, elevation 2,000 feet	....	170
Sandstone, coarse-grained, not well exposed	24	
Coal (Tiller and Jawbone), elevation 1,965 feet, reported thickness	11	35
	665	665

Local Section 16.

Up trail to east and southeast from drill hole C 82 on Fryingpan Creek, three-quarters of a mile south of Bucu. Section 30 feet too long because of dip.

	Thickness. Feet.	Intervals. Feet.
Norton formation:		
Sandstone, light buff, coarse-grained, weathers granular	120	
Shale	90	
Coal bloom (Splash Dam, upper bench), elevation 2,425 feet	1	211
Shale	20	
Coal (Splash Dam, lower bench), elevation 2,405 feet	....	20
Sandstone, medium-grained in upper part, coarse below	85	
Coal bloom (Upper Banner), elevation 2,315 feet	5	90
Shale, and thin sandstones	105	
(Lower Banner coal horizon), elevation 2,210 feet	....	100
Sandstone, medium-grained to coarse, massive	100	
Shale	40	
Sandstone, mostly medium-grained, forms bench	30	
Shale	50	
Sandstone, medium-grained to coarse at top, fine-grained and shaly below	35	
Shale	15	
(Kennedy coal horizon), elevation 1,940 feet	....	255
Sandstone, coarse, massive, forms conspicuous cliff	65	
Shale, not well exposed at base	35	
Sandstone, medium-grained to coarse, forms cliff	61	
Concealed	165	
(Raven coal horizon), elevation 1,614 feet	....	316
Concealed	30	30
	1,052	1,022

Section continued in log of drill hole C 82.

Local Section 17.

Up spur to west and north at sharp bend in Buffalo Creek, one mile east of mouth.

	Thickness. Feet.	Intervals. Feet.
Gladeville sandstone:		
Sandstone, weathers brownish-red, coarse, massive, not well exposed at top	70	70
Norton formation:		
Shale	70	
Sandstone, medium-grained, not well exposed	25	
Shale	15	
Sandstone, very coarse, massive	20	
Shale	20	
Sandstone, coarse, massive, forms cliffs	50	

	Thickness. Feet.	Intervals. Feet.
Shale, mostly sandy and with some fine-grained sandstone	180	
Sandstone, fine-grained	10	
(Upper Banner coal horizon), elevation 1,812 feet	....	390
Shale	45	
Sandstone, medium-grained	12	
Shale	30	
(Lower Banner coal horizon), elevation 1,725 feet	....	87
Sandstone, coarse, massive, forms cliffs	55	
Shale, sandy in part, and with some fine-grained sandstone	80	135
	682	682

Local Section 18.

Up spur to northeast at the mouth of Buffalo Creek.

	Thickness. Feet.	Intervals. Feet.
Norton formation:		
Shale	100	
Sandstone, coarse, massive	30	
Concealed	5	
(Upper Banner coal horizon), elevation 1,875 feet	....	135
Shale, sandy; and fine-grained, thin-bedded sandstone	59	
Sandstone, medium- to fine-grained, thin-bedded	12	
Shale, and some fine-grained, thin-bedded sandstone	55	
(Lower Banner coal horizon), elevation 1,749 feet	....	126
Sandstone, coarse, massive, cliff-making	50	
Concealed	30	
Shale, sandy in part	110	
Concealed	15	
(Kennedy coal horizon), elevation 1,544 feet	....	205
Sandstone, coarse, massive, cross-bedded	50	50
	516	516

Section continued in log of drill hole S 22.

Local Section 19.

From one-fourth mile north of Aily up spur to the west to the top of the hill.

	Thickness. Feet.	Intervals. Feet.
Norton formation:		
Sandstone, gray, resistant, coarse	40	
Covered	30	
Sandstone, thin-bedded, friable	30	
Sandstone, ledge-forming	20	
Shale	20	
Sandstone, soft, arkosic	25	
Shale, with thin seams of iron ore	25	
Coal bloom (Splash Dam), elevation 1,830 feet	....	190
Sandstone, massive, coarse, forms ledges	20	
Sandstone, with shale	20	

	Thickness. Feet.	Intervals. Feet.
Coal bloom (Upper Banner), elevation 1,790 feet...	....	40
Shale, sandy, with thin sandstone	90	
Sandstone, with coal streaks	10	
Coal bloom (Lower Banner), elevation 1,690 feet..	....	100
Sandstone, ledge-forming, arkosic	30	
Sandstone, friable, gray	120	
Sandstone, thin-bedded with sandy shale	40	
Coal bloom (Kennedy), elevation 1,500 feet.....	....	190
Sandstone, hard and massive	50	
Covered	30	
(Aily coal horizon), elevation 1,420 feet, approximately	....	
Sandstone, massive, coarse	40	120
	640	640

Local Section 20.

From Lick Creek up Turkey Branch through Cane Beech Gap to road intersection one-fourth mile west.

	Thickness. Feet.	Intervals. Feet.
Norton formation:		
Shale, gray, sandy	80	
Sandstone, arkosic	20	
Shale, gray, sandy	40	
Sandstone, gray, coarse, arkosic	5	
Coal bloom (Splash Dam), elevation 1,810 feet..	....	145
Shale, sandy	20	
Concealed	5	
Sandstone, coarse	15	
Shale	5	
Coal bloom (Upper Banner), elevation 1,765 feet..	....	45
Shale	10	
Sandstone, coarse, arkosic	60	
Coal bloom (Lower Banner), elevation 1,695 feet..	....	70
Sandstone, arkosic	105	
Concealed	15	
Sandstone, massive, gray	30	
Concealed	20	
Sandstone	10	
Concealed, probably sandstone	15	
Sandstone, fine-grained	10	
Concealed, probably fine-grained sandstone.....	25	
Sandstone, fine-grained	25	
Coal bloom (Kennedy), elevation 1,440 feet.....	....	255
Sandstone, massive, coarse	30	
Shale	5	
Sandstone	5	
Shale	10	
Sandstone	5	
Shale, fine	30	
Coal bloom (Aily), elevation 1,355 feet.....	....	85
Shale	15	15
	615	615

Local Section 21.

Up trail to north from Lick Creek of Russell Fork, one-half mile northeast of Counts School.

	Thickness. Feet.	Intervals. Feet.
Gladeville sandstone:		
Sandstone, buff, weathers reddish-brown, coarse, massive	60	60
Norton formation:		
Shale, light drab	45	
Sandstone, coarse, massive	40	
Shale	55	
(Hagy coal horizon), elevation 1,885 feet	....	140
Sandstone, massive	20	
Shale, drab, in part contorted	50	
Coal bloom (Splash Dam, upper bench), elevation 1,815 feet	....	70
Shale, drab, in part contorted	35	
Sandstone, coarse, massive, weathers granular	25	
Shale	10	
Sandstone, coarse, massive, weathers granular	25	
(Upper Banner coal horizon), elevation 1,720 feet	....	95
Shale	80	
(Lower Banner coal horizon), elevation 1,640 feet	....	80
Sandstone, coarse-grained, massive	35	
Shale, dark drab	25	60
	505	505

Local Section 22.

From Russell Prater Creek one-fourth mile northeast of Mart, up spur to north and west to triangulation station.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Concealed to triangulation station (elevation 1,973 feet)	13	
Shale	30	
Concealed	50	
Sandstone, very coarse-grained and light-gray at top, massive	60	
Shale, sandy	15	
Coal (Eagle), elevation 1,805 feet	....	168
Shale, sandy in part	70	
Coal (Blair), elevation 1,735 feet	....	70
Sandstone, coarse-grained, massive	50	
Concealed, probably shale in lower part	50	
(Dorchester coal horizon), elevation 1,635 feet	....	100
Gladeville sandstone:		
Sandstone, medium-grained to coarse, massive	50	50

	Thickness. Feet.	Intervals. Feet.
Norton formation:		
Shale	72	
Sandstone, medium-grained, forms cliffs	35	
Concealed	95	
Sandstone, fine-grained	10	
Shale, sandy	15	
Coal (Splash Dam, location 316), elevation 1,355 feet	3	230
Sandstone, fairly coarse, massive	55	
Shale, drab	15	70
	688	688

Local Section 23.

West along road from McClure River near Road Branch to knob on Big Ridge near Burnt Field School.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Sandstone, white, siliceous, very compact	15	
Shale with some shaly sandstone (Dorchester coal horizon near base)	70	85
Gladeville sandstone:		
Sandstone, reddish-brown, arkosic, coarse, massive	75	75
Norton formation:		
Shale	75	
Sandstone, buff, coarse	35	
Shale	40	
Coal (Hagy), elevation 1,745 feet	1	151
Shale	5	
Sandstone, brownish-buff, coarse, compact	45	
Shale, with a little sandstone	35	
Coal bloom (Splash Dam), elevation 1,660 feet	....	85
Sandstone, buff, compact, with a little shale and faint coal bloom in middle	65	
Shale	10	
Coal bloom (Upper Banner, upper bench), elevation 1,595 feet	....	75
Shale, sandy	10	
Coal bloom (Upper Banner, lower bench), elevation 1,585 feet	....	10
Shale	70	
Coal bloom (Lower Banner), elevation 1,515 feet	....	70
Sandstone, buff, coarse, compact	25	
Shale and a little fine-grained sandstone	60	85
	636	636

Local Section 24.

From drill hole S 32, near the mouth of Cranesnest River, along road to top of ridge south of Davis School. Section 60 feet too long because of dip.

	Thickness. Feet.	Intervals. Feet.
Wise formation:		
Sandstone, buff, weathers red and granular, coarse, massive	35	
(Lyons coal horizon), elevation 1,847 feet	....	32
Shale, chiefly, may include thin sandstones	65	
(Dorchester coal horizon), elevation 1,782 feet	....	58
Gladeville sandstone:		
Sandstone, buff, compact, massive, middle part not well exposed	55	50
Norton formation:		
Shale	55	
Sandstone, compact, massive, cross-bedded	30	
Shale, upper half doubtful	40	
Shale streak, black, carbonaceous (Hagy coal horizon), elevation 1,602 feet	....	112
Interval, probably shale	20	
Sandstone, compact, massive	20	
Shale	40	
Coal bloom (Splash Dam, upper bench), elevation 1,522 feet	....	72
Shale	10	
Coal bloom (Splash Dam, lower bench), elevation 1,512 feet	....	9
Shale	8	
Sandstone, compact, massive	22	
Interval, chiefly shale	40	
Sandstone	5	
Concealed	12	
(Estimated position of Upper Banner coal horizon), elevation 1,425 feet	....	78
Concealed	83	
Shale	22	
Sandstone	5	
Concealed	25	121
	592	532

Section continued in log of drill hole S 32.

GENERAL SECTIONS.

The following general sections for small subdivisions of the county are introduced to supplement the local sections and the general sections (Plate XIII) for the large divisions of the county. They have been carefully compiled from numerous traverses in the respective areas to which they are referred, and are sufficiently detailed to be applied to any portion of those areas. In all cases the deeper parts of the sections have been

compiled from well logs. The vertical intervals represent averages, but owing to the restricted areas for which the sections are compiled the extremes depart little from these averages.

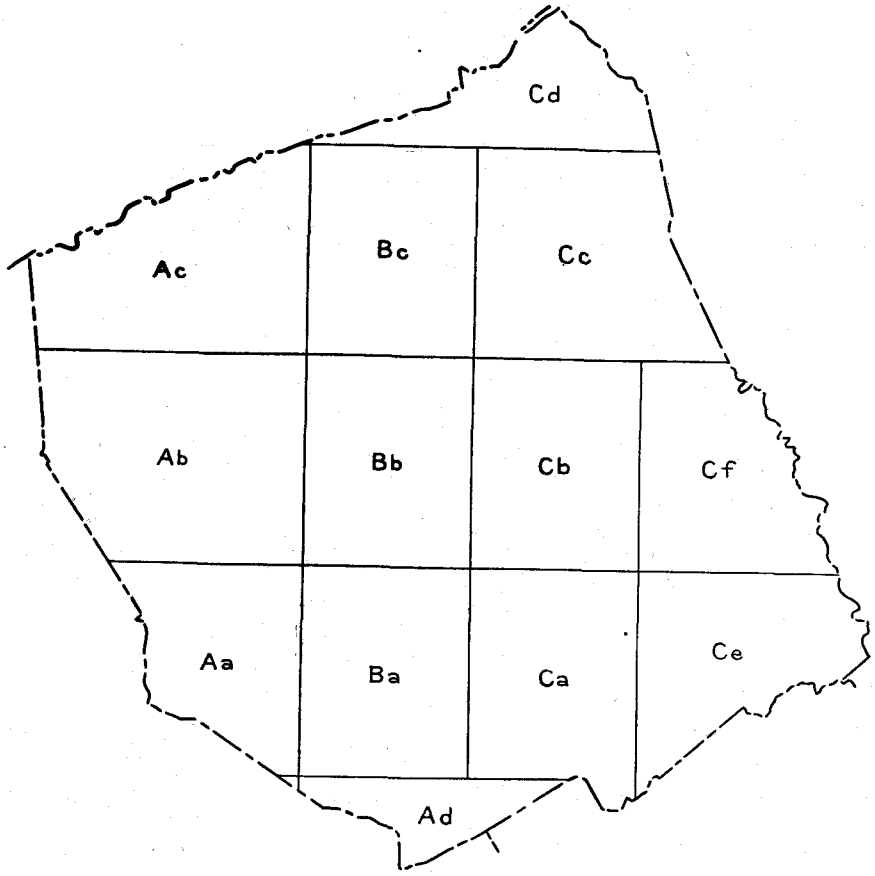


Fig. 2.—Outline map of Dickenson County showing areas for which general stratigraphic sections have been compiled.

General Section for Area Ac (Fig. 2).

	Thickness. Feet.		
Wise formation:			
Shale	20+		
Coal—Lower Bolling	.....		
Shale	10		
Sandstone	50	260–290	
Shale	170–200		
Sandstone	0–30		
Coal—Clintwood, split in most places	.....		
Sandstone, locally siliceous, chiefly arkosic	20–30		
Coal—Eagle horizon	.....		
Shale, with thin sandstones in lower part and a thin coal just above the sandstone locally	100–120		
Coal—Blair	.....		
Shale	10–20		200
Sandstone, hard, white, dense, locally has coal near base (Lyons coal bed)	20–30		
Shale, bearing sandstone in upper part locally	30–60	60–90	
Coal—Dorchester, split in places and has locally 5 feet of dark sandstone above	.....		
Gladeville sandstone:			
Sandstone, arkosic, massive	60–80		
Norton formation:			
Shale, dark to yellow	50–80		
Sandstone with a thin coal locally at top	30–75		
Shale, with thin sandstones	0–30	350	
Coal—Hagy, locally absent	.....		
Sandstone, thin sandstone alternating with sandy shale	65–125		
Coal—Splash Dam, with a little shale above in most places	.....		520–590
Sandstone, conglomeratic, forms conspicuous ledges	30–80		
Coal—Upper Banner	.....		
Shale, sandy, with locally thin sandstones	75–90		
Coal—Lower Banner	.....	215–270	
Sandstone	30–50		
Shale, sandy, with thin coal locally in lower part	90–130		
Coal—Kennedy, locally present only	.....		
Sandstone in most places, locally conglomeratic, and locally replaced by sandy shale, thin coal in lower part (Aily)	170–200		
Shale, sandy to clayey	25–60	200–260	400–550
Coal—Raven, locally present and may be split	.....		
Sandstone	30–130		
Shale, sandy with some thin sandstone	130–180		
Coal—Jawbone, thin and only locally present	.....	205–290	
Shale, sandy, alternating with thin sandstones and with a thin coal at base	75–110		
Lee formation:			
Sequence of shale, conglomerate and sandstone with thin coal beds.			
See well log S 13, Plate IX.			

General Section for Area Ab (Fig. 2).

	Thickness. Feet.		
Wise formation:			
Sandstone	50		
Shale	40		
Sandstone	50–60		
Coal—Upper Bolling	.....		
Shale	40		
Coal—Lower Bolling	.....		
Shale	10		
Sandstone, siliceous, compact, white, weathers to reddish brown	50	260–290	
Shale, with thin sandstones	170–200		
Sandstone, siliceous, compact, white	30		
Coal—Clintwood, commonly very thick	.....		
Shale	15		
Sandstone, white	30		
Shale, sandy, locally thin-bedded sandstone, with one or more thin coal beds	95		
Coal—Blair, thick locally	.....	200–230	
Sandstone, massive, compact, white	40		
Coal—Lyons, thin in most places	.....		
Shale, thickness variable	30		
Coal—Dorchester, moderately thick	.....		
Gladeville sandstone:			
Sandstone, arkosic to siliceous, locally with shale lenses	80		590–730
Norton formation:			
Shale with thin coal at base and at top (Norton coal bed)	60		
Sandstone, coarse, massive, conglomeratic locally	40	330–470	
Sandstone alternating with sandy shale, two thin coals in about the middle of the sequence (Hagy horizon)	150		
Coal—Splash Dam	.....		
Sandstone, massive, fairly coarse	50		
Coal—Upper Banner, thick in places	.....		
Shale, alternating with thin sandstone	90		
Coal—Lower Banner, locally thick	.....		
Sandstone, coarse, massive, forms conspicuous ledges	40	250–335	
Shale, sandy, alternating with fine-grained thin sandstones	120		
Below surface; compiled from drill records:			
Coal—Kennedy, thin	.....		
Sandstone, massive, coarse, locally conglomeratic	90		
Coal—Aily	.....		
Sandstone, with shale near middle and base	150		
Coal—Raven, fairly thick in places	.....		
Sandstone	60		
Shale, alternating with sandstone	110		
Coal—Jawbone, locally thick and in places absent	.....		
Sandstone, hard, resistant, locally shaly near base	260		
Coal, thin and local			
Lee formation:			
Sequence of coarse to fine sandstones, conglomerate, and shale with thin coal beds	500+		
See well logs S 1, S 10, Plate IX.			

General Section for Area Aa (Fig. 2).

	Thickness. Feet.	
Wise formation:		
Shale	30+	
Coal—Lower Bolling	.....	
Shale	10	
Sandstone, resistant, siliceous	40+	
Shale	15–40	
Coal—Clintwood	.....	
Shale, sandy, to hard sandstone	35	
Coal—Eagle, one to two blooms about 5 feet apart, absent in places	.....	
Shale, with a few sandstone lenses	30	
Coal—Blair	.....	200–220
Sandstone, hard, white, resistant, forms ledges	25	
Shale, sandy with thin beds of sandstone, Lyons coal in upper half	100	
Coal—Dorchester, 15-25 feet above base of Wise formation	.....	
Shale, sandy, with thin sandstones	15–25	
Gladeville sandstone:		
Sandstone, massive, arkosic, cliff former	100	
Norton formation:		
Shale with coal in places near base	95	
Sandstone, very arkosic, coarse, massive, conglomeratic. Splits locally and carries coal bed near middle	50	
Coal—Edwards	.....	410–450
Shale with some sandstone layers	130	
Coal—Splash Dam	.....	
Sandstone, coarse, arkosic, resistant	50	
Coal—Upper Banner	.....	
Shale, with 20-foot bed of fine-grained sandstone near middle	70–90	
Coal—Lower Banner	.....	
Sandstone, fine-grained, massive near top	60	280–350
Shale, sandy, with thin sandstones	150	
Sandstone, fine-grained, with shale at base	35	
Coal—Kennedy	.....	
Sandstone and sandy shale	110	
Coal—Aily	.....	180
Shale, sandy, with thin beds of sandstone	70	
Coal—Raven	.....	
Sandstone, shaly locally	55	
Shale, sandy to clayey	70	160
Sandstone, locally replaced by sandy shale	35	
Coal—Jawbone	.....	
Sandstone, thin layers, locally conglomeratic	85	
Shale, sandy, and thin sandstones	150	250
Coal	.....	
Shale, sandy, and thin sandstones	15	
Lee formation:		
Sandstone, hard and conglomeratic in lower half	145	
Coal	.....	
Sandstone, locally conglomeratic	200	
Sandstone and sandy shale alternating with thin shale beds —one thin coal near base and 3 thin coals in upper half	225	
Sequence continued.		
See well logs S 1, S 9, S 12, S 38, Plate IX.		

General Section for Area Ad (Fig. 2).

	Thickness. Feet.		
Wise formation:			
Sandstone, massive, siliceous to arkosic, cliff-forming	60+		
Shale, sandy with sandstones, and a thin coal locally above middle (Lyons)	35		
Shale, clayey	5		
Coal—Dorchester, moderately thick	.....		
Shale	10		
Gladeville sandstone:			
Sandstone, massive, coarse, arkosic, red to brown	90–105		
Norton formation:			
Shale, sandy to argillaceous with a thin coal near base	30		
Sandstone, arkosic, replaced in part by shale locally	40		
Shale, sandy, with a thin coal near base	35		
Sandstone, gray to brown, arkosic, cliff-former, replaced locally by shale carrying a thin coal	80		450–550
Shale with arkosic sandstone	40	300–440	
Sandstone with sandy shale locally	25		
Shale	10		
Coal—Splash Dam, moderately thick	.....		
Sandstone, coarse, arkosic, locally replaced by shale	60		
Coal—Upper Banner, thick	.....		
Sandstone, arkosic, locally replaced by shale	60–70		
Shale, with thin sandstones	40	100–160	
Sandstone and shale alternating	30–40		
Coal—Lower Banner, thick	.....		
Shale	10		
Sandstone, locally replaced in part by shale, with a thin coal in lower part	60–80		
Shale, sandy	40	200–230	
Shale, clay	20		
Shale, sandy, lower part replaced locally by arkosic sandstone	70		
Coal—Kennedy, thick	.....		
Shale, argillaceous	15		
Sandstone	35		
Shale, argillaceous	50	140	
Sandstone	40		
Coal—Aily, thin	.....		
Shale, sandy	15		
Sandstone	35		
Shale, sandy and argillaceous, with a thin coal near middle	65	115	
Coal—Raven, thin	.....		
Sandstone, massive	70		
Shale, argillaceous, with a thin coal near base	40	110	
Coal—Jawbone, thin	.....		
Sandstone, coarse, massive, conglomeratic	80		
Shale, sandy	10	250–350	
Shale, clayey, with thin coal at base	50		
Shale, sandy, with thin coal near base	180		
Lee formation:			
Sequence of sandstone, conglomerate, shale, with thin coal beds.			

General Section for Area Ba (Fig. 2).

	Thickness. Feet.		
Wise formation:			
Sandstone, siliceous, resistant	20+	155–175	
Eagle coal horizon, coal not found	.....		
Shale, sandy, with thin sandstones	55		
Blair coal horizon, coal not found	.....		
Sandstone, hard, white, weathers to orange red	20		
Shale, sandy to argillaceous, and thin sandstones. Thin coal (Lyons) in upper half	50		
Coal—Dorchester	.....		
Shale, sandy, light-colored	25		
Gladeville sandstone:			
Sandstone, massive, arkosic	100	450	780–850
Norton formation:			
Shale	95		
Sandstone, coarse, arkosic, conglomeratic at base	50		
Coal—Edwards, thin, locally present	.....		
Shale, sandy, and thin sandstones	140		
Coal—Splash Dam, locally thin	.....		
Sandstone, massive and conglomeratic	40		
Shale, sandy, variable in thickness	0–10		
Coal—Upper Banner	.....		
Shale, sandy, with thin sandstone layers in upper half	100–170		
Coal—Lower Banner	.....		
Sandstone, massive, medium to coarse-grained	40	330–420	
Shale, sandy, with thin, fine-grained sandstones	130		
Coal—Twin Sister, locally present	.....		
Sandstone, thin-bedded, fine-grained, and sandy shale	45		
Coal—Kennedy	.....		
Sandstone, coarse, massive at top, fine-grained and thin-bedded at bottom, locally conglomeratic	40	90–140	
Shale and sandy shale	40		
Sandstone	40		
Coal—Aily	.....		
Sandstone, with locally thin layers of conglomerate	50	105–135	
Shale, sandy, and sandstone	70		
Coal—Raven	.....		
Sandstone, very persistent	60	140–190	
Shale, sandy and locally clayey	40		
Shale, sandy and argillaceous, with thin coal 15 to 30 feet above base, probably split	65		
Coal—Jawbone	.....		
Sandstone, conglomeratic locally	60	260–320	
Shale, sandy and argillaceous	40		
Coal, thin but persistent, locally split	.....		
Shale, sandy to argillaceous, thin beds of sandstone	120		
Coal, locally workable, persistent, two benches in most places	.....		
Shale, sandy and argillaceous, with thin layers of hard sandstone	60		
Lee formation:			
Sandstone, conglomeratic and very resistant, in upper half, a thin coal near middle and another near base	180		
Shale, sandy and argillaceous, with thin sandstone layers, one thin coal near base and one near top	80		

	Thickness. Feet.	Intervals. Feet.
Sandstone	35	
Shale, sandy and argillaceous, with 2 thin coals near middle	30	
Sandstone, siliceous	20	
Shale, sandy	10	
Coal—1 foot 6 inches	.....	
Shale, sandy, thin sandstone at top and thin coal at bottom	75	
Sandstone	25	
Coal—2 feet 10 inches	.....	
Sandstone	20	
Sequence continues downward 350 feet farther at least. Compare well logs S 22, S 16, S 25, Plate IX.		

General Section for Area Bb (Fig. 2).

	Thickness. Feet.		
Wise formation:			
Shale	40		
Sandstone, white, siliceous, compact	50		
Shale, with local sandstone layers	40		
Coal—Dorchester, commonly thin	.....		
Gladeville sandstone:			
Sandstone, brown, massive, with local shale bed	100		
Norton formation:			
Shale, light drab, with a few thin sandstones	80		
Coal—thin in most places	.....		
Sandstone, coarse, resistant, conglomeratic	50	400–470	
Shale, with sandstone lentils locally. Two or three coal beds near middle of this shale (Hagy horizon)	150		
Coal—Splash Dam, thin in most places	.....		
Sandstone, coarse, resistant, forms ledges	40		700–770
Shale, locally may be replaced by sandstone	15		
Coal—Upper Banner, 4 feet or more thick	.....		
Shale, sandy, with sandstone layers near top and bottom	100		
Coal—Lower Banner, 2 feet or more thick in most places	.....		
Sandstone, coarse, forms conspicuous ledges	40	235–300	
Shale, sandy, with many shaly and fine-grained sandstone layers	160		
Coal—Kennedy, thin in most places	.....		
Sandstone, coarse, resistant, forming conspicuous ledges	40		
Below surface; compiled from drill records	.....		
Sandstone and sandy shale	80		
Coal—Aily, thin, locally absent	.....		
Sandstone and shale alternating	110		
Coal—Raven, moderately thick, locally absent	.....	640	
Sandstone at top and bottom separated by shale	150		
Coal—Jawbone, thick in most places	.....		
Sandstone above, shale below	90		
Coal—thin in most places	.....		
Sandstone and sandy shale	170		
Coal	.....		
Lee formation:			
Sandstone, conglomeratic, resistant	90		
Sequence of sandstone, shale and conglomerate with thin coal beds	500+		
See well logs S 17 and S 14, Plate IX.			

General Section for Area Bc (Fig. 2).

	Thickness. Feet.		
Wise formation:			
Shale and thin sandstones	60+		
Coal—Clintwood, 2 benches, 20 feet apart	.....		
Sandstone, conglomeratic, arkosic	30		
Coal—Eagle, thin	.....		
Shale and thin sandstone with coal (Blair), 15-20 feet above base	100		220
Sandstone, quartzitic and dense to arkosic and granular	30–60	75–100	
Shale, with locally some sandstone at top, 2 or 3 thin coals with one persistent at base (Dorchester)	30–60		
Gladeville sandstone:			
Sandstone, buff, granular, rather compact	60–100		
Norton formation:			
Shale	60–100		
Sandstone, buff, coarse, compact	30–60		
Shale and sandstone, variable, one or more thin coals (Hagy horizon)	145	350–400	
Coal—Splash Dam, thin in most places	.....		
Sandstone, coarse, conspicuous ledges	40–80		575–700
Coal—Upper Banner, thick except where split into 2 benches	.....		
Shale and thin sandstones	60–100		
Coal—Lower Banner, moderately thick	.....		
Sandstone, coarse, massive	30–50	225–300	
Shale and fine-grained thin sandstones, thin coals in lower part	120–140		
Coal—Kennedy, thin	.....		
Sandstone, conglomeratic toward north, split by 0-50 feet of shale	160–230	200–265	
Shale and shaly sandstone	0–35		
Coal—Raven	.....		
Sandstone, split near middle by 30-50 feet of shale and shaly sandstone	100–140	100–140	415–680
Coal—Jawbone, in 2 benches 10-15 feet apart	.....		
Sandstone	30–75		
Coal, locally absent	.....	115–275	
Shale, sandy, with thin sandstone layers	85–200		
Lee formation:			
Sandstone, siliceous, conglomeratic, with local beds of shale, and thin coals	475	475–875	
Sandstone, hard, grayish white, very conglomeratic, few thin shale beds and several thin coals	350		
Pennington shale:			
Shale	50+		

See well log S 32, Plate IX.

General Section for Area Ca (Fig. 2).

	Thickness. Feet.		
Wise formation:			
Sandstone, white, massive, cliff-former	50		
Shale	50		
Coal—Clintwood	.....		
Sandstone, locally shaly near base	40		
Coal—Eagle	.....		
Shale	60		
Coal—Blair	.....	120	
Sandstone, white, ledge former	30		220
Shale	30		
Coal—Lyons, split in places, 1–3 feet thick	.....		
Shale, very sandy, with some sandstone	45		
Coal—Dorchester, 2–4 feet thick	.....	60	
Shale, clayey and sandy	15		
Gladeville sandstone:			
Sandstone, coarse, light to brown, weathers to reddish hue	100		
Norton formation:			
Shale, yellowish drab, with 2 coals locally	100		
Sandstone, buff, coarse, locally conglomeratic at base, thin coal locally at base (Edwards horizon)	50–100	450–500	
Shale, in part sandy, with thin sandstone layers, one or more thin coals	145		
Coal—Splash Dam, ½–4 feet	.....		800–850
Sandstone, ledge former	50		
Coal—Upper Banner, split in places	.....		
Shale and fine-grained sandstone	90–130		
Coal—Lower Banner	.....		
Sandstone, buff, coarse, massive, ledge-former	40		
Shale, sandy, with thin-bedded sandstones, and with one or two thin lenticular coal beds and one thin coal about 50 feet above base	180	330–400	
Coal—Kennedy	.....		
Sandstone, buff to gray, coarse, massive, ledge-maker, slightly conglomeratic in places, finer-grained toward base	50		
Shale, sandy, with thin beds of sandstone	50	150	
Sandstone, fine-grained, resistant, locally conglomeratic	50		
Coal—Aily	.....		
Shale, sandy for the greater part	110	110	
Coal—Raven	.....		
Sandstone, uniform in character	60		
Shale, sandy and argillaceous, with occasional lenses of thin sandstone	65	165	
Sandstone	40		
Coal—Jawbone	.....		
Sandstone, conglomeratic in most places, one lenticular workable coal bed, about middle	70		
Shale, sandy to argillaceous	15		
Coal—thin but persistent	.....		
Shale, sandy with sandstones	25		
Coal—thin, locally present	.....	310	
Sandstone	40		
Shale and sandstone, variable	90		
Coal—persistent, workable in most places	.....		
Shale, sandy with thin sandstones	35		
Coal—thin	.....		
Shale, sandy	35		
Lee formation:			
Sandstone, siliceous	20+		

See well logs S 20, S 23, S 26, S 27, S 29, S 31, Plate IX.

General Section for Area Cb (Fig. 2).

	Thickness Feet.			
Wise formation:				
Sandstone, massive, reddish brown	40			
Blair coal horizon, bed possibly not present	.....			
Shale with some weak lenticular sandstone	80			
Dorchester coal horizon, bed present locally, thin	.....			
Gladeville sandstone:				
Sandstone, buff to brown, coarse	60–80			
Norton formation:				
Shale, yellow to drab	60–100			
Sandstone, coarse, granular	60		400–490	
Shale with one or more sandstone horizons and two thin coals	140			
Coal—Splash Dam	.....			
Sandstone	30–60	30–80		720–760
Coal—Upper Banner, thick	.....			
Shale and fine-grained, thin sandstones	50–100			
Coal—Lower Banner, persistent and locally thick	.....			
Sandstone, coarse, resistant	30		250–320	
Shale and fine-grained, thin-bedded sandstone, with a coarse sandstone bed near middle locally	180			
Coal—Kennedy, thin in most places	.....			
Sandstone, coarse, resistant, forms conspicuous ledges	50			
Shale and thin sandstones	40			
Coal—Aily, thin in most places	.....			
Sandstone with some shale, coal bed near middle locally	50			
Shale to sandy shale, with coarse, massive sandstone at base locally	50–70	100–120		
Coal—Raven	.....			
Sandstone	45–65			
Shale, clayey, sandy shale locally	50–90	95–175	600–660	
Coal—Jawbone, 2 benches 15–35 feet apart	.....			
Sandstone	40–80			
Shale, sandy, with coarse sandstone in upper part and lenticular sandstone in lower part	125–185	250–300		
Coal, thin in most places	.....			
Shale, sandy	40–50			
Lee formation:				
Sequence of shale, sandstone, conglomerate, and thin coals.				

General Section for Area Cc (Fig. 2).

	Thickness Feet.				
Wise formation:					
Sandstone	20				
Shale	140				
Coal—Clintwood horizon, coal not found	.....	260			
Sandstone, light drab to gray, compact, locally conglomeratic, cliff-former	50–100				
Coal—Eagle, variable in thickness	.....				
Shale and sandstone, irregularly bedded	50–90				
Coal in two benches, 20 to 30 feet apart, coal variable in thickness, Blair horizon	.....				
Sandstone, reddish brown, soft, granular	60	100			
Shale with coal in two benches 20–40 feet apart, upper bench Lyons, lower bench Dorchester	30–50				
Gladeville sandstone:					
Sandstone, reddish brown, compact, ledge-former	60				
Norton formation:		165			
Shale with one or two sandstone beds, blue shale at base	150	210			
Coal—Hagy, thin to thick	.....				
Sandstone, buff, ledge-former, shale below	60–100				
Coal—Splash Dam, thin to thick, split into 2 benches locally	.....	60–120			525–620
Sandstone, buff, medium-grained, ledge-former	60–80			275–305	
Coal—Upper Banner, thin, absent in north	.....				
Shale	40–80		200–280		
Coal—Lower Banner, thin to thick, absent throughout most of area	.....				
Sandstone, buff, medium-grained	30	165–210			
Shale and shaly sandstone, locally conglomeratic near base	175–190				
Coal—Kennedy, thin to thick	.....				
Sandstone, buff to light gray, massive, conglomeratic toward north, locally shaly, with Aily coal in lower half	170–220	200–240			
Shale, dark	25				
Coal—Raven, possibly not present	.....		400–500		
Sandstone, with some sandy and clay shales and thin coal near middle	110				
Coal—Jawbone, 2 benches, 17 feet apart	.....	205–260			
Sandstone with thin partings of shale and shaly in lower part	150				
Lee formation:					
Sandstone, hard, grayish white, with thin partings of shale and several thin coals; lenses of conglomerate throughout and locally very conglomeratic	475	475–830			
Sandstone, hard, grayish white, with lenses of conglomerate in lowest part; split by thin shale and sandy shale layers and with coal near base	355				

Compare with drill log S 35, Plates IX and X.

General Section for Area Cd (Fig. 2).

	Thickness Feet.			
Wise formation:				
Sandstone, massive, conglomeratic, split near middle, probably horizon of Lower Bolling coal	100			
Shale, yellow, with thin sandstones	140–200			
Coal—Clintwood	.....			
Sandstone, conglomeratic and massive	50–130			
Coal—Eagle	.....			
Shale, with thin sandstones and thin coal locally	40–70	140–240		
Coal—Blair, present locally only	.....			
Sandstone above, sandy shale below	60–80			
Coal—2 beds, 20–40 feet apart, upper Lyons, lower Dorchester	.....			470–520
Gladeville sandstone:				
Sandstone, conglomeratic, massive, locally shaly	39–90			
Gladeville sandstone:				
Norton formation:		190	270–290	
Shale, sandy and clay shales, with rarely thin sandstones	70–130			
Coal—Hagy	.....			
Sandstone in upper half, shale in lower half in most places	75–100			
Coal—Splash Dam	.....			
Sandstone	50–70			
Coal—Upper Banner horizon	.....			
Shale	60–70			
Coal—Lower Banner, thin, absent in most places	.....			
Shale, upper part sandy with thin sandstones, lower part blue shale with limestone concretions	90–110	275		
Coal—Elswick, thin	.....			
Sandstone, upper part thin-bedded, lower part blue shale with concretions, locally some coarse sandstone in this shale	50–60			
Coal—Kennedy, absent probably in most places	.....			
Sandstone, hard, conglomeratic, cross-bedded	170			
Shale, with one sandstone bed	25			
Coal—Raven	.....			
Shale, with some sandstone	205			
Lee formation:				
Sandstone, split by shale locally, conglomeratic	475			
Shale	50			
Coal	.....			
Shale, blue	15			
Sequence of sandstone, shale and thin coals below. Compare well logs C 116, C 121, C 122, Plate IX.				

General Section for Area Ce (Fig. 2).

	Thickness Feet.		
Wise formation:			
Sandstone, white, massive, cliff-former	50		
Shale	50		
Coal—Clintwood	.....		
Sandstone, locally shale at base	40		
Coal—Eagle	.....		
Shale, with a thin bed of sandstone	60		
Coal—Blair	.....		
Sandstone, white, ledge-former	40	220	
Shale, with thin beds of sandstone	20		
Coal—Lyons	.....		
Shale, sandy with sandstone beds	45		
Coal—Dorchester, thin and commonly split	.....		
Shale, argillaceous	15		
Gladeville sandstone:			
Sandstone, light brown, coarse	100		
Norton formation:			
Shale, with locally one bed of sandstone and a thin coal at base	80		
Sandstone, buff, coarse, thin coal at base locally, and near middle locally	60–120	420–490	
Shale, with irregular beds of sandstone, especially near top, and with one or more thin lenticular coals	160		
Sandstone, buff, coarse, massive	30–60		
Coal—Upper Banner, thick in most places	.....		
Shale and irregular beds of sandstone, mostly fine-grained, locally a conspicuous ledge at top	100–140		
Coal—Lower Banner, thick in most places	.....		
Sandstone, buff, fairly coarse, massive, locally thin coal at base	40		300–380
Shale, sandy for most part, and fine-grained sandstone, ledge 100 feet above base, one or two thin coals in lower part	175	150–270	
Coal—Kennedy, thin	.....		
Sandstone, light buff, very coarse and massive at top	40–60		
Sandstone and sandy shale with one or more thin coal beds	100		
Shale, sandy for most part, with irregular beds of sandstone and several coal beds	110–180	275–350	
Sandstone, grayish buff, fairly coarse	40		
Coal—Raven, thick locally	.....		
Shale with irregular beds of sandstone and one or more thin coal beds	130–215		
Coal—Jawbone, thick	.....		
Sandstone, gray, quartzitic, very coarse and massive, conglomeratic locally	0–75		
Coal—Tiller, thick	.....		
Shale and irregular beds of gray to buff, coarse, locally conglomeratic sandstone, with a few thin coal beds	140–250		
Coal—locally moderately thick	.....		
Lee formation:			
Sandstone, gray, compact, conglomeratic	40		
Coal—thin, locally present	.....		
Shale and conglomeratic sandstone	60		
The Lee formation continues as a sequence of conglomeratic sandstone, shale, and thin coals.			
See well logs, Plate X.			

General Section for Area Cf (Fig. 2).

	Thickness Feet.		
Gladeville sandstone:			
Sandstone	60+		
Norton formation:			
Shale, light gray to drab	80		
Sandstone, buff, coarse-grained	30–90		
Hagy coal horizon, coal not found	.....		
Shale with sandstone	70–90		
Coal—Splash Dam, probably absent in most places	.....		
Sandstone, buff, coarse, cliff-former	50–100		
Coal—Upper Banner	.....		
Shale with some sandstone	80–100		
Coal—Lower Banner, not well-exposed	.....		280–330
Sandstone, coarse to fine-grained	20–40	200	
Shale and fine-grained sandstone	170		
Coal—Kennedy, moderately thick	.....		
Sandstone, buff to gray, coarse, massive, conspicuous cliff-former	30–70	100	
Sandstone and shale	30–70		
Coal—Aily, thin	.....		
Sandstone and shale	100		300–390
Coal—Raven, thin, locally in two benches	.....	100	
Sandstone, buff, medium-grained, ledge-maker	40–60		
Shale, with some sandstone	70	120	
Coal—Jawbone, thin	.....		
Sandstone, gray, very coarse	25–60		
Coal—Tiller, thick, may unite toward south with Jawbone bed	.....		
Sandstone, massive	50		
Sandstone and shale, with thin coal locally	50	200–275	
Sandstone	25		
Shale and sandstone	75		
Shale, with thin coal locally	25		
Lee formation:			
Massive sandstone, siliceous, conglomeratic	50+		

Compare well logs C 70, C 73, C 84, C 85, Plate X.

GEOLOGIC STRUCTURE.

METHOD OF REPRESENTATION.

The position in which coal and other beds lie in a region in which there are few sharp folds is most readily shown by means of structure contours—lines drawn so that each one of them connects points at which some easily recognizable reference stratum is at the same elevation. In part of the county the Upper Banner coal bed has been chosen as the reference stratum, and in another part where the Upper Banner is nearly everywhere at a considerable depth beneath the surface, little prospected and probably poorly developed, the Splash Dam coal bed has been used

as the reference stratum. This bed is about 70 feet above the Upper Banner. 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.

Another use of the structure contours is to show the position of the outcrop of any bed on the topographic 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 Kennedy coal bed at some point on Indian Creek, the elevation of the Upper Banner horizon shown by the structure contours is first noted. Then the distance between the Kennedy and the Upper Banner is ascertained by consulting the detailed descriptions of the Kennedy in the Indian Creek drainage basin, the generalized sections in Plate XIII, the general sections, or a local section for a neighboring exposure. As the Kennedy is below the Upper Banner, this distance subtracted from the elevation of the latter bed will give the elevation of the Kennedy. By turning to the topographic map the Kennedy outcrop can then be located by noting the position of the surface contour with the same elevation, or if the Kennedy bed 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 Kennedy bed from that shown by the topographic map at that point.

The usefulness of structure contours naturally depends largely on their accuracy. There are so many possible sources of error in determining the position of such contours 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 along Pine Mountain, near areas in which the rocks are faulted and buckled like those on Russell Fork, and in some other areas.

DIP.

In the greater part of Dickenson County the strata dip gently to the northwest averaging a little more than 50 feet to the mile. This general dip is not uniform, however, and is modified and to a large extent governed by a few large open folds, and is also locally modified by short low folds or wrinkles that are irregularly distributed and whose axes trend in different directions.

FOLDS.

Middlesboro syncline.—Essentially all of Dickenson County lies in a broad fold that is synclinal, or concave upward. This fold, named by Campbell the Middlesboro syncline, extends from a few miles northeast

of the county southwestward into Tennessee, being commonly 12 to 20 miles broad, and lying between Pine Mountain on the northwest and a broad arch or anticline on the southeast. It fades out northeast of Russell Fork, and is not recognized as a distinct syncline beyond Levisa Fork in Buchanan County.

The axis, or imaginary line toward which the strata on each side dip and which connects the lowest parts of the syncline, corresponds closely in position with the valley of Pound River and is continued in the same direction northeast of Russell Fork. Strata southeast of the axis dip, in general, to the northwest at very low angles, descending for example, a vertical distance of 1,050 feet between the town of Wilder just across the county line in Russell County and the mouth of Cranesnest River, a horizontal distance of 15½ miles. Northwest of the axis the dip is to the southeast and gradually increases from the axis of the syncline where there is no dip to about 33° near the top of Pine Mountain. The southeast dips were produced in the formation of the great Pine Mountain anticline described below, and continue to the place where the Pine Mountain thrust fault formed by the rupturing of the fold comes to the surface on the northwest slopes of the mountain (See Fig. 3).

Sourwood Mountain anticline.—The extreme southeastern part of Dickenson County is affected by a structure which is the reverse of a syncline, the strata being convex upward, the rocks dipping in opposite directions from a middle line or axis. The axis of the Sourwood Mountain anticline, the name given to this structure, is a curved line having a general north-south trend and terminates at both ends in faulted areas. The anticline which is about 7 miles in length plunges slightly to the north and is slightly modified by a very shallow cross syncline at its south end. The axis of the fold lies across the county line in Russell County and closely parallels the county line, but a large part of the northwestern flank of the anticline, which is 3 miles or more in width, is in Dickenson County. The strata on this flank dip to the northwest and west, averaging about 250 feet to the mile.

Pine Mountain anticline.—The Pine Mountain anticline[1] extends southwestward from Levisa Fork in Buchanan County, forms the northern boundary of the greater part of Dickenson and Wise counties, and continues onward into Kentucky. The arch appears first as a low dome just

[1] Hinds, Henry, The Geology and Coal Resources of Buchanan County, Virginia, Bulletin XVIII, Va. Geol. Survey, 1918.

west of Levisa Fork in Buchanan County. From this dome it rises rapidly to the southwest, attaining maximum development a short distance west of the Buchanan-Dickenson County line. Its axis passes through Jane, on the county line, the middle part of The Breaks, and Skegg Gap. In Buchanan County, and in Dickenson County east of Skegg Gap, the anticlinal structure is well defined, the great Pine Mountain thrust fault lying to the north of the axis of the fold. West of Skegg Gap the anticlinal structure is obscured by the thrust fault which lies near the position of the axis of the fold and replaces its north limb. However the south limb of the structure is well defined, the beds dipping steeply southeastward toward the axis of the Middlesboro syncline. The dip near the crest is about 33 degrees but decreases as the axis of the syncline is approached.

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.

FAULTS.

In addition to the folds, faults have profoundly modified the structure and have exerted a marked influence on the economic possibilities of the region. A large part of the potentially coal-producing territory of southwest Virginia is bounded on both the northwest and the southeast by great thrust faults, the value of parts of several coal beds has been decreased by movements connected with this faulting, and buckling and faulting have made unavailable the coal beds in narrow zones within the coal field.

Pine Mountain fault.

The coal-bearing rocks of Virginia were thrust up over those in Kentucky along the plane of the great Pine Mountain fault, which comes to the surface on the north face of Pine Mountain from Russell Fork into Tennessee. The fault dies out rapidly northeast of Russell Fork, and on Levisa Fork there is no trace of it or of the anticline from which it developed. According to recent work by Keith and Butts, the fault is compound in places, breaks having occurred on two planes, that are close together everywhere, and join in places (fig. 3). The first effect of the tremendous pressure from the southeast was probably the formation of a sharply overturned fold, near the axis of which the faults originated. The rocks belonging to the Lee formation, on the hills northwest of the Pine Mountain escarpment in the Clintwood quadrangle were probably carried to that position by one of the faults and are only small remnants that have

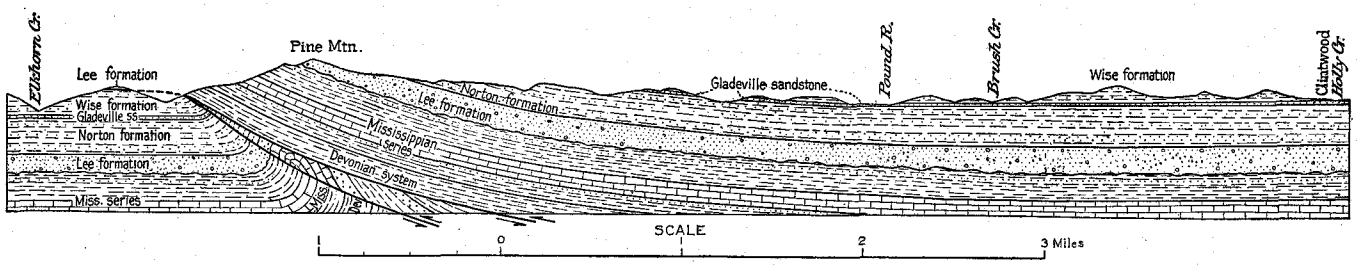
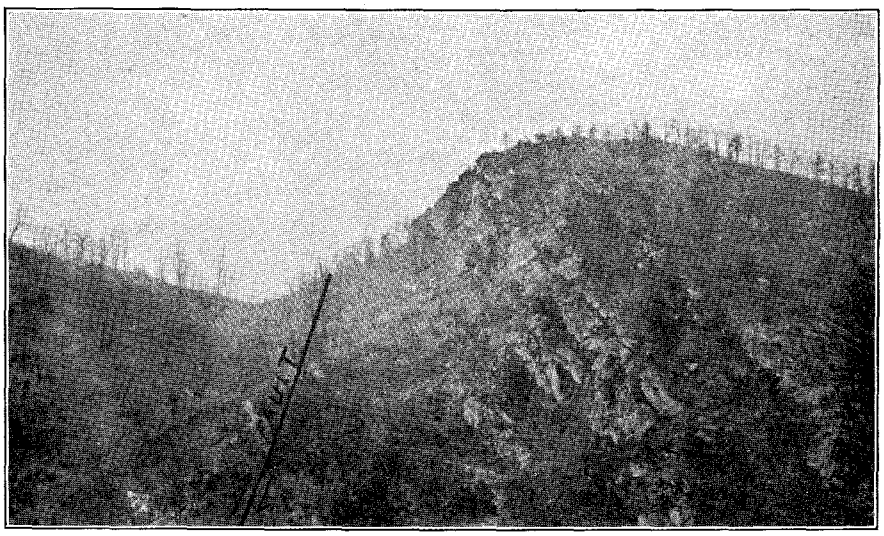
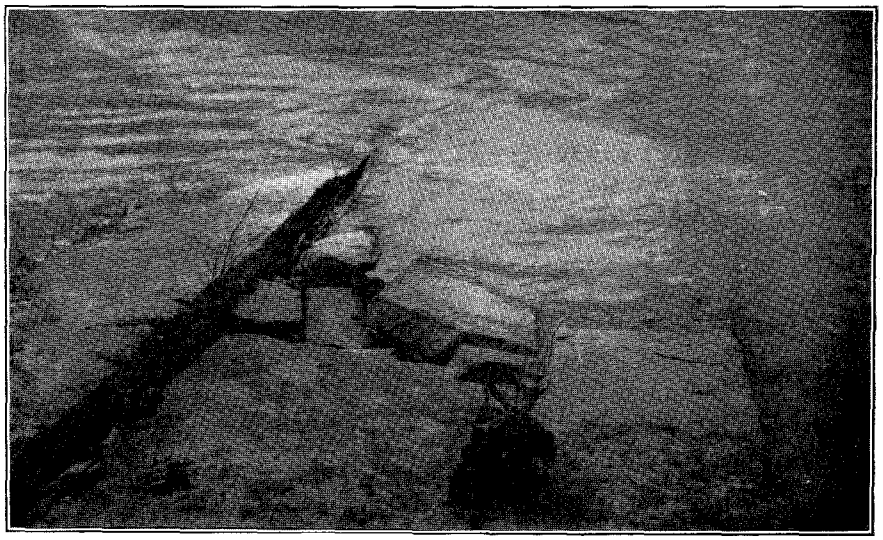


Fig. 3.—Cross-section from Elkhorn Creek, Kentucky, across Pine Mountain to Clintwood. (After Hinds: Va. Geol. Survey, Bull. XII, 1916.)

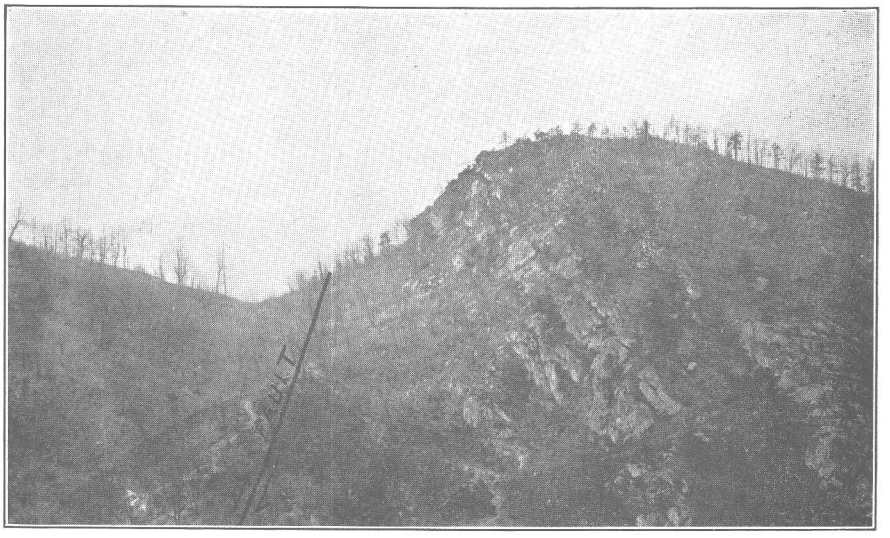


(A) View of Skegg Gap looking north along fault line. At this point the resistant basal conglomerate of the Lee formation on the overridden side (right) is adjacent to the weak rocks of the Pennington formation of the overthrust side (left).

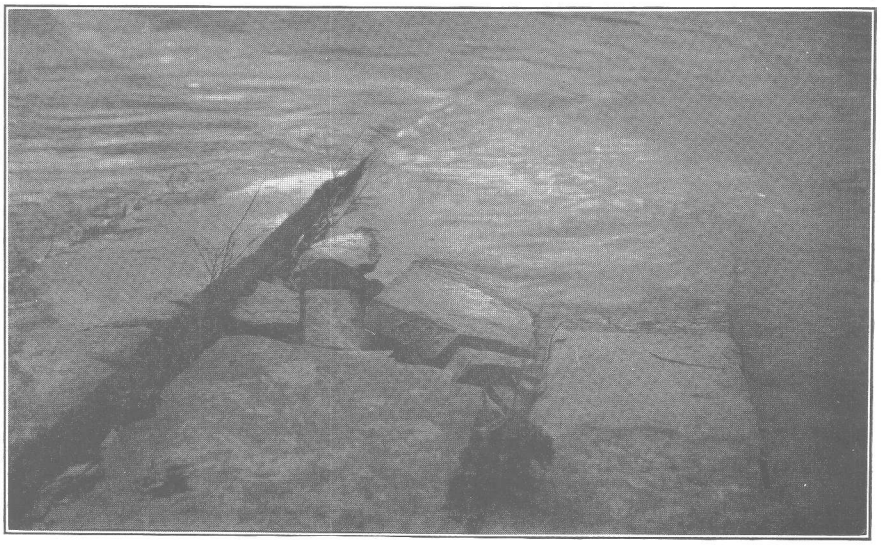


(B) Close jointing in sandstone near fault trace at the mouth of Pound River. Average space between joints is 2 feet.

PLATE XV.—VIEWS OF RUSSELL FORK FAULT SHOWING EFFECTS OF DISPLACEMENT.



(A) View of Skegg Gap looking north along fault line. At this point the resistant basal conglomerate of the Lee formation on the overridden side (right) is adjacent to the weak rocks of the Pennington formation of the overthrust side (left).



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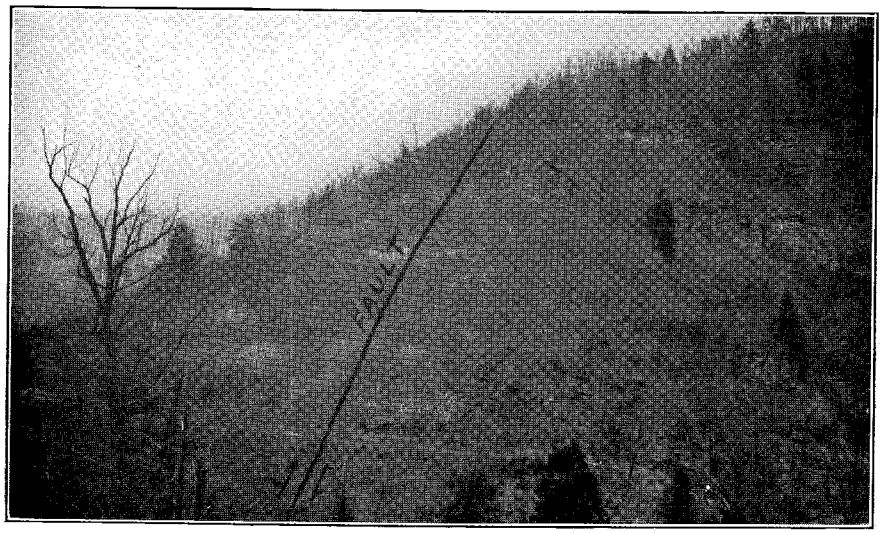
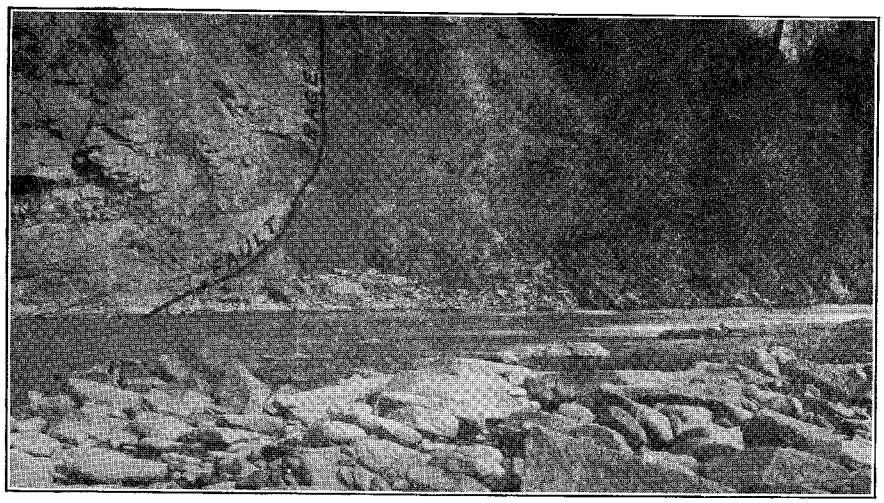
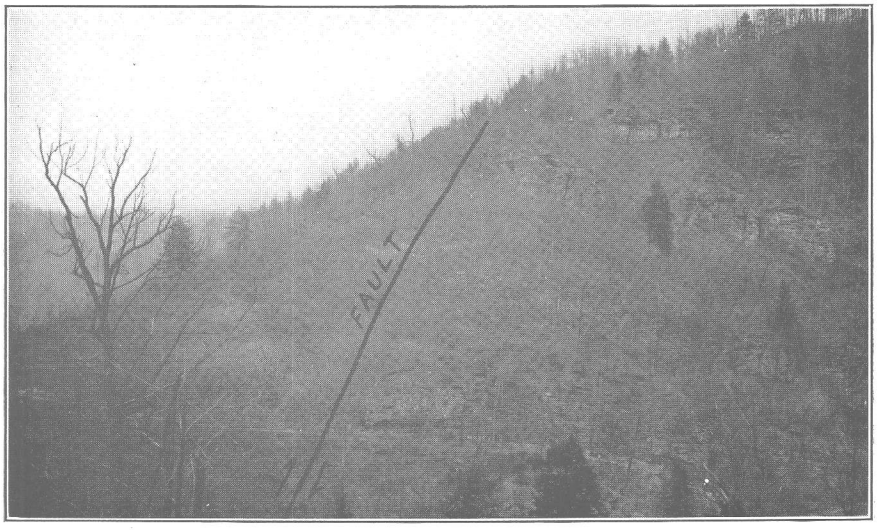


(A) View looking north from point across river from south portal of Hills Mills tunnel. Sandstone ledges near the top of the spur on the downthrow side are upturned apparently as a result of drag.

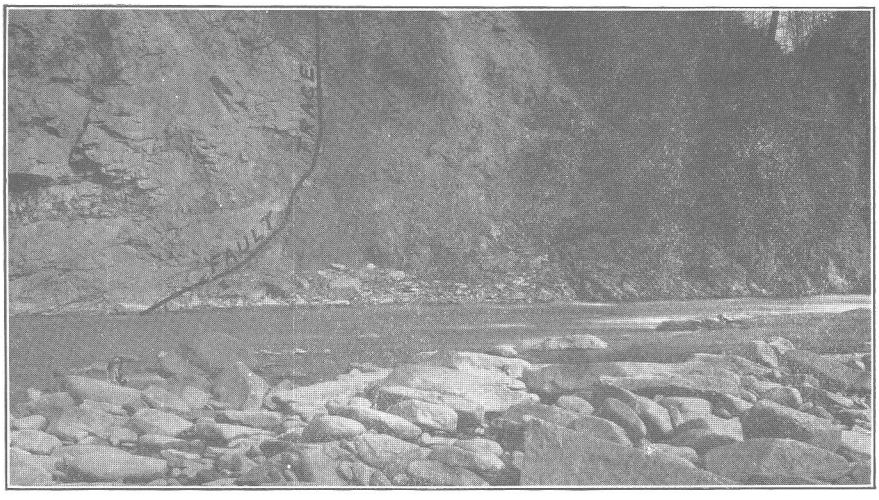


(B) View of river bank looking southeast near B. M. 1221. Massive and undeformed sandstone on left of fault trace with deformed shale at right. Strong horizontal slickensides are formed on the face of the sandstone at this place.

PLATE XVI.—VIEWS OF RUSSELL FORK FAULT SHOWING DEFORMATION OF THE ROCKS ADJACENT TO THE FAULT SURFACE.



(A) View looking north from point across river from south portal of Hills Mills tunnel. Sandstone ledges near the top of the spur on the downthrow side are upturned apparently as a result of drag.



(B) View of river bank looking southeast near B. M. 1221. Massive and undeformed sandstone on left of fault trace with deformed shale at right. Strong horizontal slickensides are formed on the face of the sandstone at this place.

PLATE XVI.—VIEWS OF RUSSELL FORK FAULT SHOWING DEFORMATION OF THE ROCKS ADJACENT TO THE FAULT SURFACE.

escaped erosion. These rocks, which overlie undisturbed strata of the Wise formation, are nearly vertical in places, and at one place 1½ miles west of Blowing Rock Gap are separated from Devonian black shale, brought up by the second fault, by overturned remnants of Pennington shale and Newman limestone. The second fault was at a lower angle and carried the rocks still higher, so that now the lower part of the Devonian black shale is in contact with beds in the Wise formation.

The vertical component of the thrust along the trace of the fault in the northwestern part of Dickenson County is 5,000 to 5,300 feet. In The Breaks, the vertical displacement is only 600 to 800 feet and there is no evidence of overfolding or of more than one fault. It is probable that one of the faults ends in the Russell Fork fault, 2 miles west of The Breaks.

Russell Fork Fault.

By Chester K. Wentworth.

Introduction.—The nature of the northeastern termination of the great overthrust block of the earth's crust, bounded on three sides by the Pine Mountain fault, the Hunter Valley fault, and the Jacksboro cross-fault of Tennessee, has long been an unsolved problem to students of Appalachian structural geology. Many geologists have noted the rather abrupt ending near The Breaks of Big Sandy River of the imposing barrier of Pine Mountain and its replacement to the northeastward by the irregular ridges and valleys of the unbroken coal field, but the manner in which the great anticlinal fold and the resulting thrust fault died out has not, until recently, been satisfactorily solved.

In 1916 Hinds,[1] in his report on the Clintwood and Bucu quadrangles, called attention to a zone of disturbed rocks nearly at right angles to the general lines of disturbance in this region and extending partly across the trough of coal-measure rocks from Big A Mountain to Skegg Gap on Pine Mountain. Hinds attributed the disturbance in this zone to the same forces that produced the Hunter Valley fault on the southeast and the Pine Mountain fault on the northwest, but he failed to perceive its significance, for he thought it was limited to certain areas and did not extend entirely across the synclinal block.

In April, 1920, M. R. Campbell, in charge of geologic work in this coal field for the United States Geological Survey, called attention to the possibility of the belt of disturbed rocks mapped by Hinds being but part of a continuous fault or zone of faulting from the Hunter Valley

[1] Hinds, Henry, The coal resources of the Clintwood and Bucu quadrangles, Virginia: Virginia Geol. Survey Bull. XII, 1916.

fault at Big A Mountain to Skegg Gap in Pine Mountain, and the writer was requested to examine the region as carefully as the limited time at his disposal would permit, in order to establish the character and extent of the movements that produced the disturbance. The result of his examination was the establishment beyond much question of the presence of an overthrust fault entirely across the great crustal block, thus showing that it is bounded on all four sides by overthrust faults and that it has moved bodily to the northwest, a distance of many miles. The results of his studies and their application to the mechanics of the problem of the overthrusting of this great mass of strata for at least six miles are here set forth.

The fault bounding the crustal block on the northeast, which, on account of its general agreement with the course of Russell Fork, is here called the Russell Fork fault, was mapped in connection with coal investigations carried on coöperatively by the Virginia Geological Survey and the federal Geological Survey. The areas mapped as undifferentiated buckled and faulted rocks by Hinds,[1] in the Clintwood and Bucu quadrangles, were subjected to careful study by the writer to determine whether or not there is a continuous break across the coal measures trough from the vicinity of Big A Mountain to Skegg Gap, but in the two weeks spent on this study there was not time to cover much of the area lying on either side of this zone and the structure contour maps of the report by Hinds furnished much data in compiling the sections shown below and in deducing the amount of displacement.

The writer is indebted to M. R. Campbell for many helpful suggestions and much assistance in the course of the study.

Hinds,[2] in his report on the coal resources of the Clintwood and Bucu quadrangles, describes the structure of the northeastern end of the Middlesboro syncline in considerable detail. His studies here and farther northeast in Buchanan County[3] have shown that the great overthrust fault of Pine Mountain suddenly becomes very much less severe at Skegg Gap and from there northeastward the structure is essentially a low anticline broken by a minor overthrust which decreases rapidly in extent of thrust and comes to an end a few miles in Buchanan County. He considered that the principal Pine Mountain overthrust was cut off at the northeast

[1] Op. cit.

[2] Hinds, Henry, Coal resources of the Clintwood and Bucu quadrangles: Virginia Geol. Survey Bull. XII, 1916.

[3] Hinds, Henry, Geology and coal resources of Buchanan County, Virginia: Virginia Geol. Survey Bull. XVIII, 1918.

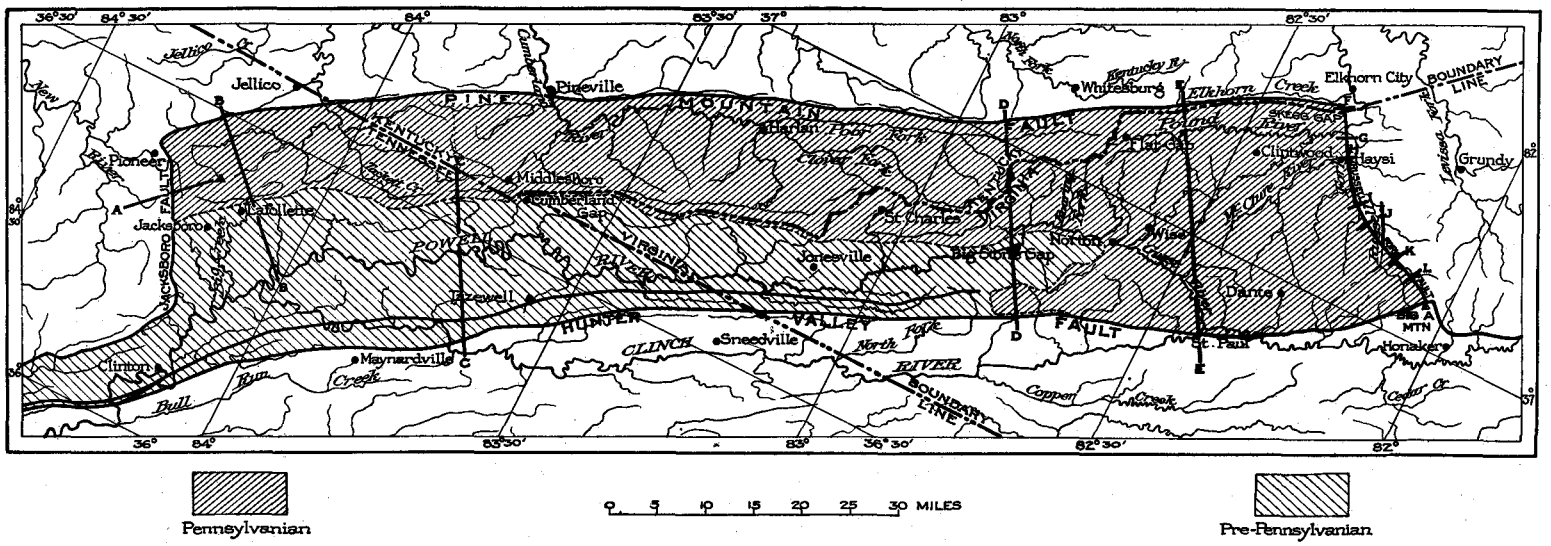


Fig. 4.—Areal map of the Cumberland Block showing its location in the states of Virginia, Kentucky, and Tennessee, and locations of the structure sections of Figures 6 and 7.

end by the Skegg Gap fault which he mapped as far as Russell Fork. Extending from this point southeastward to Big A Mountain he has mapped a number of narrow areas of faulted and buckled rocks which he describes in some detail and postulates lateral shearing with the southwest side moving northward with some overthrusting and buckling against the northeast side. He states that after this there was normal faulting along this side in which the southwest side was downthrown. His evidence for this belief is not clear, and his several areas of disturbed rocks are separated by areas in which he found no evidence of movement.

Description of the Cumberland block.[1]—The structure of the area concerned in this paper has been described in considerable detail at many points in papers by other geologists. It is not proposed to give here a thorough description of the structure or topography but rather to point out briefly their salient features.

The "remarkable quadrilateral block" whose southwestern extremity was first recognized by Safford and described in detail by Keith extends from the valley of Cove Creek in Campbell County, Tennessee, northeastward for 125 miles to the valley of Russell Fork of Big Sandy River in Dickenson and Buchanan counties, Virginia. It is surprisingly uniform in width, averaging about 25 miles, is bounded on the northwest by the Pine Mountain fault and on the southeast by the Hunter Valley fault and the closely associated Wallen Valley fault, which is developed only from near Big Stone Gap southwestward. The southwest end is terminated by the Jacksboro cross fault and the northeast end by the Russell Fork cross fault to be described below in more detail. The general relations of these boundary faults may be more clearly seen by reference to the map, figure 4 and to the structure sections, figures 6 and 7.

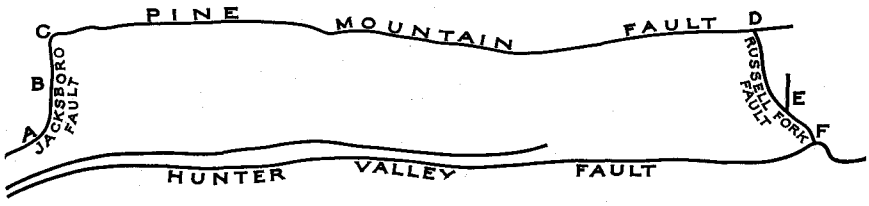


Fig. 5.—Outline diagram of Cumberland Block showing the bounding faults.

From Norton, Virginia, northeastward, coal measure rocks are exposed at the surface throughout the entire width of the block; but from Norton southwestward the block may be divided into two parts, that part lying

[1] This name is here applied for the first time.

northwest of Stone and Cumberland mountains being synclinal in structure and composed of coal measure rocks, whereas that part lying southeast of these mountains is anticlinal in structure and composed of rocks of very much greater age. The syncline, which is now generally known as the Middlesboro syncline, is a broad, flat-bottomed trough at the northeast end of the block, but farther west in the vicinity of Dante an arch appears which develops rapidly westward into the Powell Valley anticline that constitutes the southern part of the block. Both the Middlesboro syncline and the Powell Valley anticline are characterized by steep dips on the northwest limbs and gentle dips on the southeast limbs, as shown in the sections. The erosion by Powell River and its tributaries of the rising crown of Powell Valley anticline accounts for the exposures of pre-Carboniferous rocks in the southern portion of the block and the narrowing of the coal measure portion on the north.

The topography of the block is intimately related to the structure. Pine Mountain throughout its entire length is a conspicuous barrier especially on its northwest face where at many points it rises in less than a mile 1,000 to 2,000 feet above the streams which parallel it. For nearly ninety miles no stream crosses it and in the entire distance of 125 miles not over half a dozen roads afford difficult passage from one side to the other. Its crest is the resistant conglomerate of the Lee formation, which marks the edge of the overthrust block. Cumberland Mountain and Stone Mountain are composed of the same formation, which is steeply upturned in that part of the fold common to the syncline and anticline mentioned above. Black Mountain and parts of Sandy Ridge are residual mountains left in the dissection of the nearly horizontal coal measures. Big A Mountain, according to Hinds,[1] is composed of resistant sandstones of the Rockwood formation, overthrust on the coal measures.

The surface features of that portion of the block within the coal field are those of a maturely dissected plateau with sharp-crested ridges and V-shaped valleys, for the most part without valley flats. The surface of the pre-Carboniferous portion is rolling, with sinkholes in the limestone portion and some, though not at this particular point very striking, alineation of ridges and valleys with the northeast-southwest trend of the Appalachian sructure.

The Russell Fork fault.—The Russell Fork fault differs from the faults which bound the Cumberland block on the other three sides in that it is

[1] Hinds, Henry, The geology and coal resources of Buchanan County, Virginia: Virginia Geol. Survey Bull. 18, pp. 58-59, 1918.

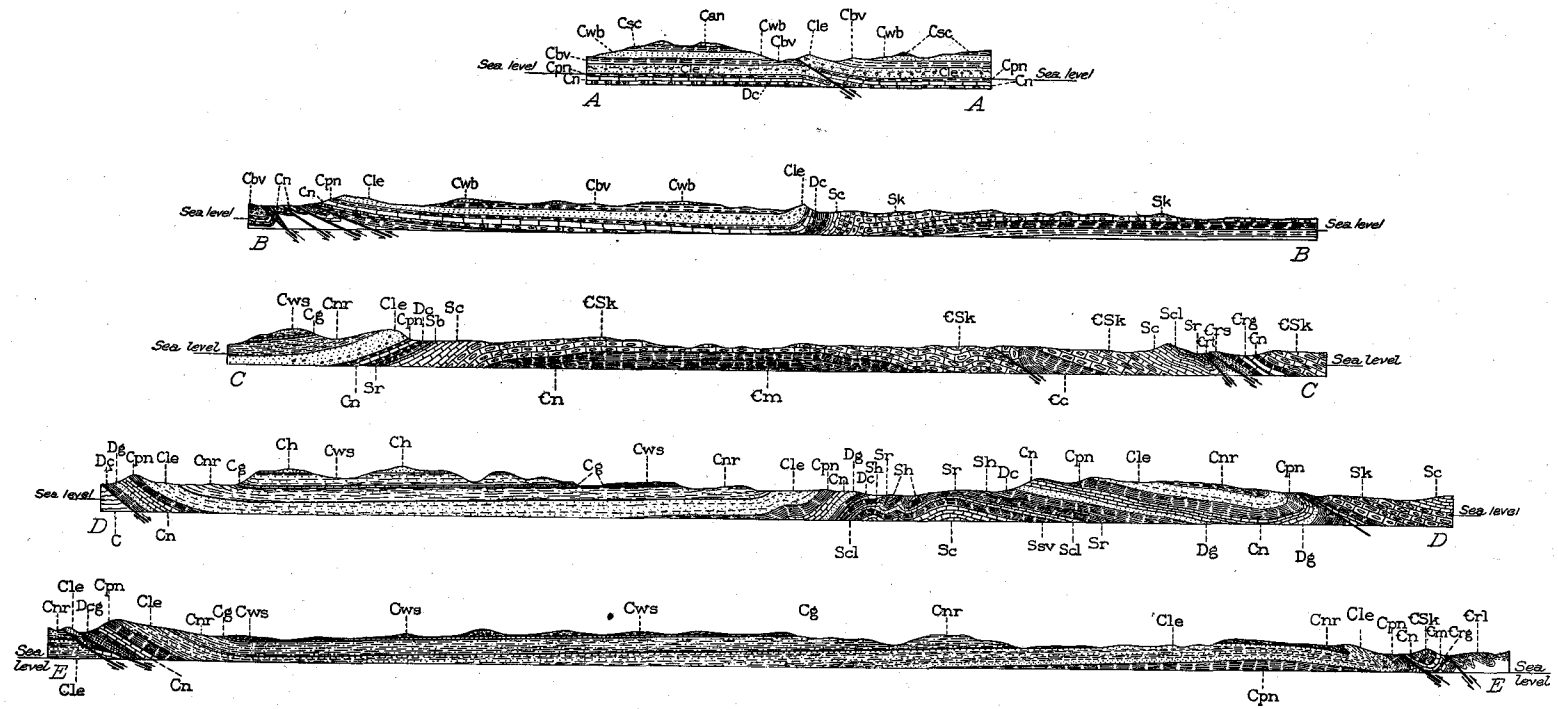


Fig. 6.—Sections showing general structure of the Cumberland Block. Section A-A is seen as looking northwest, the others as looking northeast. For locations see Figure 4. (These sections have been compiled and somewhat generalized from Geologic Folios 12, 33, 59, and 75; Professional Paper 49; and Bulletin 541f, all of the U. S. Geol. Survey.)

not a low-angle overthrust and that in it the greatest displacement is in a horizontal direction with comparatively little vertical movement. Its trace[1] is closely followed except at a few places by Russell Fork of Big Sandy River and even at those places it is marked by the alineation of minor drainage lines or surface features which would not otherwise be easily explained.

Erosion of crushed and weakened rocks along the fault trace has produced the low saddle at Skegg Gap and the saddle in the point of the spur west of Russell Fork and one mile north of B. M. 1,221[2] feet on the geologic map accompanying this report.

From a point one-half mile upstream from B. M. 1,282 feet to B. M. 1,221 feet Russell Fork flows in a course somewhat farther northeastward than in adjacent parts of its course up and down stream. In the high land which lies southwest of this part of the river and northwest of the village of Haysi are cut two short cleft-like hollows which are closely aligned with the fault trace as located to the north and south, and have without doubt been determined by the presence of the weaker rock in the zone of deformation adjacent to the fault. One of these hollows enters the river valley just at the railroad bridge east of B. M. 1,221 feet and the other extends from near Haysi south and just to the west of B. M. 1,380 feet. These hollows are somewhat straighter and narrower than most of the ravines of similar size which erosion has cut in the rocks of this region, but their most distinctive characteristic is their location where they cut off in part the narrow strip of high land between them and the river. Taken together and with the other topographic features which show alinement, they are very significant, and their locations are not to be explained as accidental.

Between McClure River and Russell Fork, at the close approach before they join, a low saddle in the spur owes its position to the weakness of the rocks along the fault line. The very straight course of Fryingpan Creek from elevation 1,311 feet to its mouth is determined by the fault and it is interesting to note that this creek has a very slight fall in this part of its course and its bed is graded for the entire distance with ripple-

[1] "Trace" of a fault is here used in its mathematical sense of the line of intersection of one surface with another, i. e., the intersection of the fault plane with the surface of the earth.

[2] The area crossed by Russell Fork fault is shown in detail on the Regina, Ky., and the Clintwood and Bucu, Va., sheets of the Topographic Atlas of the United States and published as Plate I, of this report. Frequent reference is made to points on these maps in locating the features described.

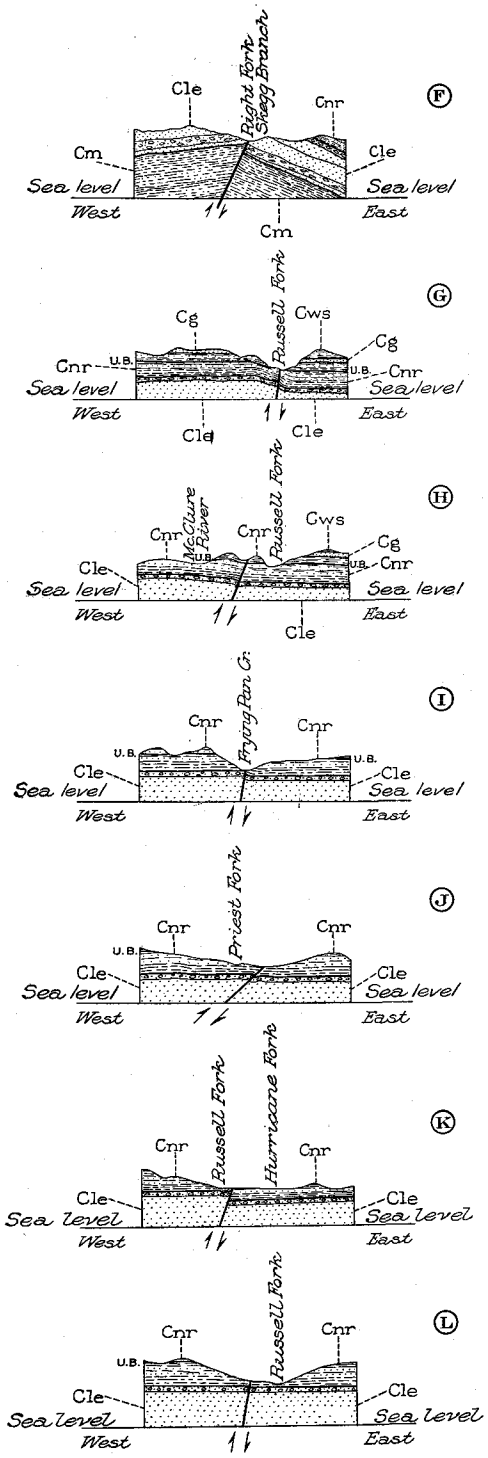


Fig. 7.—Sections showing the character of the Russell Fork fault at several places. For locations see Figure 4. Sections are shown as looking north.

marked sand. Russell Fork leaves the fault trace at a number of points and because of its cutting across the undisturbed and more resistant rocks at these places is not so perfectly graded. But the weakness of the disturbed rocks close to the fault has apparently enabled Fryingpan Creek, though a comparatively small stream, to grade its lower course to the temporary base determined by the rocks over which Russell Fork flows.

The main line of the fault passes somewhat to the north of Abners Gap; from elevation 1,424 feet southeast to the mouth of Carroll Presley Branch it follows Russell Fork for most of the distance, and thence southeast to the point where it is truncated by the main overthrust fault; in the north face of Big A Mountain its trace lies somewhat to the east of the channel of Russell Fork.

A branch leaves the main fault at elevation 1,424 feet, and extends northwestward along the course of Russell Fork to a point in Little Pawpaw Valley about a mile north of Carnady Post Office, and is here named the Little Pawpaw fault.

Along most of its course the rocks northeast of the fault are horizontal or nearly so and undisturbed. The fault plane, or better perhaps the planes of movement, for the most part dip at high angles, 75° to 90° to the southwest. That there has been intense compression is shown by the mashed condition of the shale and jointed condition of sandstone on the southwest side of the fault. At numerous exposures in the zone of faulting, slickensides indicate considerable vertical movement which has resulted in lifting the beds on the southwest above those on the northeast, displacing the coal beds by from 50 to 200 feet. Because of the shearing which has brought anticlines into contact with synclines and vice versa, it is difficult to determine the true amount of differential vertical movement, but the essential point is that the vertical movement is slight and that the hanging wall has moved up as a result of thrust. At many points there are on planes other than those which bear the vertical slickensides, a series of horizontal slickensides trending closely in the direction of the fault and usually these surfaces are rubbed and planed much smoother and more nearly plane than the others, indicating that these surfaces are the result of more extensive movement along the fault plane than the other planes along which a slighter movement has taken place to accommodate the thrust in a direction lateral to the main Russell Fork fault line.

At a few points, notably at Skegg Gap, the slickensides and planes of movement within the zone of faulting indicate a combination of the main

Fig. 8.—Serial diagram showing history of the deformation and displacement of the Cumberland Block. In sketch number 7 of the series is shown the present condition in outline. The heaviest lines show the structure in the sections schematically. The lightest lines are the "sea level" lines of the sections and the fault lines of the sections still referring to sketch 7 of the above series. The solid lines of medium weight are the present traces of the various faults. The medium weight dotted line is an arbitrary axis line, the position of which is the same with reference to the block in each sketch of the series.

In sketch 1 of the series the present fault traces are shown by the light dotted lines of the background and the present position of the axis line by the light and straight dotted line. The then position of the fault traces and of the axis line of the block is shown in sketch 1 by the medium weight solid and dotted lines respectively. The light "sea level" lines and fault lines of the sections and the very heavy lines of the schematic sections are the same as in sketch 7. The arrows which point upward in the sketches indicate the direction of the main thrust; the arrows pointing down and to the right at the left-hand end of each sketch indicate the resisting stress of the buttress southwest of Jacksboro as described in the text.

The first sketch assumes the prior formation of the Hunter Valley fault. The second shows some slight buckling of the southwest end of the block. The third shows more intense buckling here. The fourth shows more intense buckling and extension of the folding eastward along the line of the Pine Mountain fault. In number 4 also is shown the beginning of the Jacksboro overthrust fault. In number 5 this fault has extended far around the north side of the block and the Russell Fork fault has been initiated as a normal fault. Sketch number 6 shows further extension of the faulting and only a small corner of the block near the northeast corner remains attached. In sketch 7 this small attachment is broken and the block has been thrust into its present position. The relative movement of the block at different stages has been shown by the gradual migration of the heavy dashed axial line toward its final position as shown by the light dotted axial line of each sketch.

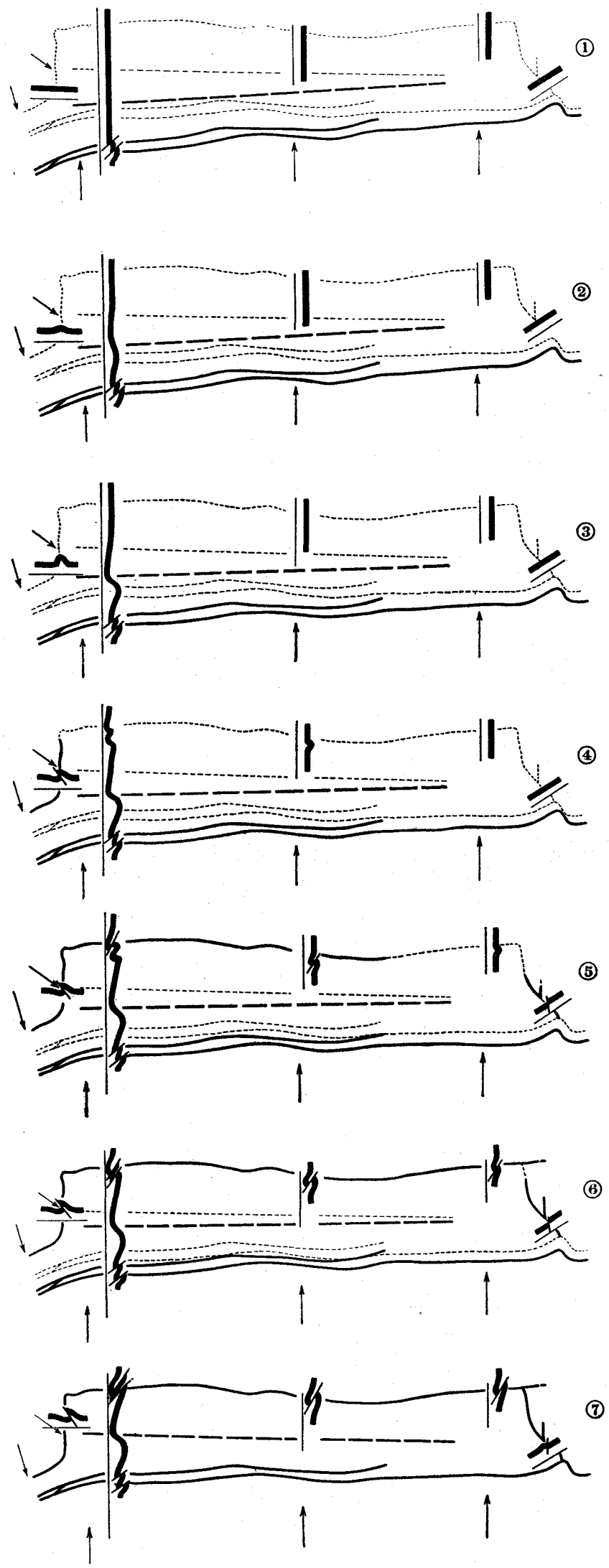


Fig. 8.—Serial diagram showing history of the deformation and displacement of the Cumberland Block.

southeast to northwest thrust with the side or southwest to northeast thrust, making the direction of movement a resultant of the two. The slickensided surface here shows the result of pronounced movement and the white quartz pebbles which are so numerous in the Lee formation are planed off flush with the matrix. It is important to mention that a short distance northwest of Abners Gap there was seen the most abundant evidence of movement in the mashing and crushing of shale in a fine exposure and that here the slickensides indicate movement at an angle of 45° to the horizontal in a due north direction. At this point the fault trace is more nearly athwart the main direction of thrust and here, if anywhere, would be expected evidence of strong overthrust.

In the Little Pawpaw fault, there was seen little indication of shearing but abundant evidence of compression and slight overthrusting.

Mechanics.—The history of the deformation is conceived to be as follows: The rocks of the Cumberland block were subjected to strong lateral compression applied from the southeast. The thicker sedimentary rocks west of *A* (Fig. 5) seem not to have yielded as did those to the east, and acted as a buttress against which the rocks to the east were deformed. The compressional stress was much more intense at the Tennessee end of the block and the first result of the stress was the folding of the Powell Valley anticline and of the lateral anticline which later broke and formed the Jacksboro cross fault. Between *A* and *B* Keith[1] found evidence of this now broken anticline which was the result of deformation of the rocks of the Cumberland block against the more competent buttress on the west.

After the Powell Valley anticline had been in large measure formed and the Jacksboro cross anticline had probably reached its full development, the stresses were then transmitted across the block and yielding farther northwest resulted in the folding of the rocks into the Pine Mountain anticline. It is probable that by this time overthrusting and shearing to the northwest had commenced at the southern end of the Jacksboro cross anticline, for the movement of the rocks of the Powell Valley anticline northwestward differentially with respect to the nearly undisturbed rocks on the west had already been very considerable. With the continued crumpling of the Pine Mountain anticline, the Jacksboro cross fault developed progressively toward the northwest, and, when it reached the then position of the corner *C* of the block, initiated the great Pine Mountain fault.

[1] Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Briceville folio (No. 33), 1896.

There had by this time been considerable skewing of the entire block which was pivoted at or near its north corner with the result that the corner of the block at *A* had been thrust more extensively on the rocks to the west than had the corner at *C*. The overthrust to the west in the Jacksboro cross fault is, however, believed to be only the smaller movement incidental to the skewing of the block, while the main movement in this fault was the shearing by which the block to the east moved several miles to the northwest. It is not believed that there was in the original stress any distinct southwesterly component, but the Jacksboro thrust is considered to be solely the result of the twisting of the block.

The Pine Mountain fault is compound at *C*, consisting of four distinct overthrusts, but becomes more simple northeastward. The faulting which commenced at the southwest developed progressively toward *D* as the stress continued, but naturally the total displacement was less at *D* than at *C*. It seems likely that there was some slight displacement beyond Skegg Gap and into Dickenson County along the Pine Mountain fault before it was intersected by the Russell Fork cross fault.

In following chronologically the development of the Jacksboro-Pine Mountain line of faulting the Russell Fork cross fault was temporarily omitted. The history of its development is correlated with the events described above as follows: Only after there had been considerable development of the Pine Mountain anticline at *C*, and some shearing along the Jacksboro cross fault, was the skewing of the Cumberland block felt at the northwest end. Its first expression was the development of a tension or normal fault starting at *F* and extending toward *E* with continued twisting of the block.

The presence of the Little Pawpaw fault, which appears to be primarily the result of such tension incident to twisting, leads to the belief that the point, or, perhaps more correctly, the area of pivoting, was somewhat to the north of *E*. On the other hand, evidence of somewhat more pronounced compression along the fault from *D*, part of the distance toward *E*, seems to indicate that compression was even at first dominant in that part of the line. It seems therefore probable that the region of pivoting is located between *D* and *E* but somewhat nearer the latter.

After the extension of the Pine Mountain fault beyond Skegg Gap and the extension of the Russell Fork cross fault beyond *E* as a normal fault, the accumulation at the northeast end of the block of the northwestward trending stresses, which had long been operative at the Tennessee end of the block reached the critical point and the northeast end was broken

loose along the line largely determined by the pre-existing normal fault. The line of this break intersected the Pine Mountain fault at Skegg Gap, stopped further movement in that fault east of that line, and permitted the Cumberland block to be thrust not over two miles northwestward at this end. Since the Russell Fork fault line forms an angle of over 90° with the line of the Pine Mountain overthrust, the overthrusting of the east end of the block brought about compression along the whole extent of the Russell Fork fault, reversing the condition of tension which produced the normal fault and producing overthrusting and considerable crumpling of the shale and crushing and jointing of the sandstone adjacent to the fault plane. The net amount of overthrust is very slight, probably at no point reaching 500 feet, and the rocks on the southwest side of the fault are nowhere over 250 feet above those on the northeast. The shearing loose of the northeast end of the block, its overthrust along the already established Pine Mountain fault and the compression and slight thrusting along the Russell Fork cross fault were the closing events in the history of the Cumberland block as a unit.

There are many especial features which are particularly in accord with this interpretation of the movement of the Cumberland block as a progressive skew with final release of the east end. The skewing of the southwest end of the block first with the Skegg Gap corner remaining longest in place explains admirably the otherwise anomalous facts of rather strong overthrust in the Jacksboro fault the trace of which is nearly at right angles to the trace of the Pine Mountain fault and of only slight overthrust and more restricted compression in the Russell Fork fault with its trace at a much greater angle with the main overthrust.

The stronger development of the Powell Valley anticline and the presence of the Wallen Valley fault only at the southwest are also strongly in accord with this suggested interpretation.

The greater intensity of stress implied by the compound character of the Pine Mountain overthrust at *C* and the probable development of the Powell Valley anticline before the rocks of the block were competent to transmit the stresses to the Pine Mountain fold, which later broke in a fault, point strongly to the initiation of the faulting at the south end of the Jacksboro cross fault to allow the necessary shortening of the strata on the northeast side of that fault. The four faults as interpreted by Keith, and corroborated by the displacement of the north limb of Powell Valley anticline in the Briceville quadrangle, give clear evidence of a movement of at least ten miles to the northwest. At Skegg Gap the evidence does not indicate over two miles of overthrust at the most.

In the development of this study, a few computations have been made, based on extremely general and only very approximate assumptions which are given below. Their value is solely to indicate orders of magnitude and it is hoped that they may serve to visualize the immensity of forces involved.

Force to shear and force to thrust.

ASSUMPTIONS.

Block 125 miles x 25 miles x ½ mile.
Density 170 lbs. per cubic foot.
Coefficient of friction, mean between rough and smooth granite, .60.
Shearing strength 200 pounds per square inch.
Average extent of overthrust, 6 miles.

RESULTS.

Force to shear block loose over entire area = 25×10^{14} pounds.
Force to move block against friction on horizontal plane = 23×10^{15} pounds.
Work done in moving block 6 miles at angle of 5° = 85×10^{19} foot pounds.
Equivalent to 420,000 horsepower working for 100,000 years.
Estimated coal in block = 50×10^{9} tons.

The burning of this coal would produce power enough to move the block 2.2 feet, assuming the usual engine efficiency. It has actually moved an average of at least 6 miles.

It is especially interesting to note that the force required to shear the block loose over the whole area is only about one-tenth of that required to produce motion against the resistance of friction. Since both forces are proportional to area, and only one—that of motion against friction—proportional to thickness, we find that for a block of any area and of a thickness of 287 feet, according to the conditions assumed, the shearing force is just equaled by the force to overcome friction, and as thickness is greater than this amount the latter force is greater in proportion. It is evident then that in the case of most faults the motion of the rock involved against the resistance of friction is more impressive than the production of the break which separated the rocks.

Other Movements.—During the movements described above the weaker rocks, particularly the shales, have been affected, so that many exposures

show steep and irregular dips in localites in which all the more massive sandstones and most other beds have only the very gentle dips that characterize the greater part of the coal field. Movement has taken place in several coal beds also, so that the coal is crushed and fractured and in places mixed with slickensided shale fragments to form "rash." Movement along the Kennedy coal bed and the rocks immediately over it has been especially common in the area south and west of Russell Fork, the coarse, massive sandstone beneath the coal forming a comparatively immovable stratum over which rode the thin-bedded rocks above. Parts of the Jawbone and partings in other coal beds are similarly affected, especially near faulted areas (Pl. XII).

Normal faults are uncommon but are not unknown. All those observed are small, the beds on the downthrow side having been dropped only a few inches to 30 feet below their normal position.

ECONOMIC GEOLOGY

GENERAL DESCRIPTION OF COAL BEDS.

INTRODUCTION.

Dickenson County contains many beds of high-grade coking coal, the quality of which will be described more completely in another part of this report. At least thirteen of these beds are minable in one or more localities under present commercial conditions, though no bed is sufficiently thick at all localities to compete with thicker beds that will be available in this and neighboring areas for years to come. As shown by the tables of ultimately available tonnages, there is a great quantity of coal that will form an important reserve for the near and distant future.

The thicknesses and general characters of each coal bed have a wide range, even in neighboring localities. Only the most complete and thorough prospecting can determine the exact possibilities in advance of mining, and such detailed prospecting has been undertaken in only about a fourth of the county. In addition to the differences in the tonnage per acre of a bed or zone from place to place, another factor of uncertainty arises from the fact that many beds split into two or more benches where shale partings thicken considerably. Very few exposures show more than 3 feet of coal without partings half an inch or more thick, the most common being shale or hard clay. The term "rash" is locally applied to an intimate mixture of coal and shale, in many places contorted and slickensided by movements along the bedding planes. Thin layers of bone and also of cannel form parts of some coal beds.

The thicknesses of coal, the distances between beds, and other economic factors are described by drainage basins in a succeeding section of this report. In this place only brief summaries of the characteristics of each bed will be given. The distances between coal beds used are averages only, and will not apply exactly to all parts of the quadrangles. Maximum and minimum distances are given in the detailed descriptions by drainage basins, in the general sections, and in the columnar sections (Pl. XIII). Many local distances are shown in the local sections.

COAL BEDS IN THE LEE FORMATION.

The Lee formation is fully exposed in this county only on the southeast slope of Pine Mountain. No economically important coal beds were

found in the formation though exposures are poor and some fairly thick beds might have escaped notice. The fact that with the exception of a 32-inch bed that has been mined in a small way one-half mile south of the State line, only thin Lee coals are present in The Breaks, where most of the Lee is clearly exposed, indicates that there is very little minable coal in the formation in at least the northern part of the county. A number of Lee coal beds are shown in the drill records of the Clinchfield Coal Corporation (Pls. IX and X), but their thicknesses have not been made public.

In Wise, Lee, and Scott counties, Virginia, where the Lee is exposed in a large area, it contains a number of coal beds that are thin in most places and a few that are fairly thick in small districts. About the same condition probably prevails in the south half of Dickenson County. Rocks equivalent to the Lee in the famous Pocahontas field, about 40 miles east of Dickenson County, include very thick and pure coal beds. These coals thin to the west, however, and the places of some of the most important beds are taken by thick conglomerates in at least part of Dickenson County.

COAL BEDS IN THE NORTON FORMATION.

TILLER COAL BED.

Although there are coal beds in places in the lower 200 feet of the Norton formation, the lowest coal bed of much commercial importance is the Tiller. The rocks in this zone are alternating shale and sandstone with no striking characteristics, though an exceptionally coarse and locally conglomeratic sandstone lies a few feet below the coal. The Tiller bed is exposed only along Indian Creek and its tributaries, along Fryingpan Creek near Bucu, and in the southern foothills of Pine Mountain. The name Tiller was applied by Stone in his report on the coal resources of the Russell Fork basin to the thick coal bed on Indian and Cane creeks. As the upper part of this thick bed is now known to be the equivalent of the Jawbone, the name Tiller is restricted in this report to the lower part.

Although the Tiller is concealed beneath the surface in much of the county, it may be safely estimated that it is a minable bed containing about 4 to 6 feet of coal in the southeastern part of Dickenson County. It will probably be mined on a large scale in the near future, and a beginning has already been made at the "slope mine" of the Clinchfield Coal Corporation on Hurricane Fork, a short distance southeast of the county. In a strip of country extending southeast from Bucu the Tiller is united with the overlying Jawbone coal to form a very thick bed. Ex-

posures in the southern and central parts of the Indian Creek drainage basin show 7 to 15 feet of minable coal in the combined beds, though part of it is somewhat impure. The Tiller contains a parting that impairs its value on Russell Fork, and thins to the north to about 30 inches on Levisa Fork beyond the county. No coal was found at the horizon of the Tiller bed on Pine Mountain or in The Breaks, indicating that it thins to the northwest and perhaps also to the west from its exposures near Bucu.

JAWBONE COAL BED.

The Jawbone coal bed commonly lies above a coarse, quartzose, locally conglomeratic sandstone that separates it from the Tiller, the distance between the two coals being 100 feet down to almost nothing. The bed takes its name from Jawbone Hollow, a tributary of Bull Run between Virginia City and Banner in the Coeburn quadrangle. It has been called in private reports on the upper Levisa Fork drainage basin the Ratliff coal bed. The Jawbone is exposed in Dickenson County in the same localities as the Tiller and, as mentioned above, is united with the Tiller in places in the southeastern part of Dickenson County.

The Jawbone makes its best showing where it is united with the Tiller bed. It is probably also thick in other areas in the southeastern part of the county, as it includes 3½ to 8 feet of somewhat impure coal in exposures on Hurricane Fork a short distance southeast of the county herein described. The coal thins to the north to less than 30 inches on Levisa Fork. Drill records show that it is a persistent bed in the central and western parts of the county and it may be minable in places. No coal was noted at the Jawbone horizon at its exposures on Pine Mountain or in The Breaks.

RAVEN COAL BED.

The Raven coal is about 340 feet above the Lee formation and 140 feet, more or less, above the Jawbone bed. The name "Garden Hole" was given it by the prospectors of the Clinchfield Coal Corporation from exposures at the Garden Hole on Russell Fork, near The Breaks. The bed is probably the same as the "so-called Imboden" of Campbell's reports on the Bristol quadrangle. It is exposed low down in the principal valleys in the extreme southeastern part of the county and along the foot of Pine Mountain. The bed is under a ledge-making sandstone in some localities and over one in others, and this fact, combined with the presence of other coal beds not far above it, makes identification of outcrops uncertain.

The Raven bed is less than 3 feet thick nearly everywhere and less than 2 feet in most places. Under and near Sandy Ridge in the vicinity of Kiser and Cane Gaps it is an attractive bed 3 to 4 feet thick. It is 44 inches thick in one place at the foot of Pine Mountain, and 1 to 6 feet thick in and near The Breaks.

AILY COAL BED.

There are in places several coal beds in a zone 200 feet thick above the Raven bed. These beds are almost everywhere less than 3 feet thick and are thinner in most exposures. The name Aily, from a post-office on Lick Creek of Russell Fork, has been applied to what appears to be the most persistent and in most places the highest of these beds. The Aily is about 500 feet above the Lee and 160 feet above the Raven coal. It appears in many of the drill records of the Clinchfield Coal Corporation, but is generally less than 2 feet thick in most of its exposures, even in those near its type locality. It is locally minable under present conditions in small areas.

KENNEDY COAL BED.

A bed that lies about 600 feet above the Lee has long been known as the Kennedy or Widow Kennedy in the mining district a short distance south of Dickenson County. It has yielded considerable coal at shipping mines at Dante and elsewhere, but has not yet yielded much profit to the operators and is not now extensively mined. One of its most marked characteristics in the region south and west of Russell Fork is its generally crushed condition and great irregularity in thickness, however in the Levisa Fork drainage basin east of the county, where it is called the Harris bed in private reports, the coal is clean and as regular in thickness as any other bed. The characteristic sandstone lying just beneath the bed had already been described.

The Kennedy contains a large aggregate of coal in the southern half of Dickenson County in a bed which ranges from a few inches to 10 feet thick within short distances. It thins to the northwest and is probably of only slight thickness along the foot of Pine Mountain. In the southeastern part of the county the bed is less than 2 feet thick, except locally, in most parts of the Russell Fork and Clinch River drainage basins. Its thickness is slightly more than 3 feet along part of Fryingpan Creek.

LOWER BANNER COAL BED.

A bed about 200 feet above the Kennedy and 800 feet above the Lee formation is widely known as the Lower Banner in the mining districts in the general region of its type locality at Banner, on the Norfolk and Western Railway. On upper Levisa Fork in Buchanan County the same

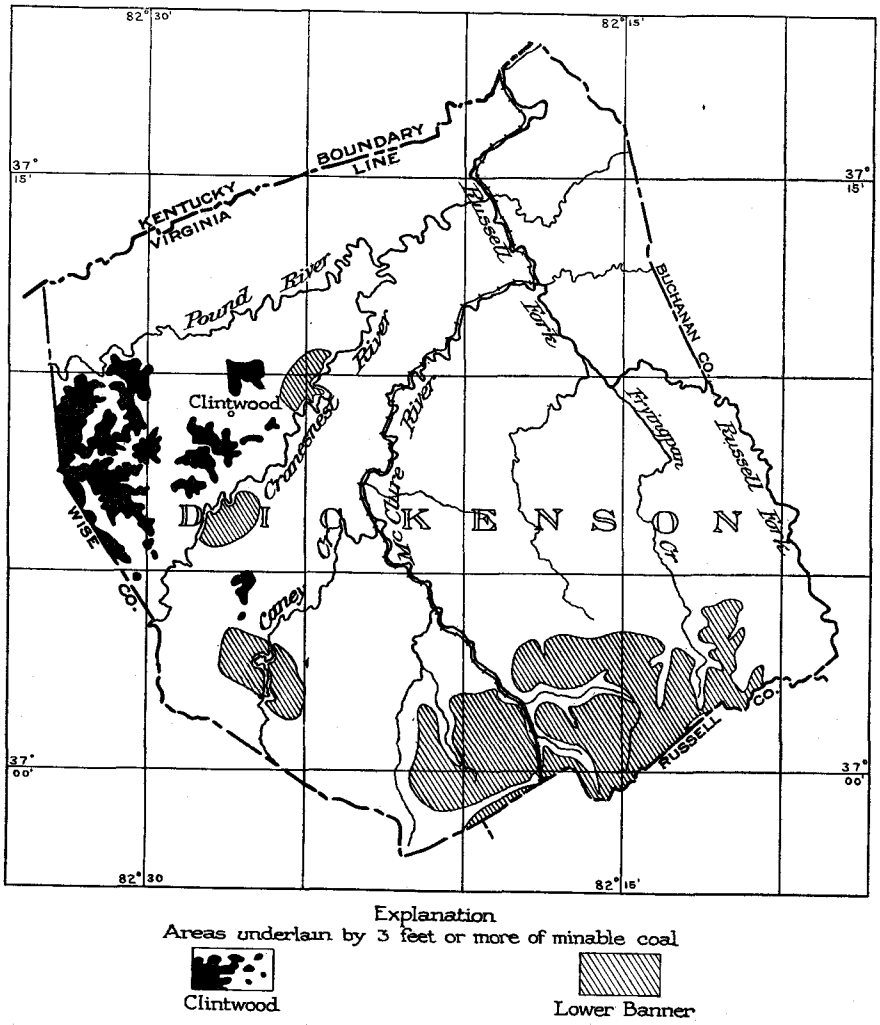


Fig. 9.—Sketch map of Dickenson County showing areas in which the Lower Banner and Clintwood beds contain 3 feet or more of minable coal.

bed has been called the Cary by private investigators. This coal is extensively mined at Wilder just southeast of Dickenson County, and at Dante, a short distance south of the county. Like the Kennedy, the Lower Banner overlies sandstone, but the sandstone is much thinner and less conspicuous on hillsides. The strata from the Kennedy to this sandstone and from the Lower Banner to the Upper Banner coal are shale and thin-bedded sandstone in most places.

The Lower Banner is minable, even under present commercial conditions, in several areas (see fig. 9). One of the best is under and in the vicinity of Sandy Ridge from Coon Branch of Open Fork east to Cane Creek, where the average thickness of coal is 3 to 5 feet. In the greater part of the county it is exceptionally free from partings. The Lower Banner is about 3 feet thick in several small areas and 2 to 3 feet in many places. It is a very persistent bed, though locally thin, in most of Dickenson County.

UPPER BANNER COAL BED.

The Upper Banner is one of the best known and most important coal beds in southwest Virginia, and is extensively mined at Wilder, Dante, Toms Creek, and elsewhere. The mine at Wilder is beyond the limits of Dickenson County; however, its workings extend northward beneath Sandy Ridge into the county; also one of the largest mines near Dante and another near Toms Creek likewise extend northward under Sandy Ridge into the county. The average distance of the bed above the Lower Banner is 100 feet, and above the Lee formation it is about 900 feet. There are shale and thin-bedded sandstone below the coal and a ledge-making, coarse-grained sandstone 20 feet or less above it. One of the most marked characteristics of the Upper Banner is the persistent sandstone parting less than 2 inches thick in the upper half of the bed.

There are two large areas and three smaller ones in which the Upper Banner is especially attractive for mining. One of these includes the territory under and near Sandy Ridge from the southwest part of the county east to Long Ridge, where the bed contains coal averaging 4 to 6 feet in thickness with only thin partings. Another is on both sides of McClure River north of Big Branch, extending westward to and beyond Cranesnest River and eastward to and beyond Lick Creek. In this area the average thickness of coal is 4 to 5 feet and partings are thin. In smaller areas on the west side and at the head of Fryingpan Creek the bed is in similar condition. Outside these districts, which are shown in Figure

10, the Upper Banner is split into two or three benches by a thickening of shale partings above and below the thin sandstone parting. These benches are so widely separated that they can not be mined as one bed, and commonly so close that only one can be utilized. In places one or the other of the separated benches contains 2 to 4 feet of coal. The Upper Banner is thin, even absent in places, in the western part of the county.

SPLASH DAM COAL BED.

The Splash Dam bed, so named on maps of the Clinchfield Coal Corporation because it rises from beneath Russell Fork near the splash dam, a short distance north of the mouth of Pound River, is about 70 feet above the Upper Banner bed and 970 feet above the Lee formation. It is probably the same as the Wilson bed of private investigators in the upper Levisa Fork country in Buchanan County, though slightly lower than a bed that has been called Wilson on Prater Creek. It lies a few feet above the sandstone directly above the Upper Banner, which is a conspicuous cliff-former along Levisa Fork and elsewhere. The rocks above the coal differ from place to place, being chiefly shale in some localities and coarse sandstone in others.

Coal appears at the Splash Dam horizon in many localities, but it is less than 30 inches thick in some places and is split into thin benches in many others. It makes its best showing in the southern part of the Open Fork drainage basin, where it includes 3 to 4 feet of coal. It is also thick on Lyons Fork of Cranesnest River. It is a more or less uniform bed averaging 3 or 3½ feet in thickness in the northeast part of Dickenson County, and is thicker farther northeast, on Bull and Poplar creeks in the Hurley quadrangle. This bed has not been thoroughly prospected and may be found to be thick in several localities where it is now unknown.

HAGY COAL BED.

A bed here named the Hagy, from exposures near Hagy School at Leemaster and in the mine of Mr. Hagy on Trace Fork of Prater Creek, is about 100 feet above the Splash Dam and 1,070 feet above the Lee formation. Northeast of Russell Fork it commonly has a coarse sandstone directly underneath. Its identification in the southern part of Dickenson County is somewhat uncertain, but it is probable it there lies only a few feet below the coarse sandstone that is near the top of the Norton formation. It may be the same as the Edwards bed of Campbell, which

he tentatively correlated with the true Imboden bed of the Big Stone Gap coal field. The Hagy is 2 feet or less thick in most places.

NORTON[1] COAL BED.

In the extreme southwestern part of Dickenson County a thin coal is found directly beneath the Gladeville sandstone, that thickens toward the southwest and is extensively mined east of Wise in Wise County. This coal bed, known as the Yellow Creek, is renamed Norton. Its outcrop occurs along Lick Fork in which region it is too thin to be workable, being everywhere less than 3 feet and generally less than 2 feet in thickness. It is apparent that this bed possesses little value as a coal resource of Dickenson County.

COAL BEDS IN THE WISE FORMATION.

DORCHESTER[1] COAL BED.

The Glamorgan (Dorchester) coal, named from mines at Glamorgan in Wise County, is about 1,305 feet above the top of the Lee formation, and less than 25 feet above the Gladeville sandstone. The name of this coal bed is here changed from Glamorgan to Dorchester.

Coal is persistent at the Dorchester horizon but in many localities is not more than 2 feet thick. Between Clintwood and Pound River and in the northeastern and southeastern parts of the county, the aggregate thickness of coal benches is 2 to 4 feet, but one or more detrimental shale partings are also commonly present.

LYONS COAL BED.

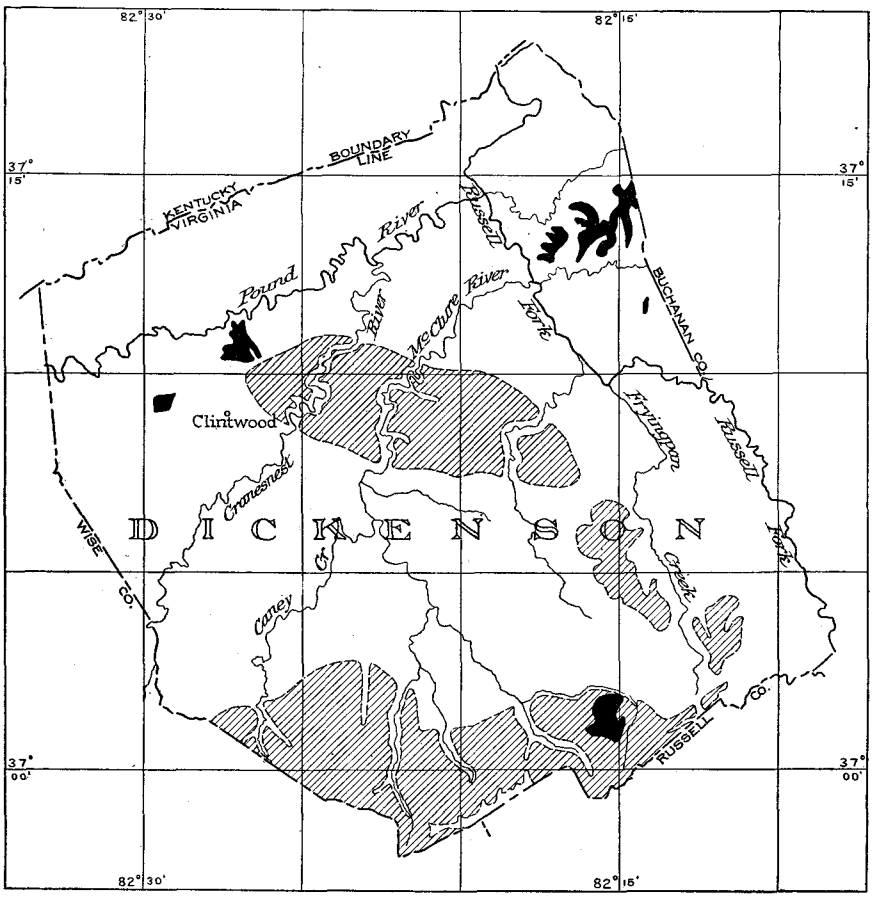
A bed that is about 60 feet above the Dorchester in the southwestern part of Dickenson County is here named the Lyons, from a post-office on Big Ridge. It is separated in most places from the Dorchester by shale, and, in the western part of the county, lies under a rather thin but conspicuous white sandstone that has already been mentioned. In places the Lyons and Dorchester beds are so close that it is difficult to distinguish the former from a split of the latter. The Lyons is too thin, except in a very few small areas, to be mined on a large scale, but can be utilized for local fuel supplies.

BLAIR COAL BED.

The Blair bed, so named by Butts from exposures on the Blair property on Indian Creek, Wise County, is about 80 feet above the Dorchester,

[1] For reasons given in the Wise County, Virginia, coal report (in preparation), the following changes in names of coal beds have been adopted by the State and Federal Surveys: For Yellow Creek, Norton; and for Glamorgan, Dorchester.

and is separated from the Lyons bed chiefly by the white sandstone overlying the latter. Locally in the northeastern part of Dickenson County the Blair is in two benches, separated by 30 feet or less of shale. The bed contains 2 to 3 feet of coal in the Clintwood district. Nearly everywhere, however, there are several shale partings interbedded with the coal.



Explanation

Areas underlain by 3 feet or more of minable coal.

Eagle

Upper Banner

Fig. 10.—Sketch map of Dickenson County showing areas in which the Upper Banner and Eagle beds contain 3 feet or more of minable coal.

EAGLE COAL BED.

A coal bed that lies about 125 feet above the Dorchester bed has been traced to War Eagle, West Virginia, where it is locally called the Middle War Eagle. This bed has been correlated with the Eagle coal of Fayette County, West Virginia, by the West Virginia Geological Survey, and the name Eagle is used here. The bed is overlain by coarse gray sandstone that makes conspicuous cliffs from Russell Fork northeast into Kentucky and West Virginia, making one of the best stratigraphic markers in the entire Pottsville group. The sandstone thins between Russell Fork and Clintwood, but may still be identified near the county seat. One of the peculiarities of the Eagle near Russell Prater in Buchanan County and Barts Lick creeks is a local development of a thin sandstone parting, almost identical in appearance with the one that is characteristic of the Upper Banner bed.

The Eagle in places is thick, but the thickest section of the bed underlies only rather small areas near the ridge tops (see fig. 10). In the northwestern part of Dickenson County the average thickness of coal is 4 to 5 feet. It is about the same on and near Flat Spur and nearly as thick in small areas near Clintwood, but is thinner elsewhere.

CLINTWOOD COAL BED.

The Clintwood bed is 200 feet above the Dorchester and only a few feet above the sandstone cap-rock of the Eagle bed. In most of the county it is overlain by nearly 200 feet of shale and inconspicuous fine-grained sandstone, but along the western border it has a thin but conspicuous white sandstone cap-rock.

The Clintwood is remarkably thick in the west-central and western parts of Dickenson County, and contains 4 to 11 feet of coal in small areas near Clintwood and Darwin and an outlier on Big Ridge (see fig. 9). The bed thins north and northeast of Clintwood. The horizon of the Clintwood was found on Flat Spur and high in the ridges in the northeastern part of the county, but no coal was seen. The coal is present and fairly thick in the Hurley quadrangle, Buchanan County, a short distance northeast of Dickenson County.

CAMPBELL CREEK OR LOWER BOLLING COAL BED.

The Campbell Creek bed derives its name from exposures on Campbell's Creek, a small branch of Kanawha River in Kanawha County, West Virginia, and has been traced to the Virginia boundary on Tug Fork by the

West Virginia Geological Survey, and thence into the Bucu quadrangle by Hinds. It is about 270 feet above the Clintwood bed and lies between thick beds of medium-grained sandstone. It was called the Lower Bolling coal by Butts in the Pound quadrangle and, as mentioned in the statement of correlations with adjoining areas, is known under several names in Pike County, Kentucky. The bed is present only in the western part of Dickenson County, west and southwest of Clintwood, where it is found high up in the ridges. Locally it develops a thickness of over 3 feet and is workable.

UPPER BOLLING COAL BED.

The Upper Bolling bed lies from 20 to 40 feet above the Lower Bolling, and 290 to 310 feet above the Clintwood bed. Like the Lower Bolling the name was applied by Butts to this bed in his work in the Pound quadrangle because it was being extensively worked by members of the Bolling family at several places in the southwestern part of that quadrangle. The bed is found in Dickenson County in the same localities as the Lower Bolling, and in most places where it is found it is thick enough to mine, ranging from 3 to 4 feet or more in thickness. The Upper Bolling has been called the "Five-foot" coal.

DETAILED DESCRIPTION OF COAL BEDS.

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 beds. 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 in a geologic outline, and summaries of the principal points of interest concerning each coal bed are given at the beginning of the description of that bed.

A number is given to each measured coal exposure and its location shown on both the geologic and topographic maps. As the numbers are assigned in the order in which the exposure is mentioned in the text, it

is easy to refer from the maps to the written descriptions. Unless otherwise stated, all measurements were made by the geologists who have worked in the several parts of the county.

The elevations given are not all of the same degree of accuracy and so certain symbols are used to show the method by which they were obtained. Those marked B were taken with an aneroid barometer and may be subject to correction. Those with an S were determined by topographers of the United States Geological Survey with stadia and dip angles, and those with C. C. C. are on transit lines of the Clinchfield Coal Corporation. The symbol H. L. indicates that an elevation was obtained by hand-leveling from neighboring stadia or transit stations.

Many measurements of coal more than 30 inches thick are shown in graphic sections and 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. The numbers just above the graphic sections refer to the locations where the sections were measured, hence the description of any graphic section may be found by turning to its number in the text.

Nearly everywhere in Dickenson County the coal beds are present as single benches. Hence in the following detailed descriptions of the coal beds and in the accompanying sections no reference will be made to benches unless the bed under consideration is present in two or more benches in which case the bench from which the section was taken will be indicated.

RUSSELL FORK DRAINAGE BASIN.

POUND RIVER AND TRIBUTARIES OTHER THAN CRANESNEST RIVER.

Geologic outline.—Pound River flows along or near the axis of the Middlesboro syncline, so that the strata dip toward it from both sides. This dip is gentle on the south side of the river and also on the north side for a short distance from the main valley, but it increases gradually toward the crest of Pine Mountain, where it is 33 degrees to the southeast. Beds which lie far below Pound River rise so as to reach the surface far up the mountain slopes, and Mississippian and Devonian strata form the upper part of the mountain on the Kentucky side and have there been thrust up over the Wise formation along the great Pine Mountain fault.

The lowest formation exposed in Dickenson County is the Pennington shale, which caps Pine Mountain west of Blowing Rock Gap. The next higher formation is the Lee, which caps the mountain east of Blowing

Rock Gap to Skegg Gap, and everywhere outcrops near the mountain top on the Virginia slopes. The most conspicuous members of the Lee are massive conglomeratic sandstones.

The Norton formation outcrops near the foot of Pine Mountain also in the valley of Pound River as far up as Laurel and Jerry branches, in most of the basin on each side of the lower part of the river, and in a small inlier on Georges Fork. The lower part of the formation is exposed only on the mountain slopes, where the underlying rock of the Kennedy is a massive quartzose conglomeratic sandstone similar to the Lee and, like the Lee, making dip slopes, and forming small hogbacks facing the mountain crest. There are 200 or more feet of shale and inconspicuous sandstones between the Kennedy bottom-rock and the Lee, but outcrops are poor. The upper part of the Norton, however, is well exposed along and near the lower part of Pound River.

The Gladeville sandstone and Wise formation appear only on the ridge tops on each side of the lower part of Pound River, but farther upstream the Gladeville is low down in the valley and the Wise outcrops are more extensive. The Gladeville is commonly slightly less than 100 feet thick, brownish, crumbly or fairly compact, and massive, though it contains some shaly layers in a few localities and is nowhere a particularly good stratigraphic marker. The thickness of Wise present is somewhat greater than 600 feet, the upper 325 feet being poorly exposed, present in only a few places, and apparently containing considerable shale. The most easily identified stratum is a thin but very resistant white siliceous sandstone that lies about 60 feet above the base of the Wise.

The stratigraphic succession of the coal-bearing formations is shown by the generalized section for the northwestern part of Dickenson County (Pl. XIII), by the general sections for areas Ac, Ab, and Bc (Fig. 2), by several drill records (Pl. IX), and by local sections 24, 1, 4, and 5.

Part of the basin drained by Pound River and its tributaries other than Cranesnest River is not particularly rich in coal resources. The Pennington is practically barren and no workable coal was found in outcrops of the Lee. Prospecting in the Norton and higher formations north of Pound River is said by the people living in that vicinity to have revealed no beds much thicker than 3 feet, and the best measurement obtained during the recent geologic survey showed only 44 inches of impure coal. Outcrops are very poor, however, and prospecting has not been thorough, so it is possible that better results may reward further search, especially in the Wise formation.

South of Pound River, no coal as much as 3 feet thick was found east of Rocky Branch, and the Upper Banner bed, though thick on lower Cranesnest River, appears to be thin elsewhere in the Pound River drainage basin. No coal was found at the Lower Banner or Kennedy horizons, though they are probably not barren everywhere. Considerable coal has been found in the Wise formation as the result of thorough prospecting of the Clintwood and associated beds between Pound and Cranesnest rivers. There are five coal beds in the lower 200 feet of the Wise that are fairly persistent and contain from 2 to 4 feet of coal, though the average for any of them is not more than 3 feet (see figs. 9, 10, and 11). The Campbell Creek or Lower Bolling coal, which is a double bed nearly 300 feet above the base of the Wise, contains workable coal in the extreme western part of the county and may eventually be found near the tops of a few knobs bordering Georges Fork and Brush Creek farther east.

Raven coal bed.—The lowest bed of commercial importance found near Pine Mountain is the Raven, which lies 400 to 500 feet below the Upper Banner coal horizon and a few feet below the thick conglomeratic sandstone that forms a low hogback at the foot of Pine Mountain. The Raven is an impure and crushed bed 44 inches thick where the wagon road crosses Skeet Rock Branch 1¼ miles southeast of Skeet Rock knob and may outcrop in a few places farther southwest, north of the line mapped as the Kennedy horizon.

Upper Banner coal bed.—The Upper Banner bed, which lies 210 to 300 feet above the Kennedy horizon, is represented only by road blooms of an apparently thin coal, except, possibly, at one place on Cane Creek, where the following is tentatively correlated with that bed:

Section of Upper Banner (?) coal bed on Cane Creek, half a mile north of Huckleberry.

(Location 1, elevation 1,550 feet B.)

	Ft.	in.
Sandstone.		
Coal		7
Shale	2	6
Coal		6
Sandstone		1
Coal, with 5 inches cannel near top, bottom not seen	1	9+
Coal	2	10+
Partings		1

Splash Dam coal bed.—The Splash Dam horizon averages 60 feet above the Upper Banner and overlies the fairly coarse sandstone that overlies

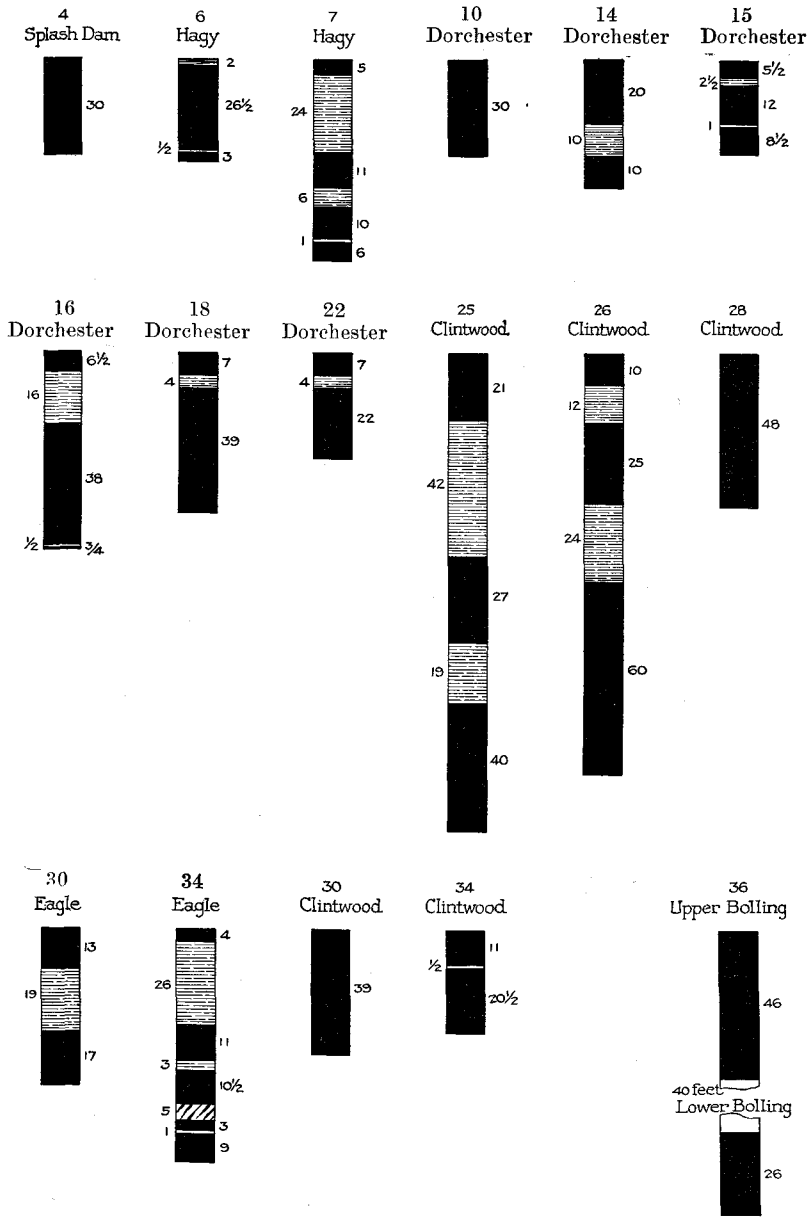


Fig. 11.—Sections of coal beds in the Pound River drainage basin.

the latter bed. Coal blossoms in roads were noticed in a number of places, and measurements were obtained in three openings. The only exposure found north of Pound River is near Cane Creek and the road from that stream to Huckleberry (location 2, elevation 1,453 feet H. L.), where the bed is 18 inches thick, and what is probably another bench of that bed is 8 inches thick a short distance down the creek. South of the lower part of Pound River the Splash Dam contains 30 inches of hard, bright coal under a roof of firm shale at two places on Cane Branch,—one a small local mine 200 yards north of the road crossing (location 3, elevation 1,492 feet H. L.), and the other an opening on the north fork (location 4, fig. 11, section 4).

Hagy coal bed.—The Hagy coal bed lies above a sandstone that is not quite so good a ledge-maker as the one under the Splash Dam horizon, and is about 150 feet above the Upper Banner horizon. Blooms of this bed appear in most of the roads that cross its outcrop in the lower part of the Pound River drainage basin, but no full measurements were obtained. The Hagy is 20 inches thick in a hollow three-quarters of a mile south of Skeet Rock (location 5, elevation 1,525 feet B.). The same bed is 32 inches thick at an exposure 1¼ miles south of Skeet Rock, near Pound River (location 6, elevation 1,460 feet B, fig. 11, section 6), the upper 2 inches being bony. Northwest of Skeet Rock the bed is as follows:

Section of Hagy coal bed half a mile northwest of Skeet Rock.

(Location 7, elevation 1,710 feet B. Fig. 11, Section 7.)

	Ft.	in.
Sandstone, shaly.		
Coal, cannel at top		5
Shale	2	
Coal		11
Shale		6
Coal		10
Sandstone, shaly		1
Coal		6
Coal	2	8
Partings	2	7

Two measurements were taken on Laurel Branch, north of Isom, on coal that is either at the Hagy horizon or near it; one, on the right-hand fork (location 8, elevation 1,580 feet B.), is about 30 inches, and the other, on the left-hand fork (location 9, elevation 1,640 feet B.), is 20 inches thick.

Dorchester and Lyons coal beds.—The Dorchester bed appears to be persistent in this basin, though rarely more than 30 inches thick. It is 320 to 400 feet above the Upper Banner horizon and 15 feet or less above the base of the Wise formation, so that its outcrop is practically the same as that of the top of the Gladeville sandstone. The Lyons coal is not commonly workable, lies 20 to 60 feet above the Dorchester in many places, and can be easily identified by means of the white siliceous sandstone which lies a short distance above it.

At four openings east (location 10, fig. 11, section 10) and south (locations 11, 12, and 13) of Skeet Rock, the Dorchester is 26 to 30 inches thick and lies near the tops of rather broad spurs. The overlying bed is commonly a drab sandy shale containing fossil plants. Farther west, in the vicinity of Isom, the Dorchester includes one or more shale partings and, on the road leading west from Laurel Branch (location 14, elevation 1,645 feet B., fig. 11, section 14), shows 30 inches or coal with 10 inches of clay 10 inches from the bottom. Underneath the bed there are a few feet of sandy clay or shale resting on sandstone.

On Georges Fork, Camp Creek, and the neighboring portion of Pound River the Dorchester coal is of workable thickness, as shown by the following sections, measured by Butts:

Section of Dorchester coal on Georges Fork.

(Location 15, Fig. 11, Section 15.)

	Ft.	in.
Coal		5½
Bone		1½
Clay		1
Coal	1	
Clay		1
Coal		8½
Coal	2	3½
Partings		2

Section of Dorchester coal on Camp Creek near mouth.

(Location 16, Fig. 11, Section 16.)

	Ft.	in.
Coal		6½
Clay	1	4
Coal	3	2
Clay		½
Coal		¾
Coal	3	9¼
Parting	1	4½

Section of Dorchester coal one-half mile north of Pound River opposite the mouth of Camp Creek.

(Location 17.)

	Ft.	in.
Coal		3
Rash		2
Coal	2	4
Coal	2	7
Parting		2

The Dorchester is exceptionally thick at an opening measured by Butts near Freeling, on Howell Branch of Georges Fork:

Section of Dorchester coal bed near Freeling.

(Location 18, elevation 1,510 feet B., Fig. 11, Section 18.)

	Ft.	in.
Coal		7
Clay		4
Coal	3	3
Coal	3	10
Parting		4

The Lyons coal was not measured on Georges Fork, but blooms of the Dorchester appear low in the valley for a considerable distance upstream. The Dorchester is 28 inches thick on the new road 1½ miles west of Clintwood (location 19, elevation 1,694 feet S.).

Near Brush Creek School (location 20, elevation 1,570 feet B.) the Dorchester is in two benches as at Freeling, but the lower bench is only 18 to 21 inches thick and the clay parting is 7 to 10 inches thick. A bed measured by W. A. Nelson near the mouth of Brush Creek is probably the Lyons; it has the following section:

Section of Lyons (?) coal bed northeast of the mouth of Brush Creek.

(Location 21, elevation 1,570 feet B.)

	Ft.	in.
Coal, impure at top		9
Shale	4	10
Coal, with half an inch of clay near base	2	
Clay and shale, with coal streak near top	3	
Coal	1	
Coal	3	9
Parting	7	10

The Dorchester and Lyons coal beds lie near the top of the Pound-Cranesnest divide east of Rocky Branch and blooms of both beds show at several places on the ridge road. The Lyons is probably thin. The Dorchester is reported to be about 2 feet thick at several places, and the following measurement is remarkably similar to the one near Brush Creek School:

Section of Dorchester coal bed near Anderson School.

(Location 22, elevation 1,750 feet B., Fig. 11, Section 22.)

	Ft.	in.
Coal		7
Shale		4
Coal	1	10
Coal	2	5
Parting		4

The two beds also lie near the top of the divide south of the lower part of Pound River and show in the ridge roads east from the mouth of Cranesnest River.

Blair coal bed.—The Blair coal bed lies 10 to 20 feet above the white siliceous sandstone that makes the first conspicuous ledge above the Lyons coal, and averages about 80 feet above the base of the Wise formation. The divide between Pound and McClure rivers is too low to contain this bed and it occurs north of Pound River only near the tops of the spurs west of Cane Creek and near Pound River. Between Pound and Cranesnest rivers its area is more extensive. An opening measured by Nelson 1 mile northwest of Clintwood (location 23) on what may be the Blair coal shows a bed 27 inches thick, including two thin partings. Full measurements were not made elsewhere on Georges Fork, Brush Creek, and Jerry Branch, but the bed is reported to be about 30 inches thick at the few places it shows. A few road blooms seemed to indicate a thickness of only about 1 foot and it is possible that the bed is thin locally.

Eagle and Clintwood coal beds.—The Eagle bed lies about 90 feet above the Blair, and the Clintwood bed is 20 to 50 feet higher—about 200 feet above the base of the Wise formation and 510 to 610 feet above the Upper Banner horizon. As indicated by the Clintwood outcrop on the accompanying geologic map (Pl. II), these beds underlie only small areas in Dickenson County except near Georges Fork, and in most places outcrop well up in the hills. The Clintwood is a very thick and valuable bed in

small outliers south of Clintwood and in a larger area on Georges and Lick forks; but it thins notably to the northeast and north, and is less than 4 feet thick on Jerry Branch, Brush Creek, and the lower part of Georges Fork. The Eagle bed contains 2 to 4 feet of coal in addition to clay partings that impair its value. It is commonly considered by prospectors to be the lower bench of the Clintwood, and it may be that in places the two beds unite.

The Clintwood is thickest on Georges and Lick forks, where it is made up of two or more benches of coal separated by clay partings, some of which in places are 1 foot or more thick. The bed has been extensively prospected by the Clinchfield Coal Corporation throughout the area of its best development. In the region about the head of Georges Fork, the bed is very thick, as shown by the following section, measured by Butts:

Section of the Clintwood coal on the head of Georges Fork, south side.

(Location 24.)

	Ft.	in.
Clay		8
Coal, impure		3
Clay		3
Coal	3	
Bone		½
Coal	3	5
Coal	6	8
Partings		3½

Section of Clintwood coal on head of Georges Fork, north side.

(Location 25, Fig. 11, Section 25.)

	Ft.	in.
Coal	1	9
Clay	3	6
Coal	2	3
Clay	1	7
Coal	3	4
Coal	7	4
Partings	5	1

The clay partings in this locality are a serious detriment to the value of the bed.

On the head of Camp Creek a mile north of Georges Fork School, the section is similar to the one at location 25, but the bottom bench is thicker:

Section of Clintwood coal at the head of Camp Creek.

(Location 26, Fig. 11, Section 26.)

	Ft.	in.
Coal		10
Clay	1	
Coal	2	1
Clay	2	
Coal	5	
Coal	7	11
Partings	3	

On a small stream just east of Camp Creek the bed is made up as follows:

Section of Clintwood coal east of Camp Creek.

(Location 27.)

	Ft.	in.
Coal		10
Clay		10
Coal	1	8
Clay		½
Coal		4
Clay		½
Coal	1	5
Coal	4	3
Partings		11

The Clintwood bed is thick near the head of Laurel Creek of Georges Fork. There are 4 feet of clear coal at a small mine 1½ miles southwest of Clintwood (location 28, elevation 1,975 feet C. C. C., fig. 11, section 28), and openings on Cranesnest River drainage in this and neighboring outliers of the same bed make an even better showing. The Eagle bed is 19 inches thick and is separated from the Clintwood by 20 feet of shale.

The Clintwood is only 22 inches thick on a tributary of Brush Creek 1 mile northwest of Clintwood (location 29), but is thicker a short distance east, as shown by the following measurement by Nelson:

Sections of Eagle and Clintwood coal beds near head of Brush Creek.

(Location 30, elevation 1,810 feet B., Fig. 11, Section 30.)

	Ft.	in.
Shale.		
Coal (Clintwood)	3	3
Interval, chiefly shale	20	
Coal } (Eagle)	1	1
Clay } (Eagle)	1	7
Coal } (Eagle)	1	5

A drift half-a-mile east of Brush Creek School (location 31) shows the Eagle to be essentially the same as at location 30, and it is not much

different at a small mine near the school (location 32), though the clay parting is there only 9 inches thick and the coal below it is somewhat thicker than at the other places. The measurement of the Eagle given below was made at a small mine half a mile southeast of the mouth of Brush Creek.

Section of Eagle coal bed near mouth of Brush Creek.

(Location 33, elevation 1,720 feet B.)

	Ft.	in.
Sandstone.		
Coal	1	
Shale, coal, and pyrite		3
Coal		10
Bone		1
Coal	1	
Shale		10
Coal	1	
Coal	3	10
Partings	1	2

The bed is much the same half-a-mile north (location 34, fig. 11, section 34), and the Clintwood is about 35 feet above it in that locality and about 32 inches thick.

Near the head of a small branch three-quarters of a mile northwest of Dwale (location 35, elevation 1,860 feet C. C. C.), there are drifts into two benches of the Clintwood coal, one 15 feet above the other. The upper bench contains coal about 2 feet thick and the lower a bed that is slightly thicker but contains several shale partings.

Bolling coal beds.—The names Upper and Lower Bolling (Campbell Creek) have been applied to a pair of beds 20 to 40 feet apart, the upper one of which is known otherwise as the "Five-foot" coal. The Lower Bolling is 250 to 300 feet above the Clintwood bed. They underlie small areas south of Georges Fork and east of Lick Fork, where they are of workable thickness. About 3 miles northeast of Pound and less than one-quarter of a mile west of Dickenson County, Butts measured the following section of the Upper Bolling bed:

Section of Upper Bolling coal bed 3 miles northeast of Pound.

	Ft.	in.
Coal	2	
Bone		3
Coal	2	1
Clay		1
Coal		1
Coal	4	2
Partings		4

The Lower Bolling lies 20 feet below the Upper Bolling at this place.

Near the summit at the head of Georges Fork there are prospects on both beds which show the following thicknesses:

Section of Bolling coals at summit at head of Georges Fork.

(Location 36, Fig. 11, Section 36.)

	Ft.	in.
Upper bed.		
Coal, clear	3	10
Interval	40	
Lower bed.		
Coal, clear	2	2

CRANESNEST RIVER.

Geologic outline.—The Cranesnest River drainage basin in Dickenson County includes a long narrow strip from 1½ to 6 miles wide extending from the mouth of the river to the southwest corner of the county. A gentle northwesterly dip prevails throughout the basin and is such that about the same beds are exposed in all of the river valley, the downstream component of the dip being nearly the same as the river gradient.

The lowest beds exposed lie a short distance above the Kennedy coal horizon. The upper part of the Norton formation is exposed in all of the main valleys, and the Gladeville sandstone and the lower part of the Wise formation cap nearly all of the main ridges bounding the sides of the basin. The highest beds present are near the horizon of the Bolling coals. The characteristics of the formations are shown by the generalized columnar sections from the Clintwood quadrangle (Pl. XIII), by a number of drill records (Pl. IX), by general sections Aa, Ab, Ac, Bb, and Bc, and by local sections 2, 3, 7, 8, 9, and 24. The distances between coal and other beds decrease, in general, from south to north, so that maximum distances given in the following pages apply to the southern part of the basin and minimum distances to the northern part. There are no reliable stratigraphic markers except the Upper Banner coal bed, which has the characteristic sandstone parting. The Gladeville sandstone and the white sandstone near the base of the Wise are useful aids to correlation.

The Cranesnest drainage basin contains coal at sixteen or more horizons, with a thickness of more than 2 feet in parts of eight or nine beds, (see figs. 9, 10, and 12). The bed that promises most for future development is the Upper Banner between Long and Tarpon branches, where it contains an average of about 4 feet of coal on the outcrop, and is evidently

thick under Big Ridge on the east and perhaps also under part of the Pound-Cranesnest divide on the west. The same bed is nearly as thick on Trace Fork just southwest of the county. The thickest coal bed in the basin is the Clintwood south and southwest of the town of Clintwood, where it is locally 9 feet or more thick, exclusive of partings, and in the Lick Fork area where it is locally 15 feet or more in thickness. Other coal beds, as well as the Upper Banner and Clintwood outside the areas mentioned, are commonly less than 3 feet thick.

Lower Banner coal bed.—The Lower Banner bed outcrops a short distance above water level from the mouth of the river nearly to its head, except in two small areas where it is below drainage. It lies 40 to 100 feet below the Upper Banner horizon, the distance in most places being nearly 100 feet, and 170 to 245 feet above the Kennedy horizon. The bed contains one to nearly four feet of coal.

The Lower Banner was reported to be 41 inches thick, including 5 inches of clay, near the mouth of Bartley Branch, but the first measurement obtained on the west side of the river above its mouth is a little south of the mouth of Holly Creek (beneath location 48, elevation 1,458 feet H. L.), where the bed is 37 inches thick and apparently clear. At the mouth of Long Branch (location 37, elevation 1,465 feet H. L.) the Lower Banner is only 20 inches thick and lies 87 feet below an opening in the outcrop of the Upper Banner bed. No measurements of the Lower Banner coal were obtained south of Honeycamp Branch, on either Cranesnest River or its tributaries, though the bed was reported to be more than 3 feet thick in an opening near the head of Ellis (Alleys) Creek and in another on Buck Branch.

The Lower Banner was measured at several places on the east side of the river. Just below the mouth of Honeycamp Branch (location 38, elevation 1,505 feet B., fig. 12, section 38) it contains 36 inches of coal and 2½ inches of clay near the middle. On Camp Creek (location 39, elevation 1,560 feet B.) the bed consists of 27 inches of coal and 8 inches of carbonaceous shale 8 inches from the bottom. Between Camp Creek and Big Branch (location 40, elevation 1,465 feet B., fig. 12, section 40) the Lower Banner is 35 inches thick, including three thin partings of "rash." Between Big and Lick branches (location 41) there are 32 inches of coal and 3 inches of clay near the middle of the bed. Near Poplar Branch (location 42, elevation 1,430 feet B.) the bed is poorly exposed, but contains at least 21 inches of coal with a 3-inch clay parting 15 inches

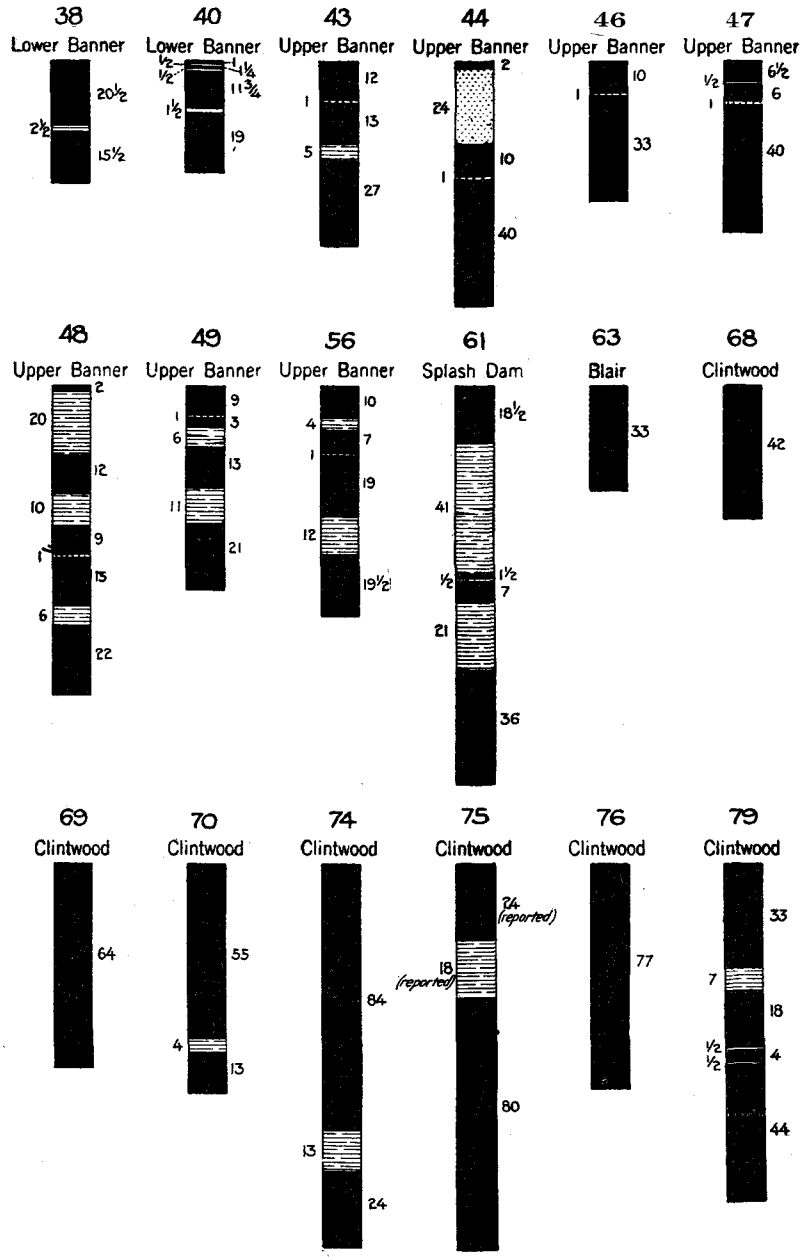


Fig. 12.—Sections of coal beds in the Cranesnest River drainage basin.

below the top. In nearly all these openings the overlying rock is shale or shaly sandstone and the underlying rock a hard clay or shale.

Upper Banner coal bed.—The Upper Banner bed lies, in this area, 850 to 1,030 feet above the base of the Norton formation and 330 to 470 feet below the top of the Gladeville sandstone, the intervals increasing to the south. The coal bed outcrops low down in the valley of Cranesnest River from its mouth to its head-waters, and extends a short distance up the western tributaries and farther up the eastern tributaries. A massive sandstone which is about 30 feet thick in most areas and lies 5 to 20 feet above the Upper Banner is a useful marker for the latter, and the characteristic thin sandstone parting also serves to identify the coal in most, but not all, of its exposures. The thickest exposures of coal, averaging about 4 feet, are along and near Cranesnest River between Tarpon and Long branches and near Keel Branch. The bed was found at only a few places south of Camp Branch, and is apparently thin and perhaps split into two or more benches, except on Trace and Steele forks, just southeast of the county, where it is 1½ to 4 feet thick.

No coal was found at the Upper Banner horizon near the mouth of Cranesnest River and the first measurement obtained on the west side of the valley is 2¼ miles south of the mouth:

Section of Upper Banner coal bed on Cranesnest River, two and one-half miles south of its mouth.

(Location 43, elevation 1,550 feet B., Fig. 12, Section 43.)

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

Half a mile up the valley Stone noted the fact that the shale parting is lacking, the coal below the sandstone parting being 37 inches thick and that above 12 inches; in the next tributary from the north (location 44, elevation 1,477 feet C. C. C., fig. 12, section 44) the section is the same except that the lower coal is 40 inches thick and the upper coal 10 inches. Two exposures on Bartley Branch are as follows:

Sections of Upper Banner coal bed on Bartley Branch.

(Location 45, elevation 1,486 feet C. C. C.)

	Ft.	in.
Coal		3
Sandstone		10
Coal		5
Shale		1
Coal		7
Sandstone		½
Coal	2	3
Coal	3	6
Partings		11½

(Location 46, elevation 1,450 feet B., Fig. 12, Section 46.)

	Ft.	in.
Coal		10
Sandstone		1
Coal	2	9
Coal	3	7
Parting		1

Stone found that the Upper Banner a short distance south of the mouth of Bartley Branch (location 47, elevation 1,526 feet C. C. C., fig. 12, section 47) consists of 40 inches of coal below the sandstone parting and 12½ inches above it, and that half-a-mile farther up Cranesnest River there are 32 inches in the lower part and 17 inches in the upper; at both places there is a thin shale parting in the upper part of the bed. He gives the thickness of the bed on Holly Creek at 40½ inches, including 1½ inches of sandstone. Two measurements by Harnsberger between Holly Creek and Long Branch follow:

Sections of Upper Banner coal bed on Cranesnest River between Holly Creek and Long Branch.

(Location 48, elevation 1,550 feet C. C. C., Fig. 12, Section 48.)

	Ft.	in.
Coal		2
Shale	1	8
Coal	1	
Shale		10
Coal		9
Sandstone		1
Coal	1	3
Shale		6
Coal	1	10
Coal	5	
Partings	3	1

(Location 49, elevation 1,593 feet C. C. C., Fig. 12, Section 49.)

Sandstone.	Ft.	in.
Coal		9
Sandstone		1
Coal		3
Bone and shale		6
Coal	1	1
Shale		11
Coal	1	9
Coal	3	10
Partings	1	6

At the mouth of Long Branch (location 50, elevation 1,564 feet C. C. C.), the Upper Banner consists only of 2 inches of coal in the top and

28 inches in the bottom bench, with 5 inches of clay between; the roof is 7 feet or more of shale, so that it is evident that the upper part of the bed shown in preceding sections was either not deposited or lies more than 7 feet above the lower part.

The Upper Banner was not seen in the Cranesnest River drainage basin above the mouth of Camp Creek except between Keel and Honeycamp branches and on Lyons fork. The part of this basin in which the bed was not found has not been thoroughly prospected, but it is thought that little thick coal is present in most of it.

Stone cites several openings on the west side of Steele Fork, just outside the county, that show the Upper Banner to contain 17 to 40 inches of coal and only thin partings, and one pit at which there is 44 inches of coal and two shale partings aggregating 63 inches. One and one-half miles southwest of the county on the east side of Steele Fork, the Upper Banner consists of 44 inches of coal, 1 inch of sandstone, and 7 inches of shale near the top.

Near the head of Trace Fork, south of Dickenson County, the Upper Banner is nearly 3 feet thick. At John Lodge's house, 1¾ miles above the mouth of Trace Fork, the bed, according to Stone, is 35 inches thick on the west side of the valley and 26 inches on the east side, including 1 inch of sandstone near the middle. Stone states that the bed is 27 inches thick at Harrison Adkin's, and that a quarter of a mile farther downstream an additional 21 inches of coal were found, separated from the 27-inch lower bench by 11 inches of clay and coal. Across the ridge to the north, on the south side of Lyons Fork near its mouth (location 51), Nelson visited an opening on a bed which is tentatively correlated with the Upper Banner and which was reported to be 84 inches thick, including 14 inches of shale. This exceptional thickness, if accurately reported, is probably local, as it has not been found elsewhere in this part of the basin. The bed is less than 2 feet thick at the head of Lyons Fork.

On the east side of Cranesnest River, between the mouths of Honeycamp and Keel branches, Stone cites the two measurements on the Upper Banner given below. The locations on the maps are only approximate, as the openings could not be found by the writer:

Sections of Upper Banner coal bed on Cranesnest River near Keel Branch.[1]

(Location 52.)

	Ft.	in.
Shale.		
Coal		10½
Shale		8
Coal		6½
Sandstone		1½
Coal	1	5
Shale		½
Coal	1	8½
Coal	4	6½
Partings		10

(Location 53.)

	Ft.	in.
Shale.		
Coal		10
Shale		4
Coal		6½
Sandstone		1½
Coal	1	6
Clay		10
Coal	1	9½
Coal	4	8
Partings	1	3½

The occurrence of such a thick bed of coal in this locality is rather surprising and is probably only a local feature.

The bloom of the Upper Banner coal may be seen at several places on the new road up Camp Creek, and the full thickness of a bed that is directly overlain by sandstone (location 54, elevation 1,635 feet B.) is 21 inches. There is coal bloom at an horizon about 20 feet lower, however, so that it is probable that the bed is split into two benches, the lower bench being the same as that measured at the mouth of Long Branch (location 50). A short distance down the Cranesnest the bed makes a better showing, and the following sections indicate its character on both sides of the mouth of Big Branch:

Sections of Upper Banner coal bed on Cranesnest River near Big Branch.

(Location 55, elevation 1,570 feet B.)

	Ft.	in.
Sandstone.		
Coal		½-3
Shale	2	3
Coal		9
Sandstone		½
Coal	1	1
Shale, carbonaceous		1
Coal	2	3
Shale.		
Coal	4	1½-3
Partings	2	4½

(Location 56, elevation 1,590 feet C. C. C., Fig. 12, Section 56.)

	Ft.	in.
Shale, under sandstone		5
Coal		10
Shale		4
Coal		7
Sandstone		1
Coal	1	7
Shale	1	
Coal	1	7½
Coal	4	7½
Partings	1	5

The Upper Banner east of the river and nearly as far north as Tarpon Branch is a thick bed with little waste in partings. On Tarpon, however, it is so split by shale that it is of comparatively little value, and farther north it appears to be an unimportant bed.

[1] Stone, R. W., Coal resources of the Russell Fork basin in Kentucky and Virginia: U. S. Geol. Survey Bull. 348, p. 110, 1908.

Section of Upper Banner coal bed on Tarpon Branch.

(Location 57, elevation 1,609 feet C. C. C.)

	Ft.	in.
Coal		½
Shale		½
Coal		2
Sandstone		¾
Coal		9
Clay		3
Coal		4
Shale	7	2
Coal		2
Clay		1
Coal	1	7
Coal	3	½
Partings	7	7¼

Splash Dam and higher coal beds in Norton formation.—Coal outcrops at nine or more horizons between the Upper Banner coal horizon and the Gladeville sandstone, but there are only a few localities where any of the exposures show more than 2 feet of coal in any one bed. A typical example may be seen on Lick Fork one-half mile west of its junction with Cranesnest River, where seven coal beds, all less than 14 inches thick, were measured in a vertical distance of 150 feet above the Upper Banner horizon. There are only three beds that can be regarded as at all persistent or important. The Splash Dam bed, which lies just above the sandstone that lies directly above the Upper Banner and is 50 to 80 feet above the Upper Banner, contains more than 3 feet of coal on Lyons Fork and more than 2 feet in several other localities. The Hagy bed is 120 to 180 feet above the Upper Banner, and has a maximum thickness of 30 inches. A bed lying just above a coarse sandstone and 180 to 250 feet above the Upper Banner horizon contains 2 feet or less of coal in some exposures.

No complete measurements were obtained on any of the beds in this part of the section in the lower part of the Cranesnest River basin, but there are a number of road blooms and a few caved drifts, especially at the Splash Dam and Hagy horizons. There are probably at least 2 feet of coal in the Splash Dam and Hagy beds in part of this basin. On the new Clintwood road up Long Branch and Camp Creek, the Splash Dam bed appears to be in two or three very thin benches and the Hagy is also thin. A higher bed is 21 inches thick on Long Branch (location 58, elevation 1,680 feet B.), including 1 inch of shale near its base, and is 24 inches thick in a drift at the mouth of that stream. The Hagy bed is reported as

30 inches thick on Lick Branch near Darwin (location 59, elevation 1,585 feet B.), and a higher bed as 18 inches thick in a small hollow by the store.

South of Foraker the Splash Dam bed has been opened at several places and is locally fairly thick. An opening measured by Nelson beside the Wise road, opposite Lyons Branch, a quarter of a mile west of the county line, contains 28 inches of coal and 4½ inches of shale 10 inches from the top of the bed. This bed is 50 feet above a bloom of the Upper Banner and eight other coals are indicated by blooms or drifts on this road in a vertical distance of 230 feet above the Upper Banner bed. Most of these beds are very thin, but one lying 180 feet above the Upper Banner contains 26 inches of coal split by 13 inches of shale near the middle, and another bed, 40 feet higher, has 22 inches of coal and 1½ inches of clay.

Nelson visited two openings near the head of Lyons Fork that are somewhat doubtfully considered to be on the Splash Dam bed and the location of which on the map is only approximate. One of these, southeast of Alka (location 60), shows 28 inches of coal and 1½ inches of bone near the middle.

The other drift is probably opened in a higher bench of the Splash Dam coal and is as follows:

Section of Splash Dam coal bed northeast of Alka.

(Location 61, Fig. 12, Section 61.)

	Ft.	in.
Coal	1	6½
Shale, with coal streak	3	5
Coal		1½
"Rash"		½
Coal		7
Shale	1	9
Coal	3	
Coal	5	3
Partings	5	2½

Dorchester and Lyons coal beds.—These two coals lie in a shale interval averaging about 60 feet thick, between the granular, brownish Gladeville sandstone at the base and a compact white siliceous sandstone at the top. The Dorchester is 350 to 470 feet above the Upper Banner horizon and less than 25 feet above the Gladeville. The Lyons bed lies near the top of the shale and underlies only a little less territory than the Dorchester. Both beds lie near the tops of the [illegible] and the Cranesnest River drainage basin. Neither bed attains [illegible] of more than [illegible] feet and both are commonly less than 2 feet [illegible]

The Dorchester is about 2 feet thick on the northern part of the Pound-Cranesnest divide, but at the head of Bartley Branch contains only 17 inches of coal split near the middle by 12 inches of shale. The bed is thin near the mouth of Long Branch and on Keel Branch and contains the same comparatively thick shale parting.

The Lyons coal is said to be nearly 3 feet thick on the southern end of Big Ridge, and the Dorchester is 21 inches thick at the only place measured in that district, three-quarters of a mile south of the county line. Farther north on Big Ridge neither the Dorchester nor the Lyons has been opened in many places, though road blooms are numerous and indicate beds less than 2 feet thick. On the northern end of the ridge, half a mile north of Tarpon (location 62, elevation 1,855 feet H. L.), the Dorchester is at least 2 feet thick in a road exposure and the Lyons is 50 feet higher and at least 18 inches thick.

Blair coal bed.—The Blair bed is 60 to 125 feet above the base of the Wise formation and lies a few feet above the hard white sandstone that overlies the Lyons coal. It underlies the higher parts of the Pound-Cranesnest divide and lies near the top of much of Big Ridge. Except where the Clintwood coal is also present, the Blair lies too near the surface and in areas that are too small for utilization. The coal is 2 to 3 feet thick near Clintwood and road blooms indicate that it is thinner on Big Ridge. It has not been thoroughly prospected and most of the openings that have been made are now caved.

The Blair coal has been opened on Flemming Branch (location 63, elevation 1,725 feet B., fig. 12, section 63), where it is 33 inches thick and without noticeable partings. Three-fourths of a mile east of Clintwood (location 64, elevation 1,930 feet B.), the bed is 29 inches thick and has shale both above and below.

On Lick Fork and its tributaries the Blair is present and may be of workable thickness, although too little prospecting has been done in this region to determine its character.

Eagle and Clintwood coal beds.—The Clintwood bed lies about 100 feet above the base of the Wise formation. There is arkosic sandstone a few feet below the coal and in some places a resistant siliceous sandstone a short distance above it. The Eagle bed is 30 to 50 feet below the Clintwood. The Clintwood coal is exceptionally thick in many places, but, unfortunately, the area underlain by it in this basin is small, including only the higher part of the Pound-Cranesnest divide and a small outlier on the southern part of Big Ridge. The bed splits and thins northeast of

Clintwood, but is 3½ to 11 feet thick elsewhere. Very few complete measurements were made on the Eagle bed, but it is thought not to exceed 3 feet in thickness, and to be thinner in most places.

Near the gap between Flemming and Jerry branches (location 65, elevation 1,800 feet C. C. C.) there are nearly 3 feet of coal in a lower bench of the Clintwood bed, and 17 inches in another bench that lies slightly higher. On the main fork of Flemming Branch the Eagle is in two benches of 13 inches each, with 29 inches of shale between (location 66, elevation 1,745 feet B.), and the Clintwood is in two benches with about 2 feet of coal in each (location 67, elevation 1,795 feet C. C. C.).

Several mines operated for local fuel are on the south side of Holly Creek, west and south of Clintwood. One of these, 1 mile from town (location 68, elevation 1,944 feet C. C. C., fig. 12, section 68) shows 42 inches of coal.[1] According to Stone, the old John Lane mine, half a mile west of town, is in 58 inches of coal, and 20 inches lower there are 35 inches more of coal and 6 inches of shale in two thin partings. The same authority states that coal at the neighboring Joe Glenn opening is 6 feet thick, including a 4-inch parting 13 inches above the floor, and that the bed is about the same thickness in openings just south of town. A small mine half-a-mile southeast of Clintwood (location 69, elevation 1,970 feet B., fig. 12, section 69) is in 64 inches of clear coal in a small outlier of the Clintwood bed. A few feet below are 60 feet of soft sandstone that forms indistinct benches on the hillside.

The mine that supplies most of the needs of Clintwood and vicinity is operated by Chase and Damron at the head of Long Branch, less than a mile south of the town; the coal bed in this mine has the following section:

Section of Clintwood coal bed at the Chase and Damron mine near Clintwood.

(Location 70, elevation 1,988 feet, H. L., Fig. 12, Section 70.)

	Ft.	in.
Shale, black, compact		8
Shale, drab, removed in mining		8
Coal, clear	4	7
Clay		4
Coal		8-18
Coal	5	8±
Partings		4

[1] An analysis of the coal of this mine is given on page 205.

An analysis of the coal from this mine is given on p. 205 of this report.

The following measurements were obtained on Keel Branch. The first is a natural exposure in the trail south from Keel triangulation station and the second a neighboring prospect reported by Stone. The poor showing at the trail exposure, as compared with other measurements on this Clintwood outlier, suggests the possibility that it is the Eagle bed or only part of the Clintwood. The third and fourth measurements were made in small mines near the head of Keel Branch.

Sections of Clintwood coal bed on Keel Branch.

(Location 71, elevation 2,025 feet B.)

	Ft.	in.
Shale, dark		6
Coal	2	3
Clay, with coal streaks	1	2
Coal	1	1
Clay		6
Coal		6
Clay, over sandstone		9
Coal	3	10
Partings	2	5

(Location 72, elevation 2,008 feet C. C. C.)

Shale.	Ft.	in.
Bone		2
Coal	5	7
Shale		½
Coal, with pyrite streak	2	11
Coal	8	6
Parting		½

(Location 73, elevation 1,962 feet C. C. C.)

Sandstone.	Ft.	in.
Coal	5	2
Shale, carbonaceous	2	
Coal	1	5
Coal	6	7
Parting	2	

(Location 74, elevation 1,972 feet C. C. C., Fig. 12, Section 74.)

	Ft.	in.
Coal	7	
Shale	1	1
Coal	2	
Coal	9	
Parting	1	1

The Clintwood coal makes an excellent showing on Honeycamp Branch, but the area underlain by it is small. The R. W. Beverly mine, on the north side of the branch (location 75, elevation 2,020 feet B., fig. 12, section 75), is in 80 inches of clear coal. It is reported that 18 inches of coal above the bench mined are separated from it by shale, and that a coal bed 22 inches thick lies 20 feet below the mine. At the Wm. Ward mine, on the south side of the valley (location 76, elevation 2,045 feet C. C. C., fig. 12, section 76), there are 77 inches of coal that is clear except for the common knife-edge partings of "mother coal." The J. E. Beverly mine is a few rods south, on the opposite side of a narrow ridge, and shows a main bench of 78 inches and a 22-inch higher bench separated from it by 18 inches of shale.

Half-a-mile southwest of Darwin (location 77, elevation 2,025 feet B.) the coal is probably correctly reported as 11 feet thick.

The Clintwood is remarkably thick on Lick Fork and its branches. The following measurement was made by Butts at the head of Lick Fork within one-half mile of the county line:

Section of Clintwood coal bed at the head of Lick Fork.

(Location 78.)

	Ft.	in.
Coal and bone		3
Coal	1	2
Clay (average)	1	3½
Coal	3	1½
Clay		1½
Coal		3½
Bone		2½
Coal	6	10¾
Shale		9½
Coal	1	3½
Coal	13	¼
Partings	2	5

This appears to be about the maximum thickness of the bed.

A measurement on the Caney Creek side of a small Clintwood outlier on Big Ridge, 5 miles south of Clintwood, is given on page 118. The section at the Elbert Powers local mine, on the Cranesnest River side, is as follows:

Section of Clintwood coal bed at Elbert Powers mine on Big Ridge.

(Location 79, elevation 2,324 feet, H. L.)

	Ft.	in.
Sandstone, shaly.		
Coal	2	9
Shale		7
Coal	1	6
Clay		½
Coal		4
Clay		½
Coal	3	8
Coal	8	3
Partings		8

An analysis of the coal from this mine is given on page 205.

Both of the Bolling coals are present in the divide east of Lick Fork, and are found also on the west between Lick Fork and Dotson and McFall forks in Wise County. The following measurements were made just west of the county line on the headwaters of McFall Fork:

Section of Bolling coal beds just west of county line in Wise County.

	Ft.	in.
Upper bed.		
Coal	4	
Lower bed.		
Coal	3	4
Bone		3
	3	7

The distance between the beds here is 40 feet. It is apparent that these coals are of workable thickness in the extreme western part of the county, but they underlie very limited areas.

MC CLURE RIVER NORTHEAST OF CANEY CREEK.

Geologic outline.—The rocks exposed in the McClure River drainage basin below the mouth of Caney Creek include the sandstone beneath the Kennedy coal bed at the base and the lower 150 feet of the Wise formation at the top. The central part of this drainage basin lies in a structural terrace in which the only dips are minor undulations. On the southern, western, and northern borders of the basin there are northerly and northwesterly dips averaging 75 feet to the mile. The principal features of the stratigraphy of the exposed rocks are shown by the generalized columnar sections for the central part of Dickenson County (Pl. XIII). The local stratigraphy of rocks below the surface is shown by drill records (Pl. IX), and of rocks above the surface by local sections 6, 7, and 23, and general sections Bb, Bc, Cb, Cc (Fig. 2).

The Kennedy, Lower Banner, Splash Dam, Glamorgan, and two other coal beds were found in this basin, but the Upper Banner bed is the only one in which extensive mining could be profitably undertaken at present. (See figs. 9 and 10). On both sides of McClure River between the mouths of Big and Road branches, the Upper Banner contains 3½ to 6 feet of coal with only thin shale and sandstone partings, and lies sufficiently low to be easily reached from the main valleys. Mining operations on a large scale have followed the completion of the railroad along the river. The mining town of Moss, on Mill Creek near its junction with McClure River, is the center of the largest operations.

Kennedy coal bed.—The Kennedy coal bed lies 250 to 300 feet below the Upper Banner coal horizon and is exposed only in the bottom of McClure River valley north of the mouths of Road Branch and Caney Creek. The horizon of the bed is easily identified by the coarse sandstone which is

just below it, but there appears to be little or no coal present in most places. In a railroad cut near the mouth of Spring Branch (location 80, elevation 1,340 feet B.), there are 16 inches of coal in what is probably the Kennedy bed, but a short distance down grade this is replaced by shale dipping about 15 degrees in what is either a slide or a local buckle. The Kennedy is 3 to 40 inches thick and greatly crushed and contorted in the tunnel at the mouth of Caney Creek; but a short distance to the south coal is lacking. Locally there are one or two very thin coal beds 50 feet or less above the Kennedy.

Lower Banner coal bed.—The Lower Banner coal bed lies 70 to 100 feet below the Upper Banner and outcrops low down in all of the valley of McClure River and in the lower parts of its tributaries. It has a thin sandstone underneath, but can best be identified by its relation to the Upper Banner and Kennedy beds or their horizons. The coal bed is persistent, but commonly less than 2 feet thick.

The Lower Banner, 18 to 24 inches thick, is exposed at the north end of the tunnel opposite the mouth of Squirrel Camp Branch (location 81, elevation 1,500 feet B.). Many road blooms, seeps, and a few caved openings were seen at the Lower Banner horizon west of McClure River, but no other complete measurements were obtained.

The bed is 15 and 16 inches thick, respectively, at two places in the upper part of Big Branch (locations 82 and 84). Several strip mines near the bridge at the forks of Big Branch (location 83, elevation 1,726 feet H. L.) show 13 to 30 inches of coal with both sandstone and shale overlying the coal, and 2 inches more of coal 9 feet below the main bench.

No measurements were made between Big Branch and Mill Creek, and in the valley of the latter stream the value of at least the upper part of the bed is greatly impaired by shale partings.

Coal in a drift beside the ridge road near the mouth of McClure River (location 85, elevation 1,527 feet S., fig. 13, section 85) is tentatively correlated with the Lower Banner. A short distance east the rocks dip steeply, indicating buckling, perhaps accompanied by faulting. In this drift there are 26 inches of coal underlain by 19 inches of shale under which there are 8 inches more of coal. A short distance below there is coarse-grained massive sandstone.

Upper Banner coal bed.—The Upper Banner outcrops in the valley of McClure River from its mouth to Caney Creek and also nearly to the heads of the principal tributaries. It lies 235 to 300 feet above the Ken-

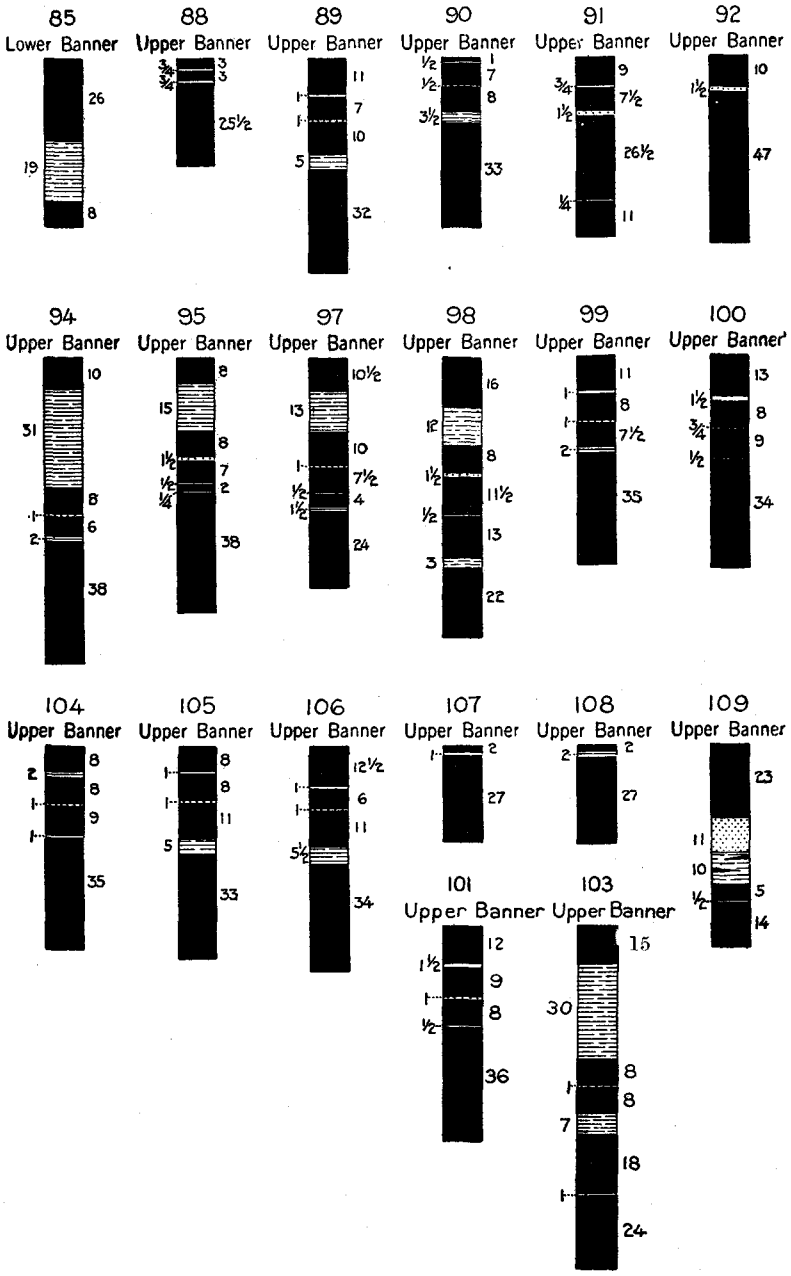


Fig. 13.—Sections of coal beds in the northern part of the McClure River drainage basin.

nedy horizon and 350 to 470 feet below the top of the Gladeville sandstone, the intervals thickening, in general, to the south. Between points a mile or more north of Mill Creek and a mile or less south of Big Branch and in adjacent territory west of the river, the average thickness of this bed is 4 to 5 feet and it is the best mining proposition in the central or northern parts of Dickenson County. Both north and south of this basin the bed apparently breaks up into two or more relatively thin benches and it may be lacking in places. Where the bed is thick it can be easily identified by the thin sandstone parting in its upper half and by a coarse-grained sandstone cap-rock a few inches to 20 feet above the coal.

What is probably the Upper Banner bed is less than 2 feet thick in a natural exposure in Rocky Branch (location 86, elevation 1,485 feet B.). The bed is 20 inches thick 1½ miles southwest of location 86, where there are several small drifts (location 87, elevation 1,615 feet B.). Near the tunnel opposite Hughes Branch (location 88, elevation 1,577 feet C. C. C., fig. 13, section 88), a 32-inch bed, including two clay partings each less than 1 inch thick, is exposed in small drifts used in railroad construction work. The roof is 3½ feet of shale under sandstone, and there is said to be another bench of coal several feet from the one mined. As shown in the two following sections, the shale parting between these two benches thins to the southwest and is only 5 inches thick in a small mine on Low Gap Branch and 3½ inches in a drift at a place half-a-mile farther south:

Sections of Upper Banner coal bed near Low Gap Branch.

(Location 89, elevation 1,597 feet C. C. C., Fig. 13, Section 89.)

Sandstone.	Ft.	in.
Shale	6	
Coal		11
Shale		1
Coal		7
Sandstone		1
Coal		10
Shale		5
Coal (reported)	2	8
Coal	5	0
Partings		7

(Location 90, elevation 1,606 feet C. C. C., Fig. 13, Section 90.)

Sandstone.	Ft.	in.
Shale	5	
Coal	1	
Shale		½
Coal		7
Sandstone		½
Coal		8
Shale		3½
Coal	2	9
Coal	5	0
Partings		4½

On the west side of McClure River, as far south as the mouth of Squirrel Camp Branch and a little beyond, the Upper Banner contains 4 to 5½ feet of coal, with only thin partings. The following section was measured in a drift used in railroad construction work near the mouth of Camp Branch:

Section of Upper Banner coal bed near Camp Branch.

(Location 91, elevation 1,615 feet B., Fig. 13, Section 91.)

	Ft.	in.
Sandstone.		
Coal		9
Shale		¾
Coal		7½
Sandstone		1½
Coal	2	2½
Shale		¼
Coal		11
Coal	4	6
Partings		2½

Stone cites an opening on the west side of the river a quarter of a mile northwest of the mouth of Squirrel Camp Branch, in which there are 8 inches of coal above the thin sandstone parting and 45 inches below it. Half-a-mile south (location 92, elevation 1,619 feet C. C. C., fig. 13, section 92) the sandstone parting is 1½ inches thick, the coal above is 10 inches, and that below it 47 inches; no partings more than a quarter of an inch thick were seen, and there are reported to be 15 inches more of coal 11½ inches above the part of the bed now exposed. No measurements of the Upper Banner were obtained either west or east of McClure River between the drift last mentiond and Caney Creek, and it is probable that the bed is either thin or split into several benches in most of that area. It may be thick near the head of Big Branch, however, and a drift near the Stratton road (location 93, elevation 1,845 feet B.) is said to have shown nearly 3 feet of coal.

On Squirrel Camp Branch and neighboring parts of McClure River, the Upper Banner contains 3½ to 5½ feet of coal in a lower bench that has only thin partings, and commonly also a top bench that would probably be left in mining. The following is exposed in a small drift mine half-a-mile south of the mouth of the branch:

Section of Upper Banner coal bed south of mouth of Squirrel Camp Branch.

(Location 94, elevation 1,633 feet C. C. C., Fig. 13, Section 94.)

	Ft.	in.
Shale.		
Coal		10
Shale, carbonaceous at base	2	7
Coal		8
Sandstone		1
Coal		6
Shale		2
Coal	3	2
Coal	5	2
Partings	2	10

Stone states that two measurements in the upper part of the south fork of Squirrel Camp Branch are as follows:

Sections of Upper Banner coal bed on right fork of Squirrel Camp Branch.

	Ft.	in.
Coal		8½
Sandstone		1½
Coal		11½
Shale		1
Coal	2	9½
Coal	4	5½
Partings		2½

	Ft.	in.
Coal		10
Sandstone		1
Coal		9½
Shale		4½
Coal		2
Shale		2½
Coal	2	11
Coal	4	8½
Partings		8

Following are thicknesses of the bed, as given by Stone, at two places on the north fork of the same stream:

Sections of Upper Banner coal bed on left fork of Squirrel Camp Branch.

(Location 95, elevation 1,606 feet C. C. C., Fig. 13, Section 95.)

	Ft.	in.
Coal		8
Shale	1	3
Coal		8
Sandstone		1½
Coal		7
Shale		½
Coal		2
Shale		¼
Coal	3	2
Coal	5	3
Partings	1	5¼

(Location 96, elevation 1,583 feet C. C. C.)

	Ft.	in.
Coal		9
Sandstone		1½
Coal		8½
Shale		¼
Coal		2
Shale		1
Coal	2	8½
Coal	4	4
Partings		2¾

The first of the following sections was measured at the mouth of a small mine at the forks of Squirrel Camp Branch; at the working face the coal below the sandstone parting is 42 inches thick and without shale partings. The second of the following sections is given by Stone as nearly half-a-mile north of the mouth of Squirrel Camp Branch:

Sections of Upper Banner coal bed near mouth of Squirrel Camp Branch.

(Location 97, elevation 1,597 feet C. C. C., Fig. 13, Section 97.)

	Ft.	in.
Coal		10½
Shale	1	1
Coal		10
Sandstone		1
Coal		7½
Shale		½
Coal		4
Shale		1½
Coal	2	
Coal	3	10
Partings	1	4

(Location 98, elevation 1,629 feet C. C. C., Fig. 13, Section 98.)

	Ft.	in.
Coal	1	4
Clay	1	
Coal		8
Sandstone		1½
Coal		11½
Shale		½
Coal	1	1
Shale		3
Coal	1	10
Coal	5	10½
Partings	1	5

The highest shale parting, which is sufficiently thick on Squirrel Camp Branch to render the coal above it unrecoverable, thins to the north to a few inches. The rest of the bed is about the same, so that on Mill Creek and neighboring parts of McClure Creek there are 4 to 6 feet of coal with only thin partings. The first of the following two measurements was made at a drift half-a-mile southwest of the mouth of Mill Creek, 90 feet above a thin coal bed at the Lower Banner horizon; the second measurement was made at a small mine on the east side of the mouth of House Fork of Mill Creek:

Sections of Upper Banner coal bed near mouth of Mill Creek.

(Location 99, elevation 1,590 feet C. C. C., Fig. 13, Section 99.)

Shale.	Ft.	in.
Coal		11
Shale		1
Coal		8
Sandstone		1
Coal		7½
Shale		2
Coal	2	11
Coal	5	1½
Partings		4

(Location 100, elevation 1,596 feet C. C. C., Fig. 13, Section 100.)

	Ft.	in.
Sandstone		1½
Coal	1	1
Shale		1½
Coal		8
Sandstone		¾
Coal		9
Shale		½
Coal	2	10
Coal	5	4
Partings		2¾

The Upper Banner is being mined extensively by the Clinchfield Coal Corporation on House Fork and Mill Creek. The operations center about the new mining town of Moss at the junction of Mill Creek and McClure River, a town of some 1,500 people at the present time (autumn 1919). Some 13 or more entries had been driven, and coal was being taken out of most of them in the late summer of 1919.

The following measurement was made in main entry No. 1 on the west side of House Fork:

Section of Upper Banner coal on the west side of House Fork.

(Location 101, elevation 1,640 feet B., Fig. 13, Section 101.)

	Ft.	in.
Coal	1	
Shale		1½
Coal		9
Sandstone		1
Coal		8
Shale		½
Coal	3	
Coal	5	5
Partings		3

The following measurement was made in main entry No. 2 on the west side of House Fork:

Section of Upper Banner coal on the west side of House Fork.

(Location 102, elevation 1,640 feet B.)

	Ft.	in.
Coal		11½
Shale		½
Coal		8
Sandstone		1¼
Coal		8
Clay		1
Coal	2	11
Coal	5	2½
Partings		2¾

In all of the entries the coal averages 5½ feet with 3 partings, the middle one being a thin layer of sandstone, the outer being of shale. The sandstone parting occurs in the upper third of the bed, the upper shale parting about 1 foot from the top of the coal bed, and the lower about 3 feet from the bottom of the bed.

One and one-half miles north of Big Branch on the east side of McClure River Valley the following section is reported:

Reported Section of the Upper Banner coal bed at location 103 (Fig. 13, Section 103.)

	Ft.	in.
Coal	1	3
Shale	2	6
Coal		8
Sandstone		1
Coal		8
Shale		7
Coal	1	6
Shale		1
Coal	2	
Coal	6	1
Partings	3	3

About the same thicknesses prevail farther east, as shown by the following two sections at small mines, the first on Toms Fork of Mill Creek and the second on Mill Creek near Tenso:

Sections of Upper Banner coal bed on Toms Fork and Mill Creek.

(Location 104, elevation 1,617 feet C. C. C., Fig. 13, Section 104.)

Sandstone.	Ft.	in.
Coal		8
Shale		2
Coal		8
Sandstone		1
Coal		9
Shale		1
Coal	2	11
Coal	5	
Partings		4

(Location 105, elevation 1,612 feet C. C. C., Fig. 13, Section 105.)

Sandstone.	Ft.	in.
Coal		8
Shale		1
Coal		8
Sandstone		1
Coal		11
Shale		5
Coal	2	9
Coal	5	0
Partings		7

Stone describes a section near the mouth of Bowling Branch (location 106, elevation 1,612 feet C. C. C., fig. 13, section 106) that is nearly identical with the one on Mill Creek near Tenso, the thickness of coal being 63½ inches and of partings 7½ inches. Less than a mile north of this the lowest shale parting, which is only 5 inches thick at locations 105 and 106, thickens, and still farther north is as much as 12 feet thick. As a result of this splitting, only the lower bench appears to be available for use on Road Branch, as shown by two openings (location 107, elevation 1,565 feet B., fig. 13, section 107); and location 108, elevation 1,630 feet B., fig. 13, section 108) at which there are 29 inches of coal and 1 or 2 inches of shale two inches from the top. The overlying rock is shale and the underlying rock sandy shale and shaly sandstone; traces of what seems to be a thin coal bed show about 10 feet above the openings, overlain by 40 feet of massive sandstone on top of which there are traces of the Splash Dam coal.

There are no openings on the Upper Banner on the east side of the McClure between Road Branch and the mouth of the river. The upper bench is only 11 inches thick where exposed near the north end of the ridge road east of the McClure, and both benches are known to be very thin near the mouth of the river. What is probably either the lower bench or both benches is exposed a mile up Camp Creek:

Section of Upper Banner coal bed on Camp Creek.

(Location 109, elevation 1,620 feet B., Fig. 13, Section 109.)

	Ft.	in.
Coal	1	11
Sandstone, coarse-grained		8-15
Shale, with coal streaks		10
Coal		5
Shale		½
Coal	1	2
Sandstone.		
Coal	3	6
Partings	1	6½-13½

The lower bench of the Upper Banner is 23 inches thick at the head of Camp Creek (location 110, elevation 1,670 feet B.), and rests upon medium-grained sandstone.

Splash Dam and higher coal beds in Norton formation.—In this basin there are at least five or six coal beds in the Norton formation above the Upper Banner horizon, but only one of them—the Splash Dam—was found to be more than 13 inches thick. The Splash Dam bed is 40 to 80 feet above the Upper Banner and only a few feet above the sandstone overlying the latter bed. It is nearly 3 feet thick near the mouth of the McClure, but less than 2 feet thick farther southwest. Few measurements were obtained, but the lack of prospects and small mines indicates that the bed is relatively unimportant.

An exposure half-a-mile south of Millard (location 111, elevation 1,730 feet B.) shows 18 inches of coal at the Splash Dam horizon, and a little more may be concealed. The same bed is reported 18 inches thick near the mouth of Road Branch (location 112, elevation 1,660 feet B.), and is 19 inches thick at the head of Camp Creek (on slope above location 110, elevation 1,780 feet B.). Coal in an opening on what is probably the Splash Dam at the mouth of McClure River (location 113, elevation 1,425 feet B.) appears to be about 3 feet thick. This pit is near steeply dipping beds and the coal exposed here may not be correctly correlated.

Coal beds in Wise formation.—The Glamorgan and Lyons coal beds show as blooms in the tops of the main ridges, but underlie only small areas and are probably very thin in most places. The Blair coal has been eroded except on one or two very small outliers and the Clintwood has likewise been removed by erosion except in these small remnants. The Dorchester attains a thickness of 2 feet on the northern end of Big Ridge and is probably the bed that is 25 inches thick near Hill School, northwest of Haysi (location 114, elevation 1,828 feet H. L.).

CANEY CREEK.

Geologic outline.—The rocks exposed in the Caney Creek drainage basin include part of the underlying rock of the Kennedy at the base and the lower 300 feet of the Wise formation at the top. These are shown by the generalized columnar sections for the central and southwestern parts of Dickenson County (Pl. XIII), by drill records C 128 and C 123 (Pl. IX), by local sections 6, 7, 9, and 10, and by general sections Aa, Ab, Ba, and Bb. Rocks not exposed are shown in drill records S 17, S 36, S 37, and S 38 (Pl. IX). The Norton formation outcrops in by far the greater part of the basin, as the Gladeville and Wise appear only on the tops of the highest ridges. The dips are, in general, to the northwest at 30 to 300 feet per mile.

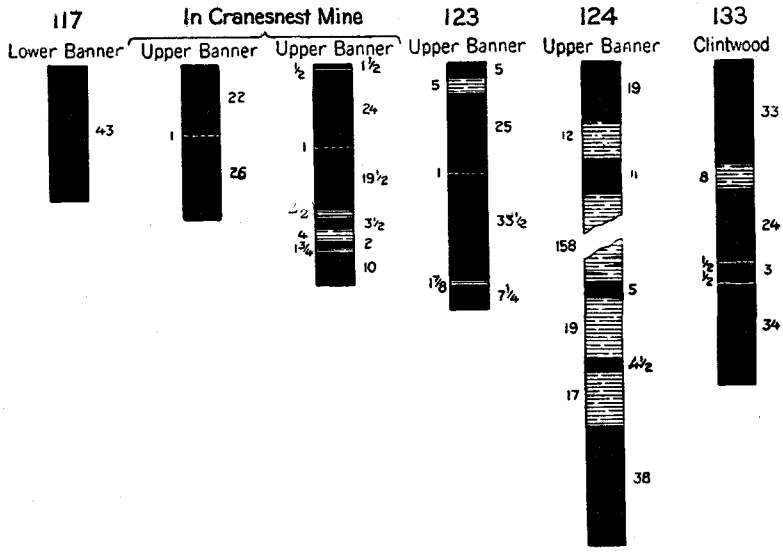


Fig. 14.—Sections of coal beds in the Caney Creek drainage basin.

The north half of the Caney Creek basin contains little coal that is likely to be utilized in the near future, though beds 2 feet or less thick are common and coal 3 feet thick is not unknown. Outliers of the Clintwood bed on Big Ridge contain more than 7 feet of coal with only thin partings, but the areas are too small for any except local mines. The

southern part of the basin, however, is rich in coal in the Upper Banner bed, which contains an average of 5 feet of excellent coal on Hurricane, Road, and Trace forks. (See figs. 10 and 14). Part of this thick coal is already being mined by the Clinchfield Coal Corporation and hauled by motor more than a mile and a half under Sandy Ridge to the mine mouth on Fuller Branch of Big Toms Creek, whence it is shipped over the Clinch Valley division of the Norfolk and Western Railway.

Kennedy coal bed.—The Kennedy coal, which lies 250 to 330 feet below the Upper Banner horizon, is below the surface except near the mouth of Caney Creek. In the railroad tunnel near the Caney Creek bridge (location 115, elevation 1,493 feet H. L.) the bed is 3 to 40 inches thick and is greatly contorted and crushed, the fracture planes striking in general S. 80° E. The coal disappears a few yards north of the tunnel. The Kennedy, though locally thick, is so irregular in thickness and so crushed and fractured that it is not a profitable mining proposition. At the tunnel there is a coarse massive sandstone under it and 100 feet of fine-grained, rather shaly sandstone above it.

Lower Banner coal bed.—The Lower Banner coal lies at an average distance of 100 feet below the Upper Banner horizon. It outcrops low in the valley of Caney Creek from its mouth nearly to its head and a considerable distance up its tributaries, especially those from the east. The bed averages about 2 feet thick, though locally it expands to a little more than 3 feet.

No complete measurements of the Lower Banner bed were made on the west side of Caney Creek, though a caved opening on Mill Branch indicates a thickness of at least 2 feet, and another at the mouth of Long Branch (location 116, elevation 1,775 feet B.) is apparently in at least 3 feet of coal. Stone states that the bed is 21 inches thick on the upper part of Hurricane Fork just south of the county.

The bed is mined for local use on the eastern Big Branch (location 117, elevation 1,830 feet B., fig. 14, section 117), where it is clean and 43 inches thick and is overlain by 6 feet of sandy shale and sandstone. The bed is reported to be thick in drifts on the east side of the loop of Caney Creek, opposite the mouth of Long Branch. Half-a-mile northeast of the loop (location 118, elevation 1,790 feet B.) there are 34 inches of coal in an upper bench and a few inches more below a shale parting. In the

bed of the upper part of Bad Branch (location 119, elevation 1,910 feet B.), an exposure that appears to be the Lower Banner contains only 7 inches of coal badly split by shale partings. It is possible that this exposure is not the principal bench of coal. A prospect on Rockhouse Branch (location 120, elevation 1,820 feet S.) shows 26 inches of clear coal.

Upper Banner coal bed.—The Upper Banner is by far the most important coal bed in this basin and outcrops 300 feet or less above Caney Creek and its tributaries from their mouths nearly to their heads. The bed contains 3½ to 8 feet of coal, with an average of 5 feet on Hurricane, Road, and Trace forks. It is now being taken out east and west of Hurricane Fork by the Cranesnest mine of the Clinchfield Coal Corporation, the entrance to which is on the south side of Sandy Ridge and the workings of which have been driven northward a short distance into Dickenson County. Analyses of the coal from this mine are given on pages 198 and 199 of this report. North of this district the Upper Banner splits into several parts the thickest of which contains only 2 to 3 feet of coal, and the lack of prospects and exposures north of Rockhouse and Mill branches indicates that there is still less coal in that district. Where the bed is thick it is characterized by an inch of sandstone in the middle or the upper half.

In a hollow near the loop of Caney Creek (location 121, elevation 1,880 feet B.) the Upper Banner is split into three benches occupying a space of about 35 feet, with coarse-grained sandstone above and medium-grained sandstone below. The upper bench of coal is 18 inches thick, the middle bench 9 inches, and the lower is reported to be 30 inches. Farther south the shale between these benches thins to a few inches and the bed is the excellent mining proposition described in the last paragraph. On the right fork of Hurricane Fork just south of the county line, small drifts show the bed to be less than 2 feet thick, but either the coal is thin in a very small area here or part of the bed is not shown at the drifts. At the main Caney entry of the Cranesnest mine (one-half mile south of the county line), the bed contains 6 feet of coal. The details of the bed are best shown by the following measurements in the mine, the first being 500 feet northeast of the main Caney entry and the second 1,500 feet southwest of it. The first measurement probably does not include the lower part of the bed:

Sections of Upper Banner coal bed in Cranesnest mine.

Shale.	Ft.	in.
Coal	1	10
Sandstone		1
Coal	2	2
Coal	4	0
Partings		1

Shale.	Ft.	in.
Coal		1½
Shale, sandy		½
Coal	2	
Sandstone		1
Coal	1	7½
Shale and coal		2½
Coal		3½
Shale		4
Coal		2
Shale		1¾
Coal		10
Coal	5	½
Partings		9¾

The coal available for mining thins slightly to the north, and near the junction of Hurricane and Road forks (location 122, elevation 2,060 feet B.) a small mine is in 42 inches of coal with the typical thin sandstone parting near the middle. Farther southeast, near the head of Trace Fork, the bed is thicker as shown by the following section:

Section of Upper Banner coal bed near head of Trace Fork.

(Location 123, elevation 2,160 feet C. C. C., Fig. 14, Section 123.)

	Ft.	in.
Sandstone, bluish, medium-grained	6	
Coal		5
Shale		5
Coal	2	1
Sandstone		1
Coal	2	9½
Shale		1⅞
Coal		7¼
Coal	5	10¾
Partings		7⅞

The following measurement in drifts beside the path west of Bad Ridge School apparently shows the Upper Banner in two parts, though it is barely possible that the upper part is the Splash Dam bed. The lowest and thickest bench of coal is reported to contain the typical thin sandstone parting in a few openings in the vicinity:

Section of Upper Banner coal bed half-a-mile west of Bad Ridge School.

(Location 124, elevation of base 1,987 feet S., Fig. 14, Section 124.)

	Ft.	in.
Sandstone, buff, fine-grained, shaly at base	5	
Coal	1	7
Shale, drab and black, carbonaceous in part	1	
Coal		11
Interval, including shale at top	8	
Shale, mostly drab, with streaks of coal in lower part; contains fossil plants	5	2
Coal		5
Shale, drab; contains fossil plants	1	7
Coal		4½
Shale, drab; contains fossil plants	1	5
Coal	3	2

The same beds are exposed in drifts near the road on a tributary of Bad Branch, as follows:

Section of Upper Banner coal bed half-a-mile east of Bad Ridge School.

(Location 125, elevation of base 2,000 feet, H. L.)

	Ft.	in.
Sandstone, buff, fine-grained, cross-bedded	12	
Coal, with shale streaks near top	1	3
Shale, very compact and sandy		2
Coal		6
Interval, including shale at top	20	
Shale, drab; contains fossil plants	6	
Coal		9½
Shale, carbonaceous in part		7
Coal	1	7
Sandstone, fine-grained, compact, massive	9	

On Little Rockhouse Branch (location 126, elevation 1,980 feet B.) the coal at the Upper Banner horizon is only 2 feet thick, and the presence of massive sandstone both above and below indicates that other benches are lacking.

Splash Dam and higher coal beds in Norton formation.—There is coal at several horizons in the Norton formation above the Upper Banner, but all the beds are less than 2 feet thick except locally. It is likely that the Splash Dam bed, which lies about 50 feet above the Upper Banner, contains in places as much as 2 or 3 feet of coal, but only blooms were found at its horizon.

The thickness of a bed that lies just above a coarse sandstone, and 280 feet and less above the Upper Banner horizon, was ascertained at two places. In one drift, in a hollow north of Pound Branch (location 127, elevation 1,980 feet B.), the bed contains 28 inches of coal separated by

a shale parting from an upper bench 8 inches thick. At the other drift, on Lick Branch (location 128, elevation 2,100 feet B.), there are only 18 inches of coal. Another bed which is 18 inches thick near Big Oak School (location 129, elevation 2,030 feet B.) is apparently at a lower horizon and is perhaps the Hagy.

Dorchester and Lyons coal beds.—The characteristics of the Dorchester and Lyons coal beds on Big Ridge have been previously mentioned in the description of coal in the Cranesnest River drainage basin. Nearly all of the exposures of these beds on the divide east of Caney Creek are on upper McClure River drainage and will be described in the section devoted to that basin.

The beds were seen at a few places on the east side of Big Ridge. A caved drift in the Dorchester bed nearly a mile south of Bearpen Gap (location 130, elevation 2,115 feet B.) shows more than 18 inches of coal with 3 inches of shale near the top and a roof of 10 feet of shale. Half-a-mile due south the bed was reported 21 inches thick, and was said to be 18 inches thick near the head of Pound Branch (location 131, elevation 2,215 feet B.). A small mine in the Lyons bed a mile northeast of Lyons, Wise County, (location 132, elevation 2,570 feet B.) was filled with water when visited, but the coal appeared to be about 3 feet thick.

Clintwood coal bed.—The Clintwood bed occurs only in small outliers on Big Ridge at the heads of Pound, Lick, and Mill branches, where it is 185 feet above the base of the Wise formation and 580 feet above the Upper Banner horizon. As shown by the following measurement at the F. T. Kennedy local mine at the head of Mill Branch and by one on page 102 (location 79), it is an exceptionally thick bed in this small area. The Eagle and Blair beds, which are less than 100 feet below the Clintwood, are represented by road blooms only.

Section of Clintwood coal bed at Kennedy mine on Big Ridge.

(Location 133, elevation 2,386 feet S., Fig. 14, Section 133.)

	Ft.	in.
Shale.		
Coal	2	9
Shale		8
Coal	2	
Shale		½
Coal		3
Shale		½
Coal	2	10
Coal	7	10
Partings		9

MC CLURE RIVER SOUTHEAST OF CANEY CREEK.

Geologic outline.—The lowest stratum exposed in the drainage basin of upper McClure River is the massive sandstone beneath the Kennedy coal bed, and the highest is a massive white sandstone the top of which is about 350 feet above the base of the Wise formation. The Gladeville sandstone and the Wise formation, however, are restricted to the tops of the main ridges. The stratigraphy above and below drainage is shown by the generalized columnar section for the southwestern part of Dickenson County (Pl. XIII), by many drill records (Pls. IX and X), by general sections Ad, Ba, Bb, Ca, and Cb, and by local sections 10, 11, 12, 13, 17, and 18. Dips, less than 100 feet per mile except locally, are to the northwest and north.

There are some important coal beds in this basin, chiefly in its southern part, near Sandy Ridge. (See figs. 9, 10, and 15). The Kennedy coal is more than 9 feet thick in a few pockets, but is thin in many places and is everywhere crushed and very irregular in thickness. The Lower Banner is 2 to 3 feet thick in many places and contains an average of more than 3 feet of coal in the southeastern part of the basin. The Lower Banner is being mined on a large scale at Dante, a short distance south of the McClure River drainage basin, where it is much the same as in part of the latter area. In the northern part of the basin the Upper Banner is split into several beds each containing less than 3 feet of coal, but these beds unite in the southeastern part of the basin, where the coal averages about 5 feet thick and contains only very thin partings of incombustible matter. A large tonnage is being derived from the Upper Banner near Dante, and the workings of the largest mine have already been extended north under Sandy Ridge and into the territory at the head of McClure River. An entry is also being driven from a large mine at Wilder, on Dumps Creek toward the head of Roaring Fork. Analyses of the coal from these mines are given on pages 200-204. The Splash Dam bed is 3 to 4 feet thick in the southern part of the Open Fork drainage basin and may be fairly thick in a few other areas. Higher beds are either too thin or occupy too small an area to be of great importance. The Dorchester and Lyons beds show 3 or 4 feet of coal locally, but commonly contain several shale partings. The Eagle bed is 30 to 51 inches thick, but underlies only about one square mile.

Kennedy coal bed.—The Kennedy coal is 300 to 420 feet below the Upper Banner horizon and outcrops low in the valley of McClure River

and the lower parts of its tributaries. The coal lies near the level of the railroad from the Sandy Ridge tunnel to Caney Creek and can be seen in many railroad cuts. The Kennedy is everywhere crushed and slickensided, and is fractured in a way that plainly shows that the beds above it were shoved to the northwest along the plane of the coal bed. As a result of this movement the thickness of the coal is remarkably irregular and the bed, though locally thick, is not likely to yield a large profit in mining. There is a coarse massive sandstone a few feet below the coal and fine-grained sandstone or sandy shale above it. There are in places several coal beds above the Kennedy and below the Lower Banner, but they are too thin or impure nearly everywhere to be of commercial importance.

The Kennedy is 3 to 40 inches thick in the tunnel at the mouth of Caney Creek, 10 to 15 inches a quarter of a mile southeast, and 12 inches half a mile farther up the railroad grade (location 134, elevation 1,501 feet H. L.), where it is 9 feet above the track. The Kennedy and a coal bed 30 feet higher are exposed at intervals in the cuts between Spraddle Branch and Buffalo Creek, but are too thin and irrgular to be mined in even a small way.

Two small drifts on Open Fork near Rush Branch (location 135, elevation 1,600 feet B., fig. 15, section 135) show 70 to 76 inches of coal with sandstone overlying the bed. A small mine at the mouth of the road fork of Spring Fork (location 136, elevation 1,647 feet S.) is in 30 inches of coal with sandstone above and below the coal bed. There is a large prospect opening on Middle Fork (location 137, elevation 1,630 feet B.) in which the Kennedy is reported 9½ feet thick, and a small stripping a few rods south is in at least 4 feet of coal. About three feet of coal, in the opening on the opposite side of the stream are in a bed about 50 feet higher than the Kennedy. A small drift just below the mouth of Rush Branch (location 138, elevation 1,607 feet S.) contains 24 to 30 inches of coal. The average thickness of the Kennedy on Open Fork drainage is much less than is indicated by these measurements.

The Kennedy is 33 feet above the grade and only 2 inches thick at the deep railroad cut at the mouth of Open Fork, and only 3 to 15 inches thick in cuts half-a-mile south. A little farther up grade (location 139, elevation 1,575 feet B., fig. 15, section 139) the bed contains 41 inches of coal near track level, but is thinner not far distant. At the tunnel at the mouth of Long Branch, the following section is exposed:

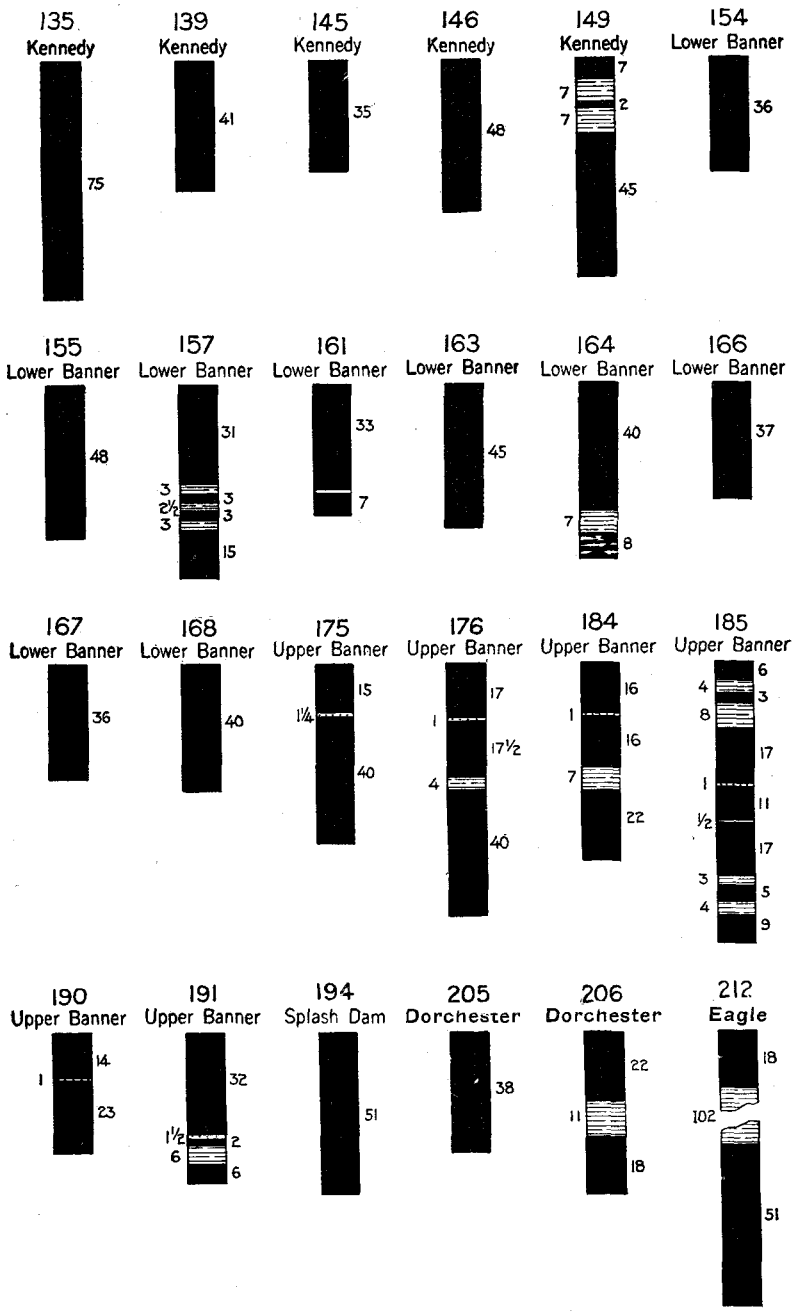


Fig. 15.—Sections of coal beds in the southern part of the McClure River drainage basin.

Section at mouth of Long Branch of McClure River.

(Location 140, elevation of base 1,635 feet B.)

	Ft.	in.
Sandstone, bluish-buff, fine-grained, thick-bedded	45	
Shale, dark blue, slaty, buckled, with coal streaks	6	
Sandstone, reddish-drab, fine-grained, massive, much fractured	19	
Coal		3-24
Slate, dark blue, slaty, buckled	5	
Sandstone, dark blue, argillaceous, much fractured along planes dipping 45 degrees	20	
Coal (Kennedy)		2-12
Sandstone, bluish, fairly coarse, massive, to railroad grade	2	
Concealed, probably sandstone	5	
Sandstone, yellowish buff, coarse	20	

The Kennedy coal bed is 10 to 24 inches thick in cuts near the mouth of Honey Branch (location 141, elevation 1,690 feet B.) and is reported 30 to 36 inches where it dips under the track a short distance north. Opposite Roaring Fork (location 142, elevation 1,700 feet B.), at railroad level, the bed is 24 to 37 inches thick. In cuts a short distance south the bed contains 30 inches of coal split by a foot of carbonaceous shale 10 inches from the top. Near the mouth of Bear Hollow the coal is 15 to 30 inches thick and includes irregular shale partings. Farther south (location 143, elevation 1,770 feet B.) the bed is 18 inches thick and in places has a shale parting near the middle. The Kennedy was utilized in railroad construction work at a mine near the end of the Sandy Ridge tunnel (location 144, elevation 1,831 feet S.), where it is 3 to 7 feet thick and contains shale partings of irregular thickness. The overlying rock is 15 feet of drab, fine-grained sandstone that needs little timbering in the rooms, and 30 feet of coarse massive sandstone shows in cuts below the coal.

There are comparatively few exposures on the east side of the river, but it may be safely assumed that the Kennedy is as irregular there as along the railroad. A drift half-a-mile south of Nora (location 145, elevation 1,580 feet B., fig. 15, section 145) shows coal 35 inches thick, separated from sandstone above and below by only a few inches of shale. A quarter of a mile north of Nora (location 146, elevation 1,572 feet S., fig. 15, section 146) there is a small mine in 3 to 5 feet of coal that is clear except for irregular sandstone lenses. An analysis of coal from this mine is given on page 196 of this report. A small mine at Stratton (location 147, elevation 1,530 feet H. L.) is in 2 to 3 feet of coal. The bed has also been utilized about a mile northwest (location 148, elevation 1,500 feet B.), where it is 25 inches thick. Beside the wagon road

near the mouth of Caney Creek (location 149, elevation 1,493 feet S., fig. 15, section 149) there is a small mine in coal 54 inches thick, exclusive of two 7-inch shale partings near the top. Caved drifts a short distance north indicate that the bed is as irregular here as in the tunnel on the opposite side of the river.

Lower Banner coal bed.—The Lower Banner is 80 to 170 feet below the Upper Banner. It is separated by a few feet of shale or clay from a moderately coarse sandstone underneath that is a fair marker. Its outcrop is less than 400 feet above the level of McClure River and extends a considerable distance up most of the tributaries. The coal is more regular in thickness and character than that in either the Kennedy or the Upper Banner bed; neverthless, it is far from uniform. The bed is 2 to 3 feet thick north of Open Fork and Hatchet Branch drainage basins. It is rather thin or split by a shale parting in most of the Open Fork basin, but contains an average of more than 3 feet of coal on the upper part of the main fork. There are 3 to 4 feet of coal in most places south and southeast of Blair and Hatchet branches; although the lower part of the bed is rather impure in the northern part of this area, there is here a large body of coal that will undoubtedly be mined in the near future.

The bed is poorly exposed in a stripping at water level on Spraddle Branch (location 150, elevation 1,760 feet B.) and is reported on unverifiable authority to be 2 to 3 feet thick.

On the tributaries and branches of Open Fork the value of the Lower Banner is impaired in many places by a shale parting near the middle. Near the head of the main fork, however, there are 3 to more than 4 feet of coal in one bench. The shale parting is 14 inches thick in a small mine on Rush Branch (location 151, elevation 1,800 feet B.), with 21 inches of coal above it and 13 inches below. The overlying rock is 10 feet or more of bluish shaly sandstone. Caved drifts on Spring and Middle forks do not indicate that the bed is very thick, and at one locality (location 152, elevation 1,965 feet B.) it contains only 11½ inches of coal with 2 inches of shale near the top. A partially filled strip-pit in the bed of Coon Branch (location 153, elevation 1,955 feet S.) and a road exposure nearly half-a-mile north indicate about 30 inches of coal. According to Stone this bench is separated by 2½ feet of shale from a lower bench of coal a foot thick. Northeast of this, on Open Fork (location 154, elevation 1,945 feet B., fig. 15, section 154), the Lower Banner is 3 feet thick and 140 feet below the Upper Banner outcrop. Nearly a mile south (location 155, elevation 1,970 feet B., fig. 15, section 155) another small mine is in

about 4 feet of coal with overlying sandy shale. The following measurements show the character of the bed farther south, the first having been made in a small mine at the mouth of Dismal Fork, and the second in a drift 40 feet below the Open Fork road:

Sections of Lower Banner coal bed near head of Open Fork.

(Location 156, elevation 1,950 feet B.)

	Ft.	in.
Sandstone.		
Coal	2	2
Shale		4
Coal		1½
Clay		1½
Coal		3
Shale		1½
Coal		7
Coal	3	1½
Partings		7

(Location 157, elevation 1,955 feet S., Fig. 15, Section 157.)

	Ft.	in.
Sandstone.		
Coal	2	7
Shale		3
Coal		3
Shale		2½
Coal		3
Shale		3
Coal	1	3
Coal	4	4
Partings		8½

Another small mine on Open Fork (location 158, elevation 1,960 feet B.) contains 32 inches of clear coal at the top and 27 inches of coal with several shale partings at the bottom. Less than a mile north (location 159, elevation 1,935 feet B.) there are 32 inches of coal in the bed. Northeast of this locality, on Long Branch of McClure River (location 160, elevation 1,930 feet B.), the coal is 34 inches thick. In the next hollow to the south (location 161, elevation 1,900 feet B., fig. 15, section 161) the bed is 41 inches thick, but with thin shale layers in the lower 8 inches. Underlying the coal bed is 6 feet of hard clay and the overlying rock is clay shale. A short distance south of this (location 162, elevation 1,910 feet B.) a small mine used by railroad contractors is in 32 inches of coal with rather soft clay underneath and sandstone above separated from the coal by over 2 inches of clay. The following sections show the character of the bed at the head of Trammel Branch:

Sections of Lower Banner coal bed at head of Trammel Branch.

(Location 163, elevation 2,136 feet S., Fig. 15, Section 163.)

	Ft.	in.
Sandstone.		
Shale	1	2
Coal, clear	3	9
Clay		3
Coal	3	9

(Location 164, elevation 2,145 feet B., Fig. 15, Section 164.)

	Ft.	in.
Shale	2	9
Coal	3	4
Shale		7
Coal, bony		8
Clay, soft		6
Coal	4	0
Partings		7

A small mine near the head of McClure River (location 165, elevation 2,075 feet B.) is in 45 inches of coal, with 6 inches more separated from its top by 26 inches of shale. A lower bench of 6 inches is reported to be separated from the main part of the bed by 4 inches of shale. The next exposure found east of the river, in going down the McClure, is at a small mine opposite Bear Hollow (location 166, fig. 15, section 166), where the bed is 37 inches thick. A small drift beside the Roaring Fork road (location 167, elevation 1,955 feet S., fig. 15, section 167) is in 3 feet of coal that is slightly bony at base with sandstone above. This thickness is less than the average of the Lower Banner on Roaring Fork and is also less than that of the same bed in the next hollow north (location 168, fig. 15, section 168), where there are 40 inches of coal separated from a sandstone roof by 3 inches of shale.

The following measurements were made on Hatchet Branch, the first in a small mine on the right fork and the second in a drift beside the wagon road on the left fork:

Sections of Lower Banner coal bed on Hatchet Branch.

(Location 169, elevation 1,905 feet B.)

	Ft.	in.
Sandstone.		
Shale, black		10
Coal, clean	2	1
Shale		½
Coal, rather dirty		7
Clay, hard.		
Coal	2	8
Parting		½

(Location 170, elevation 1,871 feet S.)

	Ft.	in.
Sandstone.		
Coal	1	11½
"Rash"	1	5
Clay.		
Coal	1	11½

The "rash" in the last section is composed of interlaminated layers of coal and shale, mixed and crumpled. The bed has the same section between the forks of Hatchet Branch, in a drift just 100 feet below an opening on the Upper Banner bed.

Coal 31 inches thick was measured in a small mine in the Lower Banner bed on the right fork of Buffalo Creek (location 171, elevation 1,760 feet H. L.), the overlying rock being a few inches of shale under sandstone and the underlying rock 8 feet of shale over sandstone. A slightly greater thickness is reported for a caved opening on the main fork of Buffalo Creek (location 172, elevation 1,700 feet B.). On Crooked Creek, however, in a drift beside the wagon road (location 173, elevation 1,744 feet H. L.), there are only 21 inches of coal overlain by a foot of shale under sandstone.

Upper Banner coal bed.—The outcrop of the Upper Banner is well up in the hills along McClure River and extends a considerable distance up

the chief tributaries. The bed is characterized by a very thin sandstone parting near the middle, and overlain by sandstone commonly separated from the coal by shale. North of Open Fork and Hatchet Branch little coal was found in this basin and blooms indicate that a thickening of the first shale partings above and below the thin sandstone layer has split the Upper Banner into three benches, neither of which is more than 2 or 3 feet thick. These partings are much thinner in much of the Open Fork drainage basin and on both sides of the upper part of the McClure, and there are in places five or six feet of coal in the bed. The value of this thick coal is greatly impaired in many places by partings that are sufficiently thick to make the ultimate recovery of all the coal doubtful. In the vicinity of Trammel Branch and the heads of McClure River and Roaring Fork, however, the Upper Banner is in splendid condition and is being utilized by the Clinchfield Coal Corporation. Mines 2 and 5 have already taken out most of the Upper Banner bed between Trammel Branch and the head of the McClure, and coal is being mined south of Knot Hollow Branch and hauled 1½ miles south under Sandy Ridge to the main mine mouths near Dante. The bed in these mines averages slightly more than 5 feet thick, with much of it 6 feet and some 7 feet, and sandstone and shale partings aggregate only a few inches in thickness. The main entry of mine 6 at Wilder is being driven southwest towards the head of Roaring Fork and the northeastern workings of mine 2, in coal averaging 6 feet thick.

If the following measurement, made in a small abandoned mine on Rush Branch of Open Fork, is of the Upper Banner, as appears probable, the bed is badly split by partings in this district. There is a possibility however, that the bed measured is the Splash Dam.

Section of Upper Banner (?) coal bed on Rush Branch.

(Location 174, elevation 1,973 feet C. C. C.)

	Ft.	in.
Sandstone, buff	4	
Shale, blue to black, in part carbonaceous	1	10
Coal	1	5
Sandstone, shaly	6	
Coal		2
Shale, very sandy at top		7
Coal		4
Shale		1
Coal		3
Shale	1	
Coal		5
Shale		4
Coal, bottom not seen	1	1+
Coal in lower bench	2	3+
Partings	2	0

Near the head of Spring Fork (location 175, elevation 2,071 feet C. C. C., fig. 15, section 175) the Upper Banner consists of 55 inches of coal with 1¼ inches of sandstone 15 inches from the top and shale overlying the coal bed. The bed is thicker on Middle Fork, as shown by the following measurements on its west side, the first being in a small mine 1½ miles from the mouth of the fork and the second near the mouth of Kilgore Branch of Middle Fork:

Sections of Upper Banner coal bed on Middle Fork.

(Location 176, elevation 2,052 feet C. C. C., Fig. 15, Section 176.)

	Ft.	in.
Sandstone	3	
Coal	1	5
Sandstone		1
Coal	1	5½
Clay		4
Coal	3	4
Coal	6	2½
Partings		5

(Location 177.)

Shale.	Ft.	in.
Coal		8
Shale		3½
Coal	1	5
Sandstone		1½
Coal	1	6½
Clay		3
Coal	1	1
Clay		7
Coal		6
Coal	5	2½
Partings	1	3

The first clay parting below the thin sandstone layer is thicker on Coon Branch. Stone cites a drift that is only approximately located on the map accompanying this report (location 178) and in which the thickness of the parting is reported to be 35 inches, the coal above it, 33 inches, and the coal below it, 41 inches. There is an inch of sandstone 15 inches below the top of the upper bench of coal. A drift below the wagon road farther south (location 179, elevation 2,053 feet S.) shows 35 inches of coal in what is probably the upper bench of the Upper Banner, and there is reported to be 41 inches more below, separated from it by 3 feet of shale.

The following section was measured near the head of Middle Fork a mile north of the southern boundary of Dickenson County:

(Location 180, elevation 2,170 feet B.)

	Ft.	in.
Sandstone	5	
Calcareous shale		9
Coal	1	½
Shale		½
Coal	1	2
Sandstone		1
Coal	2	11
Coal	5	1½
Partings		1½

The following sections were measured by the Clinchfield Coal Corporation near the head of Middle Fork of Open Fork:

(Location 181, elevation 2,100 feet, approx.)

	Ft.	in.
Shale	2	3⅝
Coal		9
Shale		1¼
Coal		⅞
Shale		⅝
Coal	1	4⅞
Sandstone		1¼
Coal	1	⅜
Shale		¼
Coal		7¼
Shale		2¾
Coal	1	⅜
Shale		7⅞
Coal		7⅞
Coal	5	6⅝
Partings	1	2

(Location 182, elevation 2,245 feet, approx.)

	Ft.	in.
Coal		1⅞
Shale		1⅞
Coal	1	11½
Sandstone		1¼
Coal	1	2½
Shale		¾
Coal		5½
Shale		8½
Coal		6
Coal	4	3⅜
Partings	1	⅜

(Location 183, elevation 2,255 feet, approx.)

	Ft.	in.
Shale		⅝
Coal		⅝
Shale		⅞
Coal	2	1¼
Sandstone		1¼
Coal	1	2½
Shale		⅝
Coal		5½
Rash		1¾
Coal		5½
Coal	4	3⅜
Partings		4½

The character of the bed near the head of the main branch of Open Fork is shown by the following measurements, the first in a small mine and the second in a prospect:

Sections of Upper Banner coal bed near head of Open Fork.

(Location 184, elevation 2,140 feet B., Fig. 15, Section 184.)

	Ft.	in.
Sandstone.		
Coal	1	4
Sandstone		1
Coal	1	4
Shale		7
Coal	1	10
Coal	4	6
Partings		8

(Location 185, elevation 2,100 feet B., Fig. 15, Section 185.)

	Ft.	in.
Sandstone.		
Coal		6
Shale		4
Coal		3
Clay		8
Coal	1	5
Sandstone		1
Coal		11
Shale		½
Coal	1	5
Clay		3
Coal		5
Clay		4
Coal		9
Coal	5	8
Partings	1	8½

The thickness of the Upper Banner in the mines near the head of McClure River has been mentioned and details of the bed are shown in the following sections. The first measurement was made in a small mine near the wagon road up Trammel Branch; the second was obtained between Kent Hollow Branch and McClure River, in the workings of mine No. 2 of the Clinchfield Coal Corporation:

Sections of Upper Banner coal bed near head of McClure River.

(Location 186.)

	Ft.	in.
Shale	6	
Coal	1	11½
Sandstone		1
Coal		7½
Clay		½
Coal	2	3
Coal	4	10
Partings		1½

	Ft.	in.
Sandstone.		
Coal	1	10
Sandstone		1½
Coal	1	2½
Sandstone		½
Coal	2	5
Coal	5	5½
Partings		2

The following measurements have been made by the Clinchfield Coal Corporation near the head of Open Fork:

Section of Upper Banner coal bed near the head of Open Fork.

(Location 187, elevation 2,220 feet, approx.)

	Ft.	in.
Coal	1	7¼
Sandstone		1¼
Coal	2	8¼
Coal	4	3½
Parting		1¼

Section of Upper Banner coal bed near the head of Open Fork.

(Location 188, elevation 2,266 feet.)

	Ft.	in.
Coal	1	6
Sandstone		1¼
Coal	2	1¼
Coal	3	7¼
Parting		1¼

Section of Upper Banner coal bed near the head of Open Fork.

(Location 189, elevation 2,105 feet, approx.)

	Ft.	in.
Coal	2	
Sandstone		1¼
Coal	1	9⅝
Coal	3	9⅝
Parting		1¼

The following measurements were made in No. 2 mine of the Clinchfield Coal Corporation at places, under Sandy Ridge, where samples of the coal were taken for analyses from the upper bench, the lower bench not being exposed. The first section was taken on the left side of the mine workings and the other on the extreme right.

Section of Upper Banner coal bed in Mine No. 2, Clinchfield Coal Corporation.

	Ft.	in.
Coal		1
Shale		2
Coal		2
Shale, sandy		5
Coal	1	4
Sandstone		1½
Coal	1	
Clay		1
Coal		5
Clay		1½
Coal	1	8
Clay		1
Coal	1	9
Coal	6	5
Partings	1	

An analysis of this coal is given on page 202.

Section of Upper Banner coal bed in Mine No. 2, Clinchfield Coal Corporation.

	Ft.	in.
Coal	1	7½
Sandstone		1
Coal	1	6
Clay		1
Coal		3
Clay		1
Coal	2	
Coal	5	4½
Partings		3

An analysis of this coal is given on page 202.

In places in No. 2 mine there is a lower bench of about 2 feet thickness separated from the main bed that is being worked, by 6 inches to 2 feet of shale.

The bed is thinner and more irregular on Roaring Fork, as indicated by the following sections:

Sections of Upper Banner coal bed on Roaring Fork.

(Location 190, elevation 2,110 feet B., Fig. 15, Section 190.)

	Ft.	in.
Coal	1	2
Sandstone		1
Coal	1	11
Coal	3	1
Parting		1

(Location 191, elevation 2,125 feet B., Fig. 15, Section 191.)

	Ft.	in.
Coal	2	8
Sandstone		1½
Coal		2
Shale		6
Coal		6
Coal	3	4
Partings		7½

A drift on Hatchet Branch (location 192, elevation 2,000 feet B.) shows only 27 inches in the Upper Banner bed, including 3 inches of clay 2 inches below the top of the coal. The overlying rock comprises 8 feet of drab shale and the underlying rock 18 inches or more of yellow clay.

Splash Dam and higher coal beds in Norton formation.—There are coal beds at 5 or 6 horizons in the Norton formation above the Upper Banner, but most of them are everywhere very thin and were laid down in rather small areas. The Splash Dam bed lies 30 to 90 feet above the Upper Banner and is separated from it chiefly by sandstone. The bed is thin in most places, but is known to contain 3 to 4 feet of coal in the southern part of the Open Fork drainage basin and is probably workable in a few

other areas where it has been thoroughly prospected. The Hagy bed, which is about 185 feet above the Upper Banner, was found to contain 24 to 30 inches of workable coal at two places.

There is a caved prospect in the Splash Dam bed just above the wagon road up Coon Branch of Open Fork (location 193, elevation 2,097 feet S.), 41 feet above the top of the Upper Banner. A road bloom near this indicates that the bed is about 5 feet thick, including, perhaps, one or two thin shale partings. A drift near the head of the main branch of Open Fork (location 194, elevation 2,190 feet B., fig. 15, section 194) is 50 feet above an opening in the Upper Banner and is in coal 51 inches thick. Farther down the fork (location 195, elevation 2,110 feet B.) the bed is about 4 feet thick, including two shale partings.

The following measurements of the Splash Dam bed have been made by the Clinchfield Coal Corporation, the first near the head of Middle Fork, the second near the head of Open Fork:

Section of Splash Dam coal bed near the head of Middle Fork.

(Location 196.)

	Ft.	in.
Coal	1	5/8
Shale		1/4
Coal	1	10 1/4
Fire clay		5/8
Coal		1 1/4
Coal	3	1/8
Partings		7/8

Section of Splash Dam coal bed near the head of Open Fork.

(Location 197, elevation 2,127 feet C. C. C.)

	Ft.	in.
Coal	2	8 7/8
Shale		7/8
Coal	1	7 1/4
Coal	4	4 1/8
Parting		7/8

The Hagy bed, which lies under a conglomeratic sandstone in this basin, contains 34 inches of coal on Low Gap Branch of Spring Fork (location 198, elevation 2,285 feet B.), but is split by 13 inches of shale 10 inches above the base. A partial exposure in the bed of a tributary of Buffalo

Creek (location 199, elevation 2,055 feet B.) shows 30 inches of coal at the top and 12 inches at the bottom, separated by an interval of 32 inches that may be in part coal.

Dorchester and Lyons coal beds.—The Dorchester and Lyons beds outcrop only close to the tops of the main ridges and, consequently, underlie only a small area. The Dorchester is 10 to 25 feet above the top of the thick Gladeville sandstone and in places is split into two beds 10 or 20 feet apart. The Lyons is about 50 feet higher and is not far below the base of a conspicuous white siliceous sandstone. The Lyons is poorly exposed and is commonly thin. The Dorchester has been utilized by people living on the ridges and appears in many natural exposures. It contains 2 to more than 3 feet of coal in many places, but several shale partings greatly impair its value. It is thickest in the southern part of the basin.

The Dorchester was reported to be 2 feet thick in post-holes near Big Oak School, north of Spraddle Branch, and 30 to 36 inches thick in pits near Smith School, south of the same stream. Shale partings were probably included in the thicknesses given. Many blooms were seen, but no reliable measurements were obtained in this district.

Two small mines on the ridge west of Spring Fork, the first near Leck and the second at the head of Low Gap Branch, show many irregular partings in the Dorchester:

Sections of Dorchester coal bed near Leck.

(Location 200, elevation 2,615 feet S.)

	Ft.	in.
Shale	2	
Coal		10
Clay	2	6
Coal	1	9
Clay		10
Coal		8
Coal	3	3
Partings	3	4

(Location 202, elevation 2,585 feet B.)

	Ft.	in.
Shale	15	
Coal		6½
Shale		½
Coal		5½
Shale		2½
Coal		8½
Rash		1
Coal		8
Clay		5¼
Coal		7½
Coal	3	0
Partings		9¼

The Dorchester contains 35 inches of coal and 4 inches of clay 11 inches below the top at a spring on the ridge between House and Low Gap branches (location 201, elevation 2,590 feet B.) The upper part is rather dirty and is overlain by the argillaceous shale that is characteristic of the

bed; friable reddish sandstone outcrops a few feet below the coal. A coal bed 30 feet above the one previously mentioned is said to be 2 feet thick on the ridge south of Low Gap Branch, and one of these two beds is reported, on apparently good authority, to have 4 feet of clear coal near the head of Spring Fork (location 203, elevation 2,580 feet B.). At Rasnake School, at the head of Coon Branch, shale partings that are very irregular in thickness may be seen in a small mine:

Section of Dorchester coal bed at head of Coon Branch.

(Location 204, elevation 2,550 feet B.)

	Ft.	in.
Shale.		
Coal	1	
Shale		8-12
Coal	1	3
Shale		18-24
Coal		6
Shale	12	
Coal		12-14
Coal	2	9
Partings	2	7±

Clear coal 38 inches thick was seen in a small mine near Smith School, on the ridge road west of McClure River (location 205, elevation 2,673 feet H. L., fig. 15), section 205). This bed may be a little higher stratigraphically than the one mined at Rasnake School. Measurements of the Dorchester bed made on Sandy Ridge just southwest of the county line show from 2 to 3 feet of coal with 1 to 3 shale partings each several inches in thickness.

There is sandstone a short distance above, as well as below, the Dorchester on Flat Spur and neighboring parts of Sandy Ridge. A small mine near the southern part of Flat Spur (location 206, elevation 2,798 feet H. L., fig. 15, section 206) shows 40 inches of coal in the bed, but with a parting of 11 inches of shale near the middle. Road blooms in the district show several thin coal beds in a distance of 100 feet above the Dorchester, but the Lyons bed is nowhere fully exposed. The Lyons is 30 inches thick in the Sandy Ridge road east of Roaring Fork (location 207, elevation 2,840 feet B.), but is only 13 inches thick half-a-mile north, near the school.

No complete exposures of the Dorchester or Lyons beds were seen on the ridge northwest of Flat Spur, but the former bed is reported to be 2 or 3 feet thick in a shallow well near the triangulation station at the

head of Hatchet Branch, and 12 to 18 inches thick on the divide between McClure River and Crooked Branch (location 208, elevation 2,320 feet B.).

Blair and Eagle coal beds.—The Blair coal lies a few feet above a ledge-making sandstone and about 120 feet above the base of the Wise formation. The Eagle is about 60 feet higher, beneath a more or less massive sandstone. These beds outcrop only on Flat Spur and a few of the highest parts of other ridges. The Clintwood coal was not found, though its horizon outcrops in a small area on the end of Flat Spur.

The Blair bed contains 20 inches of coal and 3 inches of shale on the northern part of Flat Spur (location 209). On the southern part of the spur there are 22 inches of coal split in the middle by a 9-inch shale parting.

The Eagle bed was measured at the head of Hollow Branch (location 210, elevation 2,830 feet B.), where there are at least 30 inches of coal in a lower bench and 6 inches more 3 feet higher. Overlying the coal bed are 22 inches of shale under a thick sandstone. The same measurements were obtained in an opening 500 feet to the north. There are at least 35 inches of coal in the Eagle bed on the east side of Flat Spur (location 211, elevation 2,870 feet B.). A small outlier of the same bed north of Roaring Fork (location 212, elevation 2,890 feet B., fig. 15, section 212) contains one bench of coal about 51 inches thick and another 18 inches thick, 8½ feet above the first.

LICK CREEK.

Geologic outline.—Rocks exposed in the drainage basin of Lick Creek of Russell Fork extend from about 180 feet below the Kennedy coal horizon to 250 feet above the base of the Wise formation. The Gladeville sandstone, however, appears only on the tops of high ridges and the Wise only on high knobs on the western and southern borders of the basin. Stratigraphic features are shown graphically in the generalized columnar sections for the southeastern and central parts of Dickenson County (Pl. XIII), the intervals being nearly the maximum shown in both sections. The graphic records of borings within the basin (Pls. IX and X) show the succession of rocks below the surface, and those of holes bored on the ridges farther south and southeast (Pls. IX and X) are applicable in a general way to the outcropping rocks of the basin. Local sections 13, 17, 19, 20, and 21 also show the stratigraphic succession, as well as general sections Ca and Cb. The structure except near the mouth of Lick Creek, where the proximity of a shear zone has caused minor complications, is simple and dips are, in general, northwest and north at about 50 feet per mile.

The Lick Creek basin contains a number of coal beds, but the only ones of special commercial importance are the Kennedy, Lower Banner, and Upper Banner. (See figs. 9, 10, and 16.) The Kennedy is as much as 5 feet thick in places, but is commonly much thinner. The Lower Banner is 2 to 3½ feet thick in the southern part of the basin and averages less elsewhere. The Upper Banner is the most important bed, especially on Beech Branch and neighboring parts of Lick Creek. The bed contains 4 to 6 feet of coal, but is split by shale partings into two or more parts except on Beech Branch and, possibly, under the ridges near Flint Gap School. The parts of the bed are so far apart in most places that they must be mined separately, and in places neither part is as much as 2 feet thick.

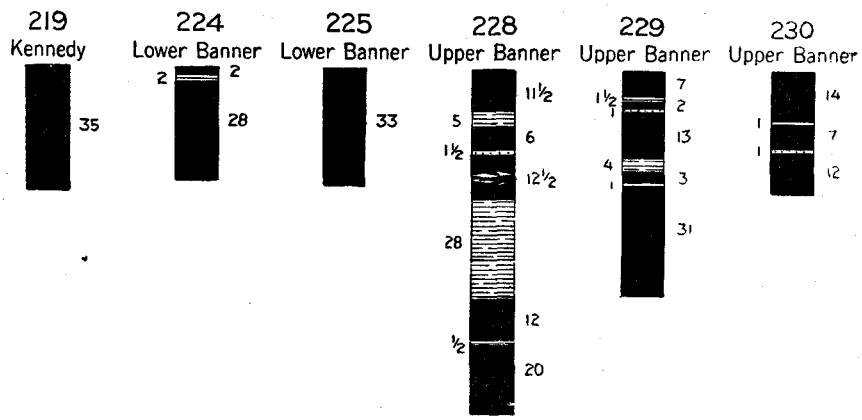


Fig. 16.—Sections of coal beds in the Lick Creek drainage basin.

Aily coal bed.—The lowest exposed coal bed in the basin is the Aily, which is about 90 feet below the Kennedy coal horizon and outcrops but little above the level of Lick Creek from near its mouth nearly to Josh Branch. As exposed in a drift at Aily (location 213, elevation 1,410 feet B.) it is 18 inches thick and rests upon sandstone. Overlying the coal bed in this district is a few feet of sandy shale containing fossil plants which is overlain by thick beds of sandstone. The Aily is 19 inches thick at the mouth of Hurricane Branch (location 214, elevation 1,320 feet B), where it has the same types of overlying and underlying beds.

Kennedy coal bed.—The Kennedy is 250 to 320 feet below the Upper Banner and outcrops low down in the valley of Lick Creek. In this basin as elsewhere west of Russell Fork and Indian Creek, the Kennedy is very irregular in thickness, ranging from a few inches to 5 feet or more. The

horizon of the bed is easily determined, as it lies only a few feet above a conspicuous coarse and massive sandstone and underlies shale and fine-grained sandstone of considerable thickness.

The Kennedy is reported a little more than 2 feet thick near the mouth of Lick Creek (location 215, elevation 1,405 feet B.). The bed is thicker farther south, for it is reported to be 4 feet thick at the mouth of the southern Linn Branch (location 216, elevation 1,575 feet B.) and 5 feet at the mouth of Cabin Creek (location 217, elevation 1,580 feet B.). The accuracy of these reports could not be verified. The following section was measured on Left Fork, half-a-mile from its mouth:

Section of Kennedy coal bed on Left Fork of Lick Creek.

(Location 218, elevation 1,480 feet B.)

	Ft.	in.
Coal		1
Shale		½
Coal	1	11
Shale		1
Coal		6
Coal	2	6
Partings		1½

The coal is 35 inches thick on Upper Hurricane Branch (location 219, elevation 1,485 feet H. L., fig. 16, section 219) and has a massive sandstone just beneath and fossiliferous shale immediately above.

Lower Banner coal bed.—The Lower Banner coal is 50 to 110 feet below the Upper Banner and outcrops in the valleys of Lick Creek and its tributaries from their mouths nearly to their heads. The bed has not been thoroughly prospected, but probably averages about 30 inches thick, being in general, 2 feet or less in the northern part of the drainage basin and 2 to 3½ feet in the southern part. The overlying rock is commonly a very sandy shale and there is sandstone a few feet below the coal.

The Lower Banner is at least 18 inches thick at Aily (location 220, elevation 1,690 feet B.), where all of the bed may not have been exposed. At the mouth of Wolfpen Branch (location 221, elevation 1,853 feet S.) the overlying rock is a very sandy shale and the coal is 28 inches thick and somewhat fractured and crushed. A stripping in 16 inches of coal near the head of Wolfpen Branch (location 222, elevation 1,930 feet B.) has not reached the bottom of the bed. The bed is reported to be 42 inches thick near the head of Long Branch (location 223, elevation 1,935 feet

B.); but this may not be accurate. Less than half-a-mile north, near Debusk (location 224, elevation 1,915 feet B., fig. 16, section 224), the bed is 32 inches thick, including 2 inches of shale 2 inches from the top. The Lower Banner consists of 33 inches of clear coal in an opening on Low Gap Branch (location 225, elevation 1,950 feet B., fig. 16, section 225.)

The only measurement of the bed obtained east of the lower part of Lick Creek is on Hurricane Branch (location 226, elevation 1,680 feet B.), where it is at least 19 inches thick and contains two very thin shale partings. It is possible that all of the bed was not seen at this place.

Upper Banner coal bed.—The outcrop of the Upper Banner is 300 to 500 feet above stream level along most of Lick Creek and extends up its tributaries nearly to their heads. The characteristics of the bed are much the same as on lower McClure River. On the upper part of Beech Branch the coal is 4 to 6 feet thick and contains only thin partings, being evidently part of the body of thick coal on Mill Creek and Squirrel Camp Branch of the McClure. At the mouth of Beech Branch, however, the partings thicken and the coal splits into two or three separate benches to both the north and south on Lick Creek. The distance between the two principal benches on the creek near Beech and Turkey branches and Aily is only a few feet and the lower bench is as much as 3 feet thick. About a mile south of Aily the two benches are 45 feet apart. Comparatively little is known about the Upper Banner in the southern and northeastern parts of the Lick Creek drainage basin, but there are indications that the bed is split into at least two distinct and rather thin benches in all of that territory except near Flint Gap School. The 1-inch sandstone parting that is characteristic of the Upper Banner is near the middle of the upper bench where the bed is split.

Coal in a drift on a spur east of the northern Linn Branch (location 227, elevation 1,710 feet B.) is said to be only 18 inches thick and is evidently in the lower bench of the Upper Banner, as massive sandstone shows just below it. As shown by the following two measurements, the parting between the two benches is only 28 inches thick on the spur west of Turkey Branch and is 4 inches thick near the head of Beech Branch. The upper part of the Beech Branch section was measured by Stone, and a 7-inch coal bench was found about 8 feet above the principal bed.

Sections of Upper Banner coal bed on Turkey and Beech branches.

(Location 228, elevation 1,763 feet C. C. C., Fig. 16, Section 228.)

	Ft.	in.
Shale	3	
Coal		11½
Shale, carbonaceous		5
Coal		6
Sandstone		1½
Coal, in part bony	1	½
Shale	2	4
Coal	1	
"Rash"		½
Coal	1	8
Coal	5	2
Partings	2	11

(Location 229, elevation 1,724 feet C. C. C., Fig. 16, Section 229.)

Sandstone.	Ft.	in.
Coal		7
Shale		1½
Coal		2
Sandstone		1
Coal	1	1
Clay		4
Coal		3
Clay		1
Coal (reported)	2	7
Coal	4	8
Partings		7½

An opening on Laurel Branch, west of Flint Gap School (location 230, elevation 1,960 feet B., fig. 16, section 230) shows 33 inches of coal, with an inch of shale 14 inches from the top and an inch of sandstone a foot from the bottom. The lower part of the Upper Banner, seen on Turkey and Beech branches, was not found here, though the parting between it and the upper part is only a foot thick a mile northeast, on Breeden Branch of Fryingpan Creek.

The Upper Banner is reported to be 43 inches thick near the mouth of Big Branch of Left Fork (location 231, elevation 1,820 feet B.), but the thickness of shale partings is not known.

Coal beds above the Upper Banner.—Coal was found at a number of places at horizons higher than that of the Upper Banner, but in nearly all cases it was too thin to be of even local importance. The Splash Dam bed, which is about 50 feet above the Upper Banner, is probably 2 or 3 feet thick in small areas, and one or more higher coal beds in the Norton formation may be in places 2 feet thick. The Dorchester and Lyons beds, near the base of the Wise formation, are poorly exposed and occupy only very small areas on some of the ridge tops. The Dorchester is reported to be 3 feet thick at a stripping on Wampler Ridge, at the head of Spring Branch (location 232, elevation 2,720 feet H. L.), and the overlying rock is a fossiliferous clay shale that is very soft at the base. In the road near this strip pit, the Lyons bed is 23 inches thick. The Blair and Eagle beds underlie only a few very small areas on the highest parts of the ridges and have not been prospected.

FRYINGPAN CREEK.

Geologic outline.—All of the Norton formation except the lower 150 feet is exposed in the Fryingpan Creek drainage basin, the Gladeville sandstone caps some of the highest ridges, and 250 feet of the Wise formation still remain on part of Wampler Ridge. The stratigraphic character of the rocks both above and below drainage is shown graphically by the generalized columnar sections for the southeastern and central parts of Dickenson County (Pl. XIII), by the logs of numerous borings in the southeastern part of the County (Pls. IX and X), and by general sections Cb, Ce, and Cf. Exposed rocks are also shown in local sections 14, 16, and 21. There is a general thinning of strata to the north, though the sandstone overlying the Upper Banner coal bed thickens slightly in that direction.

The direction of the dip is, in general, northwest at 50 to 250 feet per mile, but in part of the basin the dip is nearly due west and in another part due north. North of Bucu, moreover, there is a small dome, so that some dips in that district are to the south and east. In a small area near Priest Fork and neighboring parts of Fryingpan Creek, there are in places steep and irregular dips caused by buckling and shearing, associated with the Russell Fork fault. It is almost certain that all the exposed rocks in this area are of Norton age, but no attempt has been made to define the position of coal outcrops and structure contours on the map.

Very little coal was found in the northern part of the basin and it is not likely that many beds more than 2 or 3 feet thick are present. The Kennedy is locally thick, but is thin in most places. In the west-central and southern parts of the basin, however, there is thick coal in parts of the Tiller and Jawbone, Raven, Lower Banner, and Upper Banner beds, as well as coal about 4 feet thick in an outlier of the Eagle bed that is too small in area to be of commercial significance. (See figs. 9, 10, and 17.) The Tiller and Jawbone coals, which are so close together that they are practically one bed, contain 4 to 6 feet of slightly impure coal where they are exposed on Fryingpan Creek near Bucu. The united beds probably also form a thick mass in the region east and southeast of Bucu, where they are below drainage levels. The Raven bed is less than 30 inches thick in most places, but is as much as 4½ feet thick a short distance south and southeast of Bucu. The Lower Banner is a clear bed 2 to 4 feet thick between Lick Branch and Sandy Ridge. The Upper Banner includes 3 to 7 feet of recoverable coal between Breeden and Hardin branches and in the district east of Fryingpan Creek and south of Lick

Branch. Elsewhere the thickening of a shale parting is thought to separate the bed into two parts, though it is possible that more extensive prospecting may increase the known acreage of thick coal.

Tiller and Jawbone coal beds.—The Tiller and Jawbone beds lie 750 to 825 feet below the Upper Banner horizon, and are only a few inches apart where they are exposed on Fryingpan Creek between Hardin and Lick branches. There is a thin sandstone stratum a few feet above the coal, separated from it by shale, and a siliceous conglomeratic sandstone a few feet below it. The coal is 4 to 6 feet thick where openings were found, but is rather impure and commonly contains a thick parting of shale mixed with coal ("rash").

The bed has been utilized at several openings at Bucu. In a small mine on the west side of the creek (location 233, elevation 1,522 feet S.) there are 42 inches of coal that is somewhat bony in the middle, overlain by 10 feet of shale, and underlain by at least 24 inches of coal and clay mixed and interfoliated, and with slickensided surfaces. That all of the bed is not exposed is indicated by the following section, measured in another small mine a short distance south:

Section of Tiller and Jawbone coal beds at Bucu.

(Location 234, elevation 1,496 feet S., Fig. 17, Section 234.)

	Ft.	in.
Shale, yellowish-gray, argillaceous	1	
Coal	3	9
Shale, in part mixed with coal, irregularly foliated along curved surfaces	2	9
Coal, not well exposed	2	
Coal	5	9
Parting	2	9

The upper bench of coal, 45 inches thick, is mined on a small scale in front of the store at Bucu (location 235, elevation 1,525 feet H. L.). Near the wagon road, a little more than half-a-mile north of Bucu (location 236, elevation 1,565 feet B.), the coal is 40 inches thick and all except the upper 10 inches is foliated and slickensided. The roof is 4 feet of thin-bedded sandstone. The coal is reported to be about the same thickness half-a-mile down the creek and a thick coal bloom shows in the road.

A bed that lies 25 to 60 feet above the Tiller and Jawbone commonly contains less than 30 inches of coal in this basin and is less than a foot thick in many places. Half-a-mile west of the mouth of Priest Fork

(location 237, elevation 1,390 feet B.) this bed is 21 inches thick, but is split by shale a short distance down the creek into two parts. An exposure at stream level at the mouth of Hardin Branch (location 238, elevation 1,425 feet B.) contains 17 inches of coal under 50 feet of thin-bedded sandstone and sandy shale. At Bucu the coal is about 20 inches thick and 25 feet above the Tiller and Jawbone beds.

Raven and associated coal beds.—The Raven bed is 110 to 200 feet above the Jawbone horizon and is thin in most places. It contains 24 to 30 inches of coal in places in the northern part of the basin and 2 to 4½ feet on Lick Branch and neighboring parts of Fryingpan Creek; elsewhere it is thin and commercially unimportant. There is also coal at four or five horizons between the Raven and Kennedy beds, but no exposure of more

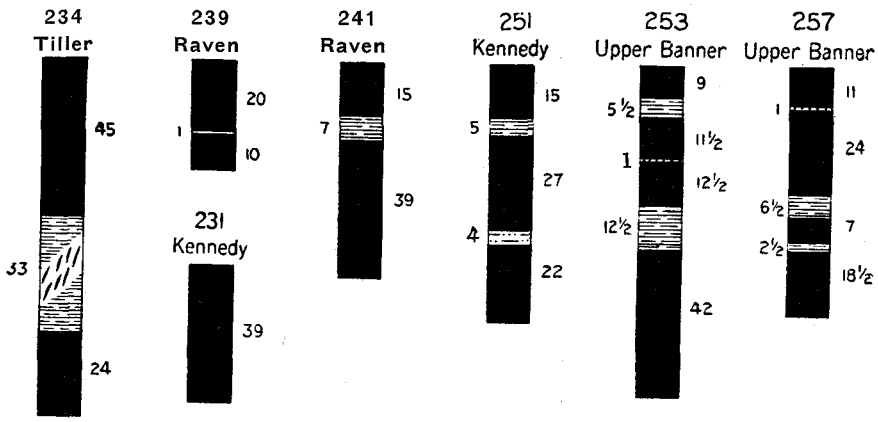


Fig. 17.—Sections of coal beds in the Fryingpan Creek drainage basin.

than 2 feet of coal was seen and it is probable that these beds are everywhere thin. There are no reliable stratigraphic markers in this part of the section, so that the identification of the Raven is difficult and in places may be in error.

The Raven bed is 31 inches thick, including an inch of shale in its lower half, at a small mine near Bucu (location 239, elevation 1,640 feet B., fig. 17, section 239), with a thin-bedded sandstone overlying the coal. On the opposite or south side of Cabin Branch the bed is 15 feet lower and there is a foot of coal 6 feet above the thicker bench. An exposure of 27 inches of coal with a dark blue shale overlying the bed near steam level at Lick Branch School (location 240, elevation 1,650 feet B.) may be the Raven, but is probably a bed a short distance above

it. A small mine above the road near the mouth of Lick Branch (location 241, elevation 1,613 feet S., fig. 17, section 241) is certainly in the Raven bed. The overlying rock is sandstone and the bed contains 54 inches of coal with a 7-inch shale parting 15 inches from the top. The Raven appears to be in two benches about 30 feet apart farther south, and the upper bench is reported to be about 3 feet thick in a stream cut at the mouth of Breeden Branch (location 242, elevation 1,403 feet H. L.).

Coal 16 inches thick is exposed at the level of a small tributary of Priest Fork (location 243, elevation 1,340 feet B.). The irregular laminae of the coal have slickensided surfaces caused by movement along the bed, and the irregular dips of strata in the vicinity make it uncertain whether this is the Raven or one of the higher beds. The same features characterize an exposure beside the path on Priest Fork (location 244, elevation 1,400 feet B.), where the coal is 22 inches thick. Farther up Priest Fork (location 245, elevation 1,455 feet B.) an opening in what is probably the upper bench of the Raven bed shows 22 inches of coal split in the middle by 5 inches of shale and dipping 2° west of south. Both benches are exposed opposite a house half-a-mile southeast of the last mentioned locality, as follows:

Section of Raven coal bed on Priest Fork.

(Location 246, elevation 1,510 feet B.)

	Ft.	in.
Shale, blue to dark drab, with coal streak near base	5	6
Coal		9
Clay and coal, mixed		2½
Coal	1	1½
Concealed	13	
Sandstone, medium-grained	5	
Coal bloom		
Coal	1	10½
Partings		2½

One of the beds between the Raven and Kennedy horizons is 19 inches thick where exposed in the bottom of a small hollow near Abners Gap (location 247, elevation 1,560 feet B.). Coal 16 inches thick may be seen by the road near the forks of Priest Fork, but the irregular dips of strata in the vicinity make its correlation doubtful.

Kennedy coal bed.—The Kennedy lies 280 to 380 feet below the Upper Banner horizon, the distance decreasing to the north. It has not been prospected much in this basin, so that its thickness is not well known. Its character in neighboring basins suggests that it is irregular in thickness,

being generally thin, but in places thickening to a bed of workable proportions. It contains 64 inches of coal at one place, as described below.

The Kennedy appears to be about 3 feet thick in a caved drift on Rock Lick Branch (location 248, elevation 1,540 feet B.). There are 39 inches of clear coal with sandstone immediately above and below the bed in a small mine near the mouth of Breeden Branch (location 249, elevation 1,655 feet B.). Near the head of Fryingpan Creek (location 250, elevation 1,950 feet B.) the bed is only 15 inches thick, but it is much thicker in at least one place in the northern part of the basin, as shown in the following section:

Section of Kennedy coal bed 1 mile southwest of the mouth of Priest Fork.

(Location 251, elevation 1,570 feet B., Fig. 17, Section 251.)

	Ft.	in.
Sandstone.		
Coal	1	3
Shale		5
Coal	2	3
Shale and fine-grained sandstone		4
Coal	1	10
Sandstone.		
Coal	5	4
Partings		9

Lower Banner coal bed.—The Lower Banner lies about 100 feet below the Upper Banner. No complete measurements were obtained, but the bed is reported to be nearly free from shale partings and to contain 2 to 4 feet of coal in the southern part of the basin, near Sandy Ridge and as far north as Lick Branch. A thickness of 34 inches of clear coal measured above the wagon road at the head of Fryingpan Creek (location 252, elevation 2,220 feet B.) is below rather than above the average for this district. North of Lick Branch the bed is probably thinner in most places and may be absent in part of the district between lower Fryingpan Creek and Russell Fork.

Upper Banner coal bed.—The Upper Banner lies only a few hundred feet below the tops of the higher ridges in this basin, and is a thick and important bed in two districts, where it includes 3 to 7 feet of coal, the characteristic very thin sandstone parting, and two or more shale partings commonly aggregating less than 1 foot in thickness. One of these districts, as now known, lies between the heads of Breeden and Hardin branches and will probably be shown by additional prospecting to extend somewhat farther north and south. The other district is in the area east of the upper part of Fryingpan Creek and south of Lick Branch. Outside these districts the principal shale parting below the thin sandstone layer thickens

and separates the bed into two benches, each containing less than 3 feet of coal. Nothing is known about the condition of the bed east of Frying-pan Creek and north of Lick Branch, but it is probable that it is split into two benches in nearly all of the basin and that both benches thin to the north.

The most southern measurement was obtained in a drift below the wagon road on the upper part of Breeden Branch, and is as follows:

Section of Upper Banner coal bed on Breeden Branch.

(Location 253, elevation 1,925 feet B., Fig. 17, Section 253.)

	Ft.	in.
Shale, sandy	2	
Coal		9
Clay, carbonaceous		5½
Coal		11½
Sandstone, carbonaceous		1
Coal	1	½
Shale	1	½
Coal	3	6
Coal	6	3
Partings	1	7

The partings are thinner at the head of Hardin Branch, where the total bed is reported to be 6 or 7 feet thick at two caved prospects (locations 254 and 255, elevation 1,990 feet B.), lying under a massive sandstone 35 to 50 feet thick. The following two measurements in the same locality are cited by Stone:

Sections of Upper Banner coal bed on Hardin Branch.

	Ft.	in.
Shale, under sandstone		6
Coal		11
Clay		½
Coal		10
Sandstone		1¼
Coal	1	5
Clay		6
Coal (seen)	2	6
Coal	5	8
Partings		7¾

	Ft.	in.
Shale		4
Coal		9
Coal, laminated		½
Coal		9
Sandstone		1½
Coal	1	
Coal, laminated		4
Shale		10
Coal	1	5
Shale		1
Coal	1	6
Coal	5	9½
Partings	1	½

The following two sections show the character of the bed in the district south of Lick Branch. The first section is cited from Stone's report and

the location is only approximate; the second is from an opening on a spur southeast of the mouth of Lick Branch. Other measurements are given in the description of the Upper Banner in the Indian Creek drainage basin.

Sections of Upper Banner coal bed south of Lick Branch.

(Location 256, elevation 2,340 feet ?)

	Ft.	in.
Shale, under sandstone		8
Coal		8
Sandstone		1
Coal	1	7
Clay and coal	1	
Coal	1	5
Shale		3
Coal	1	3
Coal	4	11
Partings	1	4

(Location 257, elevation 2,310 feet B., Fig. 17, Section 257.)

Sandstone.	Ft.	in.
Coal		11
Sandstone		1
Coal	2	
Clay		6½
Coal		7
Shale		2½
Coal	1	6½
Coal	5	½
Partings		10

Splash Dam and higher coal beds.—There is coal at a number of horizons above the Upper Banner, but only one complete measurement of any of them was obtained in this basin. It is probable that the beds in the Norton formation above the Upper Banner are less than 3 feet thick everywhere, and less than 2 feet nearly everywhere. The Dorchester, Lyons, and Eagle coal beds, in the Wise formation, occupy small areas on Wampler Ridge and measurements of them have been given in the description of coal in the Lick Creek and upper McClure River drainage basins.

The Splash Dam bed was measured at one place, at the head of Hardin Branch (location 258, elevation 2,200 feet B.), where it is 23 inches thick and has a thin band of sandstone near the middle. The sandstone is much like that in the upper part of the Upper Banner bed, but the stratigrahic relations and topographic position of this exposure indicate that it is the Splash Dam bed and not the Upper Banner bed.

INDIAN CREEK.

Geologic outline.—Only the western half of the Indian Creek drainage basin lies within Dickenson County. The rocks exposed in this part of the drainage basin include the upper 100 feet of the Lee formation, all of the Norton formation, and the lower 250 feet of the Wise formation. The upper part of the Lee appears only in the Left Fork of Cane Creek, however it is more fully exposed just east of the county boundary in Indian Creek. The Gladeville and Wise were found only in small outliers on the

high ridges on the southwest. The stratigraphic succession is indicated by generalized sections on Plate XIII, by local sections 14, 15, and 16, by drill records (Pl. X), and by general sections Ce and Cf.

The dominant structural feature of the basin is the Sourwood Mountain anticline, an elongated dome, the axis of which lies just east of the county boundary for the greater part of its length. It has rather steep sides and comparatively flat top. The western flank of the anticline lies largely in Dickenson County and the beds dip to the northwest and north at 80 to 400 feet per mile. Rocks of Norton age at the mouth of Indian Creek dip steeply in places and have been buckled and sheared by the Russell Fork fault.

The Indian Creek drainage basin contains exceptionally thick coal in parts of the Tiller, Jawbone, and Upper Banner beds, and important beds at other horizons. (See figs. 10 and 18.) In the southern and central parts of the basin the Tiller and Jawbone are so close together that they could be mined as one bed containing 7 to 15 feet of coal and underlying a large area. The upper or Jawbone part of the combined beds contains several shale partings and is impure in places, but even the lower or Tiller part alone is an attractive mining proposition. In the northern part of the basin the Tiller and Jawbone are separated by 70 feet or less of shale and sandstone, both beds being thinner than in the districts where they are united. Where the beds are separated the Tiller is the cleaner and thicker, being especially good on part of Lambert Fork and under the ridges north and south of it.

The Upper Banner contains about 5½ feet of excellent coal on Long Ridge, near the head of Cane Creek, and its shale partings are not so thick as to be seriously detrimental. In most other districts the Upper Banner is separated into two parts by an increase in the thickness of one of its partings.

Coal less than 3 feet thick is common at a number of horizons and in many places. Coal beds that are locally 3 to 4 feet thick are the Raven near Sandy Ridge, and the Lower Banner near upper Cane Creek.

Coal beds lower than the Tiller.—In addition to several thin and unimportant coal beds in the basal part of the Norton formation, there is a fairly persistent bed 30 to 60 feet below the top of the Lee formation. This bed is 28 inches thick in a hollow near the mouth of Lambert Fork, half-a-mile east of the county line, and at least 30 inches thick half-a-mile north.

Tiller and Jawbone coal beds.—The Tiller lies 800 to 880 feet below the Upper Banner horizon and outcrops low down in all the principal valleys. Along Cane Creek and its tributaries and the upper part of Indian Creek it combines with the Jawbone coal to form a remarkable bed containing 5 to 15 feet of coal. The upper or Jawbone part of the combined beds contains several layers of shale and other impurities and in some

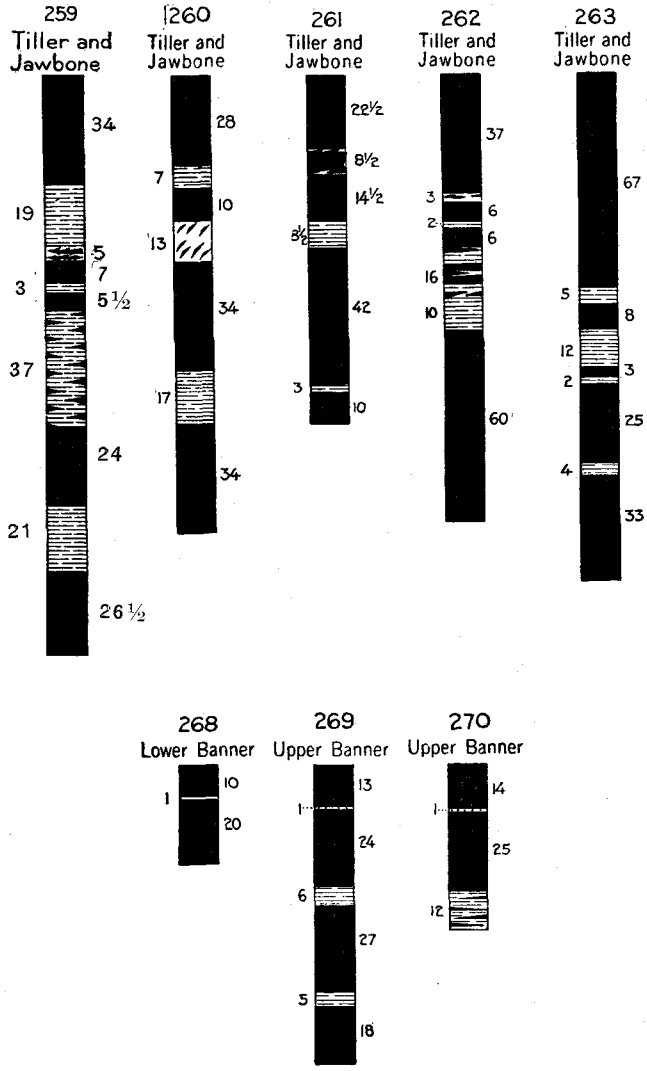


Fig. 18.—Sections of coal beds in the Indian Creek drainage basin.

localities could not be profitably mined. There are also layers of "rash," or crushed flaky coal, mixed with more or less shale. Some of the "rash" might be utilized for certain purposes, but most of it is simply waste that would give much trouble in mining. Along lower Indian Creek the two beds are too far apart to be mined as one.

The first of the following measurements is a slight modification of one cited by Stone as made in a small mine, now caved, near the forks of Cane Creek. North of this opening the coal separates into two or more thin beds. The second measurement was made at one of two openings a short distance west of the first.

Sections of Tiller and Jawbone coal beds about 1 mile southwest of Duty.

(Location 259, elevation 1,600 feet B., Fig. 18, Section 259.)

Shale, under sandstone	Ft.	in.
Coal	2	10
Shale	1	7
Bone		5
Coal		7
Shale		3
Coal		5½
Shale and coal	3	1
Coal	2	
Shale	1	9
Coal	2	2½
Coal	8	1
Partings	7	1

(Location 260, elevation 1,565 feet B., Fig. 18, Section 260.)

Sandstone.	Ft.	in.
Coal	2	4
Shale		7
Coal		10
"Rash"	1	1
Coal	2	10
Shale	1	5
Coal	2	10
Coal	8	10
Partings	3	1

Partings are less detrimental to the value of the beds south of the openings just described. The following measurements were made at small strip pits; the first at the level of Cane Creek and the second near the mouth of Middle Fork. Two openings on the south side of Cane Creek, near these strip pits, are also in 8 or 9 feet of coal with shale partings aggregating 10 to 20 inches. The sections in these openings are as follows:

Sections of Tiller and Jawbone coal beds near forks of Cane Creek.

(Location 261, elevation 1,599 feet S., Fig. 18, Section 261.)

	Ft.	in.
Shale	3	
Coal	1	10½
Coal, bony in part		8½
Coal	1	2½
Shale		8½
Coal	3	6
Shale		3
Coal		10
Coal	8	1½
Partings		11½

(Location 262, elevation 1,760 feet B., Fig. 18, Section 262.)

Shale.	Ft.	in.
Coal	3	1
Bone		3
Coal		6
Shale		2
Coal		6
Bone, shale, and coal	1	4
Shale		10
Coal	5	
Coal	9	1
Partings	2	7

The coal is at its best on the upper parts of Middle and Left Forks of Cane Creek, the following measurement, made at a strip pit less than a mile north of Kiser Gap, being typical:

Section of Tiller and Jawbone coal beds two and one-half miles south of Duty.

(Location 263, elevation 1,790 feet B., Fig. 18, Section 263.)

	Ft.	in.
Sandstone.		
Coal	5	7
Shale		5
Coal		8
Shale	1	
Coal		3
Shale		2
Coal	2	1
Shale		4
Coal	2	9
Coal	11	4
Partings	1	11

The coal is exceptionally thick along most of Cane Gap Creek and John Fork. The proportion of shale in the Jawbone member of the bed is greater near the mouths of those streams, however, and the two members are rather widely separated by shale and sandstone farther south on Indian Creek. The first of the following measurements was made near the head of John Fork one-eighth of a mile east of the county line, and the second opposite the mouth of that stream, one-half mile east of the county line:

Sections of Tiller and Jawbone coal beds on John Fork of Indian Creek.

	Ft.	in.
Sandstone.		
Coal	3	3
Sandstone		10
Coal	2	
Sandstone	1	8
Coal		5
Shale and coal		4
Coal		2
"Rash"	2	
Coal	2	1
Shale		2
Coal	2	10
Coal	10	9
Partings	5	0

	Ft.	in.
Shale	7	
Coal		8
Shale	1	10
Coal	1	
Shale	2	9
Coal	2	3
Shale		½
Coal		3½
Shale		1½
Coal	3	1
Coal	7	3½
Partings	4	9

On the Lower Indian Creek the Tiller is probably less than 32 inches thick.

No measurement of the entire Jawbone bed was obtained on lower Indian Creek except in the Indian Creek road near the mouth of Sullivan Branch, where the coal is 29 inches thick. Blooms and caved pits do not indicate that the Jawbone is very thick where separated from the Tiller.

Raven and associated coal beds.—The Raven coal bed lies about 190 feet above the Tiller and 650 feet below the Upper Banner coal horizon. In the northern part of the basin it is in most places only 1 or 2 feet thick, but in the southern part, near Sandy Ridge, it commonly contains 3 to 4 feet of coal with thin shale partings in its middle. The bed has been thoroughly prospected, but most of the prospects are caved and are difficult to find because of the position of most of the outcrop on wooded slopes 200 to 400 feet above the streams. One drift near the head of Middle Fork of Cane Creek (location 264, elevation 1,955 feet B.), in the area where the bed is thickest, is reported to be in about 4 feet of coal with a very thin shale parting in the middle.

There are several coal beds between the Raven and the Kennedy, but nearly everywhere they are less than 2 feet thick. One persistent bed is 30 to 50 feet above the Raven and another about 150 feet above the same horizon. It may be the latter bed that is 24 inches thick on the road near the mouth of Indian Creek (location 265, elevation 1,495 feet H. L.), but steep dips a short distance north make correlations uncertain. Coal 28 inches thick near the head of Cane Creek (location 266, elevation 1,920 feet B.) is 143 feet above the Raven bed in a neighboring boring, (Pl. X, log C20), and coal of the same thickness near Cane Gap (location 267, elevation 2,280 feet B.) is at the same stratigraphic horizon. The last measurement was made in a small mine, in which the overlying rock is 8 inches of drab shale under sandstone.

Kennedy coal bed.—The Kennedy lies 300 to 350 feet below the Upper Banner bed and outcrops high in the hills in most of this basin. In the southern part it is only 12 to 24 inches thick, a typical section being at an opening near Cane Creek, 1¾ miles southwest of Duty, where 21 inches of coal are overlain by drab sandy shale and a coarse sandstone forms a ledge a few feet below.

Lower Banner coal bed.—The Lower Banner lies about 100 feet below the Upper Banner and outcrops only high on the ridges. West and south of the upper part of Cane Creek the bed averages between 3 and 3½ feet thick; elsewhere it is thinner. Near the head of Sullivan Branch (location 268, elevation 2,190 feet B., fig. 18, section 268) the bed is 31 inches thick, including an inch of shale 10 inches from the top.

Upper Banner coal bed.—The Upper Banner is an important coal bed in part of the basin and outcrops high on the ridges on the western side of Indian Creek and its tributaries in Dickenson County. Under the divide west of the head of Cane Creek the Upper Banner contains an average thickness of 5½ feet of coal, with the characteristic sandstone parting in the upper part and two thicker shale partings in the lower part. Very little is known about the condition of the Upper Banner northwest of the lower part of Cane Creek and west of lower Indian Creek, but the lack of exposures or openings showing thick coal indicates that the bed thins to the north.

The following two sections show the details of the Upper Banner in small mines near the head of Cane Creek. The first measurement was made near the triangulation station on Long Ridge, and the second, which evidently does not include the lower 3 or 4 feet of the bed, at Smith Gap:

Sections of Upper Banner coal bed near head of Cane Creek.

(Location 269, elevation 2,369 feet C. C. C., Fig. 18, Section 269.)

	Ft.	in.
Sandstone.		
Coal	1	1
Sandstone		1
Coal	2	
Shale		6
Coal	2	3
Shale		5
Coal	1	6
Coal	6	10
Partings	1	

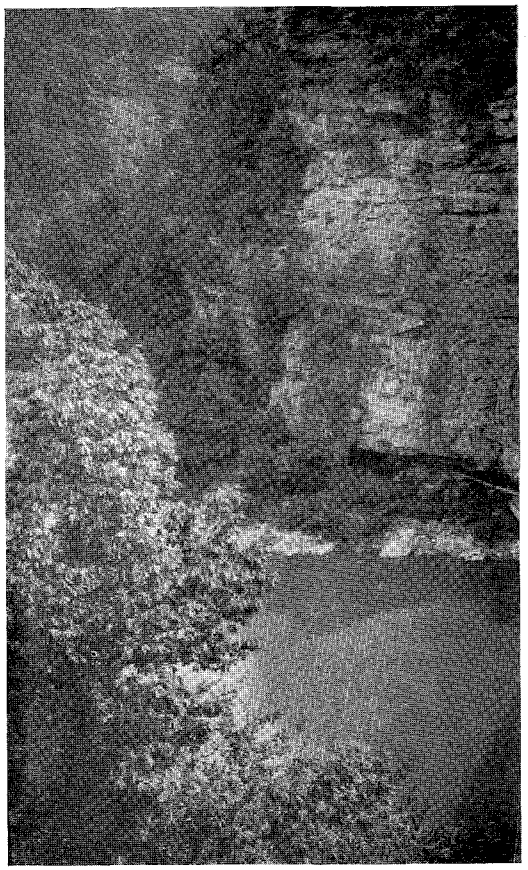
(Location 270, elevation 2,405 feet B., Fig. 18, Section 270.)

	Ft.	in.
Shale.		
Coal	1	2
Sandstone		1
Coal	2	1
Shale and coal	1	
Coal	3	3
Parting		1

Splash Dam and higher coal beds.—There is undoubtedly some coal at several horizons above the Upper Banner, especially in the Splash Dam bed, but no measurements were obtained of entire beds and no thick blooms were seen.

RUSSELL FORK AND SMALL TRIBUTARIES NORTHWEST OF INDIAN CREEK.

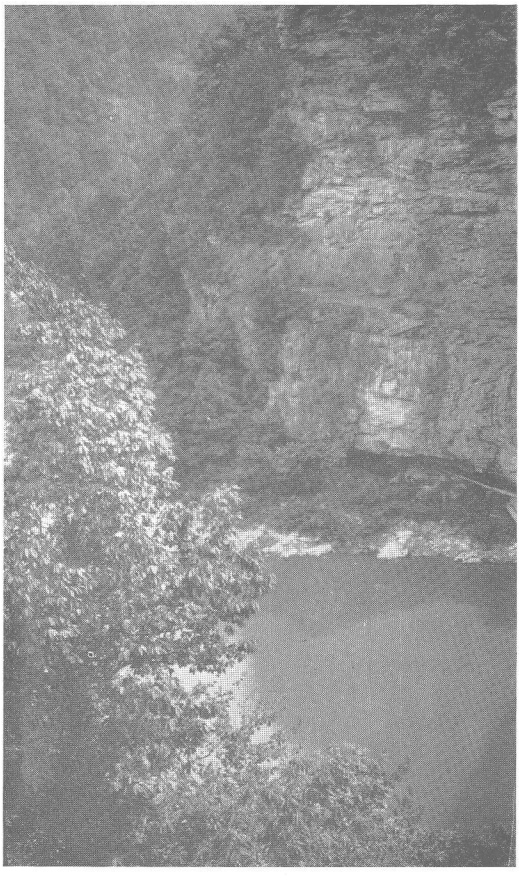
Geologic outline.—The area to be considered under this heading includes only the valley of Russell Fork below Indian Creek and the drainage basins of small tributaries not described elsewhere, and is, therefore, a long, narrow strip extending only a short distance back from the river. Rocks exposed include a large section of the Lee formation in The Breaks of Sandy, the Norton formation, the Gladeville sandstone, and the lower 425 feet of the Wise formation. The section of the Lee in The Breaks is nearly complete and is the finest exposure of the rocks of that age in Dickenson



(A) Stream and canyon wall in the Lee formation in The Breaks of Sandy.

(B) View showing the height of the canyon walls in The Breaks of Sandy. The pinnacle at the top is 950 feet above the river.

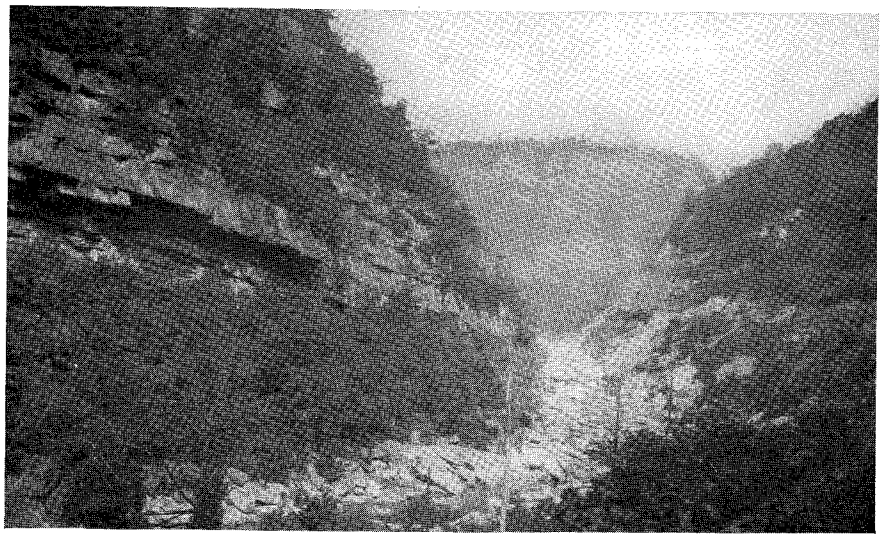
PLATE XVII.—VIEWS IN THE BREAKS OF SANDY.



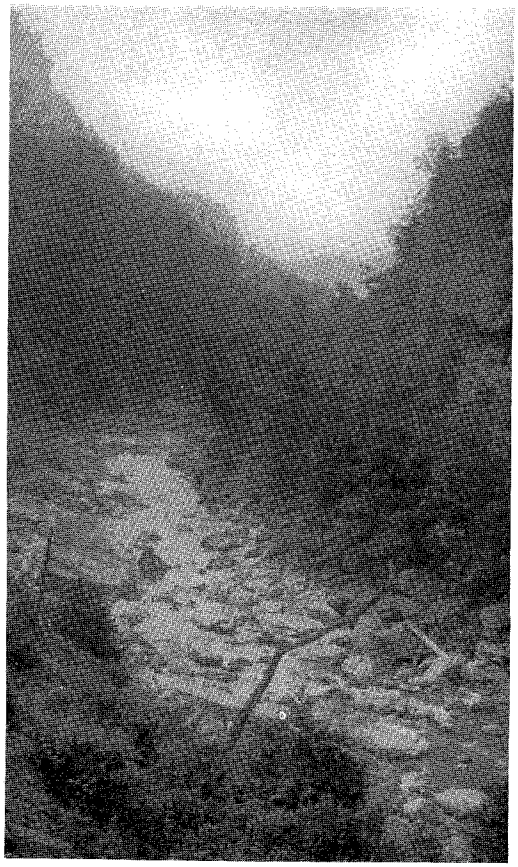
(A) Stream and canyon wall in the Lee formation in The Breaks of Sandy.

(B) View showing the height of the canyon walls in The Breaks of Sandy. The pinnacle at the top is 950 feet above the river.

PLATE XVII.—VIEWS IN THE BREAKS OF SANDY.



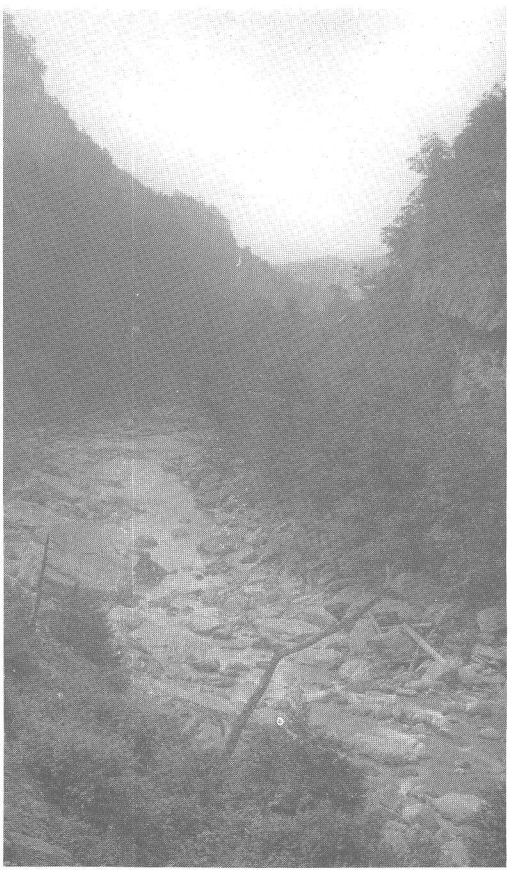
(A) Looking south up Big Sandy River in The Breaks of Sandy.



(B) Looking down Big Sandy River in The Breaks of Sandy.

PLATE XVIII.—VIEWS IN THE BREAKS OF SANDY.

(A) Looking south up Big Sandy River in The Breaks of Sandy.



(B) Looking down Big Sandy River in The Breaks of Sandy.

PLATE XVIII.—VIEWS IN THE BREAKS OF SANDY.

County. The strata mapped as undifferentiated Pennsylvanian include chiefly rocks belonging to the part of the Norton formation that is above the Raven coal horizon, with a few Wise and Gladeville beds in the district north of McClure River. Strata mapped as Gladeville and Wise occur only near the tops of a few ridges. The stratigraphic succession is shown by the generalized columnar section for the northeastern and central parts of the county (Pl. XIII), by logs of borings in the valley of Russell Fork (Pls. IX and X), by local sections 21 and 22, and by general sections Cb, Cc, Cd, and Cf.

The structure of a large part of the area is complicated by the Russell Fork fault. Beds not mapped as undifferentiated dip, in general, to the northwest and north at very low angles as far north as the axis of the Middlesboro syncline near Pound River. North of the axis they dip to the southeast. North of the Pine Mountain anticline the beds dip steeply east and northeast.

Beds northwest of Sand Lick and the mouth of Lick Creek, mapped as undifferentiated, dip chiefly northeast at high angles, though there are places where there are dips in other directions at all angles up to 90 degrees. The apparent structure in places is that of a monocline dipping steeply to the northeast, but this feature is really subordinate to shearing and buckling along one or more faults parallel to the long axis of the area. This is explained more fully on pages 57-63. This area of deformation is associated with the Russell Fork fault which has already been described.

The structure of the beds mapped as undifferentiated along Russell Fork on the eastern side of the county is even more obscure. The beds are nearly level in some places, but in others dip irregularly in different directions. Strata on the southwest have been moved northwest past those on the northeast along a vertical or very steep fault plane and have been more or less buckled and folded during the process.

The area has only a few thick coal beds. (See fig. 19.) Coal beds included among the rocks mapped as undifferentiated Pennsylvanian are nearly all thin and are commonly crushed and fractured so that probably they could not be mined with profit. Beds below the Kennedy horizon are exposed in small areas only and are less than 2 feet thick. The Lee coals are thin, only two blooms being seen in The Breaks and each of these is less than 2 feet in thickness. The Kennedy is thin in most places, though locally 3 or 4 feet thick. The Lower and Upper Banner, so far as now known, are both less than 2 feet thick, and in places are lacking. The Splash Dam bed is thin in most places, but contains about 3½ feet of coal

north of McClure River and Russell Prater Creek. The Hagy is persistent in the northwestern part of the basin, but is not more than 2 feet thick. The Dorchester, Lyons, and Blair beds contain 2 or 3 feet of coal in the small areas in which they have escaped erosion, but commonly include several shale partings. The Eagle bed is 2 to 5 feet thick, but little coal was found at the Clintwood or higher horizons.

Outcrops not correlated.—In The Breaks a coal bed 32 inches thick in the Lee formation has been mined recently, one-half mile south of the State line. The coal is free from partings, and is black, solid, and blocky. The dip is slight at the drift mouth, but 50 feet therefrom it is 15° to 18° west, and increases rapidly westward. The coal is overlain and underlain by massive conglomeratic sandstone. The drift mouth is 70 feet below railroad level and has an elevation of 1,940 feet.

Thin and moderately thick coal beds were seen in a number of places within the areas mapped as undifferentiated Pennsylvanian. The occurrence in these areas of irregular dips, indicating buckles and possible faults, makes it unsafe to assign these exposures to any definite bed, though the approximate stratigraphic position of many may be ascertained.

A coal bed that is at least 16 inches thick is exposed in the road southwest of the mouth of Pound River (location 271, elevation 1,669 feet S.) and may be the Dorchester. What may be the Lyons bed is 23 inches thick a short distance up the road from location 271 (elevation 1,705 feet B.) and a 2-foot bed of doubtful stratigraphic position was seen northeast of location 271 (elevation 1,565 feet B.) Steep dips in different directions may be seen along the road on both sides of these outcrops, involving several coal beds. The following measurement of a bed that resembles the Splash Dam was made on a western tributary of Russell Fork, north of Hill School. The bed is nearly level where measured, but strata in other parts of the hollow dip more or less steeply, chiefly to the east or northeast:

Section of coal bed one and one-fourth miles south of mouth of Pound River.

(Location 272, elevation 1,500 feet B., Fig. 19, Section 272.)

	Ft.	in.
Coal		8
Shale		3
Coal	2	3
Shale	1	
Coal	1	8
Shale, compact	1	6
Coal	4	7
Partings	1	3

Stone states that coal about 4 feet thick was reported at a caved drift by the wagon road (location 273, elevation 1,355 feet S.), just south of Sand Lick. Strata associated with this coal bed, which is probably the Kennedy, dip at an angle of about 7° in a neighboring exposure. Farther down Russell Fork, at the mouth of Duty Branch (location 274, elevation 1,284 feet H. L.), there are 18 to 24 inches of slightly impure and

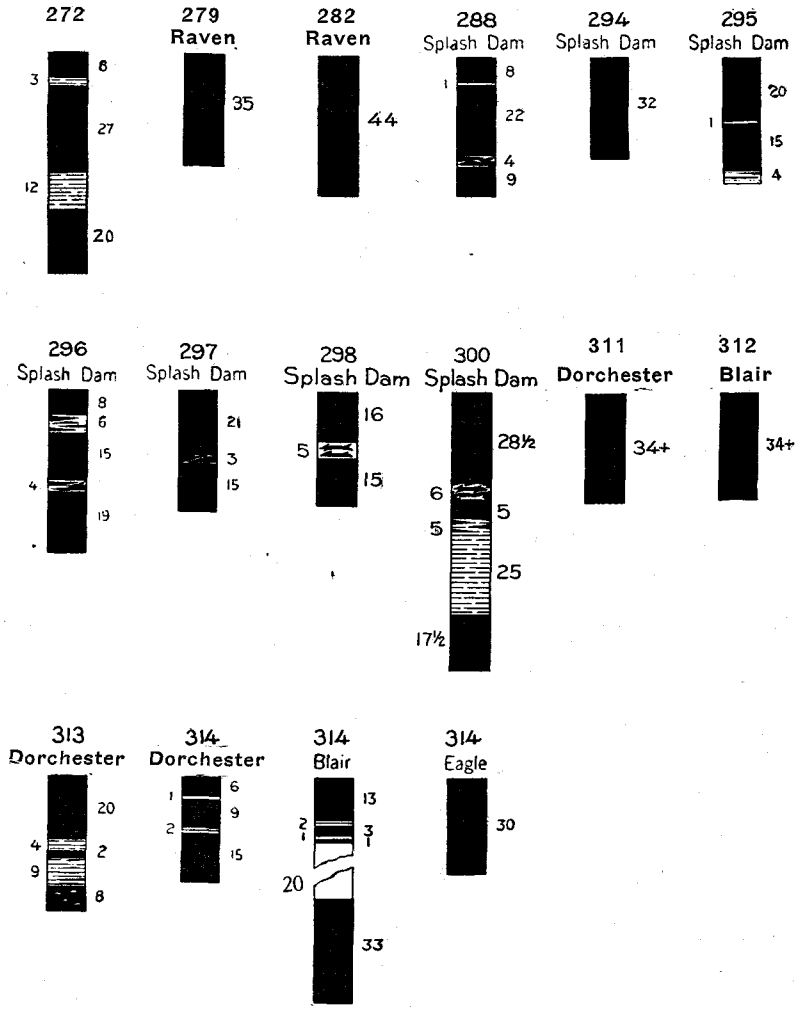


Fig. 19.—Sections of coal beds on and near Russell Fork northwest of Indian Creek.

crushed coal. There appears to be a fault at the side of this opening and beds dip steeply northeast for a few rods up Duty Branch. A few yards behind the house at the mouth of Duty Branch coal 16 inches thick dips 23° N. 65° E.

There are only a few uncorrelated coal exposures, probably of beds between the Tiller and Kennedy horizons, in the areas mapped as undifferentiated Pennsylvanian along Russell Fork on the eastern boundary of the county. One of these is at the sharp bend in Russell Fork at location 275 (elevation 1,456 feet S.), where there are 18 inches of coal with sandstone overlying the bed. There are 16 inches of coal, dipping southeast, in the road on the north side of the river a quarter of a mile below the mouth of Indian Creek. A coal bed 23 inches thick outcrops beside the same road 1½ miles farther north.

Coals in the Lee formation.—Few exposures of coals in the Lee formation have been seen in the lower part of the Russell Fork drainage basin. The following measurement was made in The Breaks:

Section of Lee coal bed in The Breaks of Sandy.

(Location 276, elevation 1,065 feet B.)

	Ft.	in.
Coal		10
Shale with streaks of coal	1	8

Raven and associated coal beds.—The Raven bed is below stream levels in most of the southern part of this area, but is exposed in the lower part of Abners Branch, which heads near Abners Gap. It has been opened at a few places on the logging tramway near Bee (location 277, elevation 1,483 feet H. L.), where it is 3 to 26 inches thick, with 4 feet of blue to drab shale under sandstone overlying the coal bed, and dips slightly down the branch.

As shown by blooms and a few caved openings, there are at least two thin coal beds between the Raven and Kennedy horizons. The only complete measurement obtained was at Abners Gap (location 278, elevation 1,550 feet B.), where a 22-inch coal bed about 150 feet below the Kennedy horizon is overlain by 2 feet of blue to drab shale under sandstone.

In the northern part of the area the Raven is largely above stream levels and a number of measurements were obtained. The bed ranges from 2½ to 4 feet in thickness and is in most places free from partings.

On Russell Fork two miles north of the mouth of Pound River the Raven coal bed is 35 inches thick (location 279, elevation 1,175 feet B., fig. 19, section 279). One mile farther northeast on Russell Fork near

the mouth of Camp Branch the same bed is 30 inches thick (location 280, elevation 1,135 feet B.). On Skegg Branch (location 281, elevation 1,171 feet S.), the bed measures 33 inches; and on Skeet Rock Branch (location 282, elevation 1,690 feet B., fig. 19, section 282), the Raven bed was found to be 44 inches thick.

Kennedy coal bed.—The Kennedy horizon is about 300 feet below that of the Upper Banner in the area in which it is exposed. It is irregular in thickness and probably thin in most places, though it is locally as much as 4 feet thick. On the east side of Russell Fork 1½ miles below the mouth of Indian Creek the coal is 3 feet thick and has 4 feet of irregularly bedded shale overlying the bed. The coal is at least 30 inches thick near the mouth of Laurel Branch, in an opening beside the road (location 283, elevation 1,336 S.), where it lies on a very coarse sandstone that outcrops conspicuously along this part of Russell Fork. The bed is reported to be 42 inches thick in a drift on the west side of the river a mile southeast of Sand Lick, and to be slightly thicker at Sand Lick, as previously mentioned.

The Kennedy is exposed just above water level along Russell Fork south of The Breaks and low down on the hillsides to the east of the river. On the east side of Russell Fork a mile north of the mouth of Pound River (location 284, elevation 1,225 feet B.) a coal bed, probably the Kennedy, measures 40 inches, and one-fourth mile farther north on the same side of the river (location 285, elevation 1,205 feet B.) a coal bed, doubtfully interpreted as Kennedy, shows 14 inches of coal. The Kennedy is thin throughout this portion of the Russell Fork drainage basin.

Lower and Upper Banner coal beds.—Both the Lower and Upper Banner coal beds are thin in this area and may be lacking in a large part of it. The Lower Banner was measured only in a drift near stream level in the upper part of Laurel Branch (location 286, elevation 1,547 feet S.), where it is 19 inches thick. The Upper Banner was seen only by a path on the spur north of Lazarus Branch (location 287, elevation 1,580 feet B.), where what is probably only one bench of a split bed is about 15 inches thick.

Splash Dam coal bed.—The Splash Dam coal lies 40 to 100 feet above the Upper Banner horizon and only a few feet above a massive sandstone that makes conspicuous ledges and cliffs. It is probably thin southeast of the mouth of Fryingpan Creek, but northwest of that place there are many openings showing 1½ to 4 feet of coal. The bed is at its best north

of Russell Prater Creek, where the average thickness of coal is about 3½ feet. Where the coal is thick there are commonly a few very thin shale partings and a characteristic layer of very hard, slightly bony coal.

The Splash Dam bed is exposed at railroad level 1 mile north of McClure River (location 288, elevation 1,267 feet S., fig. 19, section 288) and was utilized in railroad construction work. A measurement in a small drift at this place shows the bed to be 44 inches thick, including an inch of shale 8 inches from the top and a slightly bony layer in the lower part. The rock beneath is shale that is carbonaceous at the top and the rock above the coal bed is 20 feet of blue shale that grades into an overlying sandstone. At location 288a (elevation 1,295 feet), one-fourth mile west of location 288, a recent drift showed the Splash Dam to be 46 inches thick, with a clay parting one inch thick 28 inches below the top of the bed.

The Splash Dam bed is 18 to 24 inches thick at four openings on different western tributaries of Russell Fork between McClure River and Lick Creek. The opening farthest north (location 289, elevation 1,670 feet B.) contains 19 inches of coal, including at the top 5 inches of impure cannel over an inch of bony coal.

In the part of the basin that lies east of Russell Fork, the coal is at least 18 inches thick on a tributary of Tilda Anderson Branch (location 290, elevation 1,645 feet B.), 21 inches thick east of Sand Lick (location 291, elevation 1,640 feet B.), 18 inches half-a-mile north of the village (location 292, elevation 1,655 feet B.), and 19 inches opposite the mouth of Lazarus Branch (location 293, elevation 1,525 feet B.). At the opening last mentioned a thin layer of cannel coal caps the bed as at location 289, and the overlying rock is a blocky black shale in all openings near Sand Lick.

The Splash Dam coal is 32 inches thick in a drift opposite the mouth of McClure River (location 294, elevation 1,400 feet B., fig. 19, section 294), and about 44 inches in another a short distance north. At a small mine half-a-mile north of location 294 (location 295, elevation 1,350 feet B., fig. 19, section 295), the bed is 40 inches thick, including an inch of coaly shale in the middle and 4 inches of worthless coal and shale at the base. Seven double entries have recently been driven into the hill side at the bend in the river one and one-half miles north of the mouth of McClure River (location 295a, elevation 1280 feet). A measurement in the third west double entry shows the bed to be 45 inches thick, with 4 inches of clay 24 inches below the top of the coal. The bed has about the same thickness for nearly 2 miles north of the mouth of Russell Prater

Creek and then disappears beneath the river because of a gentle northward dip. Its horizon is plainly marked by a massive 60-foot sandstone the top of which is 5 or 10 feet below the coal. At the tunnel 2¼ miles from the mouth of the Russell Prater Creek, the coal again appears at river level and has been mined for railroad construction purposes. The dip at the mouth of the drift is 18° N. E., and a measurement of the bed is as follows:

Section of Splash Dam coal bed at tunnel south of Barts Lick Creek.

(Location 296, elevation 1,210 feet B., Fig. 19, Section 296.)

	Ft.	in.
Sandstone, massive at top, thin-bedded at base	20	
Shale	1	
Coal		8
Coal in some places, "rash" and shale in others		6
Coal	1	3
Bone		4
Coal	1	7
Coal	4	0
Parting		4

West along the river (location 296a, elevation 1,215 feet), the bed is split into two benches by a 6-inch parting of clay and carbonaceous shale, the upper bench being 30 inches thick, the exposed part of the lower bench measuring 20 inches, the base of the bed being concealed.

The coal is below river level from the north end of the tunnel to the Splash Dam just below the mouth of Pound River, where a northward rise of the beds causes it to reappear. In the mine of the Splash Dam Coal Company (location 296b, elevation 1,273), the bed is 32 inches thick with a clay parting one-half inch thick 2 inches below the top of the coal. The bed is overlain by 10 inches of shale which is succeeded above by sandstone. Measurements in a drift at railroad level 50 feet north of the dam and at a small mine a short distance farther north and 90 feet higher (location 297, elevation 1,300 feet C. C. C., fig. 19, section 297) show 37 to 39 inches of coal, including a 3-inch, slightly bony layer 21 inches below the top. The rock above the coal bed is 6 feet of sandy shale under sandstone, and thick massive sandstone is only 2 feet below the coal. Several recent drifts one-fourth mile northeast of location 297 (location 297a, elevation 1,330 feet), show the Splash Dam to be 30 inches thick with several thin clay partings. The roof is sandstone and the bed dips 5° towards the north.

Two drifts recently opened south of the mouth of Fall Branch (location 297b, elevation 1,435 feet), show the bed to be variable in thickness in this locality. It was reported to average 42 inches. A measurement made 100 feet from the mouth of the drift showed 32 inches of coal with sandstone cover and dipping 10° S. 25° E.

The Splash Dam bed is represented in the extreme northeastern part of Dickenson County where it is found along Camp Branch, Barts Lick, and Hunts Creek. In this area it ranges from 2½ to 4½ feet in thickness. The following measurements were made on Camp Branch:

Sections of Splash Dam coal bed on Camp Branch.

(Location 298, elevation 1,507 feet H. L., Fig. 19, Section 298.)

	Ft.	in.
Coal	1	4
Bone		5
Coal (lower 3 inches bony locally)	1	3
Coal	2	7
Parting		5

(Location 299, elevation 1,420 feet.)

	Ft.	in.
Coal	2	
Shale		½
Coal		2
Coal	2	2
Parting		½

(Location 300, elevation 1,367 feet S., Fig. 19, Section 300.)

	Ft.	in.
Coal	2	4½
Bone and bony coal		6
Coal		5
Shale, coaly at top		5
Shale	2	1
Coal	1	5½
Coal	4	3
Partings	3	0

Another measurement on the west side of Camp Branch (location 301, elevation 1,540 feet B.) shows but 12 inches of coal.

Hagy coal bed.—The Hagy coal bed in most places is 100 feet above the Splash Dam bed and is 2 feet or less thick. It lies a few feet above a massive sandstone that makes more or less conspicuous ledges, and commonly is overlain by blue shale that is succeeded above by a thin bed of sandstone. Eight measurements were made east of Russell Fork in Dickenson County, but only thin blooms were found elsewhere.

The Hagy bed is 24 inches thick at the head of the right fork of Tilda Anderson Branch (location 302, elevation 1,700 feet B.) and 19 inches on a left fork (location 303, elevation 1,740 feet B.). The coal is 18 inches thick at the end of the tunnel south of Barts Lick Creek (location 304,

elevation 1,260 feet B.), and is exposed in railroad cuts from the tunnel to a few rods beyond the creek (location 305, elevation 1,245 feet B.), where it is 23 inches thick.

Several measurements were made on Camp Branch where the Hagy bed is well exposed. Near the head of the stream the following measurement was made:

Section of Hagy coal bed near head of Camp Branch.

(Location 306, elevation 1,455 feet B.)

	Ft.	in.
Coal	1	4
Coal, bony		3
Coal, slightly bony		5
Coal	1	9
Parting		3

Farther west on Camp Branch another measurement was made (location 307, elevation 1,480 feet S.), showing the Hagy bed to be more than 1 foot thick, and a quarter of a mile still farther northwest (location 308, elevation 1,525 feet B.) the bed was found to be 27 inches thick. A measurement on the south side of Barts Lick Creek (location 309, elevation 1,450 feet C. C. C.) shows 23 inches of coal, with one inch of hard bright coal near the middle of the bed.

Coal beds in Wise formation.—There are four coal beds in the lower 200 feet of the Wise formation: The Dorchester near the base, the Lyons 20 to 40 feet higher, the Blair about 100 feet above the Dorchester, and the Eagle 50 to 90 feet above the Blair. These beds contain 2 or 3 feet of coal in most places, but underlie only small areas near the tops of a few ridges and will not be described separately.

The Lyons bed is 23 inches thick 1½ miles southwest of the mouth of Pound River (location 310, elevation 1,880 feet B.), and the Dorchester is about the same thickness at the neighboring road corner, though split into two benches by shale.

In the ridge road 1½ miles northeast of Sand Lick (location 311, elevation 1,951 feet S., fig. 19, section 311) the Dorchester is at least 34 inches thick, as is also the Blair at the head of the right fork of Tilda Anderson Branch (location 312, elevation 2,040 feet B., fig. 19, section 312.).

The first of the following measurements of the Dorchester was made at a small mine above the tunnel south of Barts Lick Creek, and the second in a small hollow a few rods north of the mouth of the creek:

Sections of Dorchester coal bed on Russell Fork near Barts Lick Creek.

(Location 313, elevation 1,435 feet B., Fig. 19, Section 313.)

	Ft.	in.
Sandstone	20	
Shale	1	
Coal	1	8
Clay		4
Coal		2
Clay		9
Coal, impure		8
Coal	2	6
Partings	1	1

(Location 314, elevation 1,420 feet B., Fig. 19, Section 314.)

	Ft.	in.
Sandstone.		
Shale, thin.		
Coal		6
"Rash"		1
Coal		9
Shale		2
Coal	1	3
Coal	2	6
Partings		3

In the hollow in which the last section was measured several higher beds are exposed. The Lyons coal (elevation 1,455 feet B.) is 20 inches thick, with two coal streaks in the thin shale overlying the coal bed. The lower bench of the Blair bed is 33 inches thick (elevation 1,550 feet B., fig. 19, section 314), and the upper bench is about 20 feet higher and contains only 13 inches of coal that could be utilized. The Eagle bed (elevation 1,630 feet B., fig. 19, section 314) is 30 inches thick. Because of rather steep dips and an error in the topographic map that makes locations uncertain, the elevations of these beds do not furnish a means of calculating the exact distance between them.

RUSSELL PRATER AND BARTS LICK CREEKS.

Geologic outline.—Beds exposed in the drainage basins of Russell Prater and Barts Lick creeks in Dickenson County include those from 140 feet below the Splash Dam coal horizon to 500 feet above the base of the Wise formation. The stratigraphy is shown by the generalized columnar section for the northeastern part of Dickenson County (Pl. XIII), by logs of borings in the northeast corner of the Clintwood quadrangle (Pl. IX), by local section 22, and by general sections for areas Cc and Cd (Fig. 2). Dips are low and their direction is governed chiefly by the Middlesboro syncline, the axis of which extends from southwest to northeast in the Barts Lick Creek drainage basin. In the small area north of this axis beds dip southeast, and elsewhere to the northwest or west.

The area contains some coal beds that afford possibilities of profitable extraction in the near future. (See figs. 10 and 20.) The Upper Banner bed, which is thick in many localities farther south and southwest, is only a few inches thick in this part of the field. The Splash Dam bed contains about 3 feet of coal along the lower part of Russell Prater Creek,

but splits to the east. The Hagy bed is about 2 feet thick along Barts Lick Creek and the lower part of Russell Prater Creek, and thickens to the east, reaching a maximum of nearly 5 feet in an opening on War Fork Creek in Buchanan County. The Dorchester, Lyons, and Blair beds are thin in many places and contain several layers of shale. Locally, however, the layers of coal are as much as 3½ feet in aggregate thickness in the Dorchester bed and 5½ feet in the Blair bed.

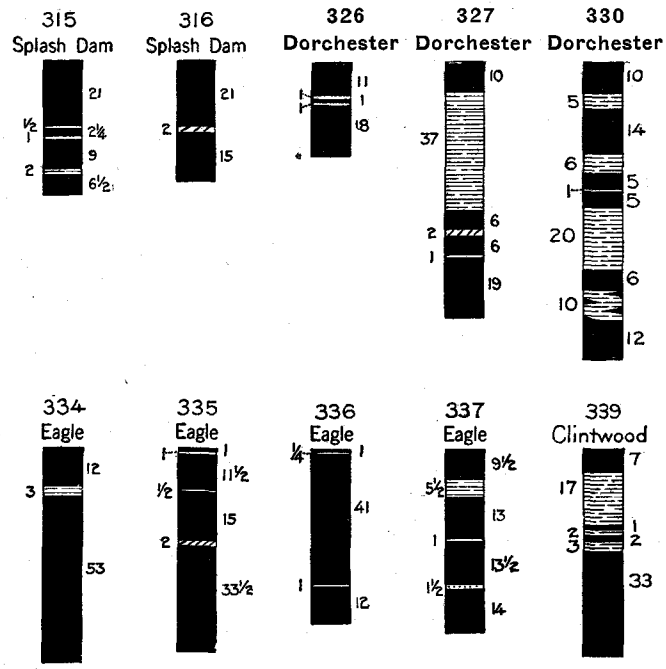


Fig. 20.—Sections of coal beds in the drainage basins of Russell Prater and Barts Lick creeks.

The Eagle bed would be by far the most valuable bed in these basins were it not for the fact that it underlies only small areas near the ridge tops. It contains coal 4 to 5 feet thick on both sides of most of Russell Prater Creek and its tributaries, and includes a few partings that would give trouble in mining. The Clintwood and Campbell Creek beds have rarely been found in the small areas in which they might outcrop near the tops of some ridges, though the Clintwood is about 4 feet thick a short distance north of the eastern part of the Russell Fork drainage basin east of Dickenson County.

Splash Dam coal bed.—The Splash Dam bed lies a few feet above a massive sandstone and is exposed a short distance above stream level along Russell Prater Creek from its mouth nearly to the head of the left fork and of War Fork in Buchanan County. The bed contains about 3 feet of coal with only thin shale partings along the lower part of Russell Prater Creek, but at the county line and eastward it is split by thin shale beds into two or three parts, of which none is more than 2 feet thick.

The coal is in two benches 16 feet apart on the county line a quarter of a mile north of Russell Prater Creek. The lower bench is 16 inches thick and the upper is 17 inches.

The coal is thicker and probably in only one bench on the lower part of Russell Prater Creek, as shown by the following measurements, the first made at a small mine near the road between Russell Prater and Barts Lick creeks and the second at an exposure a short distance west:

Sections of Splash Dam coal bed on lower Russell Prater Creek.

(Location 315, elevation 1,378 feet S., Fig. 20, Section 315.)

	Ft.	in.
Shale	3	
Coal	1	9
Shale		½
Coal		2¼
Shale		1
Coal		9
Shale		2
Coal		6½
Coal	3	2¾
Partings		3½

(Location 316, elevation 1,355 feet B., Fig. 20, Section 316.)

	Ft.	in.
Shale	4	
Coal	1	9
"Rash"		2
Coal	1	3
Coal	3	0
Parting		2

An analysis of the coal of this mine is given on page 204 of this report.

A short distance down the creek (location 317, elevation 1,381 feet C. C. C.) the bed is 29 inches thick, with only a few thin layers of impurities.

Hagy coal bed.—The Hagy coal is 60 to 120 feet above the Splash Dam bed, the average distance being about 100 feet. It is underlain by a sandstone that is slightly thinner than that of the Splash Dam and is overlain by deep blue shale. The bed is exposed low in the valley of Russell Prater Creek from its mouth nearly to the heads of the principal branches in Buchanan County and also along the lower part of Barts Lick Creek. The coal is 15 to 26 inches thick along Barts Lick Creek and Russell Prater Creek in Dickenson County. The bed is clean, shale partings being very thin in some localities and absent in others.

A caved drift on a small tributary south of Prater School (location 318, elevation 1,585 feet B.) is in coal at least 2 feet thick. The Hagy bed is 26 inches thick in a small mine beside the road from Russell Prater to Barts Lick Creek (location 319, elevation 1,473 feet S.), and is probably about the same elsewhere along the lower part of Russell Prater Creek. It is 25 inches thick near Barts Lick School (location 320, elevation 1,430 feet B.), but is only 15 to 22 inches thick along lower parts of Barts Lick Creek (location 321, elevation 1,375 feet B.; location 322, elevation 1,330 feet B.; location 323, elevation 1,275 feet B.); location 309, already described gives a section of the Hagy bed on Barts Lick Creek one mile northeast of Barts Lick School.

Dorchester and Lyons coal beds.—The Dorchester coal is 250 to 340 feet above the Splash Dam coal and only a few feet above the base of the Wise formation. The thickness of coal aggregates a few inches to about 3½ feet, but the bed commonly contains thin shale partings that impair its commercial value. The Lyons bed is 20 to 40 feet above the Dorchester and is less than 2 feet thick.

The Dorchester is about 3 feet thick on the ridge south of lower Russell Prater Creek, and 32 inches of it, the upper part being removed by erosion, shows in the road east of Prater triangulation station (location 324, elevation 1,916 feet S.). Here the coal is only 4 inches from the underlying Gladeville sandstone.

The character of the Dorchester along lower Barts Lick Creek is shown by the following four sections, the first one south of the stream and the others north of it:

Sections of Dorchester coal bed on lower Barts Lick Creek.

(Location 325, elevation 1,450 feet B.)

	Ft.	in.
Shale.		
Coal		2
Shale		2
Coal		4
Shale		1
Coal		4
Shale		1
Coal		7
Shale		1
Coal	1	
Sandstone.		
Coal	2	5
Partings		5

(Location 326, elevation 1,550 feet B., Fig. 20, Section 326.)

	Ft.	in.
Shale and coal		8
Coal		11
Shale		1
Coal		1
Clay		1
Coal	1	6
Shale.		
Coal	2	6
Partings		2

(Location 327, elevation 1,510 feet C. C. C., Fig. 20, Section 327.)

	Ft.	in.
Coal		10
Shale	3	1
Coal		6
"Rash"		2
Coal		6
"Rash"		1
Coal	1	7
Shale.		
Coal	3	5
Partings	3	4

(Location 328, elevation 1,530 feet B.)

	Ft.	in.
Shale.		
Coal		11
Clay		1
Coal		7
Shale		2
Coal		9
Sandstone.		
Coal	2	3
Partings		3

The following sections illustrate the character of the Dorchester on Upper Barts Lick Creek:

Sections of Dorchester coal bed on Upper Barts Lick Creek.

(Location 329, elevation 1,650 feet B.)

	Ft.	in.
Coal		7
Shale		7
Coal		7
Coal	1	2
Parting		7

(Location 330, elevation 1,640 feet C. C. C., Fig. 20, Section 330.)

	Ft.	in.
Coal		10
Shale		5
Coal	1	2
Shale		6
Coal		5
Shale		1
Coal		5
Shale	1	8
Coal		6
Shale and coal		10
Coal	1	
Coal	4	4
Partings	3	6

The following measurements of the Dorchester bed were made on the upper part of Little Lick Creek:

Sections of Dorchester coal bed on Upper Little Lick Creek.

(Location 331, elevation 1,580 feet B.)

	Ft.	in.
Coal	1	8
Shale		1
Coal		7
Coal	2	3
Parting		1

(Location 332, elevation 1,610 feet B.)

	Ft.	in.
Coal		1½
Shale		3
Coal	1	7
Sandstone, fine-grained		5
Coal		9
Coal	2	5½
Partings		8

Blair coal bed.—The Blair bed is 50 to 120 feet above the Dorchester coal bed. In many places it is in two benches separated by shale sev-

eral feet thick. One of the benches is so thin as to be of no economic importance, and the other, though containing layers of coal aggregating 1½ to 5½ feet thick, commonly includes several thin layers of incombustible material that make its successful utilization problematical. There are undoubtedly localities in which the bed is sufficiently clean to be an important resource. The Blair is thickest in the Greenbrier Creek drainage basin just east of Dickenson County.

The following measurement was made near the head of Barts Lick Creek:

Section of Blair coal bed near the head of Barts Lick Creek.

(Location 333, elevation 1,740 feet C. C. C.)

	Ft.	in.
Coal		11
Clay and shale	1	1
Coal (pyritiferous)	1	2
Coal	2	1
Parting	1	1

Eagle coal bed.—The Eagle bed lies 140 to 200 feet above the Dorchester coal and a few feet below a thick sandstone that makes conspicuous cliffs. In places this bed is only 20 feet above the Blair, but in others the interval is 50 to 100 feet. The coal is not very thick north of Barts Lick Creek, but elsewhere in this basin it is fairly clean and has an average thickness of 4 to 4½ feet. The bed lies so high in the hills that it has a comparatively small acreage. 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 is naturally exposed on a slope near Prater triangulation station, south of Russell Prater Creek (location 334, elevation 2,040 feet B., fig. 20, section 334) and is 68 inches thick, including 3 inches of shale a foot below the top. Another measurement 1½ miles north of Russell Prater Creek and a quarter of a mile west of the county line shows the following section:

Section of Eagle coal bed east of Wolfpen Branch.

(Location 335, elevation 1,820 feet B., Fig. 20, Section 335.)

Shale.	Ft.	in.
Coal		1
Clay		1
Coal		11½
Clay		½
Coal	1	3
"Rash"		2
Coal	2	9½
Coal	5	1
Partings		3½

Another measurement one mile farther north and just east of the Dickenson-Buchanan county line shows over 5 feet of coal with 1½ inches of partings.

The following measurements were made at two small mines that have supplied fuel for lumbering operations, the first being on Wolfpen Branch of Russell Prater Creek, and the second on Slate Branch of Barts Lick Creek:

Sections of Eagle coal bed on Wolfpen and Slate branches.

(Location 336, elevation 1,925 feet C. C. C., Fig. 20, Section 336.)

	Ft.	in.
Shale	11	
Coal		1
Clay		¼
Coal	3	5
Clay		1
Coal	1	
Shale.		
Coal	4	6
Partings		1¼

(Location 337, elevation 1,827 feet C. C. C., Fig. 20, Section 337.)

Sandstone.	Ft.	in.
Coal		9½
Clay		5½
Coal	1	1
Clay		1
Coal	1	1½
Sandstone		1½
Coal	1	2
Coal	4	2
Partings		8

An analysis of the coal from location 337 is given on page 205 of this report.

The following measurement shows the character of the Eagle bed at the head of Barts Lick Creek:

Section of Eagle coal bed at the head of Barts Lick Creek.

(Location 338, elevation 1,820 feet C. C. C.)

	Ft.	in.
Coal	1	5
Shale	2	
Coal		8
Coal	2	1
Parting	2	

Clintwood coal bed.—The Clintwood coal bed lies from 50 to 130 feet above the Eagle. It outcrops only in small areas on the highest ridges. The following section illustrates its condition near the head of Barts Lick Creek:

Section of Clintwood coal bed near the head of Barts Lick Creek.

(Location 339, elevation 1,900 feet C. C. C., Fig. 20, Section 339.)

	Ft.	in.
Coal		7
Clay	1	5
Coal		1
Clay		2
Coal		2
Shale		3
Coal	2	9
Coal	3	7
Partings	1	10

CLINCH RIVER DRAINAGE BASIN.

DUMP CREEK.

Geologic outline.—This basin includes only the extreme headwaters of Road Fork and Hurricane Fork of Dump Creek. The rocks exposed range from 165 feet below the Lower Banner to 200 feet above the base of the Wise formation. The general characters of the strata, the distances between coal beds, and other geological data are shown in the generalized columnar section for the southeastern part of Dickenson County, in the general section for area Ce (fig. 2), in local sections 14 and 15, and in the drill records (Plate X).

The basin is on the west flank of the Sourwood Mountain anticline, the axis of which trends north-south. Dips are therefore west and northwest, and are gentle.

There are important coal beds in this region, only small portions of which lie in the limited basin under consideration here. The Tiller and Jawbone beds are concealed below the surface, but are believed for reasons stated later, to be thick. There are several coal beds between the Jawbone and Lower Banner beds, but in most places they are thin. The Raven bed, however, is 3 to 4 feet thick, exclusive of local partings, and the Kennedy in a few places about 3 feet thick. Both of these lie everywhere beneath the surface.

The Lower and Upper Banner coal beds are being mined by the Clinchfield Coal Corporation on a large scale at Wilder just beyond the county line. Mine 55, in the Lower Banner bed on both sides of Laurel Branch, is in coal 3½ to 4½ feet thick. Mine 6 in the Upper Banner bed is on the south side of Laurel Branch in coal 4 to 7½ feet thick, and an entry

being driven southwest under Sandy Ridge toward the workings of mine 2 at the head of McClure River is in similarly thick coal. Both these mines are modern and well equipped in every way and have a large producing capacity. The product is shipped over a short spur of the Carolina, Clinchfield and Ohio Railway to Kiser, on the Norfolk and Western Railway. Elswhere in the Road Fork basin the Lower Banner is 3 to 7 feet thick.

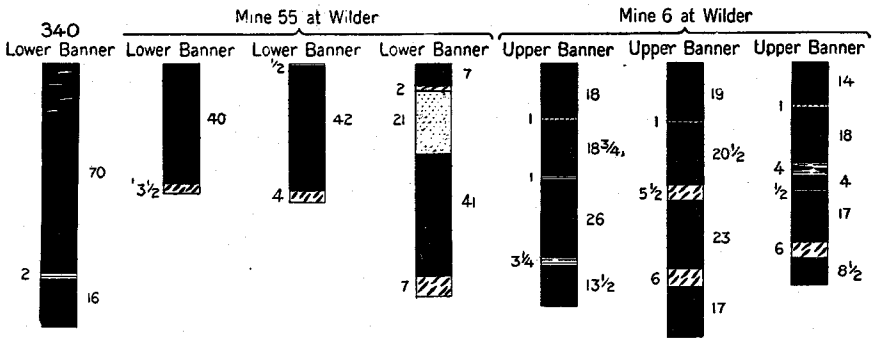


Fig. 21.—Sections of coal beds in the Clinch River drainage basin.

There are probably localities in which coal beds in the Norton formation higher than the Upper Banner, especially the Splash Dam bed, are 2 or 3 feet thick, but the only exposures seen were too thin to be considered workable. Beds in the Wise formation on Sandy Ridge may in places be fairly thick.

Tiller and Jawbone coal beds.—The Tiller coal lies 850 to 950 feet below the Upper Banner horizon. The Jawbone is as much as 100 feet above the Tiller in parts of this basin but, as shown by drill records (Pl. X), the two beds unite under a large part of the Hurricane Fork drainage basin. Where the beds are separated the interval between them is occupied chiefly by coarse-grained, siliceous sandstone that contains quartz pebbles. Both beds are below the surface. Where the two beds are united under part of the Hurricane Fork basin they are probably much like the thick and valuable double bed that is exposed north of Sandy Ridge on the headwaters of Indian and Cane creeks. Both of the beds are probably also workable in much of the area in which they are separate; for the Jawbone includes 3½ to 8 feet of coal where it comes to the surface on Hurricane Fork 3 to 4 miles south of Dickenson County, and the Tiller is 4 to 5 feet thick at the "slope mine" of the Clinchfield Coal

Corporation 5 miles southeast of the county, the main entry of which has been driven between 2 and 3 miles northward toward Dickenson County.[1] It is an excellent bed containing 3 to 4 feet of coal beneath the headwaters of Hurricane Fork, but is less than 30 inches thick elsewhere and is less than 14 inches thick in some localities. Two measurements were made just east of the county line in the headwaters of Hurricane Fork near the head of Skeen Creek, the first showing coal 39 inches thick, the other section including a 7-inch shale parting with coal 21 inches thick above it and 29 inches thick below it. The overlying rock is an 8-inch draw shale under sandstone.

There are several more or less lenticular coal beds between the Raven and Kennedy beds, but none of them is of much commercial importance, as a thickness of as much as 2 feet is exceptional.

Kennedy coal bed.—The Kennedy is 300 to 380 feet below the Upper Banner horizon. It is a very thin and commercially unimportant bed in most of this basin. The coal is only 23 inches thick in a railroad cut near Wilder, and is overlain by a 50-foot bed of fine-grained sandstone and underlain by coarser sandstone of the same thickness.

Lower Banner coal bed.—The Lower Banner coal is 200 to 270 feet above the Kennedy and 100 to 140 feet below the Upper Banner. It is present beneath Sandy Ridge and is being mined on a large scale by the Clinchfield Coal Corporation. It is a clean bed containing about 3 to 7 feet of coal and very little shale in the form of partings. In the Hart Creek district it is in most places thin, but is fairly thick in the drifts described below.

The following section shows its character on Negro Camp Branch:

Section of Lower Banner coal bed on Negro Camp Branch.

(Location 340, elevation 2,290 feet B., Fig. 21, Section 340.)

	Ft.	in.
Shale	4	
Coal at top	5	10
Clay		2
Coal, reported	1	4
Coal	7	2
Parting		2

In most parts of Mine 55 of the Clinchfield Coal Corporation, on both sides of Laurel Branch near Wilder, the Lower Banner is 3½ to 4½ feet

[1] See page 194 for analyses of this coal.

thick and shale partings are absent or very thin. The underlying rock, is, in general, a compact shale and the overlying rock either shale or sandstone. Thin layers of "rash" occur both at the top and at the bottom of the bed. Analyses of mine samples are given on pages 197 and 198 of this report.

Upper Banner coal bed.—The distribution of the Upper Banner is much the same as that of the Lower Banner. In the northern part of the Road Fork drainage basin the bed is split into two parts by the thickening of a shale parting, the upper bench being 2 to 4 feet thick and the lower bench worthless or nearly so. Near Wilder, and especially south of Laurel Branch, the shale parting thins to a few inches and both benches can be easily mined together. In the Wilder district the layers of coal aggregate 4 to 7½ feet in thickness and are being mined on a large scale.

The details of the Upper Banner bed where both parts are united are illustrated by the following measurements made in Mine 6 of the Clinchfield Coal Corporation, the workings of which are south of Laurel Branch within and east of the county line:

Sections of Upper Banner coal bed in Mine 6 at Wilder.

	Ft.	in.
Shale.		
Coal	1	7
Sandstone		1
Coal	1	8½
"Rash"		5½
Coal	1	11
"Rash"		6
Coal	1	5
Shale.		
Coal	6	7½
Partings	1	½

	Ft.	in.
Sandstone.		
Coal	1	2
Sandstone		1
Coal	1	6
"Rash"		4
Coal		4
Shale		½
Coal	1	5
"Rash"		6
Coal		8½
Shale.		
Coal	5	1½
Partings		11½

LEFT FORK OF LICK CREEK.

Geologic outline.—That part of Dickenson County drained by the Left Fork of Lick Creek is less than 4 square miles. The rocks exposed include the Norton formation from 100 feet below the Kennedy coal bed to the top of the formation, all of the Gladeville sandstone, and the lower 150 feet of the Wise formation. The succession is shown by the generalized columnar section for the southern part of Dickenson County, by local sections 10, 11, and 12, by general section for Area Ad (fig. 2), and by well logs (Plate IX).

The basin is underlain by important coal beds. The Jawbone, Tiller, Raven (Imboden so-called), and Aily are beneath the surface, but

something regarding their character may be learned by consulting the drill logs (Plate IX). The Kennedy is exposed in the lower part of the valleys of Left Fork and its tributaries. It is very variable in thickness here as elsewhere and presents the characteristic crushed appearance. Locally it is over 7 feet thick. One measurement on the railroad at the county boundary shows 54 inches of coal.

Both the Lower Banner and Upper Banner beds are being mined on a large scale in this region. The Lower Banner ranges from 2 to 5 feet in thickness, with an average thickness of from 2½ to 3½ feet. One measurement on the road northwest from Lick Fork shows 40 inches of coal. The Upper Banner ranges from 3 to 6 feet in thickness with an average of 3½ to 4 feet. It carries the characteristic sandstone parting from 1 to 2 inches thick located near the middle or in the upper part of the bed. Aside from this parting the coal is clean. Near the head of Left Fork of Lick Creek the Upper Banner measures 43 inches with 1 inch of sandstone 19 inches from the top of the bed.

The "Black Slate" or Splash Dam coal bed lies from 50 to 75 feet above the Upper Banner in the southern part of the county. It is thin—less than 3 feet thick in most places—and, while prospected generally, it has been little mined.

Higher coals in the Norton formation appear to be of little value in this basin. Several blooms were seen, none of which measured over 15 inches. Apparently they represented coals too thin to work.

The coals of the Wise formation are thin and very limited in extent, occurring only near the tops of the ridges. No coal beds were seen that measure over 2½ feet.

AMOUNT OF ULTIMATELY AVAILABLE COAL.

Actual mining operations in Europe have shown that coal of lower grade than that in southwest Virginia can be profitably mined in beds only 14 inches thick and at depths greater than any to which it would be necessary to shaft for any bed in Dickenson County. The tonnages in the following table, therefore, include all beds or parts of beds in which there are 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 these estimates were carefully prepared they are necessarily only rough approximations. The figures for beds which are below the surface in large areas are, of course, most likely to be in error. The calculated totals, though enormous, are thought to be very conservative estimates. The amount of coal already mined in Dickenson County or made unavailable by mining operations is comparatively so small as to be negligible, being only one or two hundredths of one per cent of the total original tonnage.

AMOUNT OF MINABLE COAL IN DICKENSON COUNTY, VIRGINIA.

	Acres.	Tons.
Wise formation:		
Clintwood	12,885	133,587,000
Eagle	14,300	58,541,000
Dorchester	39,818	128,257,000
Other beds	.....	149,457,000
Norton formation:		
Splash Dam	77,745	272,340,000
Upper Banner	98,985	502,285,000
Lower Banner	110,320	445,813,000
Other beds above Kennedy	.....	375,696,000
Kennedy	126,696	469,750,000
Raven	142,275	563,091,000
Jawbone	129,646	614,851,000
Tiller	20,082	112,907,000
Other beds below Kennedy	.....	756,331,000
Lee formation:		
All beds	.....	2,317,000,000
Total	.....	6,899,906,000

Of the grand total of 6,899,906,000 tons only about 70 per cent could be recovered even under the most favorable mining conditions, leaving about 4,900,000,000 tons as a possible production. At the rate of consumption of bituminous coal in 1916, a banner year, Dickenson County could supply all of the United States for about 10 years. However, much of this coal is in beds 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 today, however, are certain to be of value in the future.

CHARACTER AND QUALITY OF THE COALS.

ANALYSES.

METHOD OF SAMPLING AND ANALYZING.

The analyses on succeeding pages were made from samples collected by members of the State and Federal geological surveys and the United States Bureau of Mines in Dickenson County and neighboring areas on the west and south. Samples collected before July 1, 1910, were analyzed by the United States Geological Survey, and those taken after that date by the United States Bureau of Mines.

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 shale 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-eights 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 is taken from the can, weighed, and allowed to dry at a temperature slightly above normal until its weight becomes practically constant. It is 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 is analyzed in this condition and the results given under form B (see following tables). Forms A, C, and D are 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.

DESCRIPTION OF SAMPLES.

32513.—Sample was collected in the Burtons Ford mine of the Russell Fork Coal Mining Company, on the south side of Clinch River about 3 miles southwest of St. Paul, July 30, 1919. The coal bed is in the Pennington formation. This is one of the very few localities where coal in the Pennington formation is being worked in southwest Virginia, hence the sample is of more than ordinary interest. The sample was obtained at the face about 150 feet west of the drift mouth.

Section of Lee coal bed at point sampled in mine at Burtons Ford.

	32513	
	Ft.	in.
Shale, carbonaceous	[a]0	1
Coal	2	11
Clay with carbonaceous shale partings	[a]1	2
Included in sample	2	11
Excluded from sample	1	3

18239, 18240, 18241, and 18242.—Samples were collected from the Tiller coal bed in No. 201 slope mine of the Clinchfield Coal Corporation, on Hurricane Fork of Dump Creek, about 4 miles southeast of Dickenson County, November 26, 1913. Sample 18239 was obtained in the main entry, 4,900 feet N. 30° W. of bottom of slope; sample 18240, about 1,200 feet N. 64° W. of slope and 800 feet west of main entry; and sample 18241 in a right entry about 800 feet from main entry and 2,600 feet N. 20° W. of slope. Sample 18242 was a composite made by mixing 18239, 18240, and 18241.

Sections of Tiller coal bed at points sampled in Clinchfield No. 201 mine.

	18239		18240		18241	
	Ft.	in.	Ft.	in.	Ft.	in.
"Rash"	[a]0	9	..	..	..	..
Coal	2	0	1	9½	1	4½
Shale	..	..	[a]0	5	[a]0	3½
Sandstone	[a]0	3	..	..	..	..
Coal	3	1	2	3	2	3
Included in sample	5	1	4	½	3	7½
Excluded from sample	1	0	0	5	0	3½

5217 and 5235.—Samples were collected from the Jawbone coal bed in the Virginia City No. 1, a slope mine at Virginia City, Va., July 26, 1907.

[a]Not included in sample.

Sample 5217 was obtained in room 8, off the first cross-entry, 2,400 feet northwest of mine opening; sample 5235, in a break-through between the third and fourth cross-entries, 3,200 feet northwest of mine opening.

Sections of Jawbone coal bed at points sampled in Virginia City No. 1 mine.

	5217		5235	
	Ft.	in,	Ft.	in.
Coal	0	6½	0	5
Sandstone	..	..	[a]0	¼
"Rash"	[a]0	2	..	..
Coal	1	9½	0	2
"Rash"	..	..	[a]0	½
Coal, bony	0	2	..	..
Coal	1	5	1	4½
Shale and coal	..	..	[a]0	7
Coal, bony	0	2	0	3
Coal	4	½	4	6
Included in sample	8	1½	6	8½
Excluded from sample	0	2	0	7¾

32503, 32504, 32505, 32506, and 32507.—Samples were collected from the Jawbone coal bed in the Virginia City mine of the Virginia Iron, Coal & Coke Company, July 28, 1919. Sample 32503 was obtained in the first cross-entry off fourth east entry; sample 32504 in the first room off the third west cross-entry; sample 32505 in the second room off the second west cross-entry; sample 32506 in the third room off the first west cross-entry from the main haulway. All samples were taken at a distance of about half-a-mile from the drift mouth. Sample 32507 was a composite made by mixing the first four samples.

Sections of Jawbone coal bed at points sampled in Virginia Iron, Coal & Coke Company's mine, Virginia City, Va.

	32503	
	Ft.	in.
Coal with "rash"	3	7
Shale	[a]1	0
Coal	0	9
Included in sample	4	4
Excluded from sample	1	0

[a]Not included in sample.

	32504 Ft.	in.
Coal	0	9
"Rash"	0	¼
Coal	0	10
Bone	0	3
Coal	0	6
Coal, bony	3	4
"Rash"	[a]0	8
Included in sample	5	8¼
Excluded from sample	0	8

	32505 Ft.	in.
Coal	0	10
Bone	0	¼
Coal	0	10
Bone and coal	[a]0	6
Bone	[a]0	9
Coal, bony	0	6
Coal, impure	1	2
"Rash"	[a]0	8
Coal	1	2
Included in sample	4	6
Excluded from sample	1	11

	32506 Ft.	in.
Coal	1	0
Bone	0	1
Coal	0	8
Coal and bone	0	10
Coal	1	10
"Rash"	[a]1	6
Coal	1	4
Included in sample	5	9
Excluded from sample	1	6

32276.—Sample collected from the Jawbone coal bed in mine No. 2 of the Twin City Coal Corporation, at St. Paul, Virginia, July 1, 1919. The sample was obtained at the main entry, 300 feet northeast of the drift mouth. At this place the bed is very thick, 1 foot of coal being left to support the roof and 6 to 9 feet of coal representing the lower part of the bed remaining to be removed subsequently.

Section of Jawbone coal bed at point sampled in Twin City Coal Corporation's mine, St. Paul, Va.

	32276 Ft.	in.
Coal	[a]1	0
Coal	11	6
Coal	[a]6+	
Included in sample	11	6
Excluded from sample	7+	

[a] Not included in sample.

32277.—Sample collected from the Jawbone coal bed in mine No. 3 of the Twin City Coal Corporation, at St. Paul, Virginia, July 1, 1919. The sample was obtained at the face of the main entry, half a mile northeast of drift mouth.

Section of Jawbone coal bed at point sampled in Twin City Coal Corporation's mine, St. Paul, Virginia.

	32277 Ft.	in.
Coal	[a]1	6
Shale, carbonaceous	[a]0	6
Coal	5	0
Included in sample	5	0
Excluded from sample	2	0

32275.—Sample collected from the Raven (Garden Hole) coal bed in mine No. 1 of the Twin City Coal Corporation, at St. Paul, Virginia, July 1, 1919. The sample was obtained at the face of the main entry a quarter of a mile northeast of drift mouth.

Section of Raven coal bed at point sampled in Twin City Coal Corporation's mine, St. Paul, Virginia.

	32275 Ft.	in.
Coal	1	2
Shale, carbonaceous	[a]0	1
Coal	1	10
Included in sample	3	0
Excluded from sample	0	1

18121.—Sample collected from the Kennedy coal bed in mine No. 103 of the Clinchfield Coal Corporation, 1 mile northwest of Dante, Virginia, November 17, 1913. The sample was obtained in the main entry, 260 feet N. 55° W. of mine opening and represents 5 feet 2 inches of coal, the entire thickness of the bed.

17559, 17560, and 17561.—Samples collected from the Kennedy coal bed in a small local drift mine, half a mile north of Nora (location 146, on map), July 12, 1913. Sample 17559 was cut 300 feet east of drift mouth; and sample 17560, about 300 feet northeast of drift mouth. Sample 17561 was a composite made by mixing 17559 and 17560.

[a] Not included in sample.

Sections of Kennedy coal bed at points sampled in mine half a mile north of Nora.

	17559		17560	
	Ft.	in,	Ft.	in.
Coal	0	6⅜	0	5½
Bone	0	¼	0	⅛
Coal	1	3	0	6¼
"Rash"	0	⅛	..	..
Shale	..	..	[a]0	1¾
Coal	0	3¾	0	5¾
"Rash"	0	¼	..	..
Bone	..	..	0	¼
Coal	0	2⅝	0	8
"Rash"	0	⅛	..	..
Coal	0	4	..	..
Included in sample	2	8½	2	1⅞
Excluded from sample	0	0	0	1¾

18122, 18123, and 18124.—Samples were collected in mine No. 52 of the Clinchfield Coal Corporation at Dante, Va., November 17, 1913. Sample 18122 was cut 325 feet northeast of entrance to No. 0 drift; and sample 18123, about 1,700 feet southwest of entrance to No. 1 drift. Sample 18124 was a composite obtained by mixing 18122 and 18123.

Sections of Lower Banner coal bed at points sampled in Clinchfield No. 52 mine.

	18122		18123	
	Ft.	in,	Ft.	in.
Coal	3	0	2	6½
Coal and shale	..	..	[a]0	2
Included in sample	3	0	2	6½
Excluded from sample	0	0	0	2

32329, 32330, and 32331.—Samples collected from the Lower Banner coal bed in mine No. 52 of the Clinchfield Coal Corporation at Dante, Virginia, July 7, 1919. Samples were cut in room 5, off 3rd right entry off 4th left entry, one mile north of drift mouth.

Section of Lower Banner coal bed at point where samples 32329 and 32330 were obtained in Clinchfield No. 52 mine.

	Ft.	in.
Shale (black) roof		
Coal	4	8
Clay floor		

[a] Not included in sample.

10385.—Sample collected from the Lower Banner coal bed in Mine No. 52 (called Clinchfield when sampled) of the Clinchfield Coal Corporation at Dante, Virginia, April 30, 1910. The sample was cut in the main entry, 150 feet from the mine mouth, and represents 2 feet 4 inches of coal.

4057.—Sample was collected from the Lower Banner coal bed in mine No. 51 (called No. 2 when sampled) of the Clinchfield Coal Corporation at Dante, Virginia, October 4, 1906. The sample was obtained in room 4 off the left entry.

Section of Lower Banner coal bed at point sampled in Clinchfield No. 51 mine.

	4057	
	Ft.	in.
Coal, alternate bright and dull bands	1	7
Coal, laminated	0	3
Coal, solid	1	5
Clay	[a]0	6
Coal, bright	[a]0	2
Included in sample	3	3
Excluded from sample	0	8

18243, 18244, 18245, and 18246.—Samples collected from the Lower Banner coal bed in mine No. 55 of the Clinchfield Coal Corporation at Wilder, Virginia, November 25, 1914. Sample 18243 was obtained 900 feet S. 60° W. of No. 3 opening; sample 18244, about 2,500 feet S. 35° E. of No. 5 opening; and sample 18245, about 1,300 feet N. 35° W. of No. 2 opening. Sample 18246 was a composite made by mixing 18243, 18244, and 18245.

Sections of Lower Banner coal bed at point sampled in Clinchfield No. 55 mine.

	18243		18244		18245	
	Ft.	in.	Ft.	in.	Ft.	in.
Coal	..	..	0	7	..	..
"Rash"	..	..	[a]0	2	..	..
Sandstone	..	..	[a]1	9	..	..
"Rash"	..	..	..	..	[a]0	½
Coal	3	4	3	5	3	6
"Rash"	[a]0	3½	[a]0	7	[a]0	4
Included in sample	3	4	4	0	3	6
Excluded from sample	0	3½	2	6	0	4½

[a] Not included in sample.

32509, 32510, and 32511.—Samples collected in Lower Banner mine No. 1 of Robert Fleming and Company at Banner, Virginia, July 29, 1919. Sample 32509 was secured at the face of the main entry 700 feet west of the drift mouth, and sample 32510 was cut at the face of the main air course 600 feet west of the drift mouth. Sample 32511 was a composite made by mixing the first two samples.

Sections of Lower Banner coal bed at points sampled in Robert F. Fleming & Co.'s No. 1 mine.

	32509		32510	
	Ft.	in.	Ft.	in.
Coal	2	6	2	3
Clay	..	..	[a]0	1½
Coal	..	..	0	6
Included in sample	2	6	2	9
Excluded from sample	..	..	0	1½

18226, 18227, 18228, and 18229.—Samples were collected from the Upper Banner coal bed in the Cranesnest No. 1 mine of the Clinchfield Coal Corporation, about 1½ miles northwest of Toms Creek station, November 22, 1913. Sample 18226 was obtained 1,500 feet southwest of entrance to main Caney entry; sample 18227, about 500 feet northeast of main Caney entry; and sample 18228, about 4,100 feet southeast of main Caney entry. The main Caney entry is on Hurricane Fork of Caney Creek, about 1½ miles northeast of the main entrance to mine. Sample 18229 was a composite made by mixing 18226, 18227, and 18228.

Sections of Upper Banner coal bed at points sampled in Cranesnest mine.

	18226		18227		18228	
	Ft.	in.	Ft.	in.	Ft.	in.
Coal	0	1½	..	..	..	..
Sandy shale	[a]0	½	..	..	..	..
Coal	2	0	1	10	2	10
Sandstone	[a]0	1	[a]0	1	[a]0	1
Coal	1	7½	2	2	1	5¾
Coal and shale	[a]0	2½	..	..	..	..
Shale	...	..	..	..	0	¼
Coal	0	3½	..	..	0	3
Shale	[a]0	4	..	..	[a]0	5
Coal	0	2	..	..	0	6
Shale	[a]0	1¾	..	..	0	⅛
Coal	0	10	..	..	0	9½
Included in sample	5	½	4	0	5	10⅝
Excluded from sample	0	9¾	0	1	0	6

[a] Not included in sample.

32407, 32408, and 32409.—Samples were collected from the Upper Banner coal bed in the Cranesnest mine of the Clinchfield Coal Corporation, July 18, 1919. Sample 32407 was obtained in room B, third south Caney mine, three miles northeast of drift mouth. Sample 32408 was cut near room 20, off main entry, third south Caney mine, 3¼ miles northeast of drift mouth. Sample 32409 was a composite made by mixing samples 32407 and 32408.

Sections of Upper Banner coal bed at points sampled in Cranesnest mine.

	32407		32408	
	Ft.	in.	Ft.	in.
Shale, carbonaceous	[a]1	2	[a]0	1
Coal	2	2	2	0
Sandstone	[a]0	1	[a]0	1½
Coal	1	9	1	5
Shale	[a]0	2	[a]0	½
Coal	0	2	0	2½
Shale	[a]0	2	[a]0	6
Coal	0	4	0	11
Included in sample	4	5	4	6½
Excluded from sample	1	7	..	9

10386.—Sample collected from the Upper Banner coal bed in the Swansea mine of the Virginia Iron, Coal & Coke Company, Toms Creek, Va., April 29, 1910. The sample was taken in room 21, off west entry 17, about 2,600 feet from the outcrop.

Section of Upper Banner coal bed at point sampled in Swansea mine.

	10386	
	Ft.	in.
Coal	2	4
Sandstone	[a]0	1½
Coal	1	8
Bone	[a]1	5
Coal	2	7
Included in sample	6	7
Excluded from sample	0	4½

2281 and 2282.—Samples collected from the Upper Banner coal bed in the Coeburn mine of the Virginia Iron, Coal & Coke Company at Toms Creek, Va., October 7, 1905. Sample 2281 was obtained in east entry

[a] Not included in sample.

17, about 3,000 feet northeast of the mine opening; and sample 2282 in room 3, off west entry 11, about 2,000 feet northeast of mine opening.

Sections of Upper Banner coal bed at points sampled in Coeburn mine.

	2281		2282	
	Ft.	in.	Ft.	in.
Coal	2	2½	0	10
Sandstone	[a]0	1½	..	..
"Mother coal"	..	..	0	¼
Coal	1	6	1	6
Shale	[a]0	1½	..	..
Sandstone	..	..	[a]0	1
Coal	[a]0	2	1	8
Shale	[a]0	2	[a]0	1
Coal	[a]0	6	[a]0	2
Shale	[a]0	1½	[a]0	3
Coal	1	8	[a]0	6
"Mother coal"	0	¼	..	..
Shale	..	..	[a]0	1
Coal	1	0	2	7
Included in sample	6	4¾	6	7¼
Excluded from sample	1	2½	1	2

32410, 32411, and 32412.—Samples collected from the Upper Banner coal bed in the Lee mine, No. 6, of the Virginia Iron, Coal and Coke Company, at Cranesnest 1½ miles northwest of Toms Creek station, July 18, 1919. Sample 32410 was cut 500 feet east of the drift mouth at the crop entry and only 50 to 60 feet from the outcrop. Sample 32411 was cut half-a-mile northeast of the drift mouth in the second cross-entry. Sample 32412 is a composite of samples 32410 and 32411.

Section of Upper Banner coal bed at point sampled in the Lee mine of the Virginia Iron, Coal and Coke Company.

	32410	
	Ft.	in.
Shale, carbonaceous	[a]0	1
Coal	1	11
Sandstone	[a]0	1½
Coal	1	6
Shale, carbonaceous	[a]0	10
Coal	0	7
Shale	[a]0	½
Coal	2	10
Included in sample	6	10
Excluded from sample	1	1

[a]Not included in sample.

	32411 Ft.	in.
Coal	1	6
Shale	[a]0	½
Coal	0	11
Sandstone	[a]0	1½
Coal	1	8
Shale	[a]0	2
Coal	0	6
Shale	[a]0	½
Coal	1	3
Shale	[a]0	1
Coal	1	5
Included in sample	7	3
Excluded from sample	0	5½

32413.—Sample collected from Upper Banner coal bed in the Sexton mine (No. 2) of the Virginia Iron, Coal and Coke Company, at Toms Creek, Virginia, July 19, 1919. The sample was secured 2½ miles northeast of the drift mouth in 15 west entry off the main entry.

Section of Upper Banner coal bed at point sampled in the Sexton mine of the Virginia Iron, Coal & Coke Company.

	32413 Ft.	in.
Coal	[a]0	6
Shale	[a]0	10
Coal	1	10
Sandstone	[a]0	1½
Coal	1	5
Shale	[a]0	½
Coal	0	4
Shale	[a]0	4
Coal	0	4
Shale	[a]0	1
Coal	0	11
Shale	[a]0	2
Coal	0	5
Included in sample	5	3
Excluded from sample	2	1

18128, 18129, 18130, and 18131.—Samples of the Upper Banner coal collected in No. 2 mine of the Clinchfield Coal Corporation, 1¾ miles northeast of Dante, Virginia, November 18, 1913. Sample 18128 was obtained 2,400 feet N. 18° W. of entrance to drift No. 3, McClure; 18129, about

[a]Not included in sample.

2,750 feet S. 78° E. of entrance to drift No. 5, tunnel line (on Middle Fork of Lick Creek); and 18130, about 3,400 feet S. 85° E. of entrance to drift No. 1, McClure. Sample 18131 was a composite made by mixing 18128, 18129, and 18130.

Sections of Upper Banner coal bed at points sampled in Clinchfield No. 2 mine.

	18128		18129		18130	
	Ft.	in.	Ft.	in.	Ft.	in.
Coal	1	10	1	4	1	6
Sandstone	[a]0	1½	[a]0	1	[a]0	1
Coal	1	2½	1	2	1	5
Sandstone	[a]0	½	..	..	[a]0	1
Shale	..	..	[a]0	1	..	..
Coal	2	5	1	6	1	10
Included in sample	5	5½	4	0	4	9
Excluded from sample	0	2	0	2	0	2

10734, 10735, and 10736.—Samples collected from the Upper Banner coal bed in mine No. 2 of the Clinchfield Coal Corporation, 1¾ miles northeast of Dante, Virginia, August 13, 1910. Sample 10734 was obtained at face of butt-entry, off the fourth left drift off the McClure entry; and sample 10735 in room 16, off right entry 3, off the first drift off McClure entry. Sample 10736 was a composite made by mixing 10734 and 10735.

Sections of Upper Banner coal bed at points sampled in Clinchfield No. 2 mine.

	10734		10735	
	Ft.	in.	Ft.	in.
Coal	0	8½	0	6¾
Coal (hard)	0	3½	0	5
Coal	0	5¾	0	7
Sandstone	[a]0	¾	[a]0	1½
Coal	1	4	1	4
Shale	[a]0	¾	[a]0	2¾
Coal	0	5	0	6
Coal (hard)	0	5	0	3¾
Coal	1	5¼	1	1
Included in sample	5	1	4	9½
Excluded from sample	0	1½	0	4¼

[a] Not included in sample.

3942.—Sample of the Upper Banner coal collected in mine No. 2 (called No. 3 when sampled) of the Clinchfield Coal Corporation, 1¾ miles northeast of Dante, October 4, 1906. The sample was cut in butt-entry 6, off the main entry.

Section of Upper Banner coal bed at point sampled in Clinchfield No. 2 mine.

	3942 Ft.	in.
Coal	1	10
Sandstone	[a]0	1
Coal	0	10
Shale, gritty	[a]0	½
Coal	2	5
Included in sample	5	1
Excluded from sample	0	1½

32168, 32169, 32170, 32171, and 32172.—Samples from the Upper Banner coal bed collected in No. 2 mine of the Clinchfield Coal Corporation at Dante, Virginia, June 14 and 16, 1919. Sample 32168 was obtained in the tenth right entry, 200 feet from the main entry, at Engineer's bench mark A-870; sample 32169 was cut near room 20, fourth left entry off the main entry; sample 32170 was secured near room 15 in the third left air course off the seventh right entry; and sample 32171 was obtained in room 39 fourth right entry, off right left entry.

Sample 32172 was a composite made by mixing the first four samples. All samples were taken at a distance of 2 miles or more from the drift mouth.

Sections of Upper Banner coal bed in Clinchfield No. 2 mine.

	32168 Ft.	in.
Coal	1	7½
Sandstone	[a]0	1
Coal	1	6
Clay	[a]0	1
Coal	0	3
Clay	[a]0	1
Coal	2	0
Included in sample	5	4½
Excluded from sample	0	3

[a] Not included in sample.

	32169 Ft.	in.
Coal	0	1½
Shale, carbonaceous	[a]0	1
Coal	1	5
Sandstone	[a]0	2
Coal	1	5
Clay	[a]0	1½
Coal	0	3
Clay	0	1
Coal	2	0
Included in sample	5	3½
Excluded from sample	0	4½

	32170 Ft.	in.
Coal	0	1
Shale	[a]0	2
Coal	0	2
Shale, sandy	[a]0	5
Coal	1	4
Sandstone	[a]0	1½
Coal	1	2
Clay	[a]0	1
Coal	0	5
Clay	[a]0	1½
Coal	1	8
Clay	[a]0	1
Coal	1	9
Included in sample	6	7
Excluded from sample	1	0

	32171 Ft.	in.
Coal	1	6
Sandstone	[a]0	1½
Coal	1	4
Clay	[a]0	1
Coal	2	5
Included in sample	5	3
Excluded from sample	0	2½

10737, 10738, and 10739.—Samples of the Upper Banner coal collected in mine No. 5 of the Clinchfield Coal Corporation, 1½ miles northeast of Dante, Va., August 10, 1910. Sample 10737 was obtained at the face of room 14, right entry 5, off drift 9; and sample 10738, from the butt, on left entry 9, off drift 9. Sample 10739 was a composite obtained by mixing 10737 and 10738.

[a] Not included in sample.

Sections of Upper Banner coal bed at points sampled in Clinchfield No. 5 mine.

	10737		10738	
	Ft.	in.	Ft.	in.
Coal	0	4¾	1	10½
"Mother coal"	..	..	0	⅜
Coal	1	4¾	0	4⅝
Sandstone	[a]0	1½	[a]0	1¾
Coal	0	10	0	4½
Shale	[a]0	¾	[a]0	½
Coal	1	4¼	1	1
"Mother coal"	0	⅛	..	..
Coal	1	⅜	1	6
Included in sample	5	¼	5	3
Excluded from sample	0	2¼	0	2¼

10387.—Sample of the Upper Banner coal collected in mine No. 3 of the Clinchfield Coal Corporation at Dante, Va.; April 30, 1910. The sample was obtained in the fourth right entry, 1,000 feet from mine mouth.

Section of Upper Banner coal bed at point sampled in Clinchfield No. 3 mine.

	10387	
	Ft.	in.
Coal	0	2½
Parting	[a]0	2
Coal	1	6
Sandstone	[a]0	1
Coal	1	2½
Parting	[a]0	1
Coal	1	11½
Included in sample	4	10½
Excluded from sample	0	4

32326, 32327, and 32328.—Samples from the Upper Banner coal bed collected in mine No. 3 of the Clinchfield Coal Corporation at Dante, Virginia, July 7, 1919. Sample 32326 was cut in the third right entry off the main entry; sample 32327 was secured in room 22, main entry off fifth left entry. These locations are about 4,000 feet east of the drift mouth. Sample 32328 was a composite made by mixing the first two samples.

[a] Not included in sample.

Sections of Upper Banner coal bed at points sampled in Clinchfield No. 3 mine.

	32326		32327	
	Ft.	in.	Ft.	in.
Coal	0	3	0	1
Bone	0	2	0	1
Coal	1	4	1	2
Sandstone	[a]0	1½	[a]0	1½
Coal	1	5	1	4
Shale	[a]0	1	[a]0	1½
Coal	2	1	1	10
Included in sample	5	3	4	6
Excluded from sample	0	2½	0	3

18235, 18236, 18237, and 18238.—Samples collected in mine No. 6 of the Clinchfield Coal Corporation at Wilder, Virginia, November 25, 1913. Sample 18235 was obtained 3,000 feet S. 71° W. of No. 1 drift; sample 18236 in room 5, about 1,250 feet S. 35° E. of No. 3 opening; and sample 18237, about 4,000 feet S. 10° W. of No. 3 opening. Sample 18238 was a composite obtained by mixing 18235, 18236, and 18237.

Sections of Upper Banner coal bed at points sampled in Clinchfield No. 6 mine.

	18235		18236		18237	
	Ft.	in.	Ft.	in.	Ft.	in.
Coal	1	6	1	2	1	7
Sandstone	[a]0	1	[a]0	1	[a]0	1
Coal	1	6¾	1	6¼	1	8½
Shale	[a]0	1	..	..	[a]0	1
Coal and shale	..	..	[a]0	4¼	..	..
"Rash"	..	..	..	..	[a]0	4½
Coal	2	2	0	4¼	1	11
Shale	[a]0	3¼	[a]0	½	..	..
"Rash" and clay	..	..	..	..	[a]0	6
Coal	1	1½	1	5	1	5
Coal and shale	..	..	[a]0	6	..	..
Coal	..	..	0	8½	..	..
Included in sample	6	4¼	5	2	6	7½
Excluded from sample	0	5¼	0	11¾	1	½

17751 and 17752.—Samples collected from the Splash Dam coal bed from small local drift mine of C. C. Owens on Russell Prater Creek, 1 mile above mouth (location 315 on map), September 19, 1913. Sample 17751 was obtained 75 feet east of drift mouth and 10 feet north of main drift; sample 17752, about 25 feet south of 17751.

[a]Not included in sample.

Sections of Splash Dam coal bed at points sampled in C. C. Owens mine.

	17751		17752	
	Ft.	in.	Ft.	in.
Coal	0	8½	1	8
"Rash"	0	¼	..	..
Shale	..	..	[a]0	½
Coal	0	11	0	2
Shale	0	¼	[a]0	1
Coal	0	2	0	3½
Shale	[a]0	1¼	..	..
Shale and pyrites	..	..	0	¼
Coal	0	7½	0	4
Included in sample	2	5½	2	5¾
Excluded from sample	0	1¼	0	1½

15100 and 15101.—Samples collected from the Dorchester (Glamorgan) coal bed in Glamorgan No. 3 mine of the Stone Gap Colliery Company at Glamorgan, Virginia, November 5, 1912. Sample 15100 was obtained at the face of the second dip entry, 6,000 feet from the mine mouth; sample 15101, at the face of the Glady entry, 7,000 feet from the mine mouth.

Sections of Dorchester (Glamorgan) coal bed at points sampled in Glamorgan No. 3 mine.

	15100		15101	
	Ft.	in.	Ft.	in.
Coal	1	9	..	..
Bone	[a]0	1	..	..
Coal	1	10	3	8
Bone	[a]0	1½	[a]0	1
Coal	0	8	0	7
Included in sample	4	3	4	3
Excluded from sample	0	2½	0	1

32842, 32843, and 32844.—Samples from the Dorchester (Glamorgan) coal bed collected in Glamorgan No. 3 mine of the Stone Gap Colliery Company at Glamorgan, Virginia, August 1, 1919. Sample 32842 was secured in room 19, first right entry, 1½ miles northeast of the drift mouth; sample 32843, in the third right entry, No. 2 room, about 1½ miles northeast of the drift mouth.

Sections of Dorchester (Glamorgan) coal bed at points sampled in Glamorgan No. 3 mine.

	32842		32843	
	Ft.	in.	Ft.	in.
Coal	0	3½	0	8
Shale	0	¼	0	¼
Coal	1	3	0	3
Shale	0	¼	0	¼

[a]Not included in sample.

	32842		32843	
	Ft.	in.	Ft.	in.
Coal	0	4	0	6
Shale	[a]0	½	[a]0	½
Coal	[a]0	1	0	4
Shale	[a]0	½	[a]0	½
Coal	0	6	[a]0	1
Shale	0	¼	[a]0	1
Coal	1	4	0	6
Bone	[a]0	1	..	..
Coal, hard	0	7	1	3
Bone	..	..	[a]0	1½
Coal	..	..	0	9
Included in sample	4	4¼	4	3½
Excluded from sample	0	3½	0	4½

17743 and 17744.—Samples collected from the Eagle coal bed in a small local drift mine of the Yellow Poplar Lumber Company on Slate Branch of Barts Lick Creek, 3 miles east of the mouth of Pound River (location 337 on map), September 17, 1913. Sample 17743 was obtained 200 feet east of entrance to mine; and sample 17744, about 220 feet No. 85° E. of entrance to mine.

Sections of Eagle coal bed at points sampled in Yellow Poplar Lumber Company mine.

	17743		17744	
	Ft.	in.	Ft.	in.
Coal, pyritiferous	[a]0	8	[a]0	9½
Shale	[a]0	7	[a]0	6½
Coal	0	3	0	3
"Rash"	0	⅛	0	¼
Coal	0	9½	0	8⅛
Bone	[a]0	1	[a]0	1
Coal	1	1½	1	2⅞
Sandstone	[a]0	1½	[a]0	1
Coal	1	3	1	3½
Included in sample	3	5⅛	3	5¾
Excluded from sample	1	5½	1	6

14767.—Sample from the Clintwood coal bed collected in Elbert Powers small local drift mine on Big Ridge, 5½ miles south of Clintwood, Virginia (location 79 on map), September 17, 1912. The sample was cut 20 feet from the drift mouth.

[a]Not included in sample.

Section of Clintwood coal bed at point sampled in Elbert Powers mine.

	14767 Ft.	in.
Coal	[a]2	7½
Bone	[a]0	7
Coal	1	11
"Rash"	0	¾
Coal	0	3½
"Rash"	0	¾
Coal	2	4
Included in sample	4	8
Excluded from sample	3	2½

14766.—Sample collected from the Clintwood coal bed in John A. Yeates small local drift mine, 1 mile southwest of Clintwood, Va., September 21, 1912. The sample was cut at the end of right entry 1, off the main entry, and 100 feet from the main entry.

Section of Clintwood coal bed at point sampled in Yeates mine.

	14766 Ft.	in.
Bone	0	1
Coal	0	9
Bone	0	2
Coal	0	8½
Bone	0	1¼
Coal	0	3½
Bone	0	1½
Coal	0	3
Bone	0	1
Coal	1	8
Included in sample	4	2¾

3827.—Sample collected from the Clintwood coal bed in the Chase and Damron local drift mine, three-quarters of a mile south of Clintwood, Virginia (location 70 on map), September 21, 1906. The sample was taken at the face of a drift about 150 feet from the main entry.

Section of Clintwood coal bed at point sampled in Chase and Damron mine.

	3827 Ft.	in.
Coal	4	4
Pyrite	[a]0	2
Coal	[a]1	9
Included in sample	4	4
Excluded from sample	1	11

[a] Not included in sample.

Table of analyses of coal samples from mines in and near Dickenson County, Virginia.

A = analysis of sample as received, B = air-dried, C = moisture free, D = moisture and ash free.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
In Pennington formation.	Burtons Ford mine No. 1, south side of Clinch River, 3 miles southwest of St. Paul.	Albert W. Giles.....	176	32513	2.6	A	3.6	32.1	60.5	3.8	.47	5.32	81.01	1.35	8.03	7,905	14,230
						B	1.1	32.9	62.1	3.9	.48	5.16	83.15	1.39	5.90	8,115	14,610
						C	.....	33.3	62.7	4.0	.49	5.10	84.06	1.40	4.99	8,205	14,770
						D	.....	34.6	65.4	.....	.51	5.31	87.52	1.46	5.20	8,540	15,380
Tiller	No. 201 of the Clinchfield Coal Corporation on Hurricane Fork of Dump Creek.	T. K. Harnsberger...	176	18239	1.0	A	1.8	31.4	60.3	6.5	.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	.....	.....	.....	.....	8,590	15,460
Do.....	.....do	.....do.....	176	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
Do.....	.....do	.....do.....	176	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
Do.....	.....do	.....do.....	176	18242	1.6	A	2.2	31.9	59.4	6.5	.46	5.11	79.69	1.04	7.20	7,840	14,110
						B	.6	32.5	60.3	6.6	.47	5.02	80.94	1.06	5.91	7,960	14,330
						C	.....	32.7	60.7	6.6	.47	4.98	81.48	1.06	5.36	8,015	14,430
						D	.....	35.0	65.0	.....	.50	5.33	87.28	1.14	5.75	8,585	15,460.
Jawbone	Virginia City No. 1 mine, Virginia Iron, Coal and Coke Co., at Virginia City, Va.	K. M. Way.....	176	5217	2.2	A	3.4	28.6	53.1	14.9	1.18	.....	.....	.....	.....	6,915	12,450
						B	1.2	29.3	54.3	15.2	1.20	.....	.....	.....	.....	7,060	12,710
						C	.....	29.6	54.9	15.5	1.22	.....	.....	.....	.....	7,155	12,880
						D	.....	35.0	65.0	.....	1.44	.....	.....	.....	.....	8,470	15,240
Do.....	.....do	.....do.....	176	5235	1.8	A	3.1	27.8	54.2	14.9	1.24	.....	.....	.....	.....	6,895	12,410
						B	1.3	28.3	55.2	15.2	1.26	.....	.....	.....	.....	7,020	12,640
						C	.....	28.7	55.9	15.4	1.28	.....	.....	.....	.....	7,115	12,800
						D	.....	33.9	66.1	.....	1.51	.....	.....	.....	.....	8,410	15,140

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
Jawbone	Virginia City mine, Virginia Iron, Coal and Coke Co.	C. K. Wentworth....	177	32503	0.7	A	1.8	29.6	49.0	19.6	1.43	.....	.....	.....	.....	6,545	11,790
						B	1.1	29.9	49.3	19.7	1.44	.....	.....	.....	.....	6,595	11,870
						C	.....	30.2	49.9	19.9	1.46	.....	.....	.....	.....	6,665	11,800
						D	.....	37.7	62.3	.....	1.82	.....	.....	.....	.....	8,325	14,980
Do.....	.....do	.....do	177	32504	0.4	A	1.6	31.3	50.1	17.0	1.01	.....	.....	.....	.....	6,775	12,200
						B	1.2	31.4	50.3	17.1	1.01	.....	.....	.....	.....	6,805	12,250
						C	.....	31.8	50.9	17.3	1.03	.....	.....	.....	.....	6,880	12,390
						D	.....	38.5	61.5	.....	1.25	.....	.....	.....	.....	8,325	14,980
Do.....	.....do	.....do	177	32505	0.6	A	1.6	32.3	50.8	15.3	1.76	.....	.....	.....	.....	6,955	12,520
						B	1.1	32.4	51.1	15.4	1.77	.....	.....	.....	.....	6,995	12,600
						C	.....	32.8	51.6	15.6	1.79	.....	.....	.....	.....	7,075	12,730
						D	.....	38.8	61.2	.....	2.12	.....	.....	.....	.....	8,375	15,080
Do.....	.....do	.....do	177	32506	0.4	A	1.5	32.3	49.5	16.7	.81	.....	.....	.....	.....	6,785	12,210
						B	1.1	32.5	49.7	16.7	.81	.....	.....	.....	.....	6,815	12,260
						C	.....	32.8	50.3	16.9	.82	.....	.....	.....	.....	6,885	12,390
						D	.....	39.5	60.5	.....	.99	.....	.....	.....	.....	8,285	14,920
Do.....	.....do	.....do	177	32507	0.5	A	1.5	31.4	49.8	17.3	1.25	4.70	68.93	1.32	6.47	6,775	12,190
						B	1.0	31.6	50.0	17.4	1.26	4.66	69.28	1.33	6.05	6,805	12,250
						C	.....	31.9	50.5	17.6	1.27	4.60	69.99	1.34	5.20	6,875	12,380
						D	.....	38.7	61.3	.....	1.54	5.58	84.94	1.63	6.31	8,345	15,020
Do.....	Mine No. 2, Twin City Coal Corporation, St. Paul, Va.	Albert W. Giles.....	178	32276	1.9	A	3.0	29.2	54.9	12.9	.71	4.80	72.26	1.41	7.99	7,055	12,700
						B	1.1	29.8	56.0	13.1	.72	4.68	73.66	1.44	6.42	7,195	12,950
						C	.....	30.2	56.6	13.2	.73	4.61	74.48	1.45	5.51	7,275	13,090
						D	.....	34.8	65.2	.....	.84	5.31	85.82	1.67	6.36	8,385	15,090
Do.....	Mine No. 3, Twin City Coal Corporation, St. Paul, Va.	.....do	179	32277	0.8	A	2.1	29.9	48.5	19.5	1.01	4.41	66.78	1.27	7.09	6,535	11,770
						B	1.3	30.2	48.9	19.6	1.02	4.36	67.34	1.28	6.40	6,595	11,870
						C	.....	30.6	49.5	19.9	1.03	4.27	68.23	1.30	5.32	6,680	12,020
						D	.....	38.1	61.9	.....	1.29	5.33	85.12	1.62	6.64	8,335	15,000

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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	Mine No. 1, Twin City Coal Corporation, St. Paul, Va.	Albert W. Giles	179	32275	0.8	A	1.9	34.7	50.9	12.5	2.18	4.87	72.04	1.37	7.08	7,145	12,860
						B	1.1	35.0	51.3	12.6	2.20	4.83	72.58	1.38	6.46	7,200	12,960
						C	.....	35.4	51.9	12.7	2.22	4.76	73.37	1.40	5.56	7,275	13,100
						D	.....	40.5	59.5	.....	2.54	5.45	84.03	1.60	6.38	8,335	15,000
Kennedy	No. 103 of the Clinchfield Coal Corporation, 1 mile northwest of Dante, Va.	T. K. Harnsberger	179	18121F	1.9	A	2.9	31.9	57.8	7.4	1.78	.....	.....	.....	.....	7,655	13,780
						B	1.0	32.5	58.9	7.6	1.81	.....	.....	.....	.....	7,800	14,040
						C	.....	32.8	59.6	7.6	1.83	.....	.....	.....	.....	7,880	14,190
						D	.....	35.5	64.5	.....	1.98	.....	.....	.....	.....	8,535	15,360
Do	Small local mine on McClure River, ½ mile north of Nora.	Henry Hinds	179	17559	1.8	A	2.6	25.5	61.0	10.9	.70	.....	.....	.....	.....	7,470	13,440
						B	.9	25.9	62.1	11.1	.71	.....	.....	.....	.....	7,605	13,690
						C	.....	26.1	62.7	11.2	.72	.....	.....	.....	.....	7,670	13,810
						D	.....	29.5	70.5	.....	.81	.....	.....	.....	.....	8,640	15,550
Do	do	do	179	17560	1.7	A	2.6	26.0	63.2	8.2	.73	.....	.....	.....	.....	7,725	13,910
						B	.9	26.5	64.3	8.3	.74	.....	.....	.....	.....	7,860	14,150
						C	.....	26.7	64.9	8.4	.75	.....	.....	.....	.....	7,935	14,290
						D	.....	29.2	70.8	.....	.82	.....	.....	.....	.....	8,660	15,590
Do	do	do	179	17561F	1.8	A	2.6	26.2	61.7	9.5	.74	4.75	77.60	1.57	5.86	7,575	13,640
						B	.9	26.6	62.8	9.7	.75	4.64	78.98	1.60	4.38	7,710	13,880
						C	.....	26.9	63.4	9.7	.76	4.58	79.70	1.61	3.61	7,780	14,010
						D	.....	29.8	70.2	.....	.84	5.07	88.30	1.78	4.01	8,620	15,520
Lower Banner	No. 52 of the Clinchfield Coal Corporation at Dante, Va.	T. K. Harnsberger	180	18122	1.6	A	2.5	35.6	56.2	5.7	.66	.....	.....	.....	.....	7,930	14,280
						B	.9	36.1	57.2	5.8	.67	.....	.....	.....	.....	8,060	14,510
						C	.....	36.4	57.7	5.9	.68	.....	.....	.....	.....	8,135	14,640
						D	.....	38.7	61.3	.....	.72	.....	.....	.....	.....	8,640	15,550
Do	do	do	180	18123	1.1	A	2.0	35.7	54.5	7.8	.66	.....	.....	.....	.....	7,685	13,830
						B	.9	36.1	55.1	7.9	.67	.....	.....	.....	.....	7,770	13,990
						C	.....	36.4	55.6	8.0	.67	.....	.....	.....	.....	7,840	14,110
						D	.....	39.5	60.5	.....	.73	.....	.....	.....	.....	8,520	15,330

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
Lower Banner ..	No. 52 of the Clinchfield Coal Corporation at Dante, Va.	T. K. Harnsberger...	180	18124F	1.4	A	2.3	35.5	55.5	6.7	.67	5.26	78.84	1.69	6.83	7,780	14,000
						B	.9	36.0	56.3	6.8	.68	5.18	79.94	1.71	5.69	7,890	14,200
						C	.....	36.3	56.8	6.9	.69	5.13	80.66	1.73	4.92	7,960	14,330
						D	.....	39.0	61.0	.....	.74	5.51	86.61	1.86	5.28	8,545	15,390
Do.....	.....do	C. K. Wentworth....	180	32329	0.6	A	1.5	36.1	56.3	6.1	.68	.....	.....	.....	.....	7,920	14,250
						B	.9	36.3	56.6	6.2	.68	.....	.....	.....	.....	7,970	14,340
						C	.....	36.6	57.1	6.3	.69	.....	.....	.....	.....	8,035	14,460
						D	.....	39.1	60.9	.....	.74	.....	.....	.....	.....	8,560	15,410
Do.....	.....do	.....do	180	32330	0.6	A	1.5	36.5	55.7	6.3	.72	.....	.....	.....	.....	7,885	14,190
						B	.9	36.7	56.0	6.4	.72	.....	.....	.....	.....	7,930	14,270
						C	.....	37.1	56.5	6.4	.73	.....	.....	.....	.....	7,995	14,390
						D	.....	39.6	60.4	.....	.78	.....	.....	.....	.....	8,545	15,380
Do.....	.....do	.....do	180	32331	0.6	A	1.4	36.2	56.2	6.2	.69	5.29	79.59	1.65	6.58	7,900	14,220
						B	.8	36.4	56.6	6.2	.68	5.25	80.09	1.66	6.08	7,950	14,310
						C	.....	36.7	57.0	6.3	.70	5.20	80.72	1.67	5.42	8,010	14,420
						D	.....	39.2	60.8	.....	.75	5.55	86.14	1.78	5.78	8,550	15,390
Do.....	No. 52 (Called Clinchfield when sampled) of the Clinchfield Coal Corporation at Dante, Va.	E. G. Woodruff.....	181	10385	1.1	A	2.1	33.7	57.7	6.5	.65	5.44	78.59	1.53	7.34	7,855	14,140
						B	1.0	34.2	58.3	6.5	.66	5.38	79.46	1.55	6.43	7,940	14,290
						C	.....	34.5	58.9	6.6	.66	5.31	80.30	1.56	5.58	8,025	14,440
						D	.....	36.9	63.1	.....	.71	5.68	85.96	1.67	5.98	8,590	15,460
Do.....	No. 51 (called No. 2 when sampled) of the Clinchfield Coal Corporation at Dante, Va.	R. W. Stone.....	181	4057	1.8	A	2.8	32.1	59.3	5.8	.84	.....	.....	.....	.....	.....	.....
						B	1.0	32.7	60.4	5.9	.85	.....	.....	.....	.....	.....	.....
						C	.....	33.0	61.0	6.0	.86	.....	.....	.....	.....	.....	.....
						D	.....	35.1	64.9	.....	.92	.....	.....	.....	.....	.....	.....
Do.....	No. 55 of the Clinchfield Coal Corporation at Wilder, Va.	T. K. Harnsberger...	181	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	15,550

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
Lower Banner ..	No. 55 of the Clinchfield Coal Corporation at Wilder, Va.	T. K. Harnsberger...	181	18244	1.6	A	2.4	34.6	57.3	5.7	.83	.....	.....	.....	.....	7,945	14,300
						B	.8	35.2	58.3	5.7	.84	.....	.....	.....	.....	8,075	14,540
						C	.....	35.5	58.7	5.8	.85	.....	.....	.....	.....	8,140	14,660
						D	.....	37.6	62.4	.....	.90	.....	.....	.....	.....	8,645	15,560
Do.....	.....do	.....do.....	181	18245	2.0	A	2.7	33.7	57.9	5.7	.78	.....	.....	.....	.....	7,920	14,260
						B	.8	34.4	59.0	5.8	.80	.....	.....	.....	.....	8,080	14,540
						C	.....	34.7	59.5	5.8	.80	.....	.....	.....	.....	8,145	14,660
						D	.....	36.8	63.2	.....	.85	.....	.....	.....	.....	8,650	15,570
Do.....	.....do	.....do.....	181	18246	2.0	A	2.7	33.8	57.7	5.8	.83	5.27	79.33	1.29	7.50	7,915	14,250
						B	.7	34.5	58.9	5.9	.85	5.15	80.93	1.32	5.85	8,075	14,530
						C	.....	34.8	59.3	5.9	.85	5.11	81.55	1.33	5.22	8,135	14,650
						D	.....	37.0	63.0	.....	.90	5.43	86.70	1.41	5.56	8,650	15,570
Do.....	No. 1 of Robert Fleming and Co. at Banner, Va.	Albert W. Giles.....	182	32509	1.2	A	2.3	32.8	56.7	8.2	.65	.....	.....	.....	.....	7,640	13,750
						B	1.1	33.2	57.4	8.3	.66	.....	.....	.....	.....	7,730	13,910
						C	.....	33.6	58.0	8.4	.66	.....	.....	.....	.....	7,815	14,060
						D	.....	36.7	63.3	.....	.72	.....	.....	.....	.....	8,525	15,340
Do.....	.....do	.....do.....	182	32510	0.7	A	1.9	33.8	57.5	6.8	.77	.....	.....	.....	.....	7,790	14,020
						B	1.2	34.0	57.9	6.9	.78	.....	.....	.....	.....	7,845	14,120
						C	.....	34.4	58.6	7.0	.78	.....	.....	.....	.....	7,935	14,280
						D	.....	37.1	62.9	.....	.84	.....	.....	.....	.....	8,530	15,350
Do.....	.....do	.....do.....	182	32511	0.9	A	2.2	33.3	57.0	7.5	.70	5.13	78.05	1.57	7.10	7,710	13,880
						B	1.3	33.6	57.6	7.5	.71	5.08	78.78	1.58	6.33	7,780	14,010
						C	.....	34.1	58.3	7.6	.72	5.00	79.78	1.60	5.28	7,880	14,180
						D	.....	36.9	63.1	.....	.78	5.41	86.36	1.73	5.72	8,530	15,350
Upper Banner...	Cranesnest No. 1, of the Clinchfield Coal Corporation, about 1½ miles northwest of Toms Creek, Va.	T. K. Harnsberger...	182	18226	1.5	A	2.4	33.4	59.4	4.8	.58	.....	.....	.....	.....	8,035	14,460
						B	.9	33.9	60.3	4.9	.59	.....	.....	.....	.....	8,160	14,680
						C	.....	34.2	60.9	4.9	.59	.....	.....	.....	.....	8,235	14,830
						D	.....	36.0	64.0	.....	.62	.....	.....	.....	.....	8,660	15,590

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
Upper Banner...	Cranesnest No. 1, of the Clinchfield Coal Corporation, about 1½ miles northwest of Toms Creek, Va.	T. K. Harnsberger...	182	18227	1.5	A	2.3	32.9	59.9	4.9	.53	.....	.....	.....	.....	8,035	14,460
						B	.9	33.4	60.7	5.0	.54	.....	.....	.....	.....	8,150	14,670
						C	.....	33.7	61.3	5.0	.54	.....	.....	.....	.....	8,225	14,810
						D	.....	35.5	64.5	.....	.57	.....	.....	.....	.....	8,665	15,600
Do.....	.....do	.....do	182	18228	1.4	A	2.3	32.7	59.2	5.8	.51	.....	.....	.....	.....	7,985	14,370
						B	.9	33.2	60.1	5.8	.52	.....	.....	.....	.....	8,100	14,580
						C	.....	33.5	60.6	5.9	.52	.....	.....	.....	.....	8,170	14,710
						D	.....	35.5	64.5	.....	.55	.....	.....	.....	.....	8,685	15,630
Do.....	.....do	.....do	182	18229F	1.5	A	2.3	32.9	59.6	5.2	.54	5.18	80.78	1.57	6.71	8,010	14,420
						B	.8	33.4	60.5	5.3	.55	5.09	81.97	1.59	5.50	8,130	14,630
						C	.....	33.7	61.0	5.3	.55	5.05	82.67	1.61	4.78	8,200	14,760
						D	.....	35.5	64.5	.....	.58	5.33	87.33	1.70	5.06	8,660	15,590
Do.....	Cranesnest (Caney mine) of the Clinchfield Coal Corporation, 1½ miles northwest of Toms Creek, Va.	Albert W. Giles.....	183	32407	1.5	A	2.5	32.8	58.3	6.4	.52	.....	.....	.....	.....	7,825	14,080
						B	1.0	33.3	59.2	6.5	.53	.....	.....	.....	.....	7,940	14,290
						C	.....	33.6	59.8	6.6	.53	.....	.....	.....	.....	8,020	14,440
						D	.....	35.9	64.1	.....	.57	.....	.....	.....	.....	8,580	15,450
Do.....	.....do	.....do	183	32408	1.4	A	2.3	32.3	59.5	5.9	.59	.....	.....	.....	.....	7,865	14,160
						B	.9	32.8	60.3	6.0	.60	.....	.....	.....	.....	7,975	14,350
						C	.....	33.0	60.9	6.1	.60	.....	.....	.....	.....	8,045	14,480
						D	.....	35.2	64.8	.....	.64	.....	.....	.....	.....	8,560	15,410
Do.....	.....do	.....do	183	32409	1.4	A	2.2	32.4	59.1	6.3	.55	5.21	79.72	1.63	6.65	7,850	14,130
						B	.8	32.9	60.0	6.3	.56	5.12	80.85	1.65	5.49	7,960	14,330
						C	.....	33.1	60.5	6.4	.56	5.08	81.51	1.67	4.80	8,025	14,450
						D	.....	35.4	64.6	.....	.60	5.43	87.06	1.78	5.13	8,570	15,430
Do.....	Swansea mine of the Virginia Iron, Coal and Coke Company at Toms Creek, Va.	E. G. Woodruff.....	183	10386	1.5	A	2.5	31.7	60.3	5.5	.52	5.59	79.69	1.56	7.13	7,920	14,250
						B	1.0	32.2	61.2	5.6	.53	5.50	80.90	1.58	5.90	8,040	14,470
						C	.....	32.5	61.8	5.7	.53	5.44	81.71	1.60	5.07	8,120	14,610
						D	.....	34.5	65.5	.....	.56	5.76	86.60	1.70	5.38	8,605	15,490

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
Upper Banner...	Coeburn mine of the Virginia Iron, Coal and Coke Company at Toms Creek, Va.	J. W. Groves and W. J. von Borries.	183	2281	1.6	A	2.7	32.4	60.4	4.5	.52	.....	.....	.....	.....	8,080	14,540
						B	1.1	32.9	61.4	4.6	.53	.....	.....	.....	.....	8,210	14,780
						C	.....	33.4	62.0	4.6	.53	.....	.....	.....	.....	8,305	14,950
						D	.....	35.0	65.0	.....	.56	.....	.....	.....	.....	8,705	15,670
Do.....	.....do	.....do	183	2282	1.7	A	2.9	32.0	61.0	4.1	.55	.....	.....	.....	.....	.....	.....
						B	1.2	32.6	62.0	4.2	.56	.....	.....	.....	.....	.....	.....
						C	.....	33.0	62.8	4.2	.57	.....	.....	.....	.....	.....	.....
						D	.....	34.4	65.6	.....	.60	.....	.....	.....	.....	.....	.....
Do.....	Lee mine (No. 6), Virginia Iron, Coal and Coke Co., 1½ miles northwest of Toms Creek, Va.	Albert W. Giles.....	184	32410	2.3	A	3.9	32.3	58.1	5.7	.48	.....	.....	.....	.....	7,760	13,970
						B	1.6	33.1	59.5	5.8	.49	.....	.....	.....	.....	7,945	14,300
						C	.....	33.7	60.4	5.9	.50	.....	.....	.....	.....	8,075	14,540
						D	.....	35.8	64.2	.....	.53	.....	.....	.....	.....	8,580	15,440
Do.....	.....do	.....do	184	32411	0.9	A	2.0	33.0	60.4	4.6	.50	.....	.....	.....	.....	8,000	14,400
						B	1.2	33.3	60.9	4.6	.50	.....	.....	.....	.....	8,075	14,530
						C	.....	33.7	61.6	4.7	.51	.....	.....	.....	.....	8,165	14,700
						D	.....	35.4	64.6	.....	.53	.....	.....	.....	.....	8,565	15,420
Do.....	.....do	.....do	184	32412	1.6	A	2.9	33.0	58.9	5.2	.55	5.31	80.06	1.61	7.26	7,855	14,140
						B	1.2	33.5	59.9	5.4	.56	5.21	81.38	1.64	5.91	7,985	14,380
						C	.....	33.9	60.7	5.4	.57	5.14	82.40	1.66	4.87	8,085	14,560
						D	.....	35.9	64.1	.....	.60	5.43	87.06	1.75	5.16	8,545	15,380
Do.....	Sexton mine (No. 2), Virginia Iron, Coal and Coke Co., Toms Creek, Va.	.....do	185	32413	2.1	A	3.2	30.4	52.0	14.4	.60	4.88	71.30	1.48	7.38	7,035	12,660
						B	1.1	31.1	53.1	14.7	.61	4.75	72.81	1.51	5.65	7,185	12,930
						C	.....	31.4	53.7	14.9	.62	4.67	73.66	1.53	4.68	7,270	13,080
						D	.....	36.9	63.1	.....	.73	5.48	86.50	1.80	5.49	8,535	15,360
Do.....	No. 2 of the Clinchfield Coal Corporation, 1¾ miles northeast of Dante, Va.	T. K. Harnsberger...	185	18128	1.0	A	1.8	35.3	55.8	7.1	.58	.....	.....	.....	.....	7,800	14,040
						B	.8	35.7	56.3	7.2	.58	.....	.....	.....	.....	7,875	14,180
						C	.....	35.9	56.8	7.3	.59	.....	.....	.....	.....	7,945	14,300
						D	.....	38.8	61.2	.....	.64	.....	.....	.....	.....	8,565	15,420

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
Upper Banner...	No. 2 of the Clinchfield Coal Corporation, 1¾ miles northeast of Dante, Va.	T. R. Harnsberger...	185	18129	1.4	A	2.4	36.3	55.1	6.2	.52	.....	.....	.....	.....	7,840	14,110
						B	1.0	36.8	55.9	6.3	.53	.....	.....	.....	.....	7,945	14,300
						C	.....	37.2	56.4	6.4	.53	.....	.....	.....	.....	8,025	14,450
						D	.....	39.7	60.3	.....	.57	.....	.....	.....	.....	8,570	15,430
Do.....	.....do	.....do	185	18130	0.8	A	1.6	36.7	55.3	6.4	.58	.....	.....	.....	.....	7,870	14,170
						B	.8	37.0	55.8	6.4	.58	.....	.....	.....	.....	7,935	14,290
						C	.....	37.3	56.2	6.5	.59	.....	.....	.....	.....	8,000	14,400
						D	.....	39.9	60.1	.....	.63	.....	.....	.....	.....	8,550	15,390
Do.....	.....do	.....do	185	18131F	1.1	A	1.8	36.2	55.5	6.5	.54	5.25	79.28	1.49	6.91	7,830	14,100
						B	.8	36.5	56.1	6.6	.55	5.18	80.12	1.51	6.04	7,915	14,250
						C	.....	36.8	56.5	6.7	.55	5.14	80.76	1.52	5.38	7,980	14,360
						D	.....	39.4	60.6	.....	.59	5.51	86.51	1.63	5.76	8,545	15,380
Do.....	.....do	P. M. Riefkin.....	186	10734	1.5	A	2.3	35.2	56.2	6.3	.59	.....	.....	.....	.....	7,830	14,100
						B	.8	35.7	57.1	6.4	.60	.....	.....	.....	.....	7,950	14,310
						C	.....	36.1	57.5	6.4	.60	.....	.....	.....	.....	8,020	14,440
						D	.....	38.6	61.4	.....	.64	.....	.....	.....	.....	8,570	15,430
Do.....	.....do	.....do	186	10735	2.1	A	3.0	35.2	56.6	5.2	.59	.....	.....	.....	.....	7,860	14,150
						B	.9	36.0	57.8	5.3	.60	.....	.....	.....	.....	8,030	14,450
						C	.....	36.2	58.4	5.4	.61	.....	.....	.....	.....	8,100	14,580
						D	.....	38.3	61.7	.....	.64	.....	.....	.....	.....	8,560	15,410
Do.....	.....do	.....do	186	10736	1.8	A	2.8	34.9	56.5	5.8	.59	5.32	80.13	1.43	6.76	7,860	14,150
						B	1.0	35.5	57.6	5.9	.60	5.21	81.60	1.46	5.25	8,005	14,410
						C	.....	36.0	58.1	5.9	.61	5.15	82.41	1.47	4.43	8,080	14,550
						D	.....	38.2	61.8	.....	.65	5.47	87.60	1.56	4.72	8,590	15,460
Do.....	No. 2 (called No. 3 when sampled) of the Clinchfield Coal Corporation at Dante, Va.	R. W. Stone.....	187	3942	1.3	A	2.4	32.4	57.9	7.3	.66	.....	.....	.....	.....	.....	.....
						B	1.1	32.8	58.7	7.4	.67	.....	.....	.....	.....	.....	.....
						C	.....	33.2	59.3	7.5	.68	.....	.....	.....	.....	.....	.....
						D	.....	35.9	64.1	.....	.74	.....	.....	.....	.....	.....	.....

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
Upper Banner...	No. 2 of the Clinchfield Coal Corporation, Dante, Va.	Albert W. Giles.....	187	32168	1.6	A	2.7	34.8	56.2	6.3	.87	.....	.....	.....	.....	7,820	14,080
						B	1.1	35.4	57.1	6.4	.88	.....	.....	.....	.....	7,945	14,300
						C	.....	35.8	57.8	6.4	.89	.....	.....	.....	.....	8,035	14,470
						D	.....	38.3	61.7	.....	.95	.....	.....	.....	.....	8,590	15,460
Do.....	.....do	.....do.....	187	32169	1.1	A	2.2	35.3	53.4	9.1	.71	.....	.....	.....	.....	7,585	13,650
						B	1.1	35.7	54.0	9.2	.72	.....	.....	.....	.....	7,670	13,800
						C	.....	36.1	54.6	9.3	.73	.....	.....	.....	.....	7,755	13,960
						D	.....	39.8	60.2	.....	.80	.....	.....	.....	.....	8,550	15,390
Do.....	.....do	.....do.....	187	32170	1.4	A	2.5	34.0	56.2	7.3	.52	.....	.....	.....	.....	7,720	13,890
						B	1.1	34.5	56.9	7.5	.53	.....	.....	.....	.....	7,830	14,090
						C	.....	34.9	57.6	7.5	.53	.....	.....	.....	.....	7,915	14,250
						D	.....	37.7	62.3	.....	.57	.....	.....	.....	.....	8,550	15,410
Do.....	.....do	C. K. Wentworth....	187	32171	1.1	A	2.2	36.2	55.4	6.2	.53	.....	.....	.....	.....	7,840	14,110
						B	1.1	36.6	56.0	6.3	.54	.....	.....	.....	.....	7,925	14,260
						C	.....	37.0	56.7	6.3	.54	.....	.....	.....	.....	8,015	14,420
						D	.....	39.5	60.5	.....	.58	.....	.....	.....	.....	8,555	15,400
Do.....	.....do	Albert W. Giles and C. K. Wentworth.	187	32172	1.3	A	2.4	34.7	55.7	7.2	.58	5.25	78.22	1.51	7.28	7,740	13,930
						B	1.1	35.1	56.5	7.3	.59	5.18	79.24	1.53	6.21	7,840	14,110
						C	.....	35.5	57.1	7.4	.59	5.11	80.13	1.55	5.29	7,925	14,270
						D	.....	38.4	61.6	.....	.64	5.51	86.47	1.67	5.71	7,555	15,400
Do.....	No. 5 of the Clinchfield Coal Corporation, 1½ miles northeast of Dante, Va.	P. M. Riefkin.....	188	10737	1.4	A	2.3	35.2	57.8	4.7	.55	.....	.....	.....	.....	8,015	14,430
						B	.9	35.7	58.6	4.8	.56	.....	.....	.....	.....	8,130	14,630
						C	.....	36.0	59.2	4.8	.56	.....	.....	.....	.....	8,205	14,770
						D	.....	37.8	62.2	.....	.59	.....	.....	.....	.....	8,625	15,520
Do.....	.....do	.....do.....	188	10738	1.2	A	2.1	35.1	57.1	5.7	.56	.....	.....	.....	.....	7,930	14,280
						B	.9	35.6	57.7	5.8	.57	.....	.....	.....	.....	8,030	14,450
						C	.....	35.9	58.3	5.8	.58	.....	.....	.....	.....	8,100	14,580
						D	.....	38.1	61.9	.....	.62	.....	.....	.....	.....	8,600	15,480

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
Upper Banner...	No. 5 of the Clinchfield Coal Corporation, 1½ miles north of Dante, Va.	P. M. Riefkin.....	188	10739	1.3	A	2.1	35.9	56.7	5.3	.57	5.45	80.24	1.43	6.98	7,965	14,330
						B	.8	36.4	57.4	5.4	.58	5.37	81.30	1.45	5.90	8,070	14,530
						C	.....	36.7	57.9	5.4	.58	5.33	81.93	1.46	5.26	8,130	14,640
						D	.....	38.8	61.2	.....	.61	5.64	86.64	1.54	5.75	8,600	15,480
Do.....	No. 3 of the Clinchfield Coal Corporation, 1 mile east of Dante, Va.	E. G. Woodruff.....	189	10387	1.4	A	2.3	35.7	55.0	7.0	.66	5.48	77.91	1.53	7.42	7,740	13,940
						B	.9	36.2	55.8	7.1	.67	5.40	79.02	1.55	6.26	7,850	14,130
						C	.....	36.5	56.3	7.2	.68	5.35	79.73	1.56	5.52	7,920	14,260
						D	.....	39.3	60.7	.....	.73	5.76	85.87	1.68	5.96	8,530	15,360
Do.....	.....do	C. K. Wentworth....	189	32326	1.1	A	2.2	36.4	51.9	9.5	.60	.....	.....	.....	.....	7,510	13,520
						B	1.1	36.8	52.5	9.6	.61	.....	.....	.....	.....	7,590	13,660
						C	.....	37.2	53.1	9.7	.61	.....	.....	.....	.....	7,675	13,820
						D	.....	41.2	58.8	.....	.68	.....	.....	.....	.....	8,500	15,300
Do.....	.....do	.....do	189	32327	1.0	A	2.0	37.4	53.9	6.7	.60	.....	.....	.....	.....	7,765	13,980
						B	1.1	37.7	54.5	6.7	.61	.....	.....	.....	.....	7,845	14,120
						C	.....	38.1	55.1	6.8	.61	.....	.....	.....	.....	7,925	14,270
						D	.....	40.9	59.1	.....	.65	.....	.....	.....	.....	8,505	15,310
Do.....	.....do	.....do	189	32328	1.0	A	2.0	37.0	52.9	8.1	.58	5.22	77.15	1.39	7.63	7,635	13,740
						B	1.0	37.4	53.5	8.1	.59	5.16	77.94	1.40	6.80	7,715	13,890
						C	.....	37.8	54.0	8.2	.59	5.09	78.75	1.42	5.95	7,795	14,030
						D	.....	41.1	58.9	.....	.64	5.54	85.78	1.55	6.49	8,490	15,280
Do.....	No. 6 of the Clinchfield Coal Corporation at Wilder, Va.	T. K. Harnsberger...	190	18235	2.4	A	3.3	35.7	55.0	6.0	.55	.....	.....	.....	.....	7,760	13,970
						B	1.0	36.6	56.3	6.1	.56	.....	.....	.....	.....	7,945	14,310
						C	.....	37.0	56.8	6.2	.57	.....	.....	.....	.....	8,030	14,450
						D	.....	39.4	60.6	.....	.61	.....	.....	.....	.....	8,555	15,400
Do.....	.....do	.....do	190	18236	2.4	A	3.2	35.4	55.1	6.3	.59	.....	.....	.....	.....	7,760	13,970
						B	.9	36.3	56.4	6.4	.60	.....	.....	.....	.....	7,945	14,300
						C	.....	36.6	56.9	6.5	.61	.....	.....	.....	.....	8,020	14,430
						D	.....	39.1	60.9	.....	.65	.....	.....	.....	.....	8,575	15,440

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
Upper Banner...	No. 6 of the Clinchfield Coal Corporation at Wilder, Va.	T. K. Harnsberger...	190	18237	2.4	A	3.3	35.1	56.9	4.7	.50	.....	.....	.....	.....	7,925	14,270
						B	.9	36.0	58.3	4.8	.51	.....	.....	.....	.....	8,115	14,610
						C	.....	36.3	58.8	4.9	.52	.....	.....	.....	.....	8,195	14,750
						D	.....	38.2	61.8	.....	.55	.....	.....	.....	.....	8,615	15,510
Do.....	.....do	.....do	190	18238	2.4	A	3.3	35.1	55.9	5.7	.55	5.37	78.72	1.37	8.28	7,820	14,080
						B	1.0	35.9	57.2	5.9	.56	5.23	80.62	1.40	6.34	8,010	14,420
						C	.....	36.3	57.8	5.9	.57	5.17	81.44	1.42	5.49	8,095	14,570
						D	.....	38.5	61.5	.....	.61	5.49	86.55	1.51	5.84	8,600	15,490
Splash Dam	Small local mine of C. C. Owens on Russell Prater Creek, 1 mile northeast of mouth.	.....do	190	17751	1.3	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	.....	32.1	67.9	.....	.83	.....	.....	.....	.....	.....	.....
Do.....	.....do	.....do	190	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	.....	.....	.....	.....	.....	.....
Dorchester	Glamorgan No. 3 of the Stone Gap Colliery Co. at Glamorgan, Va.	Chas. Butts	191	15100	1.6	A	2.6	33.1	59.3	5.0	1.37	.....	.....	.....	.....	7,895	14,220
						B	1.1	33.6	60.2	5.1	1.39	.....	.....	.....	.....	8,025	14,450
						C	.....	34.0	60.9	5.1	1.41	.....	.....	.....	.....	8,115	14,600
						D	.....	35.8	64.2	.....	1.49	.....	.....	.....	.....	8,550	15,390
Do.....	.....do	.....do	191	15101	2.0	A	3.2	31.3	59.1	6.4	.87	5.27	78.02	1.65	7.82	7,730	13,910
						B	1.3	31.9	60.3	6.5	.89	5.15	79.61	1.68	6.17	7,885	14,200
						C	.....	32.3	61.1	6.6	.90	5.08	80.65	1.71	5.08	8,550	14,380
						D	.....	34.6	65.4	.....	.96	5.44	86.33	1.83	5.44	.....	15,390
Do.....	.....do	C. K. Wentworth....	191	32842	1.2	A	2.5	31.8	59.3	6.4	1.29	.....	.....	.....	.....	7,785	14,010
						B	1.4	32.1	60.0	6.5	1.31	.....	.....	.....	.....	7,875	14,170
						C	.....	32.6	60.8	6.6	1.32	.....	.....	.....	.....	7,980	14,370
						D	.....	34.9	65.1	.....	1.41	.....	.....	.....	.....	8,545	15,580

Table of analyses of coal samples from mines in and near Dickenson County, Virginia—Contd.

Coal bed.	Name and location of mine.	Collector.	Text page where coal sections that yielded the samples are described.	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
Dorchester	Glamorgan No. 3 of the Stone Gap Colliery Co. at Glamorgan, Va.	C. K. Wentworth....	191	32843	1.5	A	2.8	33.4	59.7	4.1	.99	.....	.....	.....	.....	7,985	14,380
						B	1.3	33.9	60.6	4.2	1.01	.....	.....	.....	.....	8,105	14,590
						C	.....	34.4	61.4	4.2	1.02	.....	.....	.....	.....	8,215	14,790
						D	.....	35.9	64.1	.....	1.06	.....	.....	.....	.....	8,575	15,440
Do.....	.....do	.....do	191	32844	1.3	A	2.6	32.9	59.3	5.2	1.10	5.28	79.67	1.65	7.12	7,885	14,190
						B	1.3	33.3	60.1	5.3	1.11	5.20	80.75	1.67	6.02	7,995	14,390
						C	.....	33.8	60.9	5.3	1.13	5.12	81.81	1.69	4.93	8,095	14,580
						D	.....	35.7	64.3	.....	1.19	5.41	86.41	1.78	5.21	8,555	15,390
Eagle.....	Small local mine of the Yellow Poplar Lumber Co., 3 miles east of the mouth of Pound River.	T. K. Harnsberger...	192	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	.....	.....	.....	.....	7,905	14,230
						D	.....	35.2	64.8	.....	1.61	.....	.....	.....	.....	8,565	15,410
Do.....	.....do	.....do	192	17744	1.8	A	3.0	32.4	58.4	6.2	1.62	.....	.....	.....	.....	7,795	14,030
						B	1.2	33.0	59.5	6.3	1.65	.....	.....	.....	.....	7,935	14,290
						C	.....	33.4	60.2	6.4	1.67	.....	.....	.....	.....	8,030	14,460
						D	.....	35.7	64.3	.....	1.78	.....	.....	.....	.....	8,575	15,440
Clintwood.....	Small local mine of Elbert Powers, on Big Ridge, 5½ miles south of Clintwood, Va.	W. A. Nelson.....	192	14767	3.3	A	4.3	29.4	62.1	4.2	1.02	.....	.....	.....	.....	.....	.....
						B	1.0	30.4	64.2	4.4	1.05	.....	.....	.....	.....	.....	.....
						C	.....	30.7	64.9	4.4	1.07	.....	.....	.....	.....	.....	.....
						D	.....	32.1	67.9	.....	1.12	.....	.....	.....	.....	.....	.....
Do.....	Small local mine of John A. Yeates, 1 mile southwest of Clintwood, Va.	.....do	193	14766	1.2	A	2.2	34.2	60.4	3.2	.85	.....	.....	.....	.....	8,110	14,590
						B	1.0	34.6	61.2	3.2	.86	.....	.....	.....	.....	8,205	14,770
						C	.....	34.9	61.8	3.3	.87	.....	.....	.....	.....	8,290	14,920
						D	.....	36.1	63.9	.....	.96	.....	.....	.....	.....	8,570	15,420
Do.....	Small local mine of Chase and Damron, ¾ of a mile south of Clintwood, Va.	C. W. Dodge.....	193	3827	1.2	A	2.2	30.1	63.7	4.0	.87	.....	.....	.....	.....	.....	.....
						B	1.0	30.5	64.5	4.0	.88	.....	.....	.....	.....	.....	.....
						C	.....	30.8	65.1	4.1	.89	.....	.....	.....	.....	.....	.....
						D	.....	32.1	67.9	.....	.93	.....	.....	.....	.....	.....	.....

TESTS.

GENERAL STATEMENT.

Samples of coal, from two localities only a short distance south of Dickenson County, were subjected to a series of tests in fuel-testing plants of the U. S. Geological Survey to determine their value for commercial purposes. A run-of-mine sample from the Jawbone coal bed in the Virginia City No. 1 mine, at Virginia City, Va., was used in making steaming and producer-gas tests in the plant at Norfolk, Va. It had been exposed to weathering for 36 days before use at the testing plant. A car sample of lump coal, over a 3½-inch bar screen, from the Upper Banner coal bed in the Coeburn mine of the Virginia Iron, Coal and Coke Company, at Toms Creek, Va., was tested in the St. Louis plant.

In the following tables the essential results of these tests are summarized in a manner intended to show briefly the adaptability of the coal to the uses for which it was tested. Further information regarding the types of testing apparatus used, conditions under which the tests were made, etc., may be had by referring to the publications cited in the footnotes.

The tests emphasize the excellent qualities of coal that is essentially the same as that in Dickenson County. The coking tests gave especially favorable results, as did also private coking tests made of coal from the Clintwood bed at the Beverly mine, near Clintwood. The Pishel field test[1] for coking coal was applied to coal from many places in Dickenson County and indicated excellent coking qualities in all but two trials. Commercial operations have proved that high-grade coke can be made from the Upper Banner bed in the extreme southwest part of Dickenson County, and there is no reason to suppose that any of the coal in the region is not suitable for the same purpose.

[1] This test consists in pulverizing in an agate mortar a small quantity of the coal to be tested until it will pass through a 100-mesh sieve. The coal is then poured out of the mortar. If there is left adhering to the surface of the mortar a coating of coal particles that is removed with difficulty the coal will make excellent coke; if the mortar shows no coating of coal dust, the coal is to be regarded as non-coking. This test can not be regarded as conclusive for it failed to show a coking coal in the case of one of the best coking coals in southwest Virginia.

STEAMING TESTS.[1]

Test No. 601, Jawbone coal.—The coal burned with a medium-length flame and caked. A porous clinker formed on the dead plate and adhered to the bridge wall. Size of coal as used not recorded. Duration of test, 8 hours. Kind of grate, underfeed.

Test No. 602, Jawbone coal.—The coal burned with a medium-length flame and caked. A small porous clinker formed on the dead plate and adhered to the bridge wall. Size of coal as used not recorded. Duration of test, 8.10 hours. Kind of grate, underfeed.

Test No. 280, Upper Banner coal.—Automatic air admission not operated; clinker and refuse easily removed from furnace. Size of coal as used: Over 1-inch, 44.7 per cent; ½-inch to 1-inch, 20.2 per cent; ¼-inch to ½-inch, 15.7 per cent; under ¼-inch, 19.4 per cent. Duration of test, 9.88 hours. Kind of grate, rocking.

Test No. 283, Upper Banner coal.—Automatic air admission was operated. A thin solid clinker adhered to the grate. Size of coal as used: Over 1-inch, 32.8 per cent; ½-inch to 1-inch, 16.5 per cent; ¼-inch to ½-inch, 15.6 per cent; under ¼-inch, 35.1 per cent. Duration of test, 10 hours. Kind of grate, rocking.

Proximate analyses of coal as used.

	Test 601.	Test 602.	Test 280.	Test 283.
Moisture	1.3	1.6	1.7	3.3
Volatile matter	28.7	28.7	33.3	32.0
Fixed carbon	54.3	53.1	60.3	60.2
Ash	15.7	16.6	4.7	4.5
Sulphur	.94	.94	.64	.56

[1] Burrows, J. S., Mine sampling and chemical analyses of coals: U. S. Geol. Survey Bull. 362, p. 9, 1907.

Breckenridge, L. P., Preliminary report on the operations of the fuel-testing plant of the United States Geological Survey at St. Louis, Mo., 1905: U. S. Geol. Survey Bull. 290, pp. 194-195. 1906.

Breckenridge, L. P., Kreisinger, Henry, and Ray, W. T., Steaming Tests of coals and related investigations: Bureau of Mines Bull. 23, 1912.

Ultimate analyses figured on moisture-free basis.

	Test 601.	Test 602.	Test 280.	Test 283.
Carbon	71.14	70.59	82.80	82.95
Hydrogen	4.52	4.47	4.98	4.98
Oxygen	6.21	5.69	5.18	5.19
Nitrogen	1.25	1.22	1.64	1.64
Sulphur	.95	1.16	.65	.58
Ash	15.93	16.87	4.75	4.66

Summary of steaming tests.

	Test 601.	Test 602.	Test 280.	Test 283.
Heating value of coal B. t. u. per lb. dry coal	12,911	12,607	14,908	14,936
Force of draft:				
Under stack damper.....inch water	0.39	0.35	0.42	0.37
Above fire .....do	.31	.23	.15	.16
Furnace temperature .....°F	2,336	.....	2,452	2,537
Dry coal used per square foot of grate surface per hour.....pounds	18.14	21.88	16.40	16.47
Equivalent water evaporated per square foot of water-heating surface per hour .....pounds	3.28	3.69	2.91	2.99
Water apparently evaporated per pound of coal as fired .....pounds	7.70	7.07	8.14	8.18
Water evaporated from and at 212° F.:				
Per pound of coal as fired.....pounds	8.94	8.32	9.74	9.79
Per pound of dry coal.....do	9.06	8.46	9.91	10.12
Per pound of combustible.....do	10.97	10.36	10.66	10.84
Efficiency of boiler, including grate, per cent	67.77	64.80	64.19	65.43
Boiler horse-power:				
Builder's rating	210	210	210	210
Developed on test	193.0	217.4	171.4	175.9
Analysis of ash:				
Carbon	9.93	11.26	27.88	34.47
Earthy matter	90.07	88.74	72.12	65.53

PRODUCER-GAS TESTS.[1]

Test No. 163, Jawbone coal.—As used, ½ to ⅔ slack. Failure of water supply made it impossible to carry this test beyond 8 hours, a period so short that the accuracy of the results is doubtful. Average B. t. u. of gas per cubic foot, about 149.

[1] Burrows, J. S., Mine sampling and chemical analysis of coals: U. S. Geol. Survey Bull. 362, p. 9, 1908.

Fernald, R. H., Preliminary report on the operation of the fuel-testing plant of the United States Geological Survey at St. Louis, Mo., 1905: U. S. Geol. Survey Bull. 290, pp. 193-195, 1906.

Fernald, R. H., and Smith, C. D., Résumé of producer-gas investigations: Bureau of Mines Bull. 13, 1911.

Test No. 75, Upper Banner coal.—Size as used: Over 1-inch, 51 per cent; ½-inch to 1-inch, 14 per cent; ¼-inch to ½-inch, 13 per cent; under ¼-inch, 22 per cent. Duration of test, 50 hours. Average B. t. u. of gas per cubic foot, 156.

Proximate analyses of coal as fired.

	Test 163.	Test 75.
Moisture	1.3	1.6
Volatile matter	29.7	31.7
Fixed carbon	53.6	61.8
Ash	15.4	4.9
Sulphur	1.14	.49

Analyses of gas (per cent by volume).

	Test 163.	Test 75.
Carbon dioxide (CO_2)	9.7	9.7
Carbon monoxide (CO)	19.7	19.3
Hydrogen (H_2)	14.5	13.8
Methane (CH_4)	2.3	3.1
Nitrogen (N_2)	53.8	54.1

Summary of producer-gas tests.

	Test 163.			Test 75.		
	Coal as fired.	Dry coal.	Combustible.	Coal as fired.	Dry coal.	Combustible.
Coal used in producer (pounds per horse-power per hour).						
Per electrical horse-power:						
Available for outside purposes	1.23	1.22	1.03	1.21	1.18	1.13
Developed at switch board	1.20	1.19	1.00	1.13	1.11	1.06
Per brake horse-power:						
Available for outside purposes	1.05	1.04	.87	1.03	1.01	.96
Developed at engine	1.02	1.01	.85	.96	.95	.90
Coal used by producer plant, including fuel equivalent of auxiliary power (pounds per horse-power per hour).						
Per electrical horse-power:						
Available for outside purposes	1.52	1.50	1.26	1.29	1.27	1.21
Developed at switch board	1.48	1.46	1.23	1.21	1.19	1.13
Per brake horse-power:						
Available for outside purposes	1.29	1.28	1.07	1.10	1.08	1.03
Developed at engine	1.26	1.24	1.05	1.03	1.01	.96

COKING TESTS.[1]

Two tests, Nos. 61 and 88, were made of the Upper Banner coal from Toms Creek, Va., to determine its coking properties. In test 61 the coal was finely crushed; in test 88 it was as shipped (over 3½-inch bar screen).

Summary of coking tests.

	Test 61.	Test 88.
Duration of test ....hours....	45	50
Specific gravity, real	1.93	1.87
Specific gravity, apparent	1.25	1.12
Weight per cubic foot, dry ....pounds....	77.72	69.30
Weight per cubic foot, as received (wet) ....do....	99.67	94.26
Percentage coke	65.00	60.00
Percentage cells	35.00	40.00
Six-foot drop test, percentage over 2-inch mesh:		
1	92.00	93.50
2	85.00	89.00
3	78.50	83.50
4	75.00	80.50
Weight of coal ....pounds....	12,000	12,000
Weight of coke ....do....	8,160	7,907
Weight of breeze ....do....	240	336
Percentage coke	68.00	65.89
Percentage breeze	2.00	2.80
Total percentage yield	70.00	68.69

The analysis of a typical 72-hour Connellsville coke is shown in the following table as a standard for comparison. Judged by the analyses, coke made from the Upper Banner coal is as good as that from the Connellsville district.

Analysis of coal as used and resulting coke.

	Connellsville coke.	Test 61.		Test 88.	
		Coal.	Coke.	Coal.	Coke.
Moisture	.18	2.87	0.29	2.49	0.16
Volatile matter	.32	31.58	1.21	31.90	1.26
Fixed carbon	88.75	61.43	92.60	61.16	91.85
Ash	10.75	4.12	5.90	4.45	6.73
Sulphur in coke	.87	.56	.61	.57	.55
Sulphur in ash	.033		.085		.070
Phosphorus	.018		.001		.006
Specific gravity	1.92		1.93		1.87

[1] Belden, A. W., Preliminary report on the operations of the fuel-testing plant of the United States Geological Survey at St. Louis, Mo., 1905: U. S. Geol. Survey Bull. 290, pp. 193-196, 1906.

Belden, A. W., Washing and coking tests of coal and cupola tests of coke: U. S. Geol. Survey Bull. 336, 1908.

Test 61, remarks.—Coke of light gray and silvery color; much deposited carbon; metallic ring; cell structure small; breakage good; long, large, heavy pieces; very heavy coke.

Test 88, remarks.—Coke of light gray and silvery color; much deposited carbon; metallic ring; cell structure small; breakage good; good heavy coke; decreased yield of coke and increased amount of breeze probably due to fact that coal was not crushed.

CUPOLA TESTS OF COKE.[1]

Each of the two samples of coke, made from the Upper Banner coal from Toms Creek, Virginia, was subjected to two cupola tests, the results of which are shown in the following table. The results of a typical test of Connellsville 72-hour coke are given in the first column, to furnish a standard for comparison.

[1] Moldenke, Richard, Washing and coking tests of coal and cupola tests of coke: U. S. Geol. Survey Bull. 336, 1908.

Summary of cupola tests.

	Connellsville Coke.	Coke test 61.		Coke test 88.	
	Test 19.	Test 33.	Test 91.	Test 58.	Test 40.
Charges (Pounds)—					
1 Coke bed	220	230	250	250	240
2 Pig iron	660	690	750	750	720
3 Scrap	220	230	250	250	240
4 Coke	53	50	45	45	48
5 Pig iron	398	390	375	375	383
6 Scrap	133	130	125	125	128
7 Coke	53	50	45	45	48
8 Pig iron	398	390	375	375	383
9 Scrap	133	130	125	125	128
10 Coke	52	50	45	45	47
11 Pig iron	397	390	375	375	382
12 Scrap	132	130	125	125	127
13 Coke	52	50	45	45	47
14 Pig iron	397	390	375	375	382
15 Scrap	132	130	125	125	127
Totals (Pounds)—					
Coke	430	430	430	430	430
Pig iron	2,250	2,250	2,250	2,250	2,250
Scrap	750	750	750	750	750
Ratio of iron to coke	7	7	7	7	7
Maximum blast pressure (oz.)	7¾	7	7	7	7
Iron poured (lbs.)	2,470	1,584	2,422	1,710	1,761
Iron melted (lbs.)	2,470	2,391	2,598	2,200	2,071
Iron recovered (lbs.)	283	255	288	636	683
Coke recovered (lbs.)	20	93	70	104	108
Melting loss (per cent)	8.2	11.80	3.80	5.46	8.20
Melting ratio (iron to coke)	6.02	7.09	7.22	6.75	6.43
Melting rate (lbs. per hour)	5,489	4,947	5,028	4,551	3,358
Blast on at	10.57	4.03	3.30	10.23	11.14
	A. M.	P. M.	P. M.	A. M.	A. M.
Iron running	11.03	4.12	3.37	10.36	11.23
Weight and time of each ladle—					
1 lbs.	175	85	132	102	64
at	11.07	4.15	3.45	10.45	11.27
2 lbs.	115	103	104	107	62
at	11.11	4.19	3.45½	10.45½	11.29
3 lbs.	185	98	111	77	80
at	11.13	4.20	3.47	10.50½	11.31
4 lbs.	150	94	135	74	62
at	11.14	4.21	3.47½	10.51	11.32
5 lbs.	220	88	92	84	72
at	11.16	4.22	3.51	10.51½	11.38

	Connellsville Coke.	Coke test 61.		Coke test 88.	
	Test 19.	Test 33.	Test 91.	Test 58.	Test 40.
Weight and time of each ladle—(Contd.)—					
6 lbs.	150	84	110	64	75
at	11.18	4.23	3.51½	10.54	11.38½
7 lbs.	225	73	151	64	95
at	11.19	4.24	3.52	10.54½	11.39
8 lbs.	155	71	94	83	55
at	11.22	4.25	3.54	10.55	11.41
9 lbs.	255	81	112	62	92
at	11.24	4.25½	3.54½	10.56	11.41½
10 lbs.	155	80	99	66	75
at	11.26	4.27	3.55	10.56½	11.42
11 lbs.	250	60	90	79	88
at	11.27	4.28	3.56	10.57	11.44
12 lbs.	125	63	99	56	76
at	11.28	4.30	3.56½	10.58	11.44½
13 lbs.	170	66	132	80	91
at	11.29	4.32	3.58	10.58½	11.45
14 lbs.	140	98	100	73	84
at	11.30	4.33	3.58½	10.59	11.46
15 lbs.	.....	51	80	50	75
at	.....	4.34	3.59	11.00½	11.46½
16 lbs.	.....	53	131	84	85
at	.....	4.35	4.01	11.01	11.48
17 lbs.	.....	54	90	59	92
at	.....	4.37	4.01½	11.02½	11.48½
18 lbs.	.....	58	142	47	36
at	.....	4.38	4.02	11.03	11.49
19 lbs.	.....	49	142	66	72
at	.....	4.39	4.04	11.03½	11.53
20 lbs.	.....	46	56	90	51
at	.....	4.41	4.04½	11.05	11.53½
21 lbs.	.....	27	99	48	98
at	.....	4.42	4.06	11.05½	11.54
22 lbs.	.....	37	121	103	60
at	.....	4.44	4.08	11.06	11.58
23 lbs.	.....	65	.....	64	77
at	.....	4.45	.....	11.09½	11.59½
24 lbs.	.....	.....	.....	28	44
at	.....	.....	.....	11.10	12.00
25 lbs.	.....	.....	.....	.....	.....
at	.....	.....	.....	.....	.....
Time melting (minutes)	27	29	31	29	37

Remarks:
Test 19. Iron hot.
Test 33. Iron hot and fluid; melting too fast to handle; blast off 4 minutes.
Test 91. Iron hot.
Test 58. Iron hot; blast off 5 minutes.
Test 40. Temperature of iron, medium.

SUMMARY.

An examination of the analyses and tests described in the preceding pages leads to very favorable conclusions as to the purity and value of the coals themselves. The practical features and the essential working qualities of the fuels, as indicated in a limited number of steaming, coking, briqueting, producer, and foundry tests have already been quoted from the official records of the tests. These tests, which are not so numerous as is to be desired, were not in all cases conducted under favorable circumstances or with coal from the best localities, and the results, gratifying as they may be, probably do no more than justice to either the samples submitted or the region as a whole.

Information as to the chemical composition, which discloses the purity of the coals, as to the calorific values, i. e., the heating power of the coals as determined by standard calorimetric methods in the laboratory, is given in the accompanying table of analyses. This table, though not so large as is desirable, contains the results of the analysis and calorific testing of enough cuttings taken from coal beds in widely different parts of the region to entitle it to confidence as approximately representative of the coals of Dickenson County. In fact, it must be noted that the samples from the Splash Dam, the Eagle, and the Clintwood beds, and some of those from the Kennedy, were taken from small local or country mines and therefore may not show either the full rank or the real heat value of the fuels. The proportions of the elements in the organic matter are in some cases given in the form of ultimate analyses.

From an inspection of the analyses, it will be seen that the coals are of high bituminous rank with very low moisture content; with a percentage of fixed carbon in general approximating 60 per cent; with relatively low ash, and with an exceptionally small content of sulphur. In other words, the coals are notably pure. The average of the moisture, of the ash, the sulphur, and the B. t. u.'s in the samples "as received" (line A) for all the beds except the Jawbone, Lee, and Raven are indicated in the following synopsis:

Averages of analyses for each coal.

Name of coal and number of samples.		Moisture.	Fixed carbon.	Ash.	Sulphur.	B. t. u.'s
Tiller (4)	A	2.2	59.4	6.5	.48	14,100
	D	.....	65.0	.....	.....	15,500
Kennedy (4)	A	2.7	60.9	8.99	.99	13,700
	D	.....	69.0	.....	.....	15,500
Lower Banner (14)	A	2.21	56.88	6.32	.90	14,150
	D	.....	62.19	.....	.....	15,450
Upper Banner (39)	A	2.47	56.80	6.35	.57	14,100
	D	.....	62.34	.....	.....	15,450
Splash Dam (2)	A	2.4	62.7	5.6	.78	.....
	D	.....	68.2	.....	.....	.....
Dorchester (5)	A	2.76	59.34	5.41	1.12	14,150
	D	.....	64.62	.....	.....	15,450
Eagle (2)	A	2.9	58.3	6.8	1.54	13,950
	D	.....	64.6	.....	.....	15,450
Clintwood (3)	A	2.9	62.1	3.8	.91	14,600
	D	.....	66.6	.....	.....	15,400
Averages of above coals	A	2.57	59.55	6.22	.91	14,100
	D	.....	65.32	.....	.....	15,450

In line D is shown the corresponding averages of the fixed carbon and British thermal units (B. t. u.'s) on what is sometimes known as the "pure coal basis." This form of representation, which is theoretical and should be used only in the comparative study of the qualities and ranks of coals, is obtained by excluding the moisture, ash, and sulphur from the proximate analysis and recalculating the volatile matter and fixed carbon to total 100 per cent. These percentages should not be employed to describe coals as commercially produced or sold.

The high qualities of most of the coals appear even in the cuttings from small local mines. Those of the Eagle bed, while inferior to some others, are, nevertheless, worthy of comparison with the coals of other regions. The Clintwood is exceptionally pure, and the Kennedy is relatively high in ash only southwest of Russell Fork, where it has been crushed by shearing movements. The samples from the Jawbone bed are conspicuous among the other coals of the region for their high ash and high moisture. In fact, this coal is well recognized to be relatively impure and inferior at most points at which it has been examined. Hence it will be eliminated from further discussion, though it is but little inferior to many of the competing coals from other fields.

For the purposes of comparison of the coals from other regions and fields of the United States, comprehensive and generally representative

analyses will be found in great numbers in Bulletins 22, 85, and 123, of the Bureau of Mines. To these reports the reader is referred for data concerned in the following discussion.

The examination of the analyses of coals from Dickenson County presented in the foregoing tables, and a comparison of the same with those representing the principal mining districts of West Virginia, make it evident that the coals of the region studied are equal to the highest rank of the Kanawha coals of southern West Virginia, namely, those along the easternmost border of the Kanawha field, or, in other words, those in a rather narrow zone along the border of the Pocahontas and New River coal fields. They are apparently slightly higher in rank than the coals in the region immediately northwest of Pine Mountain, though neither this difference nor its effects 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. On the whole, the coals of Dickenson County present a marked advantage over the latter as to ash and sulphur content.

The Pocahontas and New River coals are distinctly above the coals of this part of the Virginia region as to rank, being 5 to 15 per cent higher in fixed carbon, and are in general their equal in ash and sulphur, while, as is to be expected, their more advanced rank gives them notably 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.

In the Tennessee coal field there are several localities where, on account of the higher rank, as shown by the more advanced elimination of volatile matter, the coals have as great calorific value as those in question, though the ash and sulphur content are higher. 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. At some localities the fuel is clearly of higher rank and heating power than that of Dickenson County, though nearly everywhere higher sulphur is found in the former. On the whole, however, higher ash also seems to mark the Alabama coal field, the greater part of which is inferior also as to the rank and calorific value of its fuels.

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 coal rises above that of the Virginia fuel, the consequent calorific advantage is at most points neutralized by the 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 value. 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 the western Kentucky coal field, 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.

The coals of Ohio are so much lower in fixed carbon, i. e., in rank, as hardly to equal the Virginia coals in heat value even where the former are at their best. In most cases they are higher in sulphur and in ash.

Although the coals of the Potomac and Georges Creek-Frostburg basins in western Maryland are clearly much higher in rank, they are in many places lower in heat value, probably on account of the higher ash and sulphur. However, in the southern part of the Potomac basin and the neighboring region of West Virginia, the coals appear to be purer and with higher values, and are at some locations clearly superior to the Dickenson County coals. In these high-rank coals there is, again, a larger proportion of fine coal or slack in the run-of-mine product. The same is

true of the high-rank 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 with respect to moisture and sulphur, and, in many cases, to ash, the Virginia coals compare advantageously, though they are not nearly so high in rank and in calorific value.

In the northern Appalachian region the Virginia coals concerned in this study seem to find closest comparisons in the low ash and low sulphur coals in the Uniontown-Connellsville zone of Pennsylvania. With these coals the average beds of Dickenson County are comparable in rank as well as in efficiency, ash, and sulphur, slightly lower sulphur being generally found in the latter area. The low ash, low moisture, and abnormally low sulphur in Dickenson County give these coals an advantage over those farther west in northern West Virginia and in Pennsylvania, toward the western borders of which the lower fixed carbon is attended in general with lower calorific values.

The comparability in rank and other features between the coals of the southwestern Virginia region and the coals of the Uniontown-Connellsville region of Pennsylvania has just been pointed out in the preceding paragraph. Also it will have been noted in the accounts of coking tests that for coking and furnace use coals from these two regions are closely comparable and apparently nearly equal. From the single test made at the experimental plant formerly conducted by the United States Geological Survey, it would seem that the coke made from the Connellsville coal was slightly higher in sulphur than that from the Upper Banner coal of southwestern Virginia. Further tests should precede final conclusions as to the relative merits of these coals for coking. Both the Virginia and Connellsville regions are similar as to the rather large amount of volatile matter, about 35 per cent, pure coal basis, in the beds, the coking of which entails a great and lamentable waste unless by-product ovens are used. This waste should be prevented whenever and wherever possible. The coal from the Toms Creek mines has been coked for more than twenty years.

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 the Dickenson County region many mines in which the coal will contain about 60 per cent fixed carbon; will run under 2.6 per cent of moisture, 6 per cent of ash, .9 per cent of sulphur; and will contain over 14,200 B. t. u.'s as it is loaded in the cars. Most of this will make a good coke.

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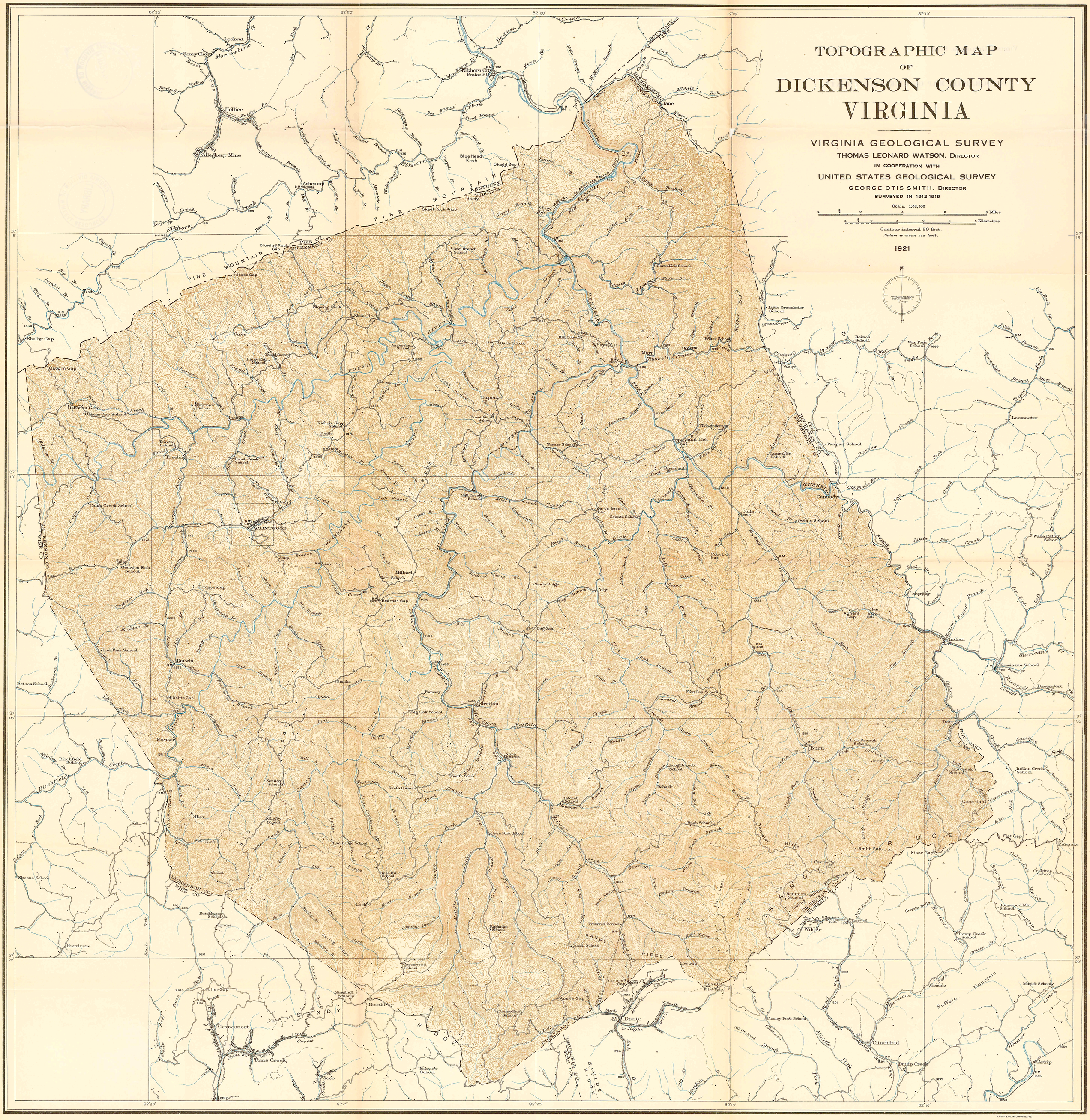

A. HOEN & CO. BALTIMORE, MD.

GEOLOGIC AND ECONOMIC MAP OF DICKENSON COUNTY VIRGINIA

VIRGINIA GEOLOGICAL SURVEY
THOMAS LEONARD WATSON, DIRECTOR
IN COOPERATION WITH
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR
SURVEYED IN 1912-1919
GEOLOGY BY
HENRY HINDS, T. K. HARNSBERGER, CHARLES BUTTS,
ALBERT W. GILES, AND C. K. WENTWORTH

Scale. 1:62,500

Contour interval 50 feet.
Datum is mean sea level.

1921

LEGEND

CARBONIFEROUS

Pennsylvanian

- **Wise formation** (*sandstone and shale containing Kelly and Imboden, Clintwood, Eagle, Blair, Lyons, Dorchester, and other coal beds.*)
- **Gladeville sandstone** (*massive gray to brown sandstone.*)
- **Norton formation above Kennedy coal** (*sandstone and shale containing Hagy, Splash Dam, Upper and Lower Banner, and other coal beds.*)
- **Norton formation below Kennedy coal** (*sandstone and shale containing Ally, Raven, Jawbone, Tiller, and other coal beds.*)
- **Lee formation** (*sandstone, conglomerate, and shale with thin coal beds.*)

Mississippian

- **Undifferentiated Mississippian** (*includes Pennington shale—variegated shale and sandstone—at top; Newman limestone in middle; and upper part of Grainger shale—green shale and brown and red sandstone—below.*)

- **Undifferentiated Pennsylvanian** (*includes Wise, Gladeville, Norton, and Lee formations in areas that are buckled, crushed, and faulted, with beds steeply dipping.*)

- **Faults**

ECONOMIC DATA

- **Coal outcrops** (lb, ub, g)

Wise formation
- cc—Campbell Creek coal
- cl—Clintwood coal
- eg—Eagle coal
- bl—Blair coal
- g—Dorchester coal

Norton formation
- sd—Splash Dam coal
- ub—Upper Banner coal
- lb—Lower banner coal
- kd—Kennedy coal
- gh—Raven coal
- ti—Tiller coal

- **Structure contours showing elevation of Splash Dam coal bed.** (*contour interval 50 feet. Datum is mean sea level.*) (1450, 1500)

- **Structure contours showing elevation of Upper Banner coal bed.** (*contour interval 50 feet. Datum is mean sea level.*) (2200, 2250)

- 102 ⛏ **Shipping coal mine.** (*numbers refer to text reference.*)

- 175 X **Small local coal mine or prospect pit.** (*numbers refer to text reference.*)

- ⊙ S34 **Diamond drill prospect hole.** (*numbers refer to text reference.*)

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