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UNIVERSITY OF VIRGINIA

ALBERT WILLIAM GILES, PH. D.

ACTING DIRECTOR

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The Geology and Coal Resources
of the Coal-Bearing Portion
of Lee County, Virginia.

By

ALBERT WILLIAM GILES

PREPARED IN CO-OPERATION WITH THE
UNITED STATES GEOLOGICAL SURVEY

WITH A CHAPTER ON

The Forests of Lee County, Virginia

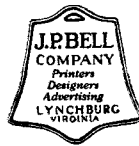
By

HARRY LEE BAKER

PREPARED IN CO-OPERATION WITH THE
OFFICE OF STATE FORESTER

CHARLOTTESVILLE
UNIVERSITY OF VIRGINIA

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LETTER OF TRANSMITTAL

VIRGINIA GEOLOGICAL SURVEY,

UNIVERSITY OF VIRGINIA,

CHARLOTTESVILLE, AUGUST 15, 1925.

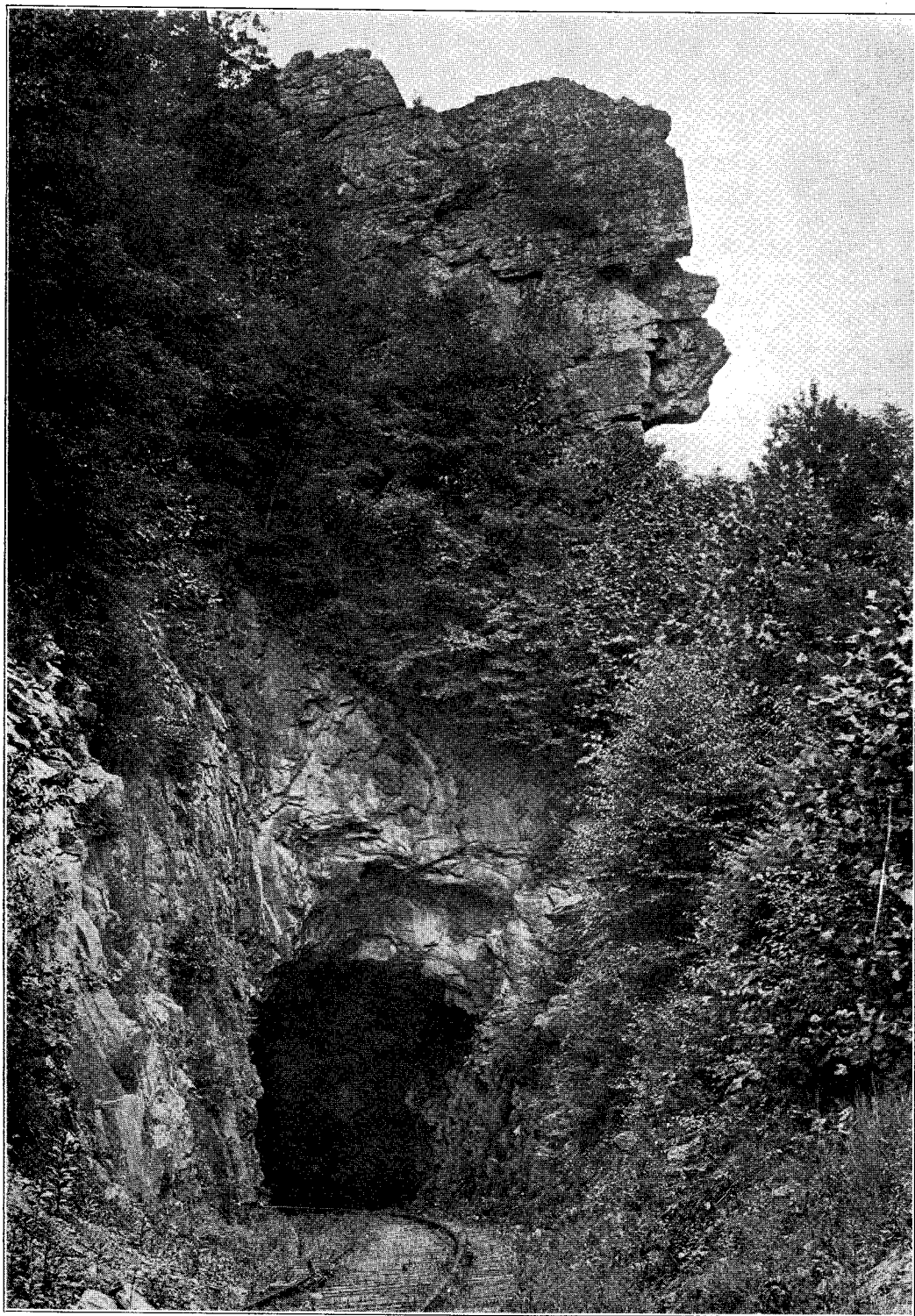
Governor E. Lee Trinkle, Chairman, and Members of the State Geological Commission:

Gentlemen:—I have the honor to transmit to you, herewith, and to recommend for publication as Bulletin No. XXVI of the Virginia Geological Survey Series of Reports, a manuscript and illustrations of a report on "The Geology and Coal Resources of the Coal-bearing Portion of Lee County, Virginia," by Doctor Albert William Giles, together with a chapter on "The Forests of Lee County, Virginia," by Mr. Harry Lee Baker.

This report has been prepared by the Virginia Geological Survey in cooperation with the United States Geological Survey and the Office of State Forester. It is the ninth one of a series of detailed reports published by the Virginia Geological Survey on the coal resources of southwest Virginia under the cooperative agreement of the State and Federal Surveys, and completes the study of the coals of Pennsylvanian age within the State. The report is accompanied by topographic and geologic maps of the Lee County coal field.

Respectfully submitted,

ALBERT WILLIAM GILES,
Acting Director.



"The Old Man of the Mountain." An erosional figure carved in massive sandstone in the upper part of the Pennington formation, Pennington Gap, Lee County, Virginia.



“The Old Man of the Mountain.” An erosional figure carved in massive sandstone in the upper part of the Pennington formation, Pennington Gap, Lee County, Virginia.

THE GEOLOGY AND COAL RESOURCES OF THE COAL-BEARING PORTION OF LEE COUNTY, VIRGINIA.

BY ALBERT W. GILES.

INTRODUCTION

Location and importance of the Lee County coal field.—Lee County is in the extreme southwestern part of Virginia, Figure 1, and is bordered on the west by Kentucky and on the south by Tennessee. The northwestern part of the County is the coal-bearing portion and consists of a narrow belt lying

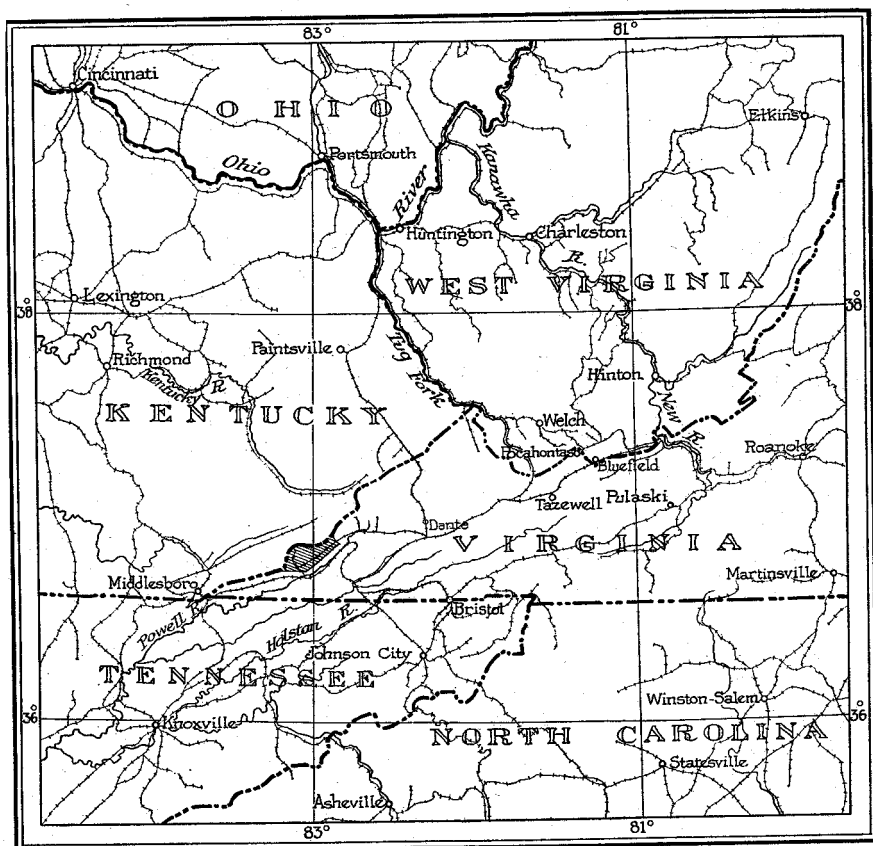


Fig. 1.—Index map showing location of the Lee County coal field.

adjacent to Harlan County, Kentucky, and bounded on the northeast by Wise County, Virginia. It lies along the southeast border of the central part of the great Appalachian coal region.

The total area of coal land, according to estimates based on the most recent maps of the State and Federal surveys, is 77.80 square miles or 49,789 acres. Of this area 40.34 square miles lie within the limits of the Big Stone Gap quadrangle, and 37.46 square miles within the limits of the Nolansburg quadrangle.

As 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 has long been known to contain, little or no attention was given to that part of the County outside the coal field. The coal-bearing portion of the County contains in beds 14 inches or more in thickness, about 1,950,000,000 tons of high grade bituminous coal. This great resource of coal is practically untouched. There are many small mines in the area furnishing coal chiefly for local consumption, and large operations established in recent years, are in progress in several places from which the coal is shipped over the Southern and the Louisville and Nashville railways.

Method of work.—Both the geologic and topographic work was done in cooperation by the Virginia Geological Survey and the United States Geological Survey, the expense being shared by both organizations. The topographic survey of the western half of the area was made in 1916 and published as a part of the Nolansburg quadrangle, the topographic survey of the eastern half of the area was made in 1920, as a part of the Big Stone Gap quadrangle. Practically all of the geologic work was done in the summer of 1920.

Some coal prospects were located instrumentally and assigned elevations by the topographers in the course of their mapping, but by far the greater number were located by the writer and their elevations determined with a barometer. Temporary stadia stations, not shown on the accompanying map, were established at many places on the main roads and these elevations were available to the geologist. By checking and resetting the barometer at points of known elevation, the large errors due to variation in atmospheric pressure were eliminated and fairly accurate results obtained.

Tracing and correlating the coal beds from one stream to the next was possible only by close detailed work. The principal difficulties encountered

were steep and irregular dips, a heavy forest cover, and lack of reliable key rocks. Geologic profiles were made along all roads and trails. All reported coal prospects and mines were visited and detailed sections of the coal beds measured where possible. The locations of prospect pits at which the coal was not exposed, are shown on the geologic map but not mentioned in the text. In some parts of the field where little prospecting had been done, it was necessary to determine the dip and the equivalence of each bed by following the outcropping ledges of sandstone and the distinct benches which mark the outcrops of coal beds. Where it was impossible to use these means the outcrops were correlated by comparing sections measured up closely adjacent spurs and in stream valleys.

Acknowledgments.—The writer desires to express his indebtedness to the many coal operators and land owners who have aided in the progress of the work. Outcrop maps, coal measurements, and other data were cheerfully furnished by Messrs. A. W. Wagner of the Virginia Lee Company, W. W. Taylor and G. E. Orr formerly of the Benedict Coal Corporation, C. H. Thompson of the Old Virginia Coal Company, D. J. O'Callaghan formerly of the Emerald Coal Company, D. C. Long of the Blue Gem Coal Corporation, C. P. Kelly of the Black Mountain Mining Company, D. A. Patterson formerly of the Virginia Iron, Coal & Coke Company, Ralph Taggart and J. D. Rogers of the Stonega Coke and Coal Company, E. H. Mould of the Black Mountain Corporation, and C. J. Creveling and E. L. Gobble of the Blackwood Coal and Coke Company. The writer is grateful for the uniform hospitality and willing assistance offered by the people living in the coal field.

The earliest reports pertaining to the Lee County coal field were published nearly half a century ago.¹

The eastern half of the field has been described in an early publication of the United States Geological Survey prepared by M. R. Campbell² at a time when little prospecting had been done and when little was known of the coals outside of the few mining districts.

¹Stevenson, J. J., Notes on geology of Wise, Lee, and Scott counties, Virginia. Am. Phil. Soc. Proc., vol. XIX, 1880-81, pp. 88-107.

McCreath and d'Invilliers, Mineral resources of the Upper Cumberland Valley in southeastern Kentucky and southwestern Virginia, 1888.

²Campbell, M. R., Geology of the Big Stone Gap coal field of Virginia and Kentucky. U. S. Geol. Survey, Bull. 111, 1893.

At a later date C. A. Fisher¹ of the United States Geological Survey prepared a short report on the coal resources of the western half of the field.

Neighboring parts of Kentucky are covered by reports² on Letcher County, on the Middle Fork of Kentucky River, and on Clover Fork.

¹ Fisher, C. A., The Pocket coal district, Virginia, in the Little Black Mountain coal field. U. S. Geol. Survey Bull. 341, pp. 409-418.

² Crider, A. F., The coals of Letcher County. Kentucky Geol. Survey, fourth series, Vol. 4, 1916.

Hodge, James M., Coals of the Middle Fork of Kentucky River in Leslie and Harlan counties. Kentucky Geol. Survey, fourth series, Vol. 5, Pt. 1.

Hodge, James M., Report on the Upper Cumberland coal field—the region drained by Poor and Clover forks in Harlan and Letcher counties. Kentucky Geol. Survey, Bulletin 13, serial 16, 1912.

GEOGRAPHY.

TOPOGRAPHIC FEATURES.

Land surface.—The surface of the country is extremely rugged. Flat lands even a few acres in extent are rare, and valley slopes, though not precipitous, are very steep. The region has been thoroughly dissected by streams, so that the principal water courses are only a few miles apart and are separated by ridges that rise 500 to 1,000 feet or even more above them. The valleys are deep, narrow, and V-shaped, and even the largest of them have only very narrow flat bottom lands. Most of the valleys are winding, so that water in the streams flows long distances between points not far apart.

The crests of the ridges are narrow and winding, but sufficiently flat-topped to present a nearly even sky-line. The heights of neighboring ridges are approximately the same in most districts. Some of the principal ridges are sufficiently wide for roads and for a few houses, but most of them are so narrow as to be without clearings of any kind.

The lowest point in the field is at Pennington Gap where the North Fork of Powell River emerges from the gorge that it has cut through Stone Mountain. The elevation of this point is 1,380 feet above sea level. The highest point in the field is Potato Hill, a knob on the crest of Little Black Mountain two miles northeast of Keokee, the top of which has an elevation of 3,732 feet. The areas of greatest local relief are on the southern flanks of Little Black Mountain.

Two conspicuous mountain ridges cross the field. Stone Mountain, an extremely rough, steep-sided ridge with narrow crest, has a northeast-southwest trend and forms the southeastern boundary of the coal-bearing rocks. The highest point on Stone Mountain in the field is three miles south of Keokee, with an elevation slightly over 3,000 feet. The average height of the mountain is about 2,500 feet, and its crest rises 1,000 feet on an average above the lowlands that flank its base on the north and south.

The crest of Little Black Mountain with a trend parallel to that of Stone Mountain and at an average distance of four and one-half miles to the northwest constitutes the Virginia-Kentucky line and hence is the northwest limit of the coal-bearing rocks of Lee County. The crest of Little Black Mountain averages 2,900 feet above sea level and 1,300 feet above its southern base, with numerous elevations rising 3,200 feet or more

above sea level. These elevations are the highest points in the field, affording excellent views over large areas of Virginia and Kentucky. The average height of Little Black Mountain everywhere north of The Pocket, is 3,250 feet, but eastward to the vicinity of Keokee it is considerably lower, averaging only 2,700 feet. North of Keokee it increases in elevation rapidly and forms a high mountain ridge extending eastward into Wise County. The lowest gaps in Little Black Mountain are between the head of Jones Creek and Potato Hill. Two of these gaps with elevations not far from 2,500 feet are utilized for roads leading into Kentucky.

Many spurs extend south and southeast from Little Black Mountain toward Stone Mountain. One of the largest of these spurs forms the eastern boundary of the western half of the coal field. The area, thus inclosed on the east by this conspicuous spur, on the northwest by Little Black Mountain, and on the southeast and south by Stone Mountain, and on the west by another prominent spur projecting southward from Little Black and forming the Virginia-Kentucky line, has long been known as "The Pocket."

The prominent spur forming the western boundary of The Pocket has an elevation of 3,500 feet where it branches off from Little Black Mountain, and decreases in altitude southward very slowly, having an elevation of 2,242 feet at the head of the west fork of Ely Creek where a road crosses into Kentucky, and an elevation of approximately 1,990 feet in its lowest gap where the road crosses the State line at the head of Stone Creek. From this gap it rises rapidly southward to blend with Stone Mountain.

The ridge east of The Pocket lies between Reeds Creek and Jones Creek, with an altitude of about 2,700 feet where it branches off from Little Black Mountain, but it decreases rapidly in elevation and averages only about 2,100 feet in the greater part of its course. Another conspicuous spur extending southward from Little Black Mountain constitutes the divide between Lee and Wise counties. It has an elevation of 3,000 feet where it branches off from Little Black Mountain but decreases rapidly in height southward. Its altitude is 2,194 feet where the Keokee-Appalachian road crosses it, and about 2,200 feet where the Southern Railroad crosses it at the station, Crest. It rises gradually from the latter elevation to blend with Stone Mountain at an elevation of about 2,800 feet.

Smaller spurs branching off from Little Black Mountain constitute the divides between the main streams that head on the southern flank of the mountain, and subsidiary spurs from these lateral spurs form the divides between the smaller tributary streams.

The scenic features of the field are the forested mountain ridges and the gorge of North Fork of Powell River through Stone Mountain. Excellent views of the mountain scenery may be had from the tops of any of the ridges, but especially from the crests of Stone and Little Black mountains. The finest view in the field is to be had from the top of Potato Hill, from which a large area in Kentucky and Virginia may be seen. Pennington Gap, the name applied to the gorge through Stone Mountain that the North Fork of Powell River has carved, is one of the most beautiful gorges in southwest Virginia. It is one and one-half miles long and affords an excellent section of the Carboniferous rocks. Northeast from Pennington Gap, the valley of the North Fork of Powell River is so narrow, so deep, and with sides so steep that it may be regarded as a gorge. This narrow valley has been utilized in the construction of the Southern 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 the coal-bearing portion of Lee County are tributary to Powell River. The North Fork of this stream drains nearly the entire field, only a small portion on the southeast flank of Stone Mountain near Wise County draining directly into Powell River. This river flows southwest into Tennessee and unites with Clinch River a few miles above its junction with Tennessee River. The latter stream flows as far south as Alabama and then turns west and north to the Ohio. The largest streams of the field, all tributary to North Fork of Powell River, are Stone, Puckett, Straight, Reeds, Jones, Cox, Bundy, and Crab Orchard creeks.

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 to utilize rowboats in navigating North Fork, the largest stream, for any considerable distance, and bridges are considered a luxury rather than a necessity.

Although the rainfall of the region is heavy, 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 streams are considered relative to the position of a person facing upstream.

Climate.—In southwest Virginia the precipitation is high, averaging about 50 inches a year. This results in many cloudy days with a murky atmosphere. It is fairly uniform in its distribution throughout the year. Droughts are infrequent and occur in late summer or autumn. Autumn is the time of least precipitation, averaging about eight inches, and summer the time of highest, averaging about 15 inches. Excessive amounts of pre-

precipitation are occasionally experienced locally as a result of severe local storms. The average number of thunderstorms each year is 23.

The average amount of snowfall in this section of the State is 21 inches, and the average number of days with snow each year is 14. The first snowfall comes in October, the last in late April or May. The average number of days with 0.01 inch or more precipitation is 120.

In southwest Virginia are to be found the greatest differences in mean daily and monthly temperatures and in variability and range of temperature occurring in the State. Through western Virginia a vertical circulation of air seems to be actively carried on. A relatively clear atmosphere favors insolation and strong air currents move up the mountain sides. During the day the valleys become filled with heated air, but at night cool, descending currents flow down the mountain slopes into the valleys, displacing the warm air and thus reducing the temperature. The mean temperature for this region seasonally and annually is as follows: Winter, 34°; spring, 54°; summer, 72°; autumn, 55°; annual, 54°. The average number of days with maximum temperature above 90° is 13, and the average number of days with minimum temperature below 32° is 117. The temperature rarely falls below 0° and rarely rises above 95°. The average date of first killing frost is about October 10, the average date of last killing frost in spring is May 2. The following figures give the normal monthly averages in degrees Fahrenheit:

	Degrees F.
January	34
February	34
March	46
April	53
May	63
June	70
July	73
August	72
September	66
October	55
November	44
December	35

The prevailing direction of the wind is west. Winds blowing at the rate of 25 or more miles per hour are infrequent, and when they do occur usually precede or accompany severe thunderstorms of late summer. The average annual hourly velocity of the wind is about five miles.

INDUSTRIAL FEATURES.

Settlement.—The original settlers subsisted chiefly by hunting, but now squirrels, rabbits, and birds are practically the only wild game. A few

wild turkeys are found on the slopes of Little Black and Stone mountains, and both wildcats and catamounts are sometimes encountered on these heavily forested mountain slopes. An occasional bear is seen on Stone Mountain. The coal-bearing part of Lee County is sparsely populated, the majority of the people living in the small mining towns of Keokee and St. Charles. Keokee has a population of about 1,400 (1920), and St. Charles 400. At the present time (1925) a large mining camp is under construction in eastern Lee County that will house several hundred persons.

The chief pursuits are coal mining, lumbering, and farming. The wealth of the field 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, and cattle. The forests which cover about 85 per cent of the field will be an important source of revenue for some time to come, and with proper management should constitute a permanent source of income.

Accessibility.—The region is penetrated by two railroads. The Southern railroad (St. Charles to Bristol division) enters the field across a low gap in the divide that separates Lee from Wise County, and follows the North Fork of Powell River westward to the mouth of Straight Creek where it turns northward to St. Charles, its terminus. Branch lines radiate from St. Charles connecting with the numerous mining camps that lie near the heads of all of the principal valleys. A branch line has been built from the main line of the Louisville and Nashville railroad at Pennington to connect with St. Charles. Hence, the field has good rail communication to the north, south, and west.

Wagon roads are rocky and in places very steep, and the usual method of travel is on horseback. A macadam road connects Pennington with St. Charles, and an improved road connects Keokee with Appalachia. Other roads follow either the winding ridge tops or the valley bottoms, and most of them are nearly impassable during large portions of the year, except to travelers on horseback. The greatest present need of the field is an improved road connecting St. Charles with Keokee. Such a road would pass through the heart of the coal area and would be of incalculable benefit to the coal operators, as well as to the inhabitants of the field.

Development of the coal mining industry in Lee County.—Prospecting of Lee County coals began before 1885. The first mines opened supplied the inhabitants with coal for fuel and blacksmithing purposes. The publication

of McCreath and d'Invilliers' report in 1888¹ called attention to the coal resources of the field, and this, together with the prospect of early opening of the field to the outside world by the building of the Louisville and Nashville railroad, encouraged extensive prospecting. However, no coal was sold until about 1889, when a few tons were mined and sold to local trade. The completion of the Louisville and Nashville railroad to Norton and the extension of the Norfolk and Western railroad (Clinch Valley division) to the same terminus in 1891, furnished the required incentive to the development of the coals of Wise County, but Lee County apparently was but little affected, although lying in the general region traversed by these new railroads. The production continued small, supplying local trade only, until 1905.

In 1905 and 1906, development in Lee County began in earnest. Mines in the vicinity of St. Charles were the first opened in the County, the large operation at Keokee not getting under way until later. One of the first operations in the St. Charles field was at Darby in the Taggart bed, two and one-half miles north of St. Charles. Other operations were soon undertaken chiefly in the Taggart bed, and before the close of the year 1910, the following operators were producing large quantities of coal for shipment: Black Mountain Collieries Company, Black Mountain Mining Company, Bondurant Coal and Coke Company, Dominion Coal Company, Pennington Coal Company, Inc., Virginia Lee Company, Darby Coal and Coke Company, and Keokee Consolidated Coke Company.

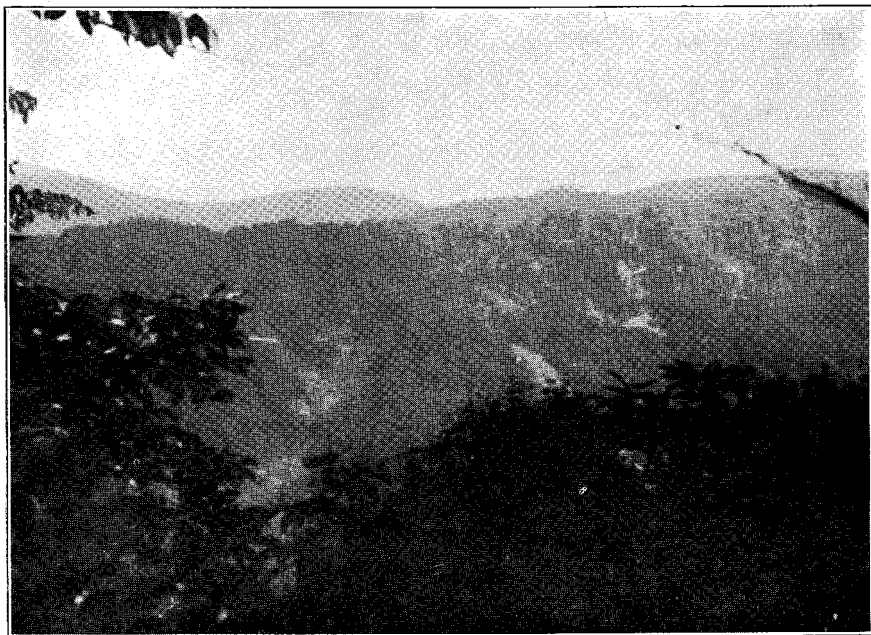
Shipment was made over the Virginia & Southwestern railroad (formerly Black Mountain railroad) to the Louisville & Nashville railroad at Pennington. With the completion of the Southern railroad about 1906, making possible connections with the Norfolk & Western railroad at Bristol, a further impetus was given to mining in Lee County and coal was shipped in considerable quantities to points southeast of Virginia.

The first year in which there was an appreciable production of coal in Lee County was in 1907, when 198,913 tons were mined. Since that year, there has been a steady increase in production, in 1923 the production totaling 1,024,668 short tons.

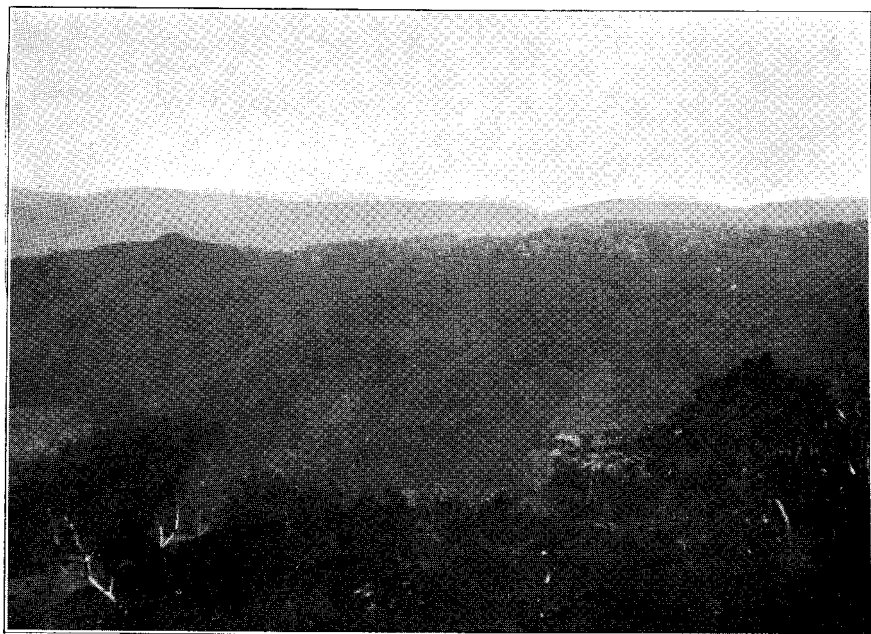
During 1907 coke ovens were built and in 1908 over 94,000 tons of coal were made into coke.² During 1908, 207 additional coke ovens were constructed, and in 1909 the production of coke had greatly increased, 110,000

¹Op. cit.

²Mineral Resources of the United States, published annually by the United States Geological Survey.

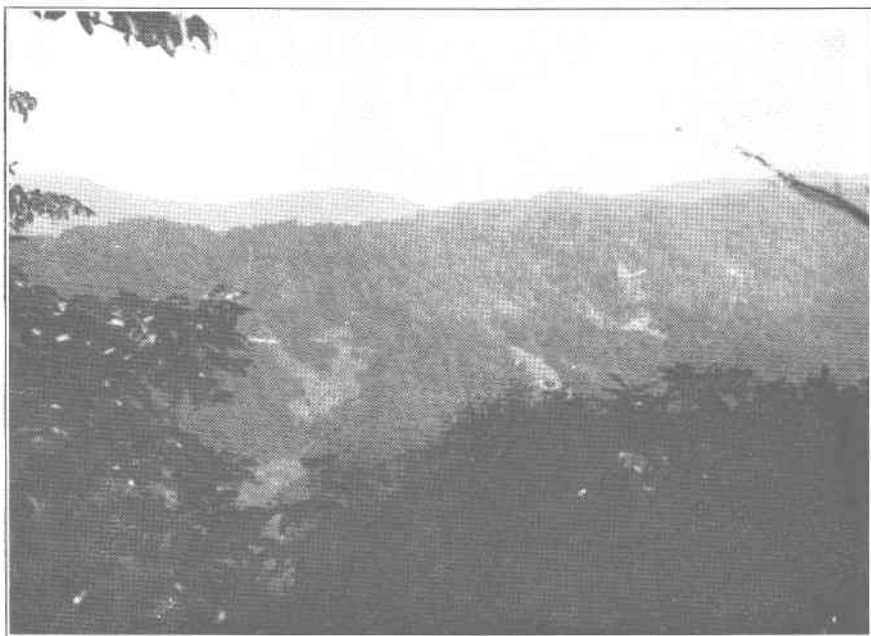


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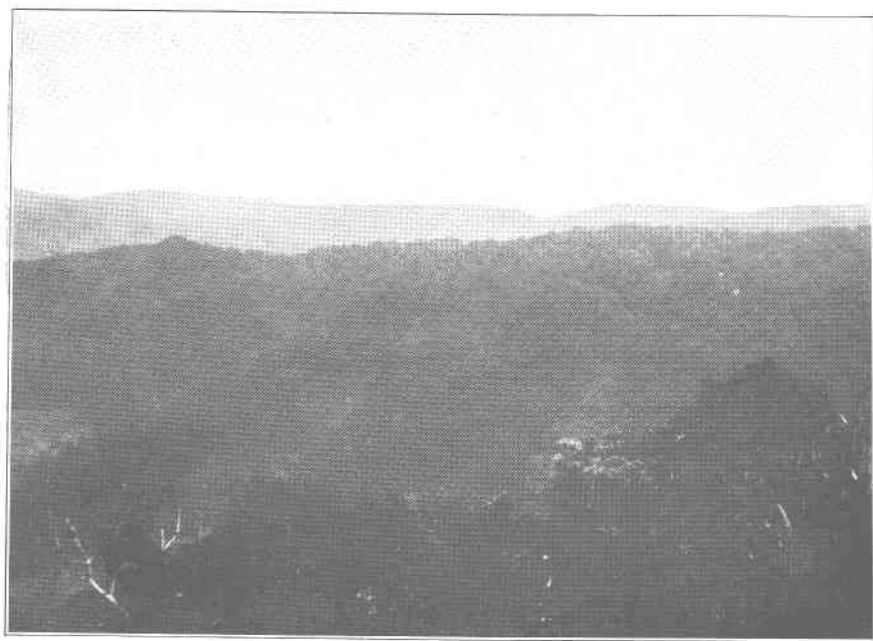


(B)

Views illustrating the rugged character of the southwest Virginia and Kentucky coal fields. Photographs taken from near the Virginia-Kentucky line looking westward into Kentucky.

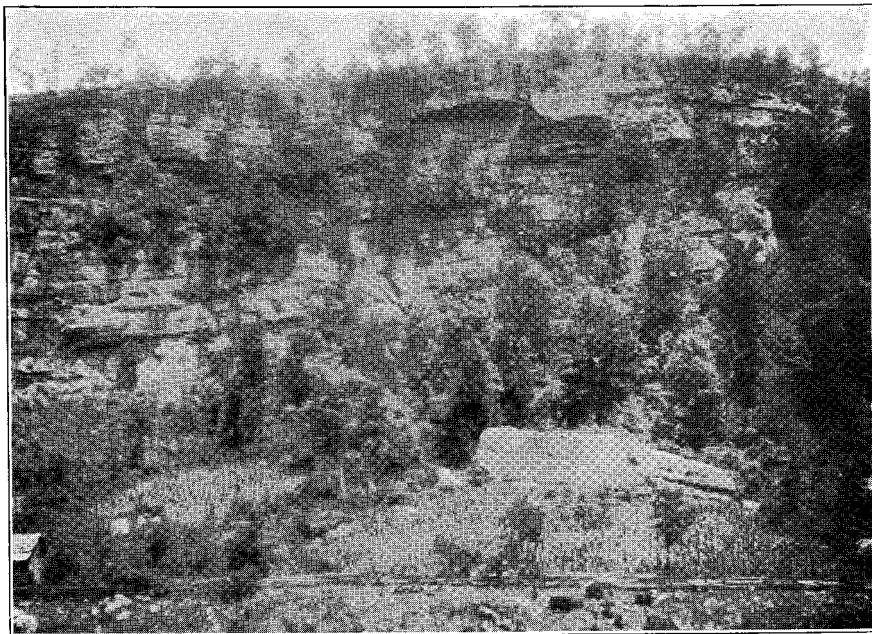


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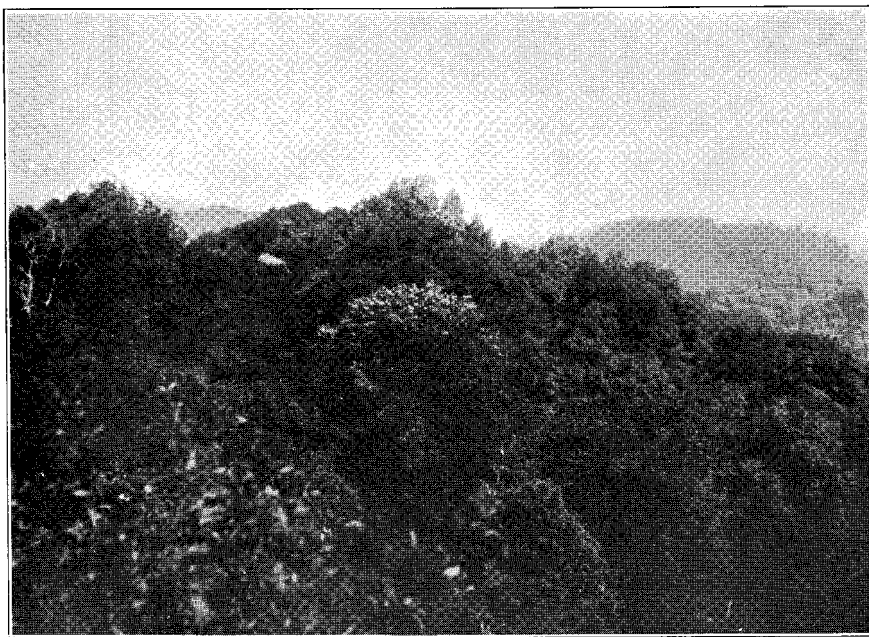


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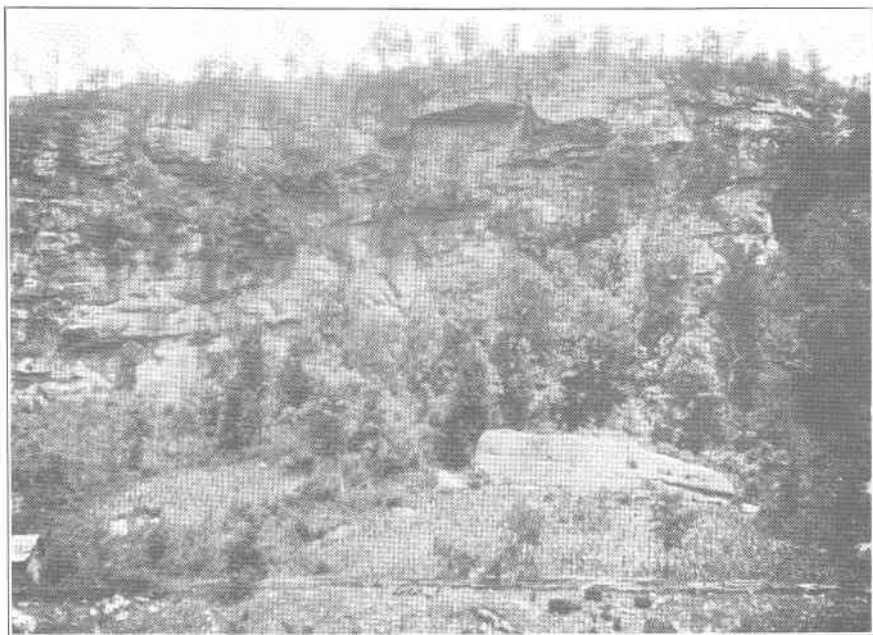
Views illustrating the rugged character of the southwest Virginia and Kentucky coal fields. Photographs taken from near the Virginia-Kentucky line looking westward into Kentucky.



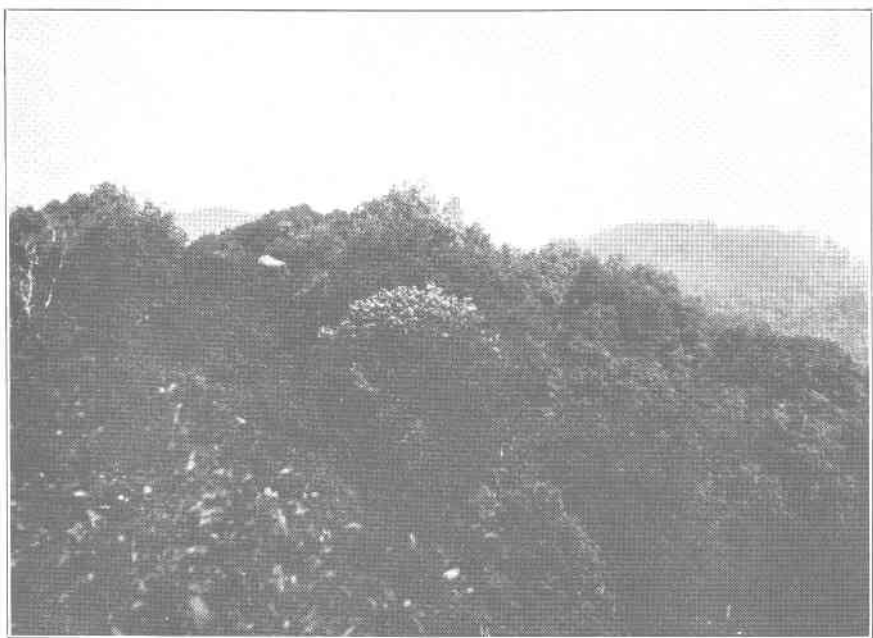
(A) Gladeville sandstone cliffs on North Fork of Powell River northeast of Purcell, Lee County, Virginia.



(B) Heavy forest cover on the slope of Little Black Mountain near the Kentucky boundary, Lee County, Virginia.



(A) Gladeville sandstone cliffs on North Fork of Powell River northeast of Purcell, Lee County, Virginia.



(B) Heavy forest cover on the slope of Little Black Mountain near the Kentucky boundary, Lee County, Virginia.

tons of coal being converted into coke. In 1910 the production of coke in Lee County reached its apex, 140,575 tons of coal being made into coke. The production of coke dropped sharply in 1911, due to the depression in the iron trade. The year 1912 furnished conditions but little better in the iron and steel business, hence the production of coke for that year was low. The industry was revived somewhat in 1913, but ceased in 1914, and all of the coke ovens in the county have since been dismantled.

*Amount, value, etc., of coal produced in Lee County, Virginia,
1907 to 1923, inclusive.¹*

Year.	Total production (Net tons).	Total value.	Average value per ton.	Tons shipped.	Tons coked.	Number of employees.
1907.....	198,913	\$ 228,888	\$1.15	179,916	.....	432
1908.....	464,261	429,531	0.93	348,240	94,091	621
1909.....	449,144	404,078	0.90	330,582	109,138	650
1910.....	797,096	768,990	0.90	643,871	140,575	946
1911.....	720,659	724,498	1.01	667,611	25,598	776
1912.....	751,276	875,092	1.16	718,570	11,736	1,081
1913.....	763,315	874,674	1.15	704,941	30,228	1,023
1914.....	732,935	800,835	1.09	708,072	.....	1,005
1915.....	742,311	778,861	1.05	719,927	.....	953
1916.....	828,000	942,622	1.14	813,543	.....	965
1917.....	871,642	2,119,913	2.43	855,446	.....	1,189
1918.....	888,400	2,500,023	2.81	873,884	.....	1,254
1919.....	679,017	1,820,310	2.68	671,585	.....	1,173
1920.....	946,125	4,045,205	4.28	923,414	.....	1,477
1921.....	687,928	1,927,000	2.80	677,029	.....	1,391
1922.....	762,305	2,045,363	2.68	753,193	.....	1,290
1923.....	1,024,668	2,725,839	2.66	1,007,318	.....	1,574

¹ Mineral Resources of the United States, published annually by the United States Geological Survey, and statistics on file in the office of the Virginia Geological Survey, compiled from returns collected annually by the State Survey in cooperation with the United States Geological Survey and the United States Department of Commerce, Bureau of the Census.

Present and Future Mining Conditions and Markets.—At the present time there are a number of large mining operations in Lee County with mines modern and fully equipped in every respect. At Keokee the Stonega Coke and Coal Company has one of the largest plants in the whole field which at the present time (1925) is inactive. The Blackwood Coal & Coke Company is at present (1925) installing a large operation at the head of Bundy Creek in eastern Lee County, modern in every respect with a tippie capacity of 2,500 tons daily. Other large operators are mining coal in the

vicinity of St. Charles, including the Virginia Lee Company, Old Dominion Coal Company, Black Mountain Mining Company, Benedict Coal Corporation, Virginia Iron, Coal & Coke Company, Old Virginia Coal Company, Blue Diamond Coal Company, and others. The mines of these companies are producing much coal but are not working to their full capacity. They are equipped with electric haulage and are under scientific management that considers the future as well as the present.

Present production is small when compared with that which would be justified by the coal resources of the region, and probably more intensive mining will be undertaken when market conditions have improved.

An area susceptible of early development lies on the headwaters of Ely and Puckett creeks. A railroad constructed up the valley of Puckett Creek would reach all of this coal readily. A large area lying between the main east-west county road and the Southern Railroad and bounded on the west by Reeds Creek and on the east by the Lee-Wise line contains several relatively thin coal beds. These beds have only been prospected as yet, but are known to contain a large tonnage of good coal. The high dip of the beds has discouraged operators from undertaking their development, however it is probable that several operations will be located in this area within a few years.

Mining conditions are good. The coal beds are only gently inclined throughout most of the field so that electric haulage may be employed, and advantage may readily be taken of the dip in order to secure natural drainage. Most of the coal beds lie above the level of the streams, and may be entered by drifts. Gas is not likely to be troublesome. The underclays of the coal beds are in most places so hard and sandy that heaving and squeezing will not be common in mine workings, and the mine roofs will be of kinds of rock that are not particularly hard to support. The supply of mine timber is notably abundant; and water for power plants and camps can be obtained with little trouble.

The natural market for most of this region is the southeastern states, with their growing industrial centers. Direct rail communication with Charleston, South Carolina, may be had over the Southern and Carolina, Clinchfield and Ohio railroads. Huge new coal loading docks have been constructed in Charleston with the expectation that the city will become a great shipping port 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. Another market is accessible through direct rail communication over the Southern, Carolina, Clinchfield & Ohio, and Chesapeake & Ohio railroads, or over the Louisville and Nashville Railroad with the Ohio Valley and the Middle West, 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 the Lee County coals and its probable competitors is made in another part of this report.

GEOLOGIC FORMATIONS.

GENERAL STATEMENT.

The rocks exposed at the surface, in the part of Lee County described in this report, belong wholly to the Carboniferous system. The Pennsylvanian series of the Carboniferous, which contains most of the coal of the Appalachian region, underlies the greater part of the Lee County field. At the surface nearly everywhere there is a thin cover of soil and other residual matter and, except for some resistant ledges of sandstone, the underlying indurated rocks may be seen only where washed bare along streams and on steep slopes. Most of the larger stream valleys are floored with alluvium, but these surficial deposits were not considered extensive enough to map.

CARBONIFEROUS SYSTEM.

Mississippian Series.

General statement.—The Mississippian series in Lee County consists of four members, the Price sandstone at the base, the Maccrady formation, the Newman formation, and the Pennington formation at the top. These formations succeed one another conformably.

PRICE SANDSTONE AND MACCRADY FORMATION.

The Price sandstone is a gray sandy formation.¹ Its most conspicuous beds are sandstones with which sandy shales are interbedded. As measured by Stose in Wise County, the lower part of the Price sandstone consists of soft fissile greenish to gray shale, with some sandstones, mostly in thin beds, 60-80 feet thick. The upper part consists of sandstone, chiefly thin-bedded and in part micaceous, and some bluish shale, with a few thick beds of greenish sandstone at the base which weather rusty. This part of the formation is about 115 feet thick.

The Maccrady formation consists of green and red shales, and trail marked sandstones, interbedded with some dark crumbly shale at the base. The sandstone is fine-grained, light gray, and weathers reddish. The formation is only 40 to 50 feet thick.

¹ The geology and mineral resources of Wise County and the coal-bearing portion of Scott County, Virginia. Bull. XXIV, Virginia Geol. Survey, 1923.

The Price sandstone and Maccrady formation are sparingly fossiliferous and are regarded by Butts as equivalent to the New Providence shale of Indiana and to the Cuyahoga shale of Ohio.¹

The two formations outcrop as a narrow belt along the eastern base of Stone Mountain below the Newman limestone. Their surfaces are covered by rock waste from above so that sections can be seen only in ravines.

NEWMAN FORMATION.

The Newman limestone, succeeding the Maccrady above, is named for Newman Ridge, Hancock County, Tennessee, where the limestone is excellently exposed. It is early Mississippian in age, and lies conformably upon the Maccrady formation.

The basal 40 feet of the Newman formation consist mainly of a dense fine-grained limestone, dark dove in color, and weathering to a creamy surface. A few oolitic beds occur alternating with the dense and fine-grained layers. Cavities and vein calcite are rare, but flint is abundant and rather uniformly distributed through the beds. Some of the flint nodules are nearly round and attain a diameter of three inches or more; they are green, brown and red in color. These basal beds are fossiliferous.

Farther up in the formation the lithologic characters change, the oolitic beds become much more important, alternating in rapid succession with dark gray to light blue fine-grained limestone. The limestone becomes more fossiliferous, the cavities increase in number, however the flint persists in about the same abundance as in the lower part of the formation. These characters continue to a height of 375 to 400 feet above the base of the formation.

The upper part of the formation is also about 400 feet thick and consists of an alternation of calcareous and argillaceous shale and shaly fine-grained limestone. Oolitic beds are found locally developed in the sequence, and both shale and limestone are fossiliferous. The following section was measured more than 30 years ago by Mr. M. R. Campbell in Big Stone Gap in western Wise County, the basal part of the section being revised recently by Charles Butts and E. O. Ulrich from a study of fresh exposures revealed in quarrying operations.²

¹ Kentucky Geol. Survey, Series VI, vol. 7, 1922.

² The geology and mineral resources of Wise County and the coal-bearing portion of Scott County, Virginia. Bulletin XXIV, Virginia Geological Survey, 1923.
Bulletin 111, United States Geological Survey, 1893.

Section of Newman formation, Big Stone Gap.

By M. R. CAMPBELL.

Sandstone, thick-bedded. (Base of Pennington shale.)	Ft.
Shale, dark-blue, calcareous	4
Sandstone, dark	3
Shale, black	6
Sandstone, blue, calcareous	5
Shale, dark-blue	18
Shale, calcareous, with beds of limestone	8
Shale, dark	6
Sandstone, green	6
Shale, green	12
Shale, sandy	19
Sandstone, dark-blue, calcareous, and shale	28
Limestone, dark, very impure	17
Shale, blue	22
Limestone, impure	26
Shale, blue, purple, and black	88
Shale, calcareous	34
Limestone, earthy, thick-bedded	17
Shale, green	4
Limestone, impure	2
Shale, green	3
Limestone, impure	22
Shale, green and brown	23
Shale, blue, with beds of limestone	10
Shale, calcareous	11
Limestone, blue, seamy	17
Limestone, impure, argillaceous, shaly	39
Limestone, oolitic, blue, in part weathers granular. Contains <i>Talarocrinus</i> sp. and <i>Pentremites pyriformis</i>	136
Limestone, white, oolitic above and dark below, with beds of fine-grained argillaceous buff-weathering limestone, each about 2 feet thick, at the top and bottom and another near the middle. Oolite beds contain <i>Platycrinus penicillus (huntsvillae)</i>	28
Limestone, white, thick-bedded, granular, in part oolitic	184
Limestone, massive, fine-grained, dark-drab, weathers white to creamy, with round black to red flints of 3-inch diameter	30
	828
Shale, reddish and gray, sandy. (Maccrady formation.)	

The Newman limestone outcrops in a narrow belt on the southeast flank of Stone Mountain, just above the base of the mountain.

Charles Butts and E. O. Ulrich regard the basal beds of the Newman formation as the equivalent of the St. Genevieve and Gasper formations of the Mississippi Valley region, basing their conclusions on paleontologic evidence. Fossils found above these basal beds appear to have affinities with the fossils of the St. Louis in age. Shaly limestone beds in the upper part of the formation yield a fauna similar to that of the Glen Dean limestone of Kentucky and for this reason Butts regards these upper beds as being of the same age as the Glen Dean limestone.

Certain beds in the lower part of the Newman limestone have been utilized for burning lime, and sites of old kilns were seen west of Dryden and at Olinger just above the foot of the mountain. The rock is crushed at Pennington Gap and used for road metal. Converted into lime or utilized as ground limestone the lower part of the formation is of high agricultural value.

PENNINGTON FORMATION

This formation was named by Mr. Campbell for Pennington Gap, where a complete section is excellently exposed. It is composed of a number of different kinds of rock. The lower part of the formation consists of thin to thick sandstone layers, succeeded upward by gray to yellow shale interbedded with thin sandstone layers. The middle of the formation is marked by 50 feet or more of massive gray sandstone which may be locally conglomerate followed by sandstone and yellow, green and red shale. The upper part of the formation in the Pennington region is composed of massive, gray sandstone, the "niggerhead rock," with two conglomeratic layers near the middle. This massive sandstone is separated from the base of the Lee formation by about 10 feet of shale. The total thickness of the formation at Pennington Gap is 1,150 feet. The type section measured in Big Stone Gap by M. R. Campbell¹ 30 years ago is as follows:

Section of Pennington shale, Big Stone Gap, Va.

By M. R. CAMPBELL.

	Ft.
Coarse conglomerate. (Base of Lee formation.)	
Shale, green, calcareous	6
Sandstone, green and red	2
Shale, blue	6
Coal	1
Shale, bluish	10
Sandstone, green	3
Shale, olive-green	7
Shale, soft, nonfissile, variegated	10
Sandstone	4
Shale, soft, red	8
Shale, sandy	4
Sandstone, bluish	19
Concealed, probably shale	507
Sandstone, white, cross-bedded	49
Conglomerate, white quartz pebbles	8
Shale, bluish yellow, calcareous	27
Shale, blue, sandy	10
Limestone, very impure and fossiliferous	4
Sandstones, calcareous and argillaceous	8

¹ Op. cit.

Shale, calcareous, very fossiliferous	6
Sandstone, blue, cross-bedded	12
Shale, purple and green	9
Shale, slightly sandy	4
Shale, green and purple	5
Sandstone, argillaceous	8
Sandstone, fine-grained	14
Sandstone, regularly bedded	80
Sandstone, much cross-bedded	107
Shale, dark-blue, calcareous	9
Shale, sandy	8
Shale, argillaceous	3
Sandstone, thick-bedded [cut by Southern Railway tunnel]	67
	<hr/>
	1,025
Shale, dark-blue, calcareous. (Newman formation.)	

The section in Pennington Gap is somewhat thicker but otherwise closely similar to the Big Stone Gap section. It is as follows:

Section of Pennington shale in Pennington Gap.

	Ft.
Shale, dark bluish gray to almost black,* with pyritiferous concretions	10
Sandstone, massive, gray to white with rippled surfaces, quartzitic. Two conglomeratic layers near middle. "Nigger-head" rock	226
Sandstone, massive to thin, alternating with shale. Black shale 20 feet from top	80
Concealed	229
Sandstone, massive, gray, coarse-grained	54
Concealed, probably shale and thin sandstones	117
Sandstone, massive, gray to brown, thin shale partings	80
Shale, light gray to chocolate colored in middle, thin, fissile....	59
Sandstone, massive to thin, dark gray, coarse-grained	22
Shale, bluish gray	32
Sandstone, massive, coarse-grained	21
Sandstone, thin to thick, beds alternate with light to dark shale.	53
Shale, dark gray, micaceous, thin sandstone beds with rippled surfaces near middle	38
Sandstone, thick bedded, with a few shale layers especially near the top	80
Shale, dark gray, weathers light to bluish gray, contains two black shale beds, each 2 feet thick	22
Sandstone, thin to thick bedded, gray with brown iron streaks..	27
	<hr/>
	1,150
Shale, calcareous, to argillaceous, with four thin limestone beds (Newman formation).	

The Pennington formation outcrops on the southeastern slope of Stone Mountain extending from near the crest half way to the base of the mountain. The "niggerhead" rock forms conspicuous cliffs and hogbacks near the crest of the mountain which closely resemble similar topographic forms

developed by the massive members of the Lee formation. Its outcrop in Lee County is everywhere clothed with a heavy forest cover.

The formation is very sparingly fossiliferous. It is regarded by Butts and Ulrich as the equivalent of the upper part of the Chester series of the Mississippi Valley.

Pennsylvanian Series.

General statement.—The Pennsylvanian series, in which occur all the commercially valuable coal beds of this field, consists of sandstone, shale, coal, and thin beds of clay. The rocks are all of Pottsville age and long ago were divided by Campbell into five formations as follows, named in ascending order: Lee, Norton, Gladeville, Wise, and Harlan. These names are for localities where the formations are fully developed and well exposed; thus, the term "Lee" is applied because that formation is splendidly developed with excellent sections in Stone Mountain in Lee County. Lithologically there is little difference between the various formations composing the Pennsylvanian series in Lee County. The Lee departs somewhat in its lithologic characters from the other formations, in that it carries a large proportion of conglomerate which is essentially absent in the other formations. With this exception there is little to distinguish one formation from another, each is composed of interbedded layers of sandstone, shale, and coal, with no perceptible order of recurrence, and with no characteristics which are persistent over a large area.

The Pennsylvanian rocks in this field are composed of about equal parts of shale and sandstone, the latter being slightly more abundant in the Lee formation and in the Harlan formation. Much of the sandstone is fine-grained and thin-bedded and contains many shaly beds. In general the coarse sandstone is massive and more resistant, forming conspicuous cliffs on the spurs. Practically all of the sandstones show marked current bedding and irregularities due to shallow water deposition. The weathered sandstone is mostly buff to brown from iron stain, but the fresh material, such as is seen in diamond drill cores, is light to dark gray, often with a bluish tinge. Grains of quartz, decomposing feldspar, and mica are the principal constituents. Locally the sandstones contain white quartz pebbles. This conglomeratic feature may aid in identifying the bed in small areas but is not strictly reliable, because the same sandstone does not contain pebbles in all localities.

Most of the rock type described as shale in this report is slightly sandy, and most of the shale beds grade into sandstone through the intermediate,

sandy shale. The common color is drab, but there are some streaks of yellow usually in the more argillaceous portions. Hard, slaty beds exposed along some of the smaller streams are distinctly blue.

The clay beds occur as thin layers or partings within or just above or beneath the coal beds. Clay occurring above the coal is generally sandy and shows distinct laminations. Some of the clays just beneath the coal may be refractory and, if found in sufficient quantities, could be utilized for fire brick.

The fossils in the Pennsylvanian series in Lee County are almost entirely plants, and are found chiefly in the roof-shales of the coal beds. Marine fossils were not found.

LEE FORMATION.

The Lee formation, named for Lee County, Virginia, constitutes the base of the Coal Measures. It is a thick formation, and complex, being made up of sandstone, conglomerate, shale, and coal beds.

In Lee County, this formation is divisible into three distinct parts, separated from one another by large intervals. The basal part is a massive conglomerate, in which white quartz pebbles varying in size from coarse shot to over an inch in diameter are imbedded in a matrix of coarse sand that is cross-bedded and rippled marked. This rock weathers to form steep slopes covered with pebbles. The interval above this basal conglomerate is occupied with shale alternating with a few thin beds of sandstone and thin beds of coal. The shale is gray in color and sandy in character. Thin bands or beds of black shale occur in this gray shale which grade laterally into thin beds of coal. The coal beds are too thin and the coal too impure to be workable.

Above the shale occurs a second massive sandstone and conglomerate. The pebbles here are similar to those of the basal part but are few in number. This portion of the formation is largely coarse sandstone, cross-bedded nearly everywhere and only locally conglomeratic.

Other beds of shale follow with characters essentially the same as those of the shale in the lower part. Thin beds of impure coal occur interbedded with this shale.

The topmost member of the formation is another massive sandstone with few pebbles. This member is about 100 feet thick and is known as the "Bee rock." The Bee rock is very resistant to weathering and forms conspicuous topographic features, chiefly long, knife-edge ridges.

The crest of Stone Mountain and nearly the entire width of its north-western flank is composed of this formation. The sandstone layers, orig-

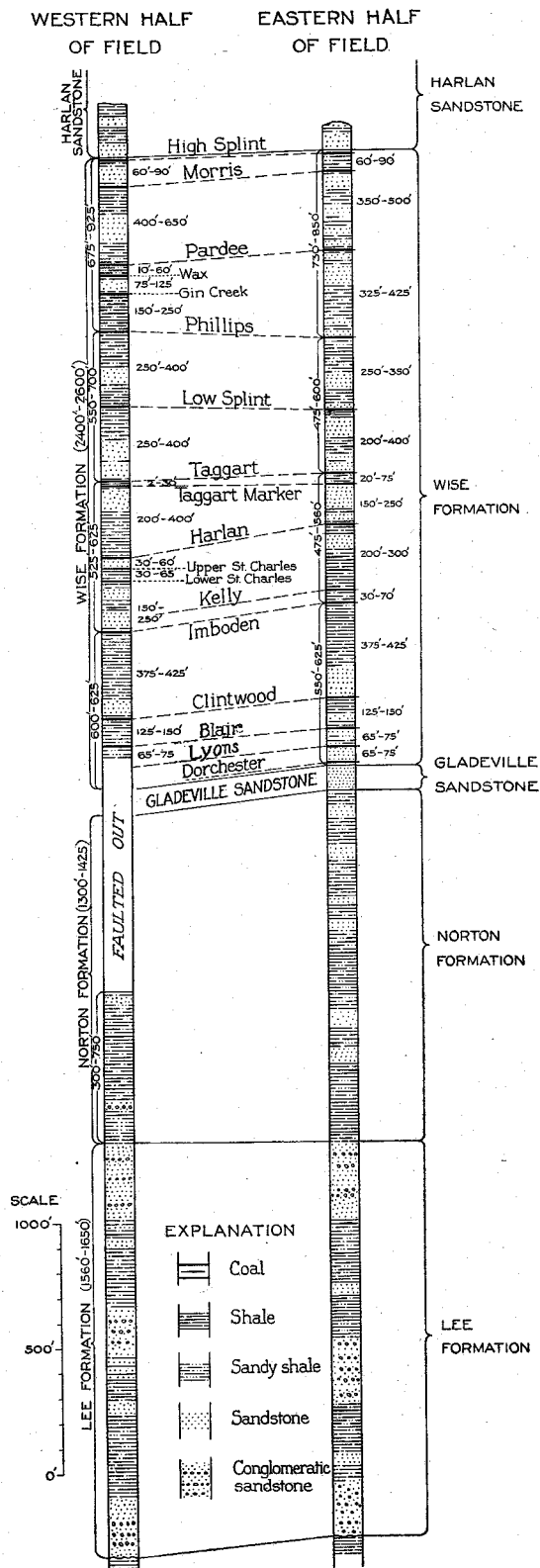


Fig. 2.—Generalized sections of the Pennsylvanian series in Lee County, Va.

inally horizontal but later upturned to a vertical position by profound movements affecting the outer shell of the earth, form linear, narrow ridges that give Stone Mountain its rugged character, its vertical cliffs, and make it impassable in many places.

The Lee formation is unfossiliferous with the exception of some remains of plants associated with the thin beds of coal.

The thickness of the formation in Pennington Gap is 1,650 feet and at Big Stone Gap, three miles northeast of the county line, 1,530 feet.

The outcrop of the formation is a relatively narrow belt with a total area of approximately $7\frac{1}{2}$ square miles in the area under consideration.

The formation is excellently exposed along the railroad through Pennington Gap and the following section gives its characters in detail.

Section of Lee formation, Pennington Gap, Va.

	Ft.
Sandstone, coarse-grained, thin to massive with rippled surfaces, slightly conglomeratic near base. Upper sandstone member —“Bee rock”	375
Concealed, probably largely sandy shales	410
Sandstone, massive, dark gray	68
Shale, thin, gray to blue, with thin sandstone layers.....	36
Sandstone, massive with rippled surfaces, coarse-grained, gray, conglomeratic. Middle sandstone member	195
Concealed, basal part probably massive sandstone, middle and upper parts probably shales, with a few thin sandstones	463
Sandstone, massive to thin, coarse-grained, white to gray, quartzitic, few conglomeratic layers. Lower sandstone member of Lee	103
	<hr/> 1,650

NORTON FORMATION.

The Norton formation, named for Norton, Wise County, Virginia, outcrops across the entire field except just east of Purcell where it is cut out by faulting. West of Purcell the formation is a narrow belt confined to the northwest base of Stone Mountain. East of Delvale the width of outcrop increases, for the formation thickens in this direction and its dip decreases. As a result its northern limit departs farther and farther from Stone Mountain.

East of Delvale the full thickness of the formation is present, but west of this place the upper part of the formation has been cut off by faulting. In places between Delvale and Purcell, the formation is entirely absent, the faulting having brought the Lee up against the Gladeville sandstone.

Owing to its proximity to Stone Mountain the dip throughout the entire extent of the formation is high, ranging from 20 degrees to verticality. East

of Delvale, the dip ranges from 20° to 30°. West of that place the dip increases, ranging from 30° to 60°, and west of Purcell, the formation is nearly or quite vertical in position.

The formation is composed of sandstone, shale, and coal. The proportion of shale to sandstone is about equal. Its thickness is about 1,400 feet in the eastern part of Lee County. West of Delvale only the lower part of the formation is exposed, the upper part having been carried beneath the surface in the movement that produced the North-Fork fault.¹

The following section measured in Pennington Gap, illustrates the character of the basal part of the formation:

Section of Norton formation, Pennington Gap, Va.

	Ft.
Concealed	156
Sandstone, massive, dark gray	9
Shale, dark, with sandstone layer near middle	6
Sandstone, thin to massive, some layers carrying pebbles up to 2 inches in diameter	6
Shale, dark gray to almost black	30
Sandstone with some shale and shaly sandstone	78
Coal	3
Sandstone	3
Shale	1½
	292½

West of Purcell, the Norton formation contains but one workable coal bed which is of little value because of its vertical position. East of Delvale, where the full thickness of the formation is present, the coal beds increase in number.

GLADEVILLE SANDSTONE.

The Gladeville sandstone was named for Gladeville, now Wise, the county seat of Wise County, where it is an important stratigraphic marker. It is a useful marker in the Lee coal field also. In its type locality it is a coarse-grained, arkosic, thick-bedded, cross-bedded sandstone composed of quartz, feldspar, and mica, and generally white in color. In Lee County these characters persist, with the addition of certain other features that tend to make the formation even more conspicuous. Throughout its extent in Lee County the formation, particularly its basal part, is a strong conglomerate. The pebbles are white quartz, ranging in size from coarse shot to pebbles an inch in diameter. The slopes below its outcrop along the

¹ See page 40.

northwest foot of Stone Mountain are mantled with these pebbles. The basal part of the formation is extremely siliceous, fresh surfaces of the rock being white and showing little else than quartz.

The Gladeville ranges in thickness from 100 to 150 feet. It is unfossiliferous.

The sandstone dips steeply, and its outcrop is a narrow belt. From Mohawk to the Wise-Lee line it lies at a considerable distance north of the base of Stone Mountain. West of Mohawk it forms a part of the northern slope of Stone Mountain, its outcrop occurring just south of the river. At Purcell it is terminated against the fault that marks the northern boundary of Stone Mountain.

WISE FORMATION.

The Wise formation, named for Wise County, Virginia, differs little in essential particulars from the Norton formation. It is very thick in Lee County and is the formation at the surface throughout the greater part of the coal-bearing portion of the county. The stratigraphic succession and thicknesses of intervals may be ascertained by consulting the generalized sections, Figure 2, the local sections, and the detailed descriptions of each drainage basin.

The formation consists of shale and sandstone with coal beds, the proportion of shale to sandstone being about equal. The coal beds of this formation are the most important in Lee County, the bulk of the workable coal being limited to this formation. At least 20 beds workable locally or throughout large areas occur between the base and the top of the formation. These are described in the part of this report devoted to coal resources.

There are a number of sandstone beds within the Wise formation that are useful in correlation and in the determination of the position of the coal beds.

Near the base of the Wise formation a sandstone bed occurs that is 50 feet or more in thickness and separated from the Gladeville in places by only 10 feet of shale. This sandstone is coarse-grained, arkosic, and gray to brown in color.

The next conspicuous bed has been called by Campbell and Eby the Addington sandstone in Wise County. It lies about 300 feet above the Gladeville and is 60 to 80 feet in thickness. It is a persistent sandstone and locally makes pronounced cliffs and ledges, however it possesses no marked characteristics that would tend to separate it from other sandstone members

of the Wise formation. The determination of its position is of considerable importance as the Clintwood (North Fork) coal bed occurs directly beneath it.

A mass of shale alternating with thin, fine-grained, arkosic sandstone several hundred feet in thickness, lies above the Addington sandstone. It gives rise to long, gentle slopes.

The Upper St. Charles coal bed (No. 2A) is overlain by a thick-bedded, coarse-grained sandstone throughout the entire area of its outcrop in The Pocket region. This sandstone is so thin, however, as to be inconspicuous in most places.

The Taggart (No. 5) bed is overlain and underlain by sandstone beds 100 feet or more thick. These sandstones are more conspicuous in the western half of the field where they form prominent cliffs and ledges in much of The Pocket region. Massive sandstones are likewise found beneath the Phillips (No. 7) bed and above and below the Pardee (No. 10) coal bed.

The formation is unfossiliferous with the exception of the plants which are found in abundance in association with many of the coal beds. The thickness of the Wise formation in The Pocket is 2,600 feet, and in the vicinity of Keokee it is 2,500 feet. The total area of its outcrop in this coal field is nearly 60 square miles.

HARLAN FORMATION.

This formation, named for Harlan County, Kentucky, is the highest member in the Pennsylvania series in Lee County. It is composed chiefly of coarse, white sandstone, but the formation also carries many beds of sandy shale and thin coal beds. Its base is everywhere prominent, being an extremely massive siliceous sandstone about 40 feet thick, and forming on some of the narrow spurs, rugged and picturesque ledges.

The formation is found only in the higher summits of Little Black Mountain. The greatest thickness of the part remaining is about 200 feet, measured at the head of Gin Creek. Its total area is small, but since hundreds of feet of its upper part may have been removed by erosion since the close of the Pennsylvanian period, its original area may well have been several times the present area.

The history of this region, so far as recorded in its rocks, closes with the deposition of the Harlan sandstone, if exception be made of the deposits of small extent described in the following section, which have accumulated in recent geologic time. If other formations were laid down on the Harlan formation, all traces of them have been removed by erosion long ago. The

subsequent history of the region is to be deciphered almost entirely in the study of the land forms into which its surface has been carved by erosion since the close of the coal age.

QUATERNARY SYSTEM.

Recent Series.

ALLUVIUM.

The lower portion of every valley in the field 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 flood plains are narrow but are nearly everywhere cleared and under cultivation, for their soils are the richest in the field. The largest accumulations of alluvium are along Straight Creek, North Fork of Powell River, Jones Creek, Cox Creek, Craborchard Creek, and Stone Creek.

SOIL.

The soil of the coal-bearing portion of Lee County is essentially the result of the decay and disintegration of the underlying formations, and its character is therefore largely dependent upon the nature of the parent rock. The underlying rocks being chiefly arkosic sandstones and sandy shales the soil is consequently sandy, being chiefly sandy loam of inferior quality agriculturally. On the long level-topped ridges the soil is thick and of fair quality, hence locally there are small clearings that are cultivated. On the uncleared hillsides the soil may be thick locally and of fair quality, although generally mixed with some coarse sandstone talus. When cleared and cultivated the hillsides are rapidly denuded of their soil mantle. For this reason in the course of a few years clearings are allowed to revert to a forested condition. Because of the steep slopes throughout much of the field and the infertile soil the agricultural possibilities of the coal-bearing portion of Lee County are severely limited.

Correlations with Adjoining Coal Fields.

In this report the correlation of the coal beds of Lee County will be made with those of Wise County on the east, and with those of the adjacent part of Kentucky on the north and west. (Plate VI). The correlations east of Wise County may be ascertained by consulting the reports

published by the Virginia Geological Survey on the several coal-bearing counties that lie to the east and northeast of Wise County. The Kentucky Survey reports will afford information relative to the correlation of the coals in the eastern part of Kentucky. In making the correlation with the coal beds of Kentucky, recent publications of the Kentucky Geological Survey have been followed.¹

The Dorchester (Glamorgan) coal occurs directly above the Gladeville sandstone but has been mined only at Purcell where it is known as the Mar-see or Cornett bed. The Lyons coal bed has been mined at the mouth of Jones Creek where it is known as the Thompson bed. The Bentley bed, mined near Purcell, is probably to be correlated with the Blair of Dickenson, Wise, and Buchanan counties, and of West Virginia. The North Fork bed is the same as the Clintwood of Wise and Dickenson counties. It occurs directly beneath the Addington sandstone which forms prominent ledges and cliffs just above the coal bed.

Bed No. 1 of The Pocket region is the same as the Imboden and Bolling farther east. This correlation has been determined by the tracing of the bed eastward in the field, by its occurrence above the Addington sandstone, and by the very similar character of the coal and of the roof rock overlying the coal. The Kelly bed apparently does not persist in workable thickness into The Pocket. Bed No. 3 of The Pocket has been traced through and found to be equivalent to the Wilson bed at Keokee. This bed is the same as the Harlan bed of Kentucky, and is probably the equivalent of one of the Standiford coals of Wise County. The Taggart bed is the No. 5 of The Pocket, and McConnell of Keokee. It is also known as the Kellioka and is the same bed as the famous Upper Elkhorn of eastern Kentucky. The Phillips coal is the same as the Dean coal of eastern Kentucky. It is the Fire Clay coal of Wise County, Virginia, and No. 7 of The Pocket. It has been called also the Wallens Creek coal in Kentucky. Bed No. 10 of Lee County is the Smith or Limestone bed of the Kentucky reports and the Pardee of Wise County. Bed No. 11 is the Cornett bed of Kentucky and the Morris bed of Keokee and Wise County. Bed No. 12 with an extremely limited area in Virginia is the High Splint.

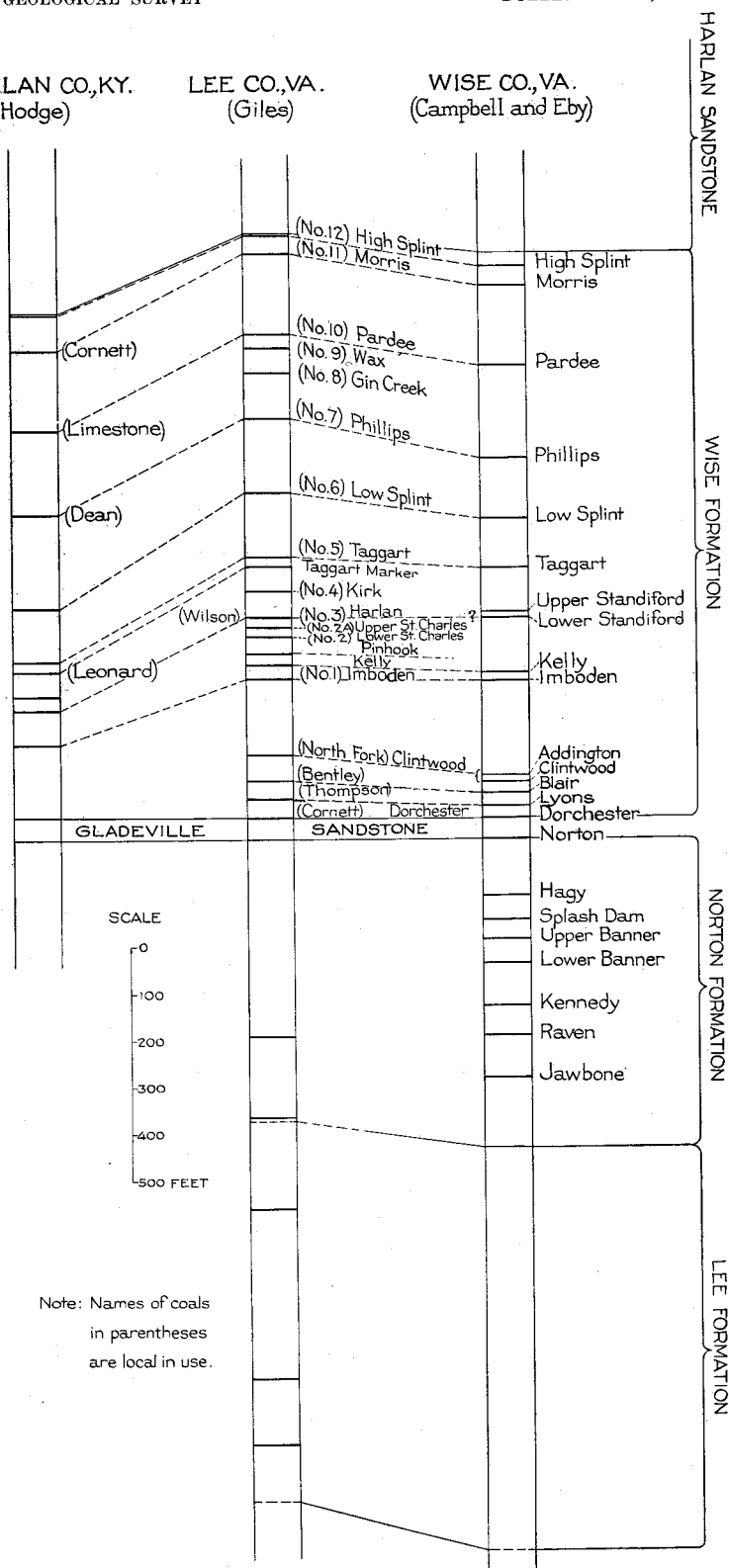
¹ Hodge, J. M., Report on the Upper Cumberland coal field. The region drained by Poor and Clover Forks in Harlan and Letcher counties. Bull. No. 13, Serial No. 16, Kentucky Geol. Survey, 1912.

Crider, A. F., The coals of Letcher County. Vol. IV, Fourth Series, Kentucky Geol. Survey, 1916.

HARLAN CO., KY.
(Hodge)

LEE CO., VA.
(Giles)

WISE CO., VA.
(Campbell and Eby)



Note: Names of coals
in parentheses
are local in use.

SECTIONS SHOWING CORRELATIONS OF COAL BEDS OF LEE
COUNTY WITH ADJOINING COAL FIELDS.

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, however, be used with caution, as parts of every one of them are poorly exposed, and the intervals are not in every case the averages for the locality. Corrections for dip have been made in the thicknesses of the beds in the case of each section. The columns showing intervals have also been generalized with reference to the dip.

Local Section 1.

Along road westward from elevation 1,676 on Ely Creek to the Virginia-Kentucky line, elevation 2,242.

	Thickness. Ft.	Intervals. Ft.
Wise formation:		
Shale, gray, sandy	35	
Sandstone, massive, gray	10	
Coal bloom, Low Splint, elevation 2,190 feet		45
Shale, sandy, gray	85	
Sandstone, arkosic, brown	10	
Shale	20	
Sandstone, arkosic	80	
Shale	10	
Sandstone	10	
Shale, sandy	20	
Sandstone, coarse, massive, arkosic	65	
Coal, Taggart, elevation 1,890 feet	3½	300
Sandstone, coarse, massive, brown, arkosic	100	
Shale	5	
Sandstone, massive, coarse	15	
Shale	10	
Coal bloom, elevation 1,760 feet		130
Sandstone, shaly	20	
Sandstone, thin to thick-bedded	10	
Concealed, probably sandstone	15	
Sandstone	5	
Shale, sandy	30	
Coal, Harlan, elevation 1,680 feet	4	80
Shale	10	10
	572½	565

*Local Section 2.**From Puckett Creek northward to the head of Big Branch.*

	Thickness. Ft.	Intervals. Ft.
Wise formation:		
Sandstone, massive, gray to brown, coarse, ledge forming	110	
Coal, Taggart, elevation 1,820 feet	4	110
Concealed, probably sandstone	15	
Sandstone, massive, coarse, gray to brown	85	
Shale, dark	20	
Coal, elevation 1,700 feet	4 (?)	120
Sandstone	10	
Coal, elevation 1,690 feet	1	10
Shale	10	
Sandstone, thin-bedded and shaly	30	
Coal, elevation 1,650 feet	2	40
Sandstone, thin-bedded in upper half, massive in lower half	30	
Shales and thin layers of sandstone alternating...	30	
Coal, Harlan, elevation 1,590 feet	4-5	60
Shale	10	10
	366	350

*Local Section 3.**From B. M. 1,662, one mile northeast of Bondurant, along road eastward to top of ridge.*

	Thickness. Ft.	Intervals. Ft.
Wise formation:		
Sandstone, thin-bedded, arkosic	30	
Shale	5	
Coal, Taggart, elevation 1,960 feet		35
Shale	10	
Sandstone, massive, arkosic	40	
Concealed, probably massive sandstone	40	
Sandstone, thin-bedded to massive	40	
Concealed	30	
Sandstone, thin-bedded	20	
Concealed	10	
Sandstone	10	
Concealed	10	
Sandstone, thin-bedded, arkosic	10	
Concealed	10	
Sandstone, massive	70	300
	335	335

Local Section 4.

From Straight Creek north one mile up creek that flows into Straight Creek one-fourth mile west of mouth of Benedict Branch.

	Thickness. Ft.	Intervals. Ft.
Wise formation:		
Sandstone, massive	20	
Concealed, probably sandstone	20	
Sandstone, thin to massive	20	
Concealed	50	
Sandstone, forms ledges, massive	15	
Concealed, probably sandstone	20	
Sandstone, thin-bedded	10	
Concealed, probably sandstone	10	
Sandstone, thin to massive, arkosic	30	
Concealed, probably sandstone	20	
Sandstone, thin to massive	20	
Coal, Taggart, elevation 1,880 feet		235
Sandstone, thin to massive in upper part, massive in lower part, brown to gray	120	
Sandstone, thin-bedded	20	
Shale	10	150
	<hr/> 385	<hr/> 385

Local Section 5.

From Straight Creek up Benedict Branch to mine of Benedict Coal Corporation in Phillips bed.

	Thickness. Ft.	Intervals. Ft.
Wise formation:		
Coal, Phillips, elevation 2,465 feet		
Shale, sandy	65	
Concealed	70	
Sandstone, massive	10	
Shale, sandy	25	
Shale and thin sandstone alternating	75	
Concealed	50	
Coal horizon, Low Splint, estimated elevation 2,170 feet		295
Concealed	10	
Sandstone, gray, massive	100	
Concealed	40	
Sandstone, massive, gray to brown	100	
Coal, Taggart, elevation 1,920 feet		250
Sandstone, massive, gray to brown	70	
Shale	10	
Coal bloom, elevation 1,840 feet		80
Shale	10	
Sandstone	20	
Coal bloom, elevation 1,810 feet		30
Shale	10	10
	<hr/> 665	<hr/> 665

*Local Section 6.**From Imperial Leona mines northeast to top of Little Black Mountain.*

	Thickness.	Intervals.
	Ft.	Ft.
Harlan sandstone:		
Sandstone, very thick-bedded, cliff former	115	115
Wise formation:		
Concealed, probably shale and thin sandstone	10	
Coal horizon, High Splint, estimated elevation 3,265 feet		10
Concealed, probably shale and thin sandstone	60	
Coal horizon, Morris, estimated elevation 3,205 feet		60
Sandstone, massive, forms cliffs	60	
Concealed, probably shale	30	
Sandstone, massive	30	
Concealed	10	
Sandstone, cliff former	60	
Shale and thin sandstone	100	
Sandstone, massive, gray	10	
Concealed	20	
Sandstone	10	
Shale, sandy	20	
Coal horizon, Pardee, estimated elevation 2,855 feet		350
Shale	10	
Sandstone, massive	20	
Shale and thin sandstone alternating	20	
Coal horizon, Wax (No. 9), estimated elevation 2,805 feet		50
Shale	10	
Shale, sandy	30	
Sandstone	10	
Shale	30	
Coal horizon, Gin Creek (No. 8), estimated elevation 2,725 feet		80
Shale	20	
Sandstone, massive, cliff former	60	
Shale and thin sandstone alternating	100	
Shale	30	
Sandstone, thin to massive	20	
Shale	20	
Coal horizon, Phillips, elevation 2,475 feet		250
Concealed, probably shale	10	
Sandstone	5	
Shale, sandy	40	
Sandstone, thin	20	
Sandstone, massive, cliff former	30	
Shale, sandy	15	
Concealed	30	
Sandstone, arkosic, massive	40	
Shale with a few thin sandstones	90	
Shale	30	
Coal, Low Splint, elevation 2,165 feet		310
Shale	20	
Sandstone, massive, arkosic	30	
Shale	60	
Sandstone, thin to massive	140	
Coal, Taggart, elevation 1,915 feet		250
	1,475	1,475

Local Section 7.

*Up Big Branch of Straight Creek from one-fourth mile west of Sandlick
Branch road to crest of divide one mile northeast.*

Wise formation:	Thickness. Ft.	Intervals. Ft.
Sandstone, massive	50	
Concealed	20	
Shale and thin sandstone	40	
Sandstone, massive, gray	30	
Concealed, probably sandstone	40	
Concealed, probably shale and thin sandstone	20	
Coal horizon, Harlan, elevation 1,780 feet ...		200
Sandstone, thin to thick bedded	20	
Concealed	20	
Shale	10	
Coal, Upper St. Charles (No. 2A), elevation 1,730 feet		50
Shale	5	
Sandstone, thin-bedded	25	
Sandstone, thin to massive, arkosic	10	
Shale	10	
Coal, Lower St. Charles (No. 2), elevation 1,680 feet		50
Shale	10	
Sandstone, thin to massive, arkosic	30	40
	<hr/> 340	<hr/> 340

Local Section 8.

*From top of ridge three-fourths mile east of the mouth of Benedict Branch
down Summers Creek one mile.*

Wise formation:	Thickness. Ft.	Intervals. Ft.
Sandstone, massive, gray, arkosic	100	
Shale	10	
Coal, Low Splint, elevation 2,260 feet		110
Shale	20	
Sandstone, massive	20	
Concealed, probably shale and thin-bedded sand- stone	50	
Shale	60	
Sandstone, gray, massive	140	
Shale	10	
Coal, Taggart, elevation 1,960 feet		300
Sandstone, massive chiefly	130	
Shale	5	
Coal bloom, elevation 1,825 feet		135
Shale	5	
Sandstone, thin to massive, arkosic	15	
Shale	10	
Coal bloom, elevation 1,795 feet		30
Shale	20	
Sandstone	30	50
	<hr/> 625	<hr/> 625

Local Section 9.

Up Sandlick Branch one and one-half miles from Southern railroad to top of divide south of Big Branch. Lower part of section generalized due to relatively high dip.

	Thickness. Ft.	Intervals. Ft.
Wise formation:		
Sandstone, coarse, arkosic	40	
Shale	10	
Coal bloom, Harlan, elevation 1,890 feet		50
Sandstone, thick, coarse-grained, brown	30	
Coal bloom, Upper St. Charles (No. 2A), elevation 1,860 feet		30
Concealed	30	
Coal bloom, Lower St. Charles (No. 2), elevation 1,830 feet		30
Sandstone, thin to massive	25	
Sandstone, very massive, forms ledges	20	
Concealed	25	
Sandstone, probably	30	
Sandstone, thin, arkosic	25	
Shale, sandy	25	
Coal, Imboden, elevation 1,680 feet		150
Shale	20	
Sandstone, thin to massive, gray	30	
Shale	10	
Sandstone, Addington	30	
Concealed, probably chiefly sandstone	60	
Coal, elevation 1,550 feet		150
Concealed	10	
Sandstone, massive	40	
Shale and shaly sandstone	30	80
	490	490

Local Section 10.

From Virginia-Kentucky line southward on Jones Creek road to east-west county road.

	Thickness. Ft.	Intervals. Ft.
Wise formation:		
Sandstone	20	
Shale	10	
Coal, Low Splint, elevation 2,390 feet	5	30
Concealed	10	
Sandstone, arkosic, coarse, from thin to massive ..	60	
Coal bloom, elevation 2,320 feet		70
Shale	5	
Coal bloom, thin, elevation 2,315 feet		5
Sandstone, thin with shale	25	
Sandstone, coarse, brown, massive	40	
Shale, sandy	20	
Coal bloom, thin, elevation 2,230 feet		85
Shale	10	
Sandstone, massive, arkosic	50	
Sandstone, thin, alternating with shale	20	
Shale, sandy	30	
Sandstone, arkosic, thin to massive	50	
Shale	10	
Coal bloom, elevation 2,060 feet		170
Shale	10	
Sandstone, thin to massive	20	
Concealed	20	
Shale, clayey	10	
Coal bloom, Taggart, elevation 2,000 feet		60
Shale	10	
Sandstone, thin layers chiefly	60	
Concealed	10	
Shale	5	
Coal bloom, elevation 1,915 feet		85
Shale	5	
Concealed	10	
Sandstone, thin, coarse, arkosic	50	
Shale	10	75
	585	580

Local Section 11.

From Virginia-Kentucky line southward along creek one mile east of Little Bundy Creek to county road.

	Thickness.	Intervals.
	Ft.	Ft.
Wise formation:		
Sandstone, massive for the most part, arkosic ...	60	
Shale	20	
Coal, Phillips, estimated elevation 2,750 feet ..	.....	80
Shale and thin sandstone alternating	30	
Concealed	10	
Sandstone, forms ledges, massive	30	
Shale and thin sandstone alternating	30	
Sandstone, massive, forms ledges	30	
Concealed, probably shale	30	
Sandstone, thin	20	
Concealed, probably shale	20	
Coal, Low Splint, estimated elevation 2,550 feet ..	.....	200
Concealed, probably largely shale	50	
Shale and thin sandstone alternating	90	
Concealed, probably largely shale	100	
Shale	10	
Coal, Taggart, estimated elevation 2,300 feet ..	.....	250
Sandstone	50	
Shale with a few thin sandstones	40	
Sandstone, massive, arkosic	50	
Concealed	5	
Coal bloom, Harlan, elevation 2,155 feet .....	.....	145
Concealed	15	
Sandstone, arkosic	50	65
	740	740

Local Section 12.

From Keokee north along road to Virginia-Kentucky line.

	Thickness.	Intervals.
	Ft.	Ft.
Wise formation:		
Sandstone, massive, gray	30	
Sandstone, thin to massive, gray	20	
Coal, Low Splint, elevation 2,590 feet .....	.....	50
Sandstone, gray to brown, thin to massive	40	
Coal bloom, elevation 2,550 feet .....	.....	40
Sandstone, massive to thin, arkosic	30	
Coal bloom, elevation 2,520 feet .....	.....	30
Shale	10	
Sandstone, thin to massive, arkosic in upper part, coarse, massive, gray to brown in lower part ..	170	
Coal bloom, elevation 2,350 feet .....	.....	170
Sandstone	20	
Coal bloom, Taggart, elevation 2,330 feet ..	.....	20
Sandstone	10	
Coal bloom, elevation 2,320 feet .....	.....	10
Sandstone, coarse, massive, gray to brown	100	
Coal bloom, elevation 2,220 feet .....	.....	100
Sandstone, thin and shaly, coarse-grained	80	
Coal bloom, Harlan, elevation 2,140 feet .....	.....	80
Sandstone, coarse, arkosic	20	
Concealed	30	50
	560	550

*Local Section 13.**From Keokee northward one mile to above Low Splint coal bed.*

	Thickness.	Intervals.
	Ft.	Ft.
Wise formation:		
Sandstone, arkosic	40	
Coal, Low Splint, elevation 2,620 feet	4	40
Shale	20	
Coal bloom, elevation 2,600 feet		20
Shale	5	
Sandstone	5	
Shale	5	
Sandstone	5	
Shale	5	
Coal bloom, elevation 2,575 feet		25
Shale	5	
Sandstone	10	
Shale	5	
Coal bloom, elevation 2,555 feet		20
Sandstone	20	
Shale	5	
Coal bloom, elevation 2,530 feet		25
Shale	25	
Coal bloom, elevation 2,505 feet		25
Shale, sandy	25	
Sandstone	10	
Concealed	25	
Sandstone, massive to thin	25	
Concealed, probably sandstone	30	
Sandstone	20	
Coal, Taggart, elevation 2,370 feet	3½	135
Sandstone	50	
Coal bloom, elevation 2,320 feet		50
Sandstone, thin to massive	110	
Shale	20	
Coal, Harlan, elevation 2,190 feet	5	130
Shale	10	
Coal bloom, elevation 2,180 feet		10
Shale and thin sandstone	20	
Coal bloom, elevation 2,160 feet		20
Shale	10	
Coal bloom, elevation 2,150 feet		10
Shale	10	10
	532½	520

GEOLOGIC STRUCTURE.**Method of Representation.**

The position in which coal and other beds lie in a region in which there has been little disturbance by folding or faulting, and in which dips are low, is best shown by structure contours—lines drawn so that some important or easily recognizable reference stratum is at the same elevation along any one of them, and a certain conventional distance, the contour interval,

above or below that elevation along the next line. The contour interval used for this report is 50 feet, and the datum of the elevations shown by the structure contours is the same as that of the surface contours—mean sea level. In Lee County, the Taggart coal bed has been chosen as the reference stratum because of its widespread extent and because it is the most extensively mined coal bed of the field.

By reading the structure contours on the geologic map it is possible to determine the direction and amount of the dip at any point and to determine the position and elevation of any of the coal beds. It is frequently convenient to employ the contours for the latter use where the outcrop of a coal is buried deeply beneath the talus and soil, or where the bed is below drainage. For example, if it is desired to find the position of the Harlan bed at some point on Gin Creek, the elevation of the Taggart horizon, as shown by the structure contours, is first noted. Then the interval between the Taggart and the Harlan is ascertained for that locality from the detailed description of the coal beds on that stream or from the generalized sections in figure 2. As the Harlan is below the Taggart, this interval subtracted from the elevation of the latter bed will give the elevation of the Harlan, from which the position of its outcrop can be readily ascertained by reference to the surface contours. If the bed under consideration is below the surface, the depth to which it is necessary to drill or shaft in order to reach it can be determined by subtracting its elevation from that of the surface at that point.

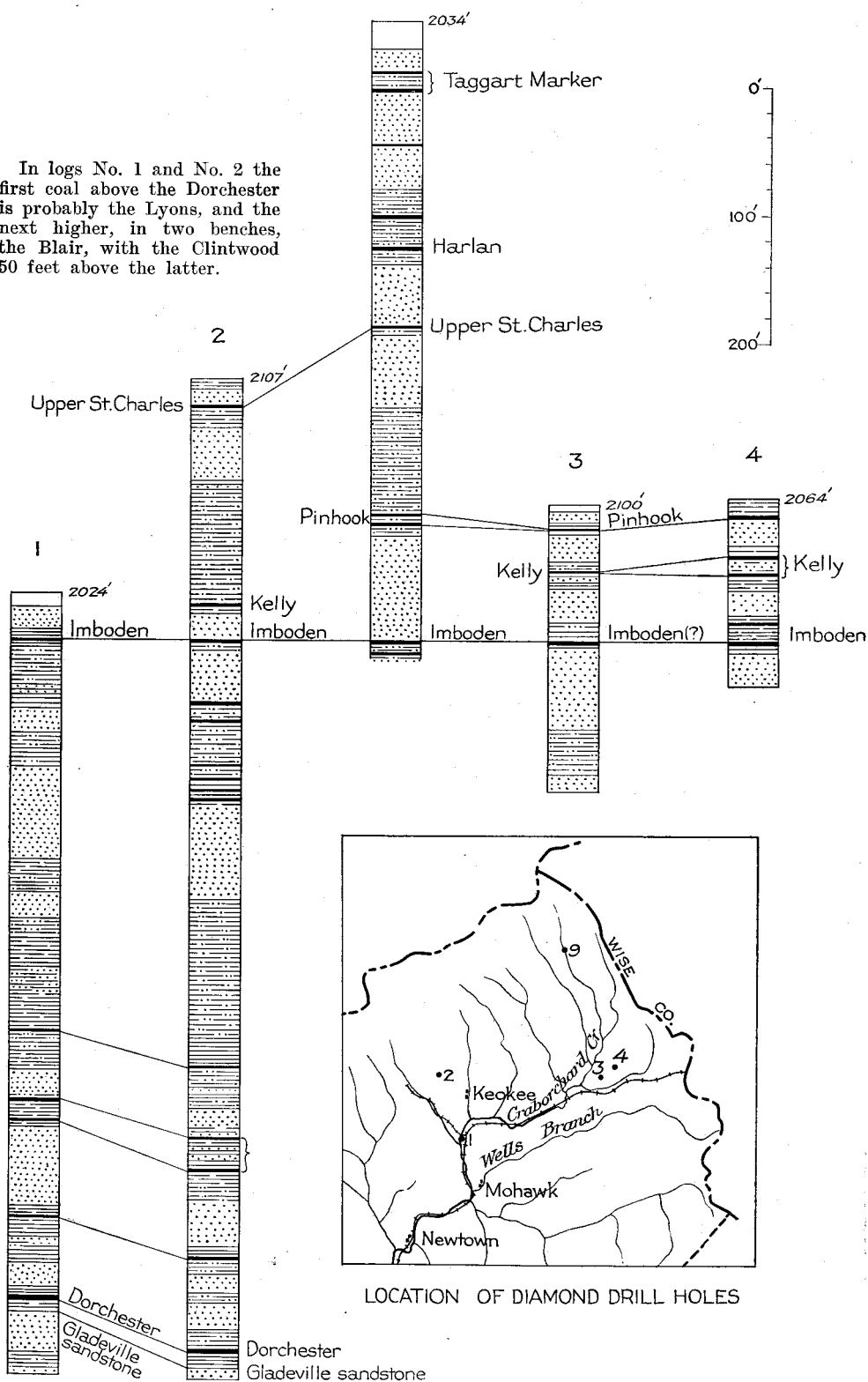
The usefulness of structure contours naturally depends largely on their accuracy. There are so many possible sources of error in determining them that it is not maintained that absolute accuracy has been achieved. It is believed, however, that inaccuracies of more than 50 feet in vertical distance are very rare. Errors are most likely to be made where dips are exceptionally steep, as along the northwestern slope of Stone Mountain and in the adjoining area to the northwest.

Dip.

In the greater part of the field there is a gentle dip to the northwest averaging about 75 feet per mile. This gentle dip is not uniform, but is modified by local folds and undulations in the strata, that are irregularly distributed and whose axes trend in different directions. As Stone Mountain is approached the dip increases, the strata becoming nearly or quite vertical in its flanks.

9

In logs No. 1 and No. 2 the first coal above the Dorchester is probably the Lyons, and the next higher, in two benches, the Blair, with the Clintwood 50 feet above the latter.



SECTIONS OF DIAMOND DRILL HOLES IN EASTERN LEE CO., VA.

Folds.

Middlesboro syncline.—All of the coal-bearing portion of Lee County lies in a broad fold that is synclinal, or concave upward. This fold, named by Campbell, the Middlesboro syncline, extends from the northwestern part of Buchanan County southwestward into Tennessee. It is 12 to 20 miles broad and lies between Pine Mountain on the northwest and a broad arch or anticline on the southeast, of which Stone Mountain forms the western limb.

The axis or imaginary line toward which the strata on each side dip and which connects the lowest parts of the syncline, passes through Harlan County in a direction parallel to Pine Mountain and at a distance of only about three miles southeast of the crest of that mountain. In consequence the northwest limb of this great trough is short with the strata dipping steeply. The southeast limb extending through eastern Harlan County and the coal-bearing portion of Lee County is long with gentle dips. Little Black and Big Black mountains are a part of this southeastern limb, hence the strata composing these mountains dip gently northwestward toward the axis of the syncline. The rate of dip is approximately 90 feet per mile, or very nearly one degree, the strata descending a vertical distance of 460 feet between Maness and Little Black Mountain at the head of Gin Creek, a horizontal distance of about five miles.

Powell Valley anticline.—The coal area in Lee County is bounded on the southeast by a structure that is just the reverse of a syncline, the strata being convex upward and dipping away from the axis. This feature is the Powell Valley anticline. This great fold has its northeastern termination in the southern part of Wise County and extends thence southwest as far as Jacksboro, Tennessee, where it is cut off by the Jacksboro fault.¹ It is generally a single, broad fold, but in places is composed of several smaller anticlines or narrow faulted strips developed therefrom; in width it varies from five to twelve miles, with an average of seven or eight miles. In Lee County Stone Mountain constitutes the western limb of the fold, the axis of the fold being two miles southeast of the crest of the mountain. The fold is unsymmetrical, the strata on the eastern limb dipping gently southeastward, whereas in Stone Mountain the strata are nearly or quite vertical. The strata flatten out within a short distance northwest of the foot of Stone Mountain, to form the southeast limb of the Middlesboro syncline

¹ The geology and coal resources of Dickenson County, Virginia. Virginia Geol. Survey, Bull. XXI, 1921, pp. 53-67.

already described, the dip immediately north of Stone Creek and the North Fork of Powell River having the gentle character that this limb of the Middlesboro syncline elsewhere possesses.

Faults.

North Fork fault.—The northwestern foot of Stone Mountain is marked by a fault which is here named the North Fork fault because its course closely coincides with the North Fork of Powell River. The fault is of the thrust type, and is characterized by large displacement throughout its entire extent across the field considered in this report. The courses of both North Fork and Stone Creek have been determined by this fault.

The North Fork fault may be considered the boundary between the Powell anticline on the southeast and the Middlesboro syncline on the northwest. Northwest of the fault the dips are gentle, whereas on the southeast in Stone Mountain the strata are vertical or nearly so.

The fault originates a short distance west of Delvale with slight displacement which increases rapidly westward, until east of Purcell the whole Norton formation is cut out, involving a throw of 1,200 to 1,400 feet. At Pennington Gap the displacement is about 1,100 feet. From here it diminishes toward the west being about 550 feet five miles southwest of Pennington Gap in the vicinity of Belgium branch.

Other faults.—With the exception of the North Fork fault no important faults were found in the coal-bearing portion of Lee County. A few normal faults have been seen, but they are very small being but a few rods in length, the beds on the downthrow side having been dropped only a few inches to 30 feet below their normal position.

A number of faults with slight displacement were found in both the lower and upper parts of the Newman formation.

ECONOMIC GEOLOGY

GENERAL DESCRIPTION OF COAL BEDS.

Introduction.

The total thickness of coal-bearing rocks in the coal-bearing portion of Lee County is about 5,650 feet, every portion of which outcrops in some part of the field. At least 20 coal beds are 30 inches or more thick in areas of sufficient size to justify mining. In general the coal is of excellent coking quality and has a high fuel rank, hence thin beds can be worked more profitably than in some other parts of the Appalachian field. Beds two feet and less in thickness are not at present considered as assets but they will become so when the thicker coals have been exhausted. Some beds which are thin along the outcrop may increase in thickness below drainage and hence be profitably mined by shafts. In going from southeast to northwest, successively higher coal beds are encountered coming in at the tops of the hills, the lower beds disappearing below drainage. This results in the exposure of a large number of beds in small areas, but as comparatively little drilling has been done, practically no information is available for any bed except in the region where it outcrops. General considerations based on observed stratigraphic tendencies may furnish a clue to whether a coal bed becomes thicker or thinner after it disappears below drainage. From the data available it would seem that the coals of the Wise formation may be expected to maintain essentially the same thicknesses through Little Black Mountain as they exhibit at their outcrops on the Kentucky side. Coals in the Norton formation are generally thin in Lee County. It is possible that some of these beds may thicken somewhat northwest of the area of disturbance near Stone Mountain where the beds outcrop. The position of these beds beneath Little Black Mountain will be favorable for mining as they have the gentle dip here characteristic of the higher Wise coals.

Few beds are constant enough in thickness or have sufficiently well marked characteristics to be identified throughout the area of their outcrop, even though that area be small. The roof may change from clay to coarse sandstone within a prospect, and partings one inch thick on one side of a spur may increase to several feet on the other side, making the bed worthless. The most common roof is sandy shale, or very fine-grained sandstone. This may be separated from the coal by a few inches to a foot or more of

"draw slate" which comes down when the coal is taken out. Some beds have coarse sandstone directly on the coal throughout considerable areas, but in most places a few inches of "slate" intervene. Very few exposures show more than three feet of coal without partings half an inch or more thick. Most of the partings are clay or shale, but thin lenses of sandstone occur in a few beds, and some fairly thick layers of "rash" were seen. The term "rash" is applied to an intimate mixture of coal and shale, in many places contorted and slickensided by movement, so that it breaks up in fine scales. Thin layers of bone and also of cannel coal form parts of some coal beds. The underclays are generally light drab in color and slightly sandy. Some may be of sufficient purity to be utilized in the manufacture of heat-resisting products. In general they are very hard and not likely to cause trouble in the mines by "heaving." Many of the coal beds have "slate" directly beneath the coal throughout large areas.

Because of the variability of the coal beds in this field, plans for development should be preceded by careful and thorough prospecting under the direction of an experienced geological engineer. Outcropping coals may be prospected by short drifts, spaced at such short distances that they will reveal important changes in the characters of the coals. To guard against the possibility of mistaking one bed for another in areas of steep or irregular dips, it is well to open one or two beds above and below the one being investigated, even though they may be too thin for profitable mining. The structure contours portrayed on the map accompanying the report will be a valuable guide in prospecting, but they are not accurate enough to serve as a basis for the laying out of the plan of a mine. For this purpose the openings should be located by transit survey on a large scale map and the elevation of each prospect accurately determined. Beds which go below drainage should be proved by prospecting with the diamond drill. Such prospecting will doubtless demonstrate the existence below the surface of some beds of minable thickness of which outcrops give no indication.

The thicknesses of coal, the intervals 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 intervals used are averages only, and will not apply exactly to all parts of the field in Lee County. Maximum and minimum intervals are given in the detailed descriptions by drainage basins and in the generalized sections. (Figure 2). Many local intervals are shown in the local sections. The geologic map, Plate II, accompanying this report shows the location of the outcrops of the more important and persistent coal beds in the Lee County coal field.

Coal Beds in the Lee Formation.

General statement.—The Lee formation is fully exposed in this field on the northwest slope of Stone Mountain. The strata have a very high dip, being in most places vertical or nearly so. The Lee coals are thin, and in conformity with the strata are nearly or quite vertical in their attitude. They have been severely crushed and this crushing has resulted in their contortion and in the incorporation of shale, originally lying against the coal, into the mass, and also in the original partings of shale being distributed through the coal of the bed. The coals are consequently very impure. These various factors preclude the successful and profitable development of these coal beds.

Stevenson¹ reported six coal beds in his section at Pennington Gap, three of which were seen by him and three reported. None of these exceeded three feet in thickness, and all were greatly crushed.

During the course of the present geological survey a number of coal beds in the Lee formation were examined but they are so thin and crushed and so thoroughly mixed with fragments of shale as to be of no economic significance.

At Big Stone Gap just northeast of Lee County, coal beds also occur in the Lee formation. Immediately beneath the "Bee rock" there is a mass of black carbonaceous shale which represents the continuation of the coal bed occurring at the same horizon in Pennington Gap. Above the heavy conglomerate at the base of the formation there is a coal bed 28 inches to three feet thick, showing in the southern end of the Louisville and Nashville tunnel. At the northern end of the same tunnel, a coal is reported by Campbell¹ to be four feet ten inches thick. Both of these coals are badly crushed and contorted.

Coal Beds in the Norton Formation.

General statement.—The area of outcrop of the Norton formation lies almost entirely between the North Fork of Powell River and the northwest base of Stone Mountain. The Norton formation lies adjacent to Stone Mountain and hence was disturbed by the earth movements that deformed that mass. The strata of the formation therefore possess a high dip on their outcrop. This high dip, together with the fact that the coal beds have been found generally to be thin where prospected, has discouraged coal operators from exploiting the Norton coals. However it is possible, as already indi-

¹ Loc. cit.

cated, that some of them may thicken appreciably in the direction of Little Black Mountain, and it is certain that their dip diminishes in that direction, the coal beds becoming parallel to the gently dipping Wise coals above. The Norton coal beds in this situation can only be reached by shafts, therefore it is imperative that the characters of the coals be thoroughly tested by the diamond drill before active operations are undertaken.

Only two coal beds of significance were found in the Norton formation west of Pocket. One bed has been prospected recently in Pennington Gap, and the second bed was disclosed in driving the Louisville and Nashville tunnel through the northwestern flank of Stone Mountain just southeast of Pocket station. The bed is vertical in position and is severely crushed and contorted. The coal measures about 36 inches in thickness. The attitude of the bed and the inferior quality of the coal make its successful exploitation very doubtful.

East of Delvale it is probable that the Norton coal beds increase in number as the outcrop of the formation broadens. Very little is known regarding these coals. They have not been prospected, but it is probable that some of them will be found to be workable and to contain coal of good quality. Their high dips, however, will be an unfavorable factor in their development.

Coal Beds in the Wise Formation.

General statement.—The greater part of the coal-bearing portion of Lee County is directly underlain by the Wise formation. This formation contains the bulk of the coal of the county, and its coal beds have long been mined. Essentially all of the operations of any size in the county are in the Wise coals. The coal beds are thick and nearly horizontal in position, and the coal is of excellent quality. There are at least 20 beds that are workable locally or in large areas under present mining conditions.

DORCHESTER COAL BED.

The Dorchester coal bed lies immediately above the Gladeville sandstone, this position making it one of the easiest beds to locate in the entire coal field. In Wise County the bed is of great importance having been extensively mined in the Norton region, and also at Glamorgan where it has long been known as the Glamorgan bed. Little development of this bed has been undertaken in Lee County. It has been mined in a small way at Purcell where it is known as the Marsee or Cornett bed. The proximity of the bed to Stone Mountain gives it a relatively high dip and causes it to "pinch"

and "swell." As a result this bed was found to range in thickness from two and one-sixth to four feet within short distances. However it has a hard, smooth shale floor, a substantial roof, and is generally free from partings. These favorable factors, together with its proximity to the railroad, would seem to make it an inviting proposition from a commercial standpoint. The bed is terminated just west of Purcell where it passes into the North Fork fault.

LYONS COAL BED.

The Lyons coal bed lies from 65 to 75 feet above the Dorchester bed, and above the massive sandstone that underlies the latter bed. Very little is known regarding this bed in Lee County. The bed is persistent in Wise and Dickenson counties and its characters well known, but in Lee County it has been developed only at the mouth of Jones Creek near Purcell where it is known as the Thompson bed. The bed dips rather steeply at its outcrop, and thins and thickens within short distances. But wherever examined it was found to be of workable thickness with no partings.

Although known with certainty only in the vicinity of Purcell the Lyons coal bed probably extends east to the eastern limit of the county. Westward it terminates in the North Fork fault a short distance west of Purcell.

BLAIR COAL BED.

Another coal has been developed in the vicinity of Purcell where it is known locally as the Bentley bed. It is split into two benches separated by 30 feet of shale. The lower bench lies from 65 to 75 feet above the Lyons bed, and averages 140 feet above the Gladeville sandstone. Like the Dorchester and Lyons beds the Blair dips steeply and varies considerably in thickness. The lower bench is split by a thick shale parting; the upper bench carries one thin shale parting. Both benches are thin, the lower being three to three and one-half feet, including parting, where examined, and the upper two to three feet. Both coals are well displayed in the railroad cut one-half mile west of Purcell. Westward the Blair descends gradually, passing into the North Fork of Powell River near the mouth of Wolf Harbor branch. Eastward its extent is unknown, the bed not having been identified with certainty east of Jones Creek.

CLINTWOOD COAL BED.

A bed that is 125 to 150 feet above the Blair and averaging 275 feet above the Gladeville sandstone has been extensively mined in Lee County. It is known locally as the North Fork coal bed. It lies within 20 feet below

the base of a sandstone that makes conspicuous ledges and cliffs, known as the Addington sandstone in Wise County. In Wise and Dickenson counties where the bed has long been known and mined it is called the Clintwood for the county seat of Dickenson County. It is a thick and valuable bed in Lee County. It possesses a northwestward dip of 10 to 12 degrees, and varies considerably in thickness. However in few places it is less than four and one-half feet, and has been found to be over eight feet in thickness locally. It carries in most places one shale parting ranging from three to twelve inches in thickness in the lower half of the bed.

It passes into the North Fork fault just east of Pocket. Eastward it extends into Wise County. Its proximity to the railroad and its thickness will probably lead to its early exploitation on a large scale across the entire length of its outcrop in Lee County.

Analyses of coal from this bed may be found on page 138 of this report.

IMBODEN COAL BED.

The famous Imboden bed of Wise County extends into Lee County and is workable in a large area. In The Pocket the coal bed lies 260 to 300 feet above the Addington sandstone. Its distance above this sandstone increases eastward, so that it is over 300 feet in eastern Lee County. It is separated from the Addington sandstone by shale and is overlain by shale and thin sandstones. This coal has been extensively mined at Manass in The Pocket, where it is known as the No. 1 coal bed, and at Newton. The bed is minable throughout the coal-bearing portion of the County, except possibly in the southwestern part on Stone Creek where its character is not known, little prospecting having been done in this section. The bed "pinches" and "swells" in short distances, a characteristic of this bed in Wise County also. Locally it is free from partings, but within short distances partings may develop to such an extent as to make the bed quite worthless. The bed ranges from two and one-half to six and one-half feet in thickness. The coal is widely known because of its excellent coking qualities. Analyses of the Imboden coal may be found on page 138 of this report.

KELLY COAL BED.

The Kelly coal bed lies from 30 to 70 feet above the Imboden bed from which it is separated by shale and thin sandstones. It is overlain by rocks of the same character. The Kelly bed has been opened in several places in the eastern part of the field. It varies from two and one-half to six and one-half feet in thickness. This bed is workable as far west as Big Bundy

Creek where active operations in both this bed and the Imboden have been carried on. One or more shale partings are present which impair the value of the bed, however the coal is of good quality. Analyses of coal from this bed may be found on page 139 of this report. The continuation of the Kelly coal bed has not been recognized in The Pocket of Lee County, and it probably does not persist that far west in workable thickness.

PINHOOK COAL BED.

The Pinhook coal bed, the Meadow bed of western Wise County, is 30 to 60 feet above the Kelly bed. It is separated from the Kelly by alternating beds of shale and thin sandstone, and is overlain nearly everywhere by massive, coarse sandstone. The bed is minable in the eastern part of Lee County, however it is nearly everywhere thin, from 20 inches to four and one-half feet. It has been opened in but few places, and in only one locality, near Keokee, has it been mined to any extent. The bed is characterized by thin partings of shale and clay nearly everywhere, but the quality of the coal is good. The Pinhook was not recognized west of Mill Creek, and, if it persists west of this stream, it is present only as a very thin bed.

LOWER ST. CHARLES (NO. 2) COAL BED.

The coal bed known as No. 2 in Lee County is here named the Lower St. Charles because of the desirability of designating coal beds by name rather than by number. The bed passes beneath drainage near the railroad station at St. Charles. This coal bed lies 150 to 250 feet above the Imboden bed, and 50 to 120 feet below the Harlan bed. It is separated from the Imboden by shale above which occurs a massive gray sandstone which in turn is succeeded by shale just beneath the coal bed. It is separated from the Upper St. Charles (No. 2A) coal bed above also by shale. The coal of this bed is thin, probably not averaging over two and one-half feet. In no place was the bed found to be over three feet in thickness. The bed where examined was free from partings, the coal being hard and compact with thick layers of bone. An analysis of this coal is given on page 139 of this report. The bed is present throughout The Pocket and may be readily found because of its proximity to the well-known Harlan bed. It has been opened in only a few places.

UPPER ST. CHARLES (NO. 2A) COAL BED.

The coal bed known as No. 2A in Lee County will be called the Upper St. Charles in this report. Its outcrop is just above the level of the main

street of St. Charles. This coal bed lies from 30 to 60 feet below the Harlan bed and from 30 to 65 feet above the Lower St. Charles coal bed. It is from 200 to 300 feet above the Imboden bed. This bed is underlain by shale, but a massive coarse sandstone overlies the bed and separates it from the Harlan bed. This is also a relatively thin bed, ranging from two and one-half to six feet throughout The Pocket, and averaging about three and one-half feet. The coal is characterized by the presence of one or more shale partings. Layers of bony coal occur within the bed, but the most distinguishing feature of this bed is the large amount of shaly coal that it carries. Every opening examined showed that one-fourth to one-half of the bed was composed of shaly coal. From a commercial standpoint this is a damaging feature for it greatly injures not only the appearance but the quality of the coal. Analyses of this coal may be found on page 139 of this report. The Upper St. Charles coal bed is easily found because of its occurrence directly beneath the Harlan bed and the presence of the coarse massive sandstone immediately above the bed. This coal bed has been little mined, but it has been opened in a number of places, description of which may be found in a subsequent section of this report.

HARLAN COAL BED.

The Harlan is a thick and valuable coal bed throughout Lee County. In The Pocket it is known as No. 3 and the "Jack Rock" bed, at Keokee it is called the Wilson bed. The bed has been extensively mined at Keokee for a long time, and in The Pocket a number of operators have actively mined the coal. The bed lies from 225 to 350 feet above the Imboden, and 150 to 400 feet below the Taggart bed. It is underlain by a few feet of shale which in turn is succeeded below by the massive sandstone that overlies the Upper St. Charles bed. Shale occurs above the bed also and it is succeeded above by the massive sandstone that underlies the Taggart bed. The bed ranges in thickness from 32 inches to six and one-half feet, averaging about four feet. In The Pocket the bed averages three and one-half feet, and in the Keokee district, six feet, including partings.

It is characterized by one or more partings of hard pyritiferous shale, hence the name "Jack Rock" applied to the bed. These partings range from an inch or two to more than a foot in thickness. The bed also carries one or more layers of bony coal which may be several inches in thickness. The coal is relatively high in sulphur which has created an unfavorable impression regarding it, an impression that is in part unwarranted. The bed is

underlain throughout considerable areas by clay, the roof everywhere is shale that is readily supported. A number of analyses of this coal may be found on pages 139-142 of this report.

KIRK (NO. 4) COAL BED.

The coal bed known as No. 4 has been prospected on the W. T. Kirk farm near the head of Ely Creek. The name "Kirk" will be used to designate this coal bed in this report. This coal bed is known only in The Pocket and apparently attains workable thickness in but few places in that part of the field. The bed has been little prospected so that its character is only indefinitely known. It is from two to two and one-half feet thick except locally where it may be four to six feet thick, but in these places the increase in the number of partings renders the bed worthless. This coal bed is 150 to 200 feet above the Harlan bed and the same distance below the Taggart bed.

TAGGART MARKER COAL BED.

A coal bed lying below the Taggart has been prospected in a number of places in the Straight Creek and Jones Creek drainage basins. It ranges from 18 to 40 inches in thickness, and where prospected has been found to be free from partings. This bed is undoubtedly the correlative of the Taggart Marker which has been developed in a number of places in the western part of Wise County.

In the western part of the Straight Creek basin the bed is separated from the Taggart by 20 to 30 feet of shale. Near the head of Straight Creek and in Lone Mountain the two beds are less than 15 feet apart, and locally they may be sufficiently close together to be mined as one bed. Its thickness in this basin ranges from 18 to 30 inches.

The Taggart Marker is thicker in the Jones Creek basin ranging from 30 to 40 inches. It lies from 20 to 75 feet below the Taggart bed. The bed resembles the Taggart very closely, so that care must be exercised to properly discriminate them. Analyses of coal from the Taggart Marker bed in Wise County may be found on page 142.

TAGGART COAL BED.

The Taggart coal bed is the best known and one of the most valuable coal beds in Lee County. It is minable throughout the entire area of its occurrence in the County and is being extensively exploited in The Pocket

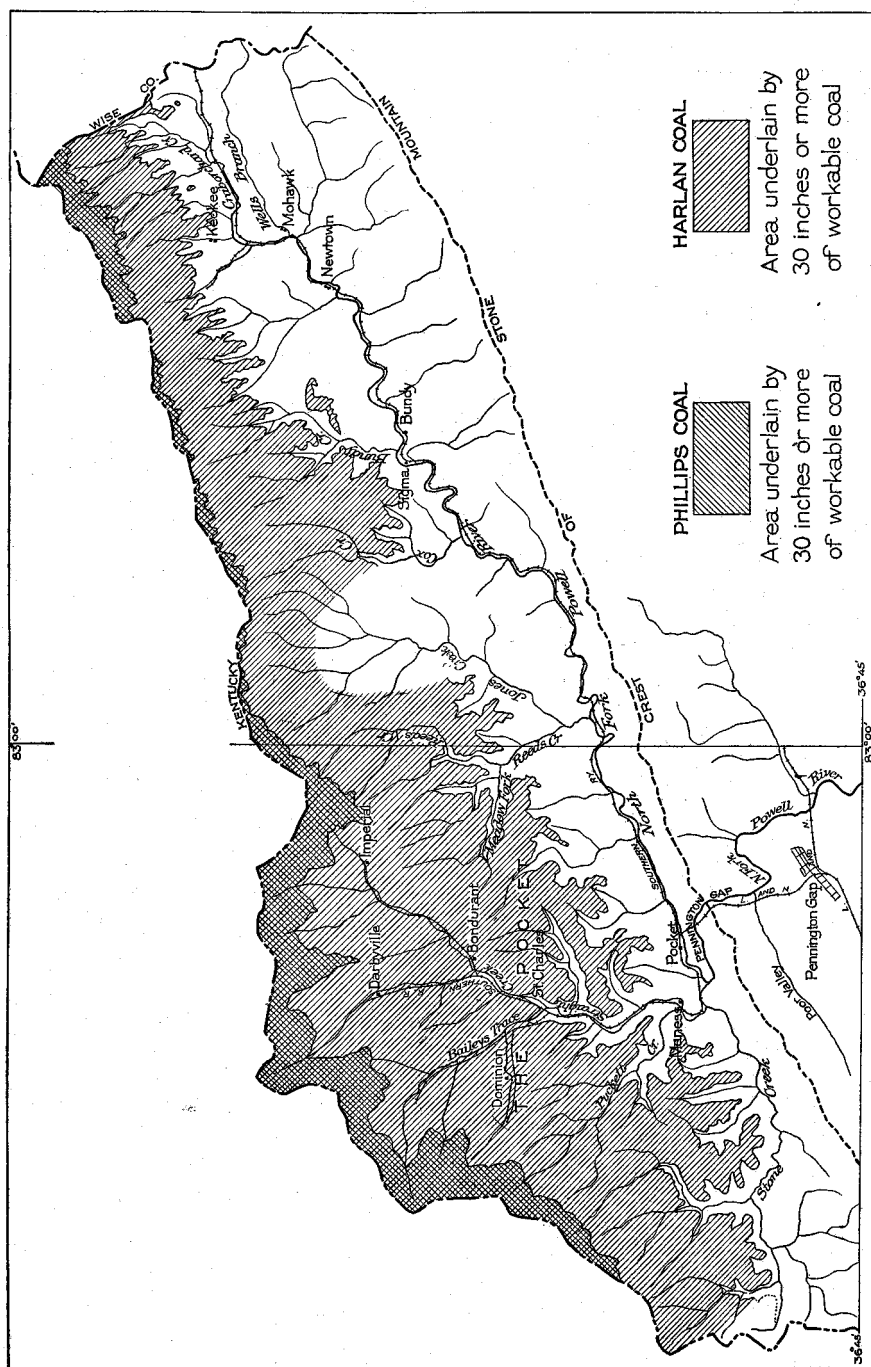


Fig. 3.—Sketch map of the Lee County coal field showing areas in which the Harlan and Phillips coal beds contain 30 inches or more of minable coal.

and at Keokee. In The Pocket the bed is known as No. 5, Darby, and the "42-inch bed." At Keokee it is called the McConnell or Keokee bed. Farther east in Wise County it is known as the Taggart and Roda seam. The bed is 475 to 625 feet above the Imboden, and 150 to 400 feet above the Harlan bed. In The Pocket the bed is overlain and underlain by massive sandstone 100 feet or more thick. The presence of these massive beds is of great value in readily locating the coal bed. However in eastern Lee County these sandstones are not so conspicuous and are replaced in part by shale.

The floor is nearly everywhere a hard, smooth shale, and the roof is a coherent "slate" that is easily supported. Locally the roof rock is sandstone. The coal is of excellent quality and cokes readily. The bed is free from partings except locally where layers of "rash," clay or shale, one-half inch or less up to five inches in thickness, are present. "Rash" up to one foot or more in thickness may separate the coal from the roof, or there may be only an inch of clay between the coal and the roof rock. "Draw slate" is present in many places above the coal also.

The coal is thin on Gin Creek but thick in Lone Mountain and in the vicinity of Keokee. The bed averages three and one-half feet in thickness throughout the county. Analyses of the coal from this bed may be found on pages 143-148 of this report.

LOW SPLINT COAL BED.

The Low Splint is the No. 6 coal bed of The Pocket, and the Creveling bed farther east in Lee County. It is a thick and valuable bed in large areas on the southeast flank of Little Black Mountain. The bed lies 200 to 400 feet above the Taggart bed. The coal is overlain by shale and underlain by either clay or shale, and carries one or more partings of shale which may attain a thickness of several inches each. The coal averages four and one-half to five feet in thickness in the area of its best development. Locally it becomes a very thick bed but in these places it is always badly split by shale partings. The term "Low Splint" is not fully appropriate as a designation for the bed as it carries but a small proportion of splint coal. Analyses may be found on page 148 of this report.

This bed of coal has been extensively mined at Keokee, and large operations are now being carried on in it at the head of Straight Creek. A very large operation is at present being installed at the head of Bundy Creek to mine this bed. The area of its best development is between the County line on the east and Gin Creek on the west. Throughout this area the bed may be easily located as it forms one of the most conspicuous benches to be

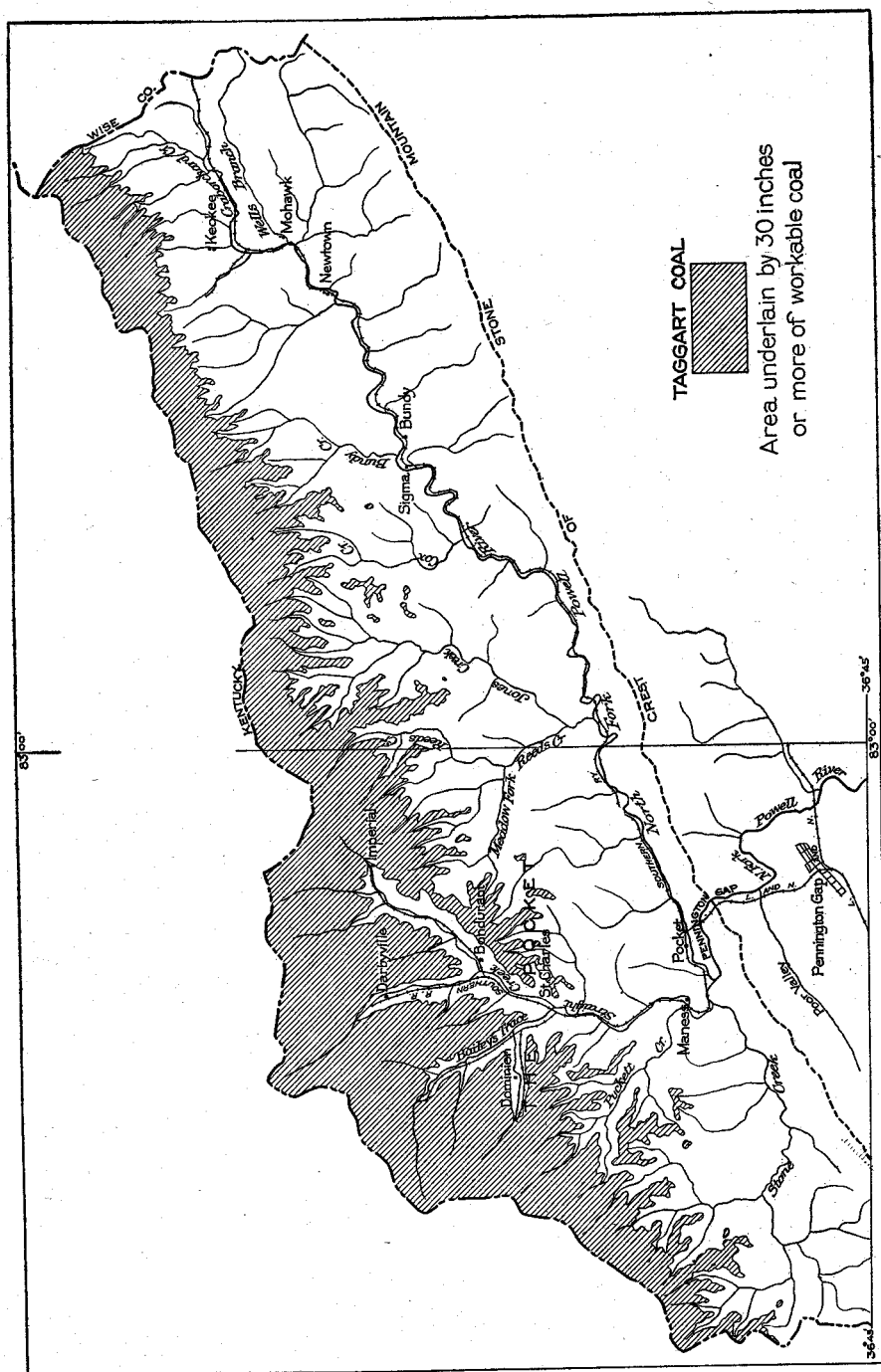


Fig. 4.—Sketch map of the Lee County coal field showing area in which the Taggart coal bed contains 30 inches or more of minable coal.

found on the flank of Little Black Mountain. West of Gin Creek the bed is not well known as little prospecting has been done at its horizon. In this part of the field it is reported to be split into two thin benches.

PHILLIPS COAL BED.

This bed has long been known as the "Fire Clay" coal both in Virginia and Kentucky. It has also been called the Dean coal in the Kentucky Survey reports.¹ It is the No. 7 bed of The Pocket.

It is a thick and valuable bed between Gin Creek and the head of Straight Creek in which area it is being actively exploited. Outside of this area very little is known regarding the character of the bed, for the height of its outcrop on Little Black Mountain has been a discouraging feature in its development. Sufficient information regarding it has been obtained, however, to warrant the conclusion that it is workable throughout a considerable area.

The Phillips coal is 250 to 400 feet above the Low Splint bed and is separated from that bed by shale and sandstone, a well-defined bed of sandstone occurring in the upper part of the series.

Its characteristic feature is its clay parting which ranges from two inches to a foot or more in thickness. The parting occurs in most places in the lower part of the bed. Aside from this the bed is generally free from partings. It averages four feet in thickness in The Pocket between Straight and Gin creeks. The bed is characterized by a smooth, hard shale floor, and the roof is also shale. This bed is of sufficient importance to warrant extensive prospecting. Its altitude ought not to be a deterrent factor, for the coal can be readily handled. Analyses of this coal may be found on pages 148-149 of this report.

GIN CREEK (NO. 8) COAL BED.

The name "Gin Creek" is here used to designate a coal bed locally known as No. 8. It lies from 150 to 250 feet above the Phillips bed and ranges from two and one-half to four feet or a little more in thickness. Its outcrop high up on the flank of Little Black Mountain gives it a very limited distribution in Lee County. The bed has been little prospected and not much is known about it. Its height above the railroad at the base of the mountain and its small acreage will preclude its development for a long time in the future.

¹ Op. cit.

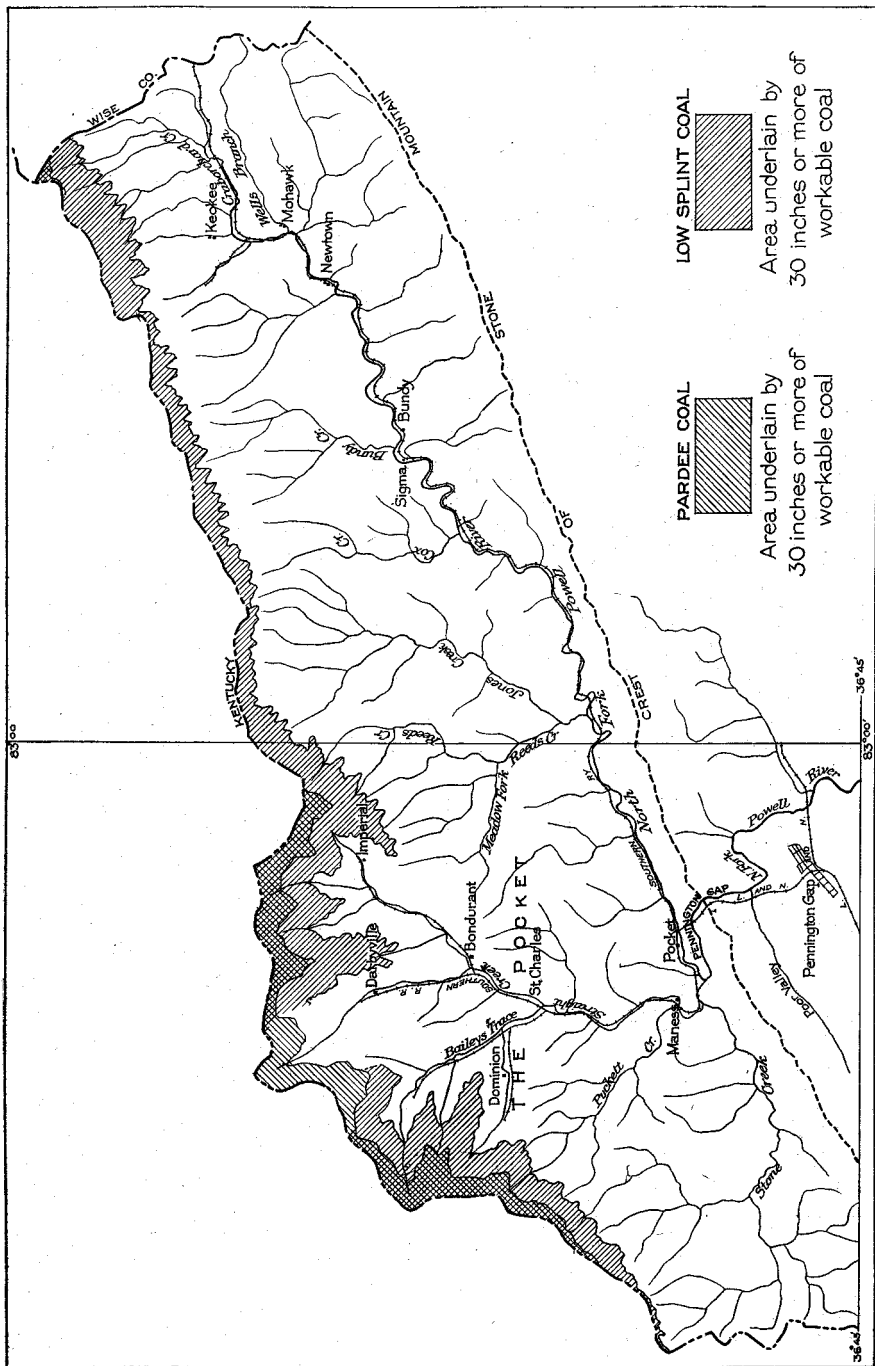


Fig. 5.—Sketch map of the Lee County coal field showing areas in which the Low Splint and Pardee coal beds contain 30 inches or more of minable coal.

A coal bed half way between the Phillips and the Gin Creek, that is of workable thickness locally, but in most places is so badly split by shale partings as to be worthless, has been reported.

WAX (NO. 9) COAL BED.

Fisher in his report previously cited describes a prospect in a bed locally known as No. 9, as the Wax prospect. The name "Wax" will be used to designate this coal bed in this report. This coal bed lies from 75 to 125 feet above the Gin Creek bed. It is nearly five feet in thickness with a parting locally in its lower half. It has been prospected at a number of places but not mined. The bed is overlain and underlain by shale, and is apparently a feasible mining proposition, but its development, as that of the Gin Creek coal bed, is subject to the same adverse conditions, such as its limited acreage and its altitude above the base of the mountain. An analysis of the coal from this bed may be found on page 149 of this report.

PARDEE COAL BED.

The Pardee coal bed underlies only the higher parts of Little Black Mountain. It is a thick and valuable bed and has been mined to a limited extent at the head of Fawn Branch, and at present is being extensively mined at the head of Baileys Trace. The bed is the same as the Limestone coal and Smith coal of the Kentucky Survey reports, and is known as No. 10 in The Pocket. Its distance above the Wax bed averages 40 to 50 feet and at the head of Baileys Trace it is only 10 to 12 feet above the Wax bed. It lies 250 to 425 feet above the Phillips bed. It is separated from the lower coals by shale and sandstone. The bed is underlain by clay or shale and overlain by shale or sandstone. It averages six feet in thickness, and carries a thin clay parting in its upper part and a thin shale parting in its lower part in most places where it has been examined. The thickness of the bed and the quality of the coal ought to lead to its early development, notwithstanding its height above the base of Little Black Mountain and its very limited acreage. Analyses of this coal may be found on pages 149-150 of this report.

MORRIS COAL BED.

The Morris coal bed lies from 350 to 650 feet above the Pardee coal bed. It is known as No. 11 bed in The Pocket of Virginia, and is the Cornett bed of Kentucky. There are no openings in this coal bed accessible at the present time, but the bed is reported to average 3 feet in thickness. Its distance

below the base of the Harlan sandstone averages 70 feet, hence it underlies only the highest summits of Little Black Mountain and its acreage in Virginia is very small.

HIGH SPLINT COAL BED.

The highest coal bed in Lee County is the High Splint which lies 70 feet on an average above the Morris bed. In The Pocket this bed is known as No. 12. It lies from five to twenty-five feet below the base of the Harlan sandstone. The coal is from four to five feet in thickness, hard and firm, and of excellent quality, a large proportion being splint. The bed has been prospected at a number of places, but has not been mined in Lee County. There are only a few acres of this coal in the county. Analyses are given on page 150.

DETAILED DESCRIPTION OF COAL BEDS.

Method of Treatment.

It has been deemed advisable in the following discussion of the coal resources of Lee County to treat each drainage basin as a unit and describe it separately. This method is adopted because of its convenience, and because the exploitation of the coals will necessarily be planned with especial reference to the principal valleys along which railroads will be constructed for the removal of the coal. In the following descriptions, the basins are taken up in order from west to east. Each coal bed in the basin is described separately, beginning with the lowest, and its outcrop is traced along one side of the main stream, including tributaries on that side, to the head of the valley 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.

Each measured coal exposure has been given a number which appears on the geologic map. The location of many openings for which no section was obtained is also shown. The numbers are consecutive for each bed in the basin being described and are assigned in the order in which the exposure is mentioned in the text. All measurements were made by the writer unless otherwise stated.

Nearly all of the elevations given were determined with an aneroid barometer by the writer; a few were determined by dip angles in the course of

the topographic mapping by the United States Geological Survey topographers. Some elevations were taken from the outcrop maps furnished by the coal companies.

Many coal measurements described in the text are shown graphically. The numbers on the right side of the graphic sections indicate the thicknesses in inches of the layers of coal; those on the left side, the partings or binders that could be discarded in mining.

Stone Creek and Ely Creek Basins.

General features.—This district includes the basin drained by Stone Creek and Ely Creek, as well as a number of smaller branches, the total area of the basins being less than 10 square miles. The exposed section includes all of the Lee formation except a few feet of the lowermost beds, the lower part of the Norton formation, and all except a thin basal portion and the upper 350 feet of the Wise formation. The Lee formation occupies the northwest flank of Stone Mountain. Stone Creek follows closely the trace of the North Fork fault which marks the boundary between the Norton and Wise formations, and Ely Creek drains an area entirely underlain by the Wise formation.

The Lee formation is composed of three massive members; at the base, near the middle and at the top of the formation. These massive members are coarse sandstone and conglomerate and are separated by shale. The shale erodes rapidly, consequently the massive sandstones and conglomerates form conspicuous hogbacks with steep dip slopes. The Norton formation is made up of shale alternating with thin beds of sandstone; the two kinds of rock comprising about equal proportions of the formation.

The lower part of the Wise formation is over half shale, thick beds of shale alternating with thin beds of sandstone. The proportion of sandstone increases upward in the formation, however, and above the Taggart coal the formation is fully half sandstone.

Structurally that part of the basin southeast of Stone Creek and the North Fork fault lies on the northwestern flank of the great Powell Valley anticline, whereas that part of the basin northwest of Stone Creek may be considered as a part of the southeast flank of the Middlesboro syncline. The beds of the Lee formation range in attitude from verticality at the crest of Stone Mountain to a dip of 60 to 75 degrees at the upper limit of that formation near the northwestern base of Stone Mountain. The strata of the Norton formation dip steeply also. North of the fault the Wise beds de-

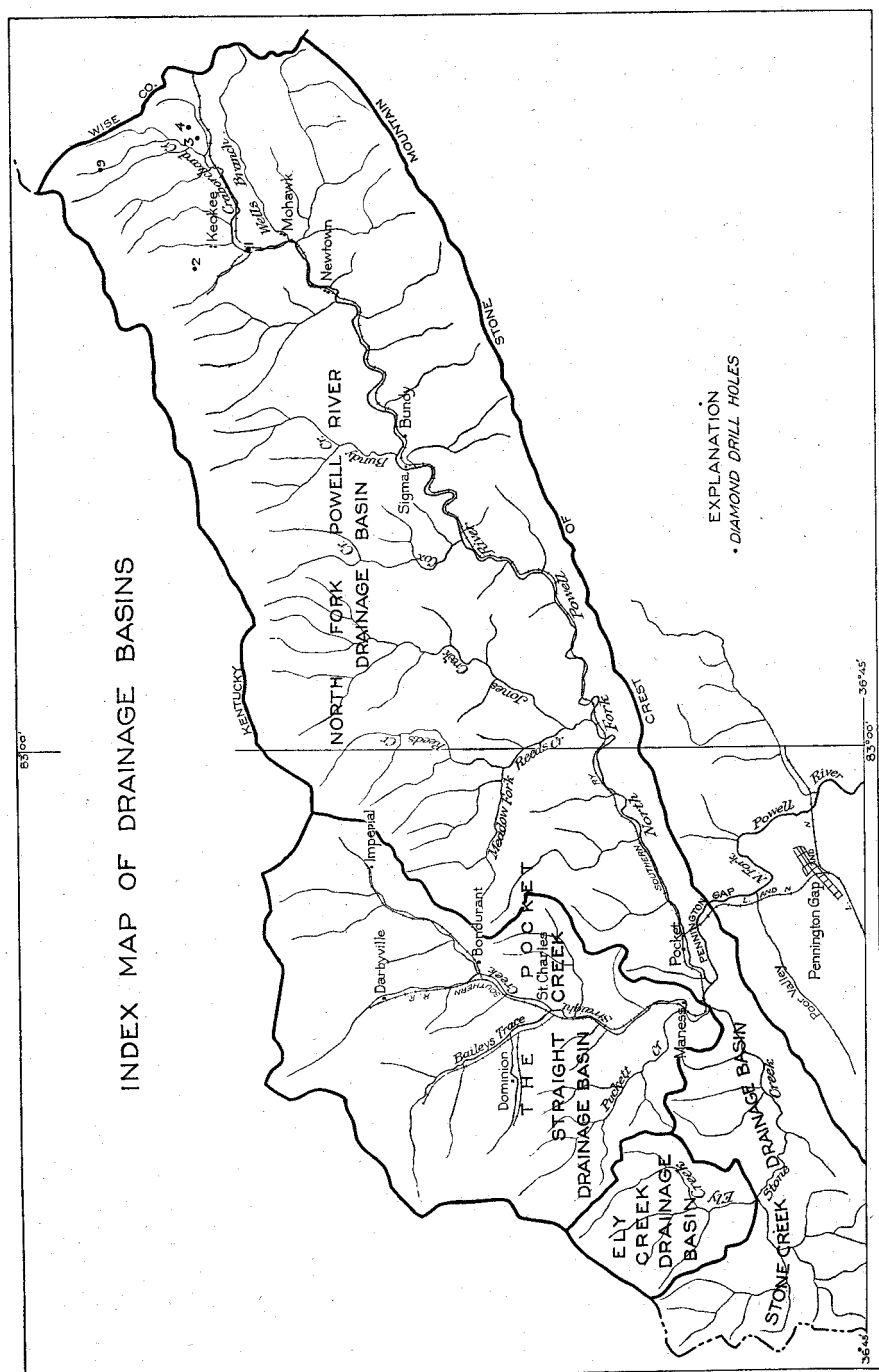


Fig. 6.—Index map of drainage basins in the Lee County coal field.

crease in dip rapidly to the gentle dip characteristic of the southeast flank of the Middlesboro syncline. The direction of dip throughout the district is north-northwest.

Many of the characteristics of the formations are shown by the generalized columnar section for The Pocket, Figure 2, by the cross-section, Plate II, and by local sections. A general description of the structure and formations may be found on pages 20-27, 37-40 of this report.

Part of the basin drained by Stone Creek is poor in coal resources. The coal beds in the Lee are thin, being three feet or less in thickness; and their steep dip, together with their mashed and contorted structure and the inferior quality of the coal, make the beds practically worthless from a commercial standpoint. Prospecting in the Norton has revealed no beds over 36 inches in thickness, and the best measurement obtained during the recent geologic survey showed only 36 inches of coal so impure and so steeply dipping as to be practically worthless.

Southwest of Stone Creek there are large and valuable resources of coal in the Wise formation. At least 10 coal beds of workable thickness occur between the North Fork fault and the Virginia-Kentucky line. As yet but little prospecting has been done in these higher coals in the area where they occur in these drainage basins, so that their characters are only imperfectly known. The beds most promising for future development are the Harlan, Taggart, Low Splint, Phillips, and Pardee. Thorough prospecting will probably reveal the value of these beds as a commercial proposition, and it is probable that each will range from three to five feet in thickness throughout the area where they occur in these drainage basins.

The best stratigraphic markers in these drainage basins are the Harlan coal with its pyritiferous shale parting generally in the lower half of the bed; the Taggart which maintains an almost constant thickness of 42 inches, the coal of which is firm and blocky, free from partings, with a layer of "rash" between the top of the coal and the overlying rock; the conspicuous bench of the Low Splint coal; and the Phillips coal with its characteristic clay parting in the lower part of the bed. Massive sandstone beds both underlie and overlie the Taggart coal bed, and constitute conspicuous markers on all slopes developed near the middle of the Wise formation.

COAL BEDS NOT CORRELATED.

No coal outcrops were found in the Lee formation, but the presence of thin coal beds in this formation in Pennington Gap just northeast of these drainage basins warrants the assumption that the same beds persist south-

eastward in Stone Mountain. The dense forest cover on the slopes of the mountain with the thick growth of underbrush effectually conceal the coal beds from observation. Coal beds in the Norton formation occur southeast of Stone Creek. The steep and irregular dips in this part of the coal field and the widely separated locations where the coal beds are exposed preclude the possibility of making correlations. Coal in a prospect drift near the mouth of Stone Creek (location 1, elevation 1,450 feet), showed a thickness of 36 inches. The bed is nearly vertical and the coal is badly crushed and contorted. The same bed has been opened just around the point of the mountain to the southwest (location 2, elevation 1,450 feet), where the coal has the same thickness and characteristics. This coal bed is in the lower part of the Norton formation and close to the North Fork fault.

COAL BEDS IN THE WISE FORMATION.

A number of coal beds have been prospected in the lower part of the Wise formation adjacent to Stone Creek.

A coal bed has been opened on Belgium Branch (location 3, elevation 1,850 feet). The upper part of the bed measured 24 inches; the lower part being concealed. The section of the bed exposed is free from partings and is overlain by shale. The total thickness is reported to be from 40 to 48 inches and free from partings. Another bed apparently somewhat higher in the formation than the one just described has been opened on the right fork of Bergen Branch (location 4, elevation 1,920 feet), and the coal is reported to be four feet thick with no partings. Both of these coal beds dip at high angles. On the left fork of Bergen Branch a higher coal bed has been opened to obtain a supply of coal for domestic purposes, which shows the following section:

Section of coal bed on Bergen Branch.

(Location 5, elevation 1,780 feet)

	Ft.	In.
Shale.		
"Rash"		3
Coal	1	2
Clay		11
Coal		8
Clay		$\frac{1}{2}$
Coal	2	
Shale.		
Coal	3	10
Partings		11 $\frac{1}{2}$

Stone Creek coal bed.—A thin coal bed occurs just north of Stone Creek directly overlain by massive sandstone. This bed has been opened in a number of places between Wolf Branch and Ely Creek. The coal nowhere measured more than 30 inches. Near Wolf Branch the bed is essentially free from partings, farther west a clay parting from two to four inches thick splints the bed into two benches. The dip of the bed is high, averaging 12 degrees north-northwest. An analysis of this coal may be found on page 138 of this report. Near the mouth of Wolf Branch the first of the following measurements was made at the face of the main entry in the mine of the Stone Creek Coal Company. The second measurement was obtained one-fourth mile northwest of the mouth of Belgium Branch.

Sections of Stone Creek coal bed on Stone Creek.

(Location 6, elevation 1,560 feet)			(Location 7, elevation 1,670 feet)		
Sandstone.	Ft.	In.	Sandstone.	Ft.	In.
"Draw slate"		2½	Coal	1	1
Coal	1	10½	Clay		4
"Rash"		¼	Coal	1	
Coal		5			
		<hr/>	Coal	2	1
Coal	2	3½	Parting		4
Parting		¼			

Imboden coal bed.—The Imboden bed is being mined on an extensive scale at Maness near the mouth of Stone Creek, however in the drainage basin under consideration this bed has been little prospected. The coal lies from 260 to 300 feet above the top of the Addington sandstone. It dips 10 to 12 degrees northwest at the outcrop, but flattens out within a short distance. At the outcrop the coal is three to four feet thick and free from partings, but the bed thins down the dip and locally is so split by partings within a short distance of the outcrop as to be worthless. Analyses of the coal from this bed may be found on page 138 of this report. In an old drift near the mouth of Stone Creek, the bed measures four feet with no partings (location 8, elevation 1,630 feet). Prospects farther west on Stone Creek had fallen in to such an extent that measurements were impossible.

Lower and Upper St. Charles coal beds.—Neither one of these beds has been prospected in these drainage basins, but both are probably present, for their blooms and benches were recognized in a number of localities. The Upper St. Charles averages from 30 to 60 feet below the Harlan bed, and the Lower St. Charles bed averages from 65 to 90 feet below that bed.

Judging from neighboring districts, where the beds have been opened, they will be found to be thin, averaging less than three feet in thickness.

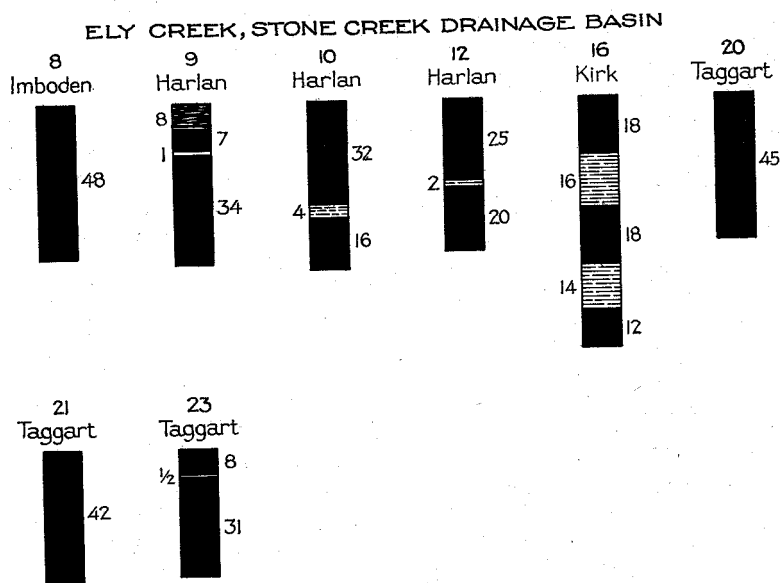


Fig. 7.—Sections of coal beds in the Ely Creek, Stone Creek drainage basin.

Harlan coal bed.—The Harlan bed ranges from 250 to 350 feet above the Imboden, and 250 to 325 feet below the Taggart bed. The Harlan is one of the best known beds in the district, having been extensively prospected. At a number of places the coal is being mined for local use, but so far no coal has been shipped. The coal averages four feet in thickness throughout the drainage basins with the characteristic pyritiferous shale, “jack rock,” parting almost universally present in the lower part of the bed.

At the head of Lady Branch the following measurement was obtained in a small drift from which coal is obtained for local use:

Section of Harlan coal bed at head of Lady Branch.

	(Location 9, elevation 1,910 feet)		Ft.	In.
Shale	5+	
“Rash”		8
Coal		7
Shale		1
Coal	2	10
				<hr/>
Coal	3	5
Parting		1

One mile west of location 9 at the head of Wolf Branch the following section was measured in a small mine:

Section of Harlan coal bed at head of Wolf Branch.

(Location 10, elevation 1,789 feet)

	Ft.	In.
Shale	5+	
Coal	2	8
Clay		4
Coal	1	4
Clay		6+
Coal	4	
Parting		4

A number of openings have been made on Ely Creek and its tributaries, the following measurements being representative of the bed in this section:

Sections of Harlan coal bed in Ely Creek basin.

(Location 11, elevation 1,720 feet)

	Ft.	In.
Coal	2	6
Shale, pyritiferous ..		2-3
Coal	1	6
Coal	4	
Parting		2-3

(Location 12, elevation 1,670 feet)

	Ft.	In.
Coal	2	1
Shale		2
Coal	1	8
Coal	3	9
Parting		2

The Harlan bed has been opened about one-half mile east of the Virginia-Kentucky line, at the head of the right fork of Stone Creek (location 13, elevation 1,720 feet). The coal is 32 inches thick and free from partings. It is probable that this is only the upper bench of the bed, the shale floor of the mine being the pyritiferous shale parting of the lower part of the bed.

Kirk and associated coal beds.—A number of coal beds were found on Ely Creek and its tributaries between the Harlan and the Taggart beds. These beds are local in their distribution and are thin with the exception of the Kirk which is a very thick bed in this drainage basin, but is so badly split by shale partings as to be worthless. The Kirk bed lies from 150 to 200 feet above the Harlan bed.

On the right fork of Ely Creek one-fourth mile northeast of the road, a coal bed has been opened at the side of the stream (location 14, elevation 1,750 feet), that is 24 inches thick with a clay floor and a sandstone roof. The same bed was found on the left fork of Ely Creek (location 15,

elevation 1,720 feet), and measures 22 inches with shale floor and sandstone roof. This bed lies from 50 to 80 feet above the Harlan bed.

Two measurements were obtained on the Kirk bed, one on the right fork of Ely Creek and the other on the left side of the main stream within a half-mile of its source:

Sections of Kirk coal bed on Ely Creek.

(Location 16, elevation 1,780 feet)

	Ft.	In.
Coal	1	6
Shale	1	4
Coal	1	6
Shale	1	2
Coal	1	0
<hr/>		
Coal	4	
Partings	2	6

(Location 17, elevation 1,750 feet)

	Ft.	In.
Coal	1	2
"Rash"		2
Coal		6
Shale		4
Clay		6
"Rash"		3
Coal		5
Shale		2
Coal		6
Clay		4
Coal		4
Shale		4
Coal		2
"Rash"		8
Clay		11
Coal		8
<hr/>		
Coal	3	9
Partings	3	8

Another coal bed lies from 40 to 60 feet above the Kirk bed which is everywhere thin in the Ely Creek basin. On the right fork of the creek (location 18, elevation 1,820 feet) the bed showed 30 inches of coal free from partings. Near the head of Ely Creek the same bed measures 24 inches and is also free from partings (location 19, elevation 1,800 feet).

Taggart coal bed.—The Taggart coal lies from 250 to 350 feet above the Harlan bed. It is the best known coal bed in the Ely Creek basin having been extensively prospected. However, very little coal of this bed has been shipped from the region due to inadequate transportation facilities. The Taggart is one of the most valuable beds of these drainage basins, maintaining an average of 42 inches in thickness and essentially free from partings. Its position is easily determined as it is overlain and underlain by coarse and massive sandstones that are 100 feet or more in thickness.

At the head of Ely Creek (location 20, elevation 1,920 feet), the bed measures 45 inches in thickness with 32 inches of clay overlying the bed which is succeeded above by sandstone. At the head of one of the left forks of Ely Creek, one-half mile west of location 20 (location 21, elevation 1,890

feet), the coal is 42 inches thick with sandstone roof and a clay floor. The following measurements were obtained near the heads of the several branches of Ely Creek west of location 21:

Sections of Taggart coal bed in the western part of the Ely Creek basin.

(Location 22, elevation 1,900 feet)			(Location 23, elevation 1,880 feet)		
Sandstone.	Ft.	In.	Sandstone.	Ft.	In.
"Rash"		1	Coal		8
Coal		8	Clay		$\frac{1}{2}$
Clay		$\frac{1}{2}$	Coal	2	7
Coal	2	6			
			Coal	3	3
Coal	3	2	Parting		$\frac{1}{2}$
Parting		$\frac{1}{2}$			

Higher coal beds.—A number of coal beds lie above the Taggart. They occur high up on the flank of Little Black Mountain in the northern part of the Ely Creek drainage basin, and are of very limited extent in this basin. These coals have not been prospected, but their blooms were seen at a number of localities, and their benches are conspicuous on the steep mountain slopes. The bloom of the Low Splint coal shows just below the Virginia-Kentucky line at the side of the road connecting Ely Creek with Davis Branch in Kentucky. The elevation of the bed here is 2,190 feet, and it lies about 300 feet above the Taggart. The Phillips and Pardee beds are present near the crest of the mountain. The Phillips bed is about 350 feet above the Low Splint in this drainage basin, and the Pardee bed is 300 feet on an average above the Phillips coal. West of the head of Pucketts Creek near the Kentucky line the Phillips bed is reported to be 52 inches thick with a three-inch parting one inch above the bottom of the bed. The other beds are also probably workable in this basin inasmuch as they are thick beds two to three miles northeast. Nothing is known about the Gin Creek and Wax coal beds.

Straight Creek Basin.

General features.—Straight Creek drains nearly the entire western half of the coal-bearing portion of Lee County. The area of its drainage basin is about 20 square miles.

The lowest beds exposed are in the lower part of the Norton formation which outcrops in an extremely small area in this drainage basin, only occurring at the mouth of Straight Creek. The upper part of the Norton

formation, the Gladeville sandstone, and the basal part of the Wise formation are lacking, having been carried beneath the surface in the movements producing the North Fork fault. The Wise formation forms the surface of essentially all of the drainage basin of Straight Creek. The Harlan formation occupies only the highest summits of Little Black Mountain, hence the area of its outcrop is insignificant in the Straight Creek basin.

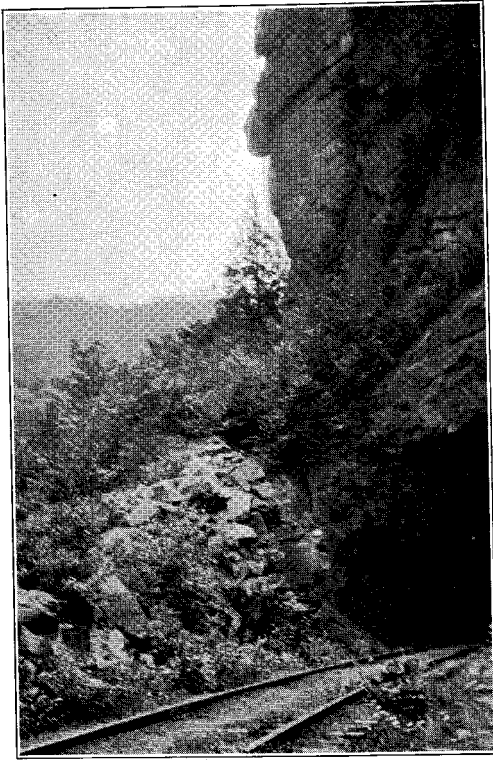
The Wise formation is about 2,600 feet thick and composed of sandy shale and sandstone in about equal proportions. In the lower third shale predominates, the middle portion of the formation is over half sandstone and the upper part is composed of shale and sandstone alternating and in about equal proportions. The dip is gentle being about 75 to 100 feet per mile toward the north-northwest. The base of the Harlan formation constitutes the highest parts of Little Black Mountain. The greatest thickness of this formation is at the head of Gin Creek where it measures about 200 feet. The lower 40 to 50 feet of the formation is a very massive quartzose sandstone that is succeeded by shale and sandstone above.

Structurally the basin is almost entirely a part of the southeastern limb of the great Middlesboro syncline. Only that part of the Norton formation lying near the mouth of Straight Creek and south of the North Fork fault, may be considered as belonging to the Powell Valley anticline of which Stone Mountain is the western flank.

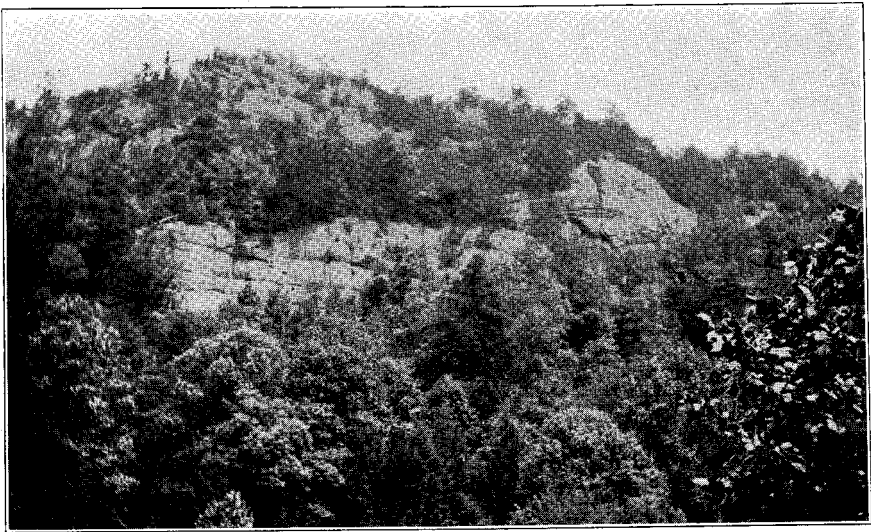
Many of the characteristics of the formations are shown by the generalized columnar section for The Pocket, Figure 2, by the cross-section, Plate II, and by local sections.

A more elaborate description of the structure and general features of the formations may be found on pages 23-27, 37-40 of this report.

Essentially all of the coal of commercial value in the Straight Creek drainage basin is limited to the Wise formation. This formation contains coal at 15 or more horizons, with a thickness of more than two feet in parts of all of these beds. A number of these beds have been extensively worked and are thick and valuable coal beds throughout essentially all of the area of their occurrence within the Straight Creek basin. These more important beds are the North Fork (Clintwood), the Imboden (No. 1), the Harlan (No. 3), the Taggart (No. 5), the Low Splint (No. 6), and the Phillips (No. 7). The Pardee coal bed (No. 10) is a very thick and valuable bed throughout the area, and has been exploited at one or two localities. Unfortunately the bed occurs very high up on the slopes of Little Black Moun-



(A) Upper Lee formation conglomerate, "Bee Rock," in Pennington Gap, Lee County, Virginia.

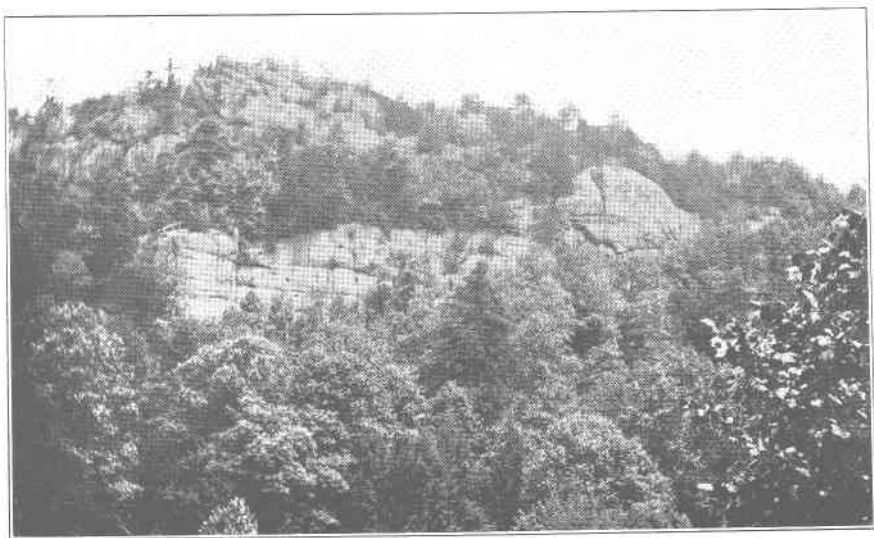


(B) Massive sandstone and conglomerate of the Lee formation forming the walls of the gorge of Pennington Gap, Lee County, Virginia.

(Photos by G. W. Stose.)

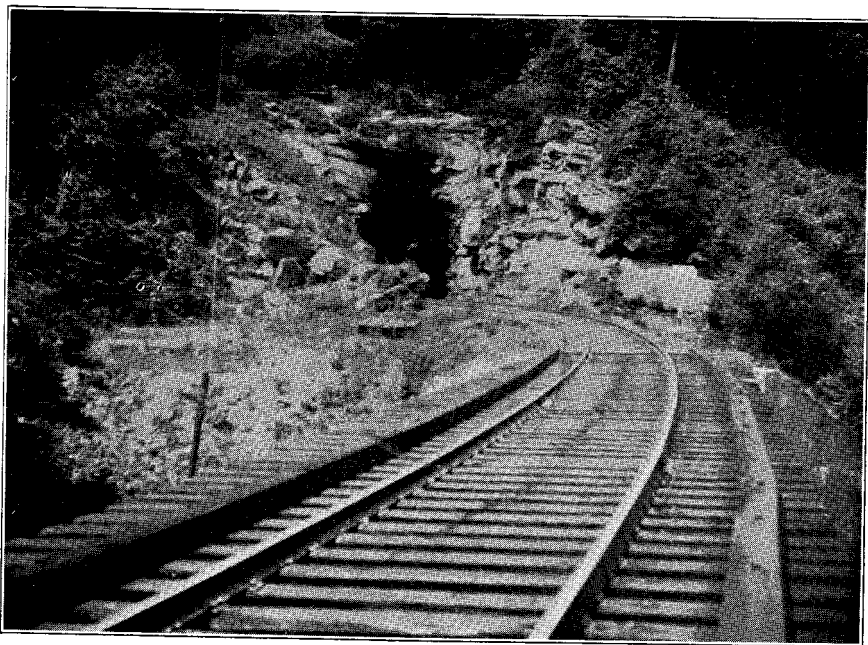


(A) Upper Lee formation conglomerate, "Bee Rock," in Pennington Gap, Lee County, Virginia.

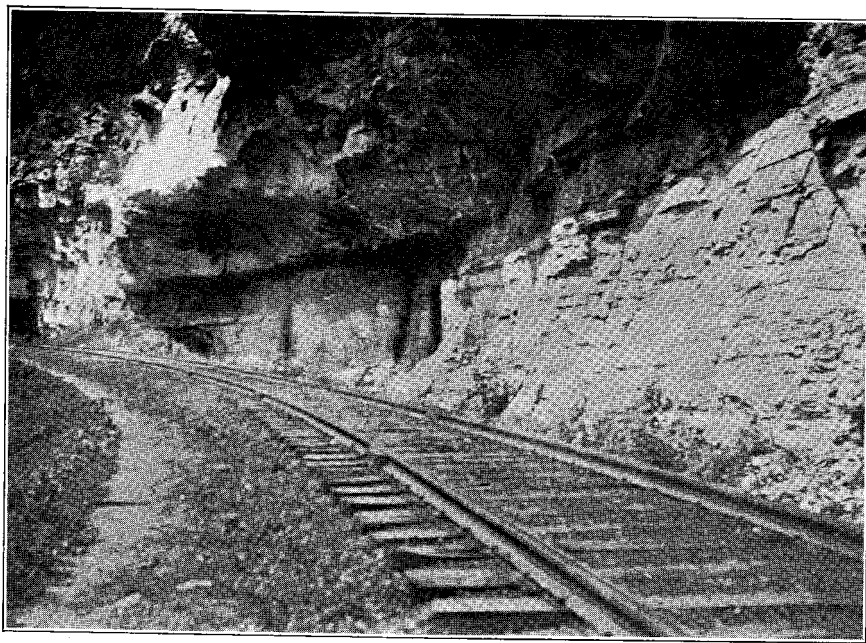


(B) Massive sandstone and conglomerate of the Lee formation forming the walls of the gorge of Pennington Gap, Lee County, Virginia.

(Photos by G. W. Stose.)



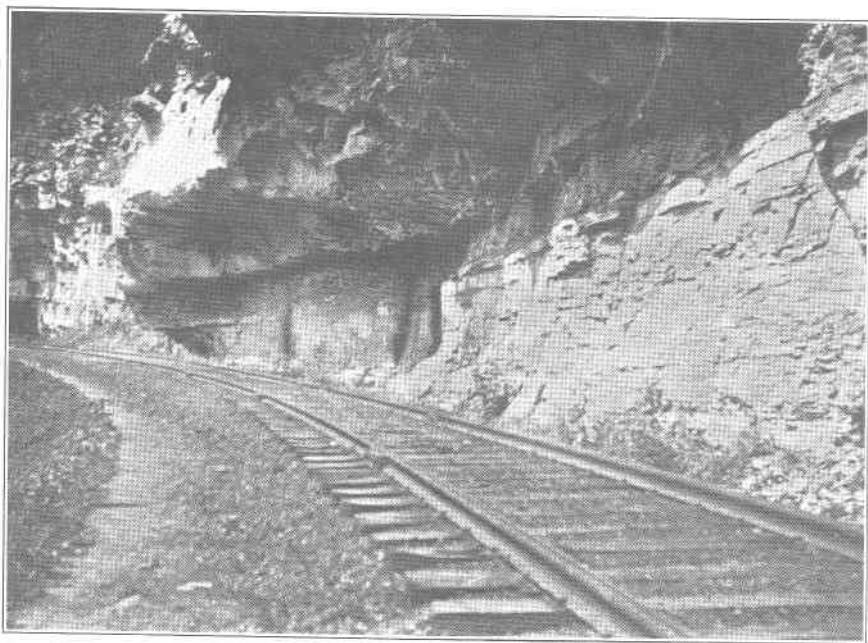
(A) Southern railroad tunnel piercing massive Gladeville sandstone northeast of Purcell, Lee County, Virginia.



(B) Massive Wise sandstone resting on shale a short distance southwest of Pocket station, Southern Railroad, Lee County, Virginia.



(A) Southern railroad tunnel piercing massive Gladeville sandstone northeast of Purcell, Lee County, Virginia.



(B) Massive Wise sandstone resting on shale a short distance southwest of Pocket station, Southern Railroad, Lee County, Virginia.

tain which has deterred its extensive development. The Morris and High Splint are thick beds, but they lie so near the top of Little Black Mountain that their areas are extremely limited.

The same stratigraphic markers that occur in the Stone Creek and Ely Creek drainage basins characterize the Straight Creek basin also. The Harlan bed carries its characteristic pyritiferous shale or "Jack rock" parting; the Taggart is nearly everywhere overlain by its distinctive layer of "rash" with a thin layer of fire clay directly above the coal in many places; the Low Splint bench marking the general position of the outcrop of the coal bed is very pronounced; and the Phillips coal is everywhere characterized by the clay parting in the lower half of the bed. The Addington sandstone is a well-defined bed overlying the Clintwood coal bed. The Taggart bed is underlain and overlain by thick sandstone beds that are very conspicuous and in places form cliffs on slopes developed in that part of the formation. The quartzitic massive sandstone at the base of the Harlan formation forms high cliffs near the crest of Little Black Mountain.

COAL BEDS NOT CORRELATED.

Two openings located near the mouth of Straight Creek in a coal bed that occurs in the lower part of the Norton formation have already been described (locations 1 and 2, page 60). Elsewhere in this drainage basin the coal beds in the Norton formation are too thin to be of commercial importance.

COAL BEDS IN THE WISE FORMATION.

Imboden coal bed.—The Imboden is the lowest coal bed of commercial significance in this drainage basin. It outcrops on the hillsides from near the mouth of Straight Creek to just north of the mouth of Meadow Branch where it passes beneath drainage. Its outcrop in this drainage basin is only about two miles in length. Little is known concerning the character of the bed north of its outcrop, but it may persist in workable thickness throughout the entire extent of the drainage basin. Extensive mining operations in this bed are located at Maness. The bed is thick and free from partings near the mouth of Straight Creek, but thins rapidly down the dip and becomes so badly split by shale partings as to have its value seriously impaired.

An abandoned drift just south of Maness (location 24, elevation 1,610-feet), shows 31 inches of coal with shale roof and shale floor. A measurement obtained a short distance within the main drift of the Penn-lee Coal

Company at Maness shows 45 inches of coal free from partings (location 25, elevation 1,580 feet). About one-fourth of a mile farther north at the face of a recent drift the following measurement was obtained:

Section of Imboden coal bed one-fourth mile north of Maness.

(Location 26, elevation 1,550 feet)

	Ft.	In.
Shale.		
Coal		6
Shale	1	8
Coal	1	8
"Rash"		4
		<hr/>
Coal	2	2
Parting	1	8

The first of the following measurements was obtained on the west side of Straight Creek near the mouth of Puckett Creek, and the second near the mouth of Straight Creek:

Sections of Imboden coal bed on the west side of Straight Creek.

(Location 27, elevation 1,540 feet)

	Ft.	In.
Shale.		
Coal	1	
Shale		9
Coal	1	
		<hr/>
Coal	2	
Parting		9

(Location 8, elevation 1,630 feet)

	Ft.	In.
Shale.		
Coal	4	
Shale.		

Analyses of this coal may be found on page 138 of this report, and additional measurements of the bed on page 121.

Lower St. Charles coal bed.—This bed lies from 150 to 250 feet above the Imboden, and from 50 to 120 feet below the Harlan bed. The proximity of the Lower St. Charles bed to the latter bed greatly aids in its location. It outcrops high on the hillsides on either side of the lower part of Straight Creek, but its northwesterly dip carries it downward rapidly so that it passes beneath the waters of Straight Creek near the railroad station at St. Charles. The bed has been prospected on Puckett Creek and has been mined in a small way on Big Branch of Straight Creek. The bed is thin where examined in this drainage basin, averaging but two and one-half feet thick, which has discouraged operators from undertaking its exploitation.

Near the mouth of Big Branch south of St. Charles (location 28, elevation, 1,630 feet), the bed has been opened but the drift has fallen in so that it was impossible to examine the coal. One-half mile east of the mouth of Big Branch (location 29, elevation 1,620 feet), the coal is 31 inches thick and free from partings. Analysis may be found on page 139 of this report. At St. Charles (location 30, elevation 1,540 feet), the coal is reported to be 30 inches thick with no partings. No measurements were obtained on Puckett Creek, but the coal is reported to be from two to two and one-half feet thick.

Upper St. Charles coal bed.—This bed lies from 30 to 65 feet above the Lower St. Charles bed, and about the same distance below the Harlan bed.

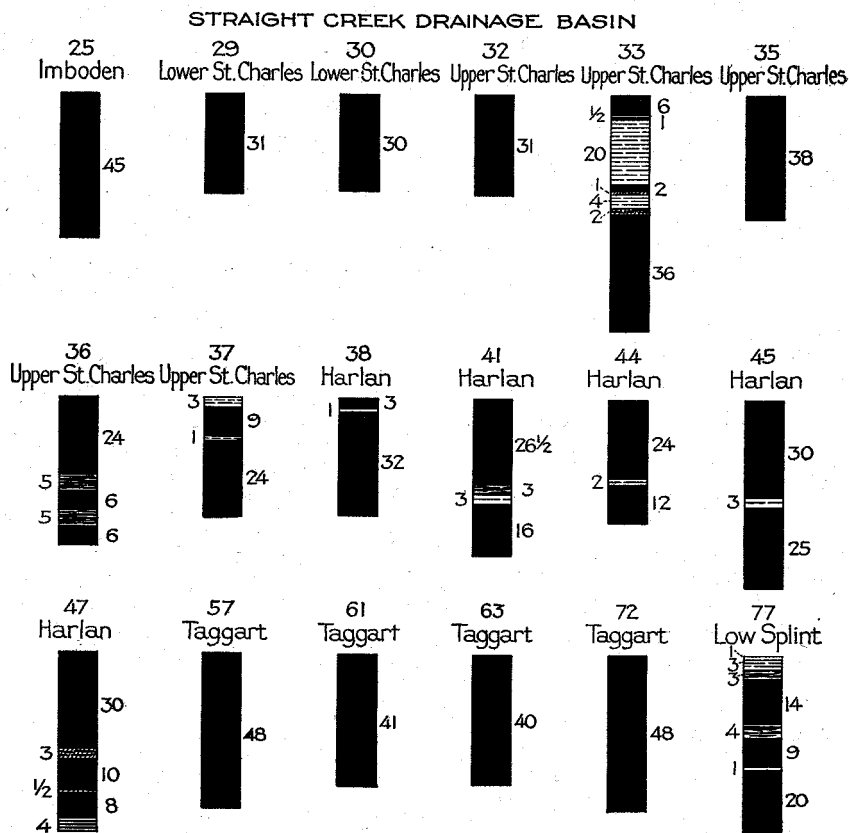


Fig. 8.—Sections of coal beds in the Straight Creek drainage basin.

The bed is overlain by massive sandstone which, together with its proximity to the well-known Harlan bed, makes its location a simple matter. The coal has been worked at St. Charles and on Big Branch of Straight Creek, and has been prospected on Puckett Creek. Although the bed has been found to be thick where examined, it is one of the less important coals of the region, its shaly character being a very damaging feature from the commercial standpoint. Analyses of coal from this bed may be found on page 139 of this report.

Both the Lower and Upper St. Charles beds may underlie all of the basin north of their outcrops in Lee County in workable thicknesses, however nothing definite regarding the beds in this area is known because no prospecting has been undertaken with the diamond drill.

In an old drift at the mouth of Big Branch (location 31, elevation 1,700 feet), the coal in the exposed portion of the bed measures 32 inches, the bottom of the bed being concealed. In an old drift on the south side of Big Branch (location 32, elevation 1,710 feet), the bed measures 31 inches, the coal being fissile but free from partings. The following measurements were also made on Big Branch, the first in the mine of W. H. Wax, and the second in the mine of the Freeheart Coal Company.

Sections of Upper St. Charles coal bed on Big Branch.

(Location 33, elevation 1,760 feet)

	Ft.	In.
Sandstone	5	
Shale	1	6
Coal		6
Shale		$\frac{1}{2}$
Coal		1
Shale	1	8
Coal		2
"Rash"		1
Shale		4
"Rash"		2
Coal	3	
<hr/>		
Coal	3	9
Partings	2	$3\frac{1}{2}$

(Location 34, elevation 1,700 feet)

	Ft.	In.
Shale		
Clay		$\frac{1}{2}$
Coal		4
Shale, pyritiferous ..		$\frac{1}{2}$
Coal		$2\frac{1}{2}$
Shale, pyritiferous ..		$\frac{1}{2}$
Coal	1	6
Coal, shaly		9
Coal		4
<hr/>		
Coal	3	$1\frac{1}{2}$
Partings		1

An analysis of the coal from the Upper St. Charles bed on Big Branch is given on page 139 of this report.

The Upper St. Charles bed has been actively mined at St. Charles. A drift on the property of the Black Diamond Coal & Coke Company (location 35, elevation 1,580 feet), shows 38 inches of coal free from partings. The following measurements were made in the mine of the St. Charles Coal

Company, just north of St. Charles, the first near the drift mouth, the second at the face of the main entry 350 feet southeast of the drift mouth, where a sample was cut for analysis (see page 139):

Sections of Upper St. Charles coal bed just north of St. Charles.

(Location 36, elevation 1,560 feet)

	Ft.	In.		Ft.	In.
Sandstone, massive.			Shale, sandy.		
Clay		1	"Draw slate"		3
Coal	2		Coal	1	2
Coal, fissile		5	Coal, fissile	1	2
Coal		6			
Coal, fissile		5	Coal	2	4
Coal		6			
Coal	3	10			

The following measurement was made on Puckett Creek near the mouth of Big Branch:

Section of Upper St. Charles coal bed on Puckett Creek.

(Location 37, elevation 1,610 feet)

	Ft.	In.
Sandstone	10	
Clay		3
Coal		9
Clay		1
Coal	2	
Coal	2	9
Parting		1

Harlan coal bed.—The Harlan coal bed, better known as No. 3, outcrops completely across The Pocket and is a thick and valuable bed throughout its extent. It has been mined on a large scale on Big Branch, at St. Charles, and on Puckett Creek. The bed lies 250 to 350 feet above the Imboden coal bed, and 200 to 400 feet below the Taggart bed. A pyritiferous shale parting, known as "jack rock," occurs nearly everywhere in the lower half of the bed. This parting may be six inches thick locally. The bed averages three to three and one-half feet in thickness in the Straight Creek basin. It is thickest on Puckett Creek and its tributaries, measuring from four to five feet, and thinnest on Big Branch of Straight Creek, where it is from two and one-half to three feet. Its character in the northern part of the Straight Creek basin where it is everywhere deeply buried is unknown, but it is reasonable to assume, in view of its persistent thickness in an east-west direction across The Pocket and the fact that it is minable on Clover Fork in Kentucky, that it maintains its thickness northward beneath Little Black Mountain.

An old opening at the mouth of Big Branch (location 38, elevation 1,770 feet), shows the bed to be 36 inches thick, with one inch of "rash" three inches below the top of the coal. Shale overlies and underlies the bed.

The following measurements of the Harlan bed were made on Big Branch of Straight Creek, the first in an abandoned drift on the south side, the second in a recent drift on the north side of the creek:

Sections of the Harlan coal bed on Big Branch.

(Location 39, elevation 1,765 feet)		(Location 40, elevation 1,735 feet)	
	Ft. In.		Ft. In.
Shale.		Shale.	
Coal	7	"Rash"	2
Shale	$\frac{1}{2}$	Coal	2 6
Coal	1 1		
Shale, pyritiferous ..	6	Coal	2 6
Coal	2+		
<hr/>			
Coal	1 10+		
Partings	6 $\frac{1}{2}$		

The Harlan bed has long been mined on a large scale at St. Charles and a large tonnage has been shipped from the several mines. Measurements were obtained in a number of the mines:

Sections of the Harlan coal bed at St. Charles.

(Location 41, elevation 1,630 feet)			
	Ft.	In.	Ft. In.
Shale.		1	
"Rash"		2 $\frac{1}{2}$	7 $\frac{1}{2}$
Coal	2	3	
Coal, bony		3	$\frac{1}{2}$
Shale		4	3 $\frac{1}{4}$
Coal	1		$\frac{1}{4}$
Shale			6
Coal			10
Coal, bony			7
Coal			2
Shale, pyritiferous ..			8
Coal			
<hr/>			
Coal	3	9 $\frac{1}{2}$	3 5 $\frac{3}{4}$
Partings		3	2 $\frac{3}{4}$

Both of these measurements were made in the same mine, the first in the face of the main entry about 2,000 feet northeast of the drift mouth, the second at the face of the second right entry, off the main entry, 600 feet from the drift mouth.

The following sections were measured in small drift mines just north of St. Charles:

Sections of the Harlan coal bed near St. Charles.

(Location 42, elevation 1,590 feet)			(Location 43, elevation 1,560 feet)		
	Ft.	In.		Ft.	In.
Coal	1	10	Coal	2	
Coal, bony, pyritiferous		6	Shale, pyritiferous		2
Coal		8	Coal		10
Coal	3		Coal	2	10
			Parting		2

Fisher¹ reported the thickness of the Harlan bed as three feet two inches at the Virginia Lee Company's mine, one-fourth mile above St. Charles station on the west side of Baileys Trace, where in 1908 the bed was being worked (location 44, elevation 1,590 feet approximately). A two-inch parting which he found about one foot above the base of the bed is probably pyritiferous shale.

Analysis of the Harlan coal sampled at St. Charles may be found on page 140 of this report.

There are several operations in the Harlan coal bed on Puckett Creek. The following measurements represent typical sections of the bed in this basin:

Sections of Harlan coal bed on Puckett Creek.

(Location 45, elevation 1,740 feet)			(Location 46, elevation 1,630 feet)		
	Ft.	In.		Ft.	In.
Shale			Shale		
Coal	2	6	Coal	2	1
Shale, pyritiferous		3	Shale, pyritiferous		3
Coal	2	1	Coal	2	
Coal	4	7	Coal	4	1
Parting		3	Parting		3

The following section was measured in the mine of the Emerald Coal Co. on Lick Branch of Puckett Creek:

Section of Harlan coal bed on Lick Branch.

(Location 47, elevation 1,740 feet)			Ft.	In.
Coal			2	6
"Rash"				3
Coal				10
"Rash"				1½
Coal				8
Coal, pyritiferous				4
Coal			4	
Parting				3½

¹ Op. cit.

Analyses of coal from the Puckett Creek mines may be found on pages 139-140.

Kirk and associated coal beds.—A number of thin coal beds occur between the Harlan and Taggart beds. Prospects have been opened in these beds, but no mining has been undertaken, except to obtain small supplies for homes in the vicinity.

On the west side of Straight Creek just north of the mouth of Benedict Branch (location 48, elevation 1,820 feet), a coal is exposed in the railroad cut that measures 14 inches in thickness. On the left side of Gin Creek, three-fourths of a mile from its mouth (location 49, elevation 1,675 feet), a coal bed just above the railroad shows 10 inches of coal with sandstone above and shale below the bed. What is probably the same bed as that described at location 49 is exposed near the mouth of Potts Branch where the coal is 10 inches thick (location 50, elevation 1,680 feet). Fisher¹ reports the presence of the Kirk bed on the west side of Baileys Trace just above the mouth of Fawn Branch (location 51, elevation 1,725 feet approximately). No measurements of this bed were obtained in the Straight Creek basin, but it is reported in a few places to attain a thickness of two and one-half feet. A short distance above the mouth of Fawn Branch on the right a coal bed measuring about 24 inches thick was seen (location 52, elevation 1,690 feet).

Two prospect drifts were found on Big Branch of Puckett Creek. In the first of these drifts, the bed measures 24 inches, having a shale roof directly overlain by sandstone (location 53, elevation 1,660 feet). The dip at this prospect is five degrees northwest, which probably does not persist for any distance. The coal is reported to be four feet thick in the second drift (location 54, elevation 1,700 feet), and it is overlain and underlain by shale.

Just north of Puckett School on Bubby Branch a coal bed occurs measuring 24 inches and free from partings (location 55, elevation 1,650 feet). The bed is overlain by sandstone. This is probably the same bed as that described under location 53.

On the south side of Puckett Creek a short distance west of the mouth of Buddy Branch (location 56, elevation 1,700 feet), a prospect has been driven a short distance into a coal bed that measures 24 inches and is free from partings. The coal is overlain by 30 inches of sandstone that is succeeded above by five feet or more of shale. The floor is of clay.

¹ Op. cit.

Taggart coal bed.—The Taggart coal bed, known in The Pocket as No. 5, the “42-inch seam,” and also the Darby bed, and farther east as the Taggart, McConnell, and Keokee bed, lies 200 to 400 feet above the Harlan bed, and averages about 550 feet above the Imboden. The Taggart is regarded as one of the most valuable beds in the Straight Creek basin, and numerous mines are located on its outcrop. The larger part of the tonnage shipped from the St. Charles field comes from this bed. The bed is very uniform in thickness, averaging 42 inches throughout the basin and nearly everywhere free from partings. The coal is of excellent quality, lustrous and blocky. The bed is at its best in Lone Mountain where it averages 48 inches in thickness, locally attaining a thickness of 52 inches. It is thinnest on Gin Creek where it averages 39 inches in thickness. The coal is underlain nearly everywhere by hard, smooth shale, and overlain in most places by “rash” from four to twelve inches thick. Locally the “rash” may be separated from the coal by a thin layer of clay, or the “rash” may be lacking and massive sandstone may rest directly upon the coal or be separated from the coal by a thin layer of clay.

Massive sandstones, 100 feet or more in thickness, lie above and below the bed, which form steep slopes making the location of the coal bed a simple matter. Analyses of coal from this bed may be found on pages 143-148.

The first of the following measurements was made in a recent prospect drift southeast of Bondurant, the second near the entrance of the main drift of the Bondurant Coal Mining Company on the east side of Straight Creek.

Sections of Taggart coal bed in Lone Mountain.

(Location 57, elevation 1,950 feet)			(Location 58, elevation 1,960 feet)		
	Ft.	In.		Ft.	In.
Sandstone	10+		Sandstone.		
“Rash”		1	Shale	2	4
Coal	4		“Rash”		9
			Coal		8
Coal	4		Clay		1
			Coal	3	3
			Coal	3	11
			Parting		1

A bed of coal, the Taggart Marker, 22 inches thick lying from 8 to 15 feet below the Taggart bed was reported at location 58.

The following section was also measured in Lone Mountain in another mine of the Bondurant Coal Mining Company, one-fourth mile south of the Meadow Fork road:

Section of Taggart coal bed in Lone Mountain.

(Location 59, elevation 1,960 feet)

	Ft.	In.
Sandstone	10+	
"Rash"		5
Clay		1
"Rash"		1
Coal	3	11
Shale		
Coal	3	11

Locally in Lone Mountain the "rash" above the coal pinches out, leaving the massive coarse sandstone resting directly on the coal or separated from the coal by a thin layer of clay. The Taggart bed in Lone Mountain ranges from 44 to 52 inches in thickness.

The Taggart bed thins slightly northward toward the source of Straight Creek, as shown by the following measurements in mines of the Old Virginia Coal Company:

Sections of Taggart coal bed near head of Straight Creek.

(Location 60, elevation 1,900 feet)

	Ft.	In.
Sandstone		
Shale		
"Rash"		1½
Coal	3	3

(Location 61, elevation 1,930 feet)

	Ft.	In.
Sandstone	5+	
Shale	3	
Clay		1½
Coal	3	5
Coal	3	5

Additional sections of the bed measured in the mine may be found on page 128, and analyses of the coal sampled where these sections were measured are shown on page 143.

A number of mines have been operated on Benedict Branch by the Benedict Coal Corporation from which a large tonnage has been shipped. A number of small drifts were also found on the next creek to the west. The following represent typical measurements:

Sections of Taggart coal bed on Benedict and neighboring branches.

(Location 62, elevation 1,920 feet)

	Ft.	In.
Sandstone	5+	
Shale	1	
"Rash"		3
Coal	3	2
Coal	3	2

(Location 63, elevation 1,900 feet)

	Ft.	In.
Sandstone, massive ...	20+	
Shale		4
Coal	3	4
Coal	3	4

A small mine at the head of a tributary of Straight Creek one mile southeast of Darbyville, shows the following section:

Section of Taggart coal bed, one mile southwest of Darbyville.

(Location 64, elevation 1,910 feet)

	Ft.	In.
Sandstone.		
Shale	1	6
Clay		1
"Rash"		$\frac{1}{2}$
Coal	3	5
Coal	3	5

The bed thins slightly toward the source of Gin Creek, the coal in the main drift at Darbyville (location 65, elevation 1,840 feet), measuring 36 inches. The bed is overlain by three feet of shale which is succeeded above by coarse-grained sandstone. In the vicinity of Darbyville the Taggart bed ranges in thickness from 36 to 42 inches.

On the west side of Gin Creek, one mile above its mouth (location 66, elevation 1,810 feet), the bed is 42 inches thick and is here also overlain by three feet of shale with sandstone above. In the mine one-half mile south of location 66 the coal ranges in thickness from 36 to 44 inches, averaging 42 inches.

The Taggart bed has been worked on a large scale near the head of Baileys Trace and on Potts Branch. The following sections illustrate the character of the bed in this basin:

Sections of Taggart bed near the head of Baileys Trace.

(Location 67, elevation 1,770 feet)

	Ft.	In.
Sandstone	5+	
Shale, sandy	2	
Sandstone	3	4
Coal	3	2
Coal	3	2

(Location 68, elevation 1,780 feet)

	Ft.	In.
Sandstone	5+	
Shale	3	
Sandstone		6
Coal	3	1
Coal	3	1

(Location 69, elevation 1,780 feet)

	Ft.	In.
Sandstone.		
"Rash"		$1\frac{1}{2}$
Coal	3	2
Coal	3	2

(Location 70, elevation 1,800 feet)

	Ft.	In.
Shale.		
"Rash"		$\frac{1}{2}$
Coal		1
"Rash"		2
Coal	3	3
Coal	3	4

In this vicinity the bed will range in thickness from 36 to 44 inches.

Extensive mines in the Taggart bed are located on Fawn Branch, the mines being completely equipped with modern machinery and producing a large tonnage of coal. This is one of the oldest mining districts in Lee County. The bed ranges from 37 to 50 inches in thickness, averaging 43 inches. The following measurements are typical of the bed in this locality:

Sections of Taggart coal bed on and near Fawn Branch.

(Location 71, elevation 1,780 feet)			(Location 72, elevation 1,900 feet)		
	Ft.	In.		Ft.	In.
Sandstone	10+		Sandstone	10+	
"Rash"		6	"Rash"		9
Clay		1	Coal	4	0
"Rash"		1			
Coal	3	8	Coal	4	0
Coal	3	8			

Analyses of coal collected from the Taggart bed on Fawn Branch are given on pages 143 and 146 of this report.

The bed has been extensively prospected on Puckett Creek and its tributaries. The following sections show the character of the bed on Big Branch of Puckett Creek:

Sections of Taggart coal bed on Big Branch of Puckett Creek.

(Location 73, elevation 1,900 feet)			(Location 74, elevation 1,820 feet)		
	Ft.	In.		Ft.	In.
Shale	3+		Sandstone	5+	
"Rash"		4	Clay		2
Coal	4	0	Coal	1	10
			Shale		1
Coal	4	0	Coal	2	1
			Coal	3	11
			Parting		1

The bed maintains nearly the same thickness west of Big Branch of Puckett Creek as shown by the following measurement on the right fork of Bubby Branch:

Section of Taggart coal bed on Bubby Branch.

(Location 75, elevation 1,820 feet)				
	Ft.	In.		
Sandstone.				
Clay	1	8		
Shale		2		
Coal	3	9		
Coal	3	9		

Three openings have been made near the head of the main fork of Bubby Branch, but in none was the full thickness of the bed exposed. In each drift the bed is overlain by shale and the coal is free from partings in the portions of the bed exposed to view.

Near the head of Puckett Creek (location 76, elevation 1,890 feet), the bed is 45 inches thick, free from partings and overlain by eight inches of clay which is succeeded above by sandstone.

Throughout the Straight Creek drainage basin the Taggart is underlain by another coal bed 18 to 30 inches thick. In the western part of the basin this bed is separated from the Taggart by 20 to 30 feet of shale. Near the head of Straight Creek and in Lone Mountain the two beds are less than 15 feet apart, and locally they may be sufficiently close together to be mined as one bed. This lower bed is the Taggart Marker, mined extensively at Dunbar in Wise County.

Low Splint coal bed.—The Low Splint, known as No. 6 in the St. Charles field, lies from 250 to 400 feet above the Taggart bed. Its outcrop is high up on the slope of Little Black Mountain, near the sources of the streams tributary to Straight Creek. The position of the bed is defined by one of the most conspicuous of the several benches marking the southern slope of Little Black Mountain. The bed is being mined on a large scale near the head of Straight Creek.

The bed is thick but is nearly everywhere split by one or more shale partings that greatly impair its value. At the head of Straight Creek shale partings occur in the bed but they are thin and readily separated from the coal. Farther west, on Benedict Branch, the bed possesses essentially the same character as on Straight Creek. On Gin Creek it is split into two benches by a shale parting a foot or more in thickness. Little was learned regarding the character of the Low Splint bed west of Gin Creek. On the road leading from Ely Creek into Kentucky a bloom six inches thick occurring a few hundred feet east of the State line marks the position of the bed.

In view of the absence of definite knowledge regarding the character of the Low Splint bed in the western part of the Straight Creek basin it would seem that extensive prospecting is needed to determine whether or not there is any workable coal in this bed. The bed may be found to be workable throughout considerable areas.

Analyses of the coal from the Low Splint bed may be found on page 148 of this report.

The following measurements made near the head of Straight Creek are representative:

Sections of Low Splint coal bed near head of Straight Creek.

(Location 77, elevation 2,165 feet)

	Ft.	In.
Shale	10	
Bone		1
Shale		3
Bone		3
Coal	1	2
Coal, bony		4
Coal		9
Shale		1
Coal	1	8
<hr/>		
Coal	3	11
Parting		1

(Location 78, elevation 2,160 feet)

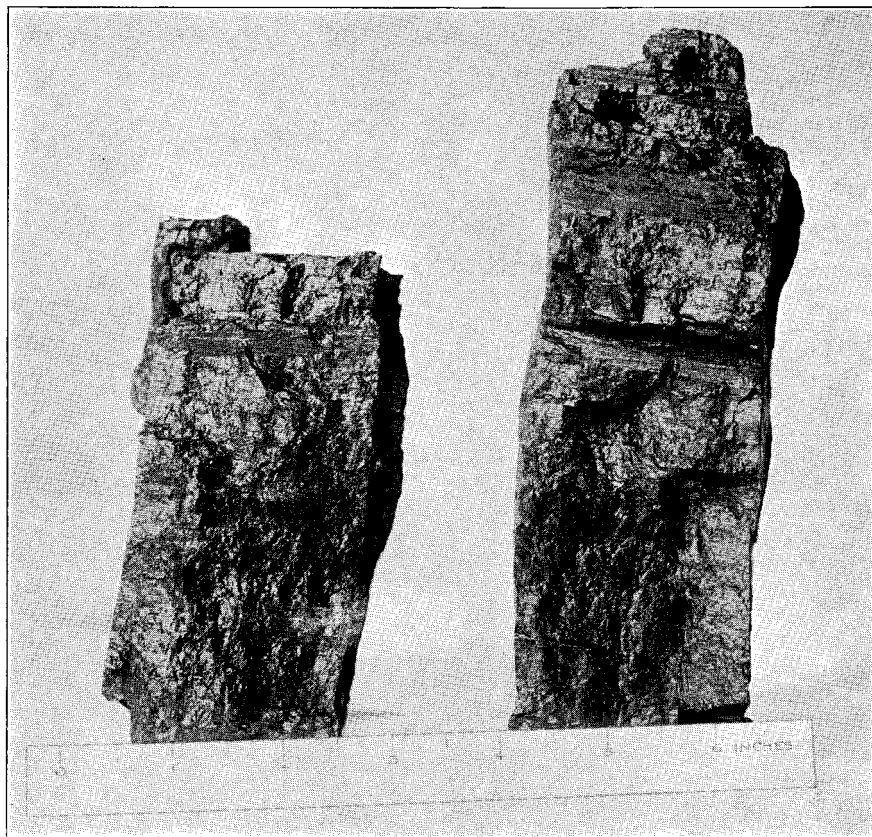
	Ft.	In.
Shale		2
"Draw slate"		1
Coal		3
Shale, carbonaceous, hard	1	6
Coal		2
Shale, pyritiferous		8
Coal		3
Shale	1	6
Coal		2
<hr/>		
Coal	3	11
Partings		8

On Benedict Branch the coal has been prospected but mining has not been undertaken. The following measurements were reported, the locations on the map being approximate only:

Sections of Low Splint coal bed on Benedict Branch.

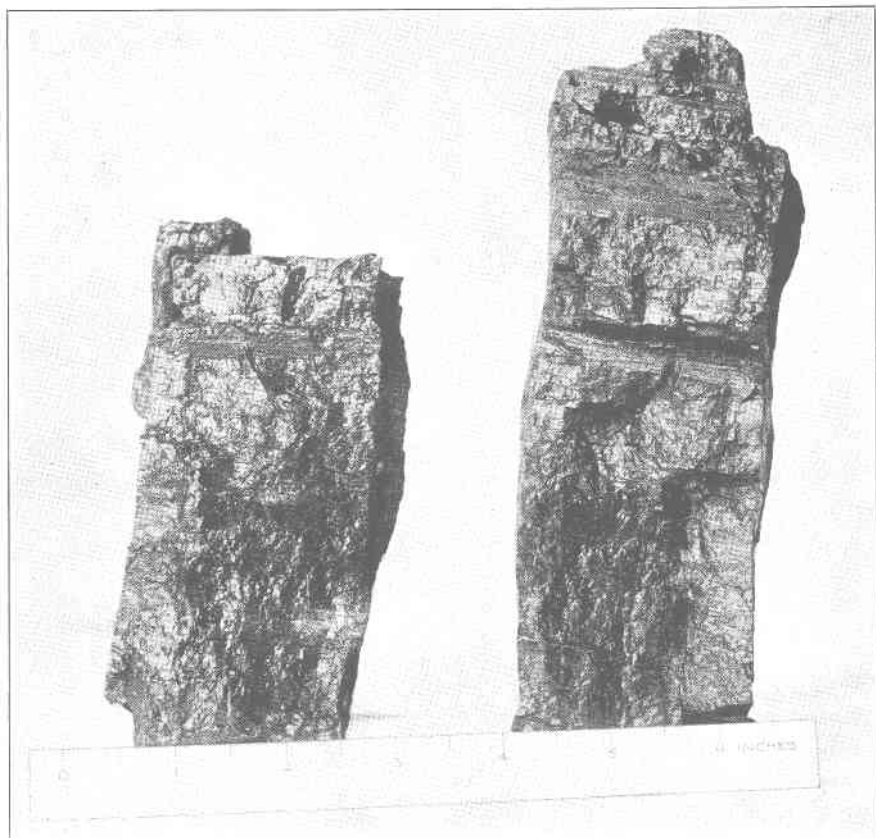
(Location 79, elevation 2,169 feet)

	Ft.	In.
Coal		1½
Shale		2
Coal	2	6
Shale		4
Coal	1	6
<hr/>		
Coal	4	1½
Partings		6



Bituminous coal from the Wise formation of southwest Virginia, illustrating the bright lustrous character of the coal. As shown in the photograph, the coal is usually banded by irregular layers of dull coal.

(Photo by U. S. Geological Survey.)



Bituminous coal from the Wise formation of southwest Virginia, illustrating the bright lustrous character of the coal. As shown in the photograph, the coal is usually banded by irregular layers of dull coal.

(Photo by U. S. Geological Survey.)



(A) Looking up Straight Creek above Bondurant.



(B) Looking down Summers Creek from near its source.



(A) Looking up Straight Creek above Bondurant.



(B) Looking down Summers Creek from near its source.

(Location 80, elevation 2,170 feet)		Ft.	In.
Coal	.....		1
Shale	.....		5
Coal	.....	1	3
Shale	.....		1
Coal	.....		8
Shale	.....		1
Coal	.....	2	1
Shale	.....		2
Coal	.....	1	3
		<hr/>	
Coal	.....	5	4
Parting	.....		9

About one mile west of Darbyville a short entry has been driven into the Low Splint bed to obtain a supply of coal for domestic purposes. The following measurement represents the section near the entrance of the drift:

Section of Low Splint coal bed east of Darbyville.

(Location 81, elevation 2,170 feet)		Ft.	In.
Sandstone.	.....	
Shale.	.....	
Clay	.....		3½
Coal, shaly	.....		3
Coal	.....	2	
Shale.	.....	<hr/>
Coal	.....	2	3

From this section it is apparent that either the bed thins rapidly west of Benedict Branch or only a single bench has been opened that was measured at this location.

No recent openings into the Low Splint bed were found on Gin Creek but the bed has been prospected as indicated by caved prospects. The bed was reported to be split into two benches by a shale parting one foot thick. The upper bench is reported to be one foot, and the lower three feet thick (location 82, elevation 2,130 feet approximately). The location is approximate. A recent measurement north of the Darby tipple is as follows:

Section of Low Splint coal bed on Gin Creek.

		Ft.	In.
Coal	.....		4
Shale	.....		3
Coal	.....		1
Bone	.....		3
Coal	.....		8
Bone	.....		1
Shale	.....		4
Coal	.....	1	
		<hr/>	
Coal	.....	2	1
Partings	.....		11

Phillips coal bed.—The Phillips bed, or No. 7 as it is called in the St. Charles field, lies from 250 to 400 feet above the Low Splint bed. It outcrops relatively high on the slopes of Little Black Mountain, and consequently has a smaller areal distribution than any of the beds previously described. The Phillips is one of the thickest beds in the Straight Creek basin, averaging five feet. It is characterized everywhere by a clay parting two to ten inches thick, which occurs in most places in the lower half of the bed. This is the only parting of significance that was found with the exception of thin shale layers that occur locally in the bed. The shale beneath the bed affords a hard, smooth floor in the mines and the shale overlying the bed is compact and coherent making an excellent roof in mining operations.

From a mining standpoint the characteristics of the Phillips would seem to make it one of the most attractive of all the coal beds in the Straight Creek basin, yet there is only one large mine in the bed. The height of the bed above railroad level has been the deterrent factor apparently in its development, however with proper equipment coal at that or even higher levels can be handled in large quantities rapidly and successfully.

At the head of Straight Creek the bed has been prospected recently and shows the following section:

Section of Phillips coal bed at the head of Straight Creek.

(Location 83, elevation 2,475 feet)

	Ft.	In.
Sandstone	10+	
Shale	1	
Coal	3	5
Clay, gray		10
"Rash"		2
Coal	1	4
Shale	1	
Coal		8
Coal	5	5
Partings	2	

A number of sections were measured in the mines of the Benedict Coal Corporation on Benedict Branch, the following of which may be taken as typical:

Sections of Phillips coal bed on Benedict Branch.

(Location 84, elevation 2,465 feet)

	Ft.	In.
Shale.....		
Coal	2	11
Clay, light gray		9
Coal	1	6
<hr/>		
Coal	4	5
Parting		9

	Ft.	In.
Shale.....		
Coal	3	2
Clay, light gray		6½
Coal	1	8
<hr/>		
Coal	4	10
Parting		6½

The following section was measured by Fisher¹ on the left fork of Gin Creek:

Section of Phillips coal bed on Gin Creek.

(Location 85, elevation 2,440 feet, approximately)

	Ft.	In.
Shale	5+	
Coal	2	5
Clay, light gray		7
Coal	1	9
<hr/>		
Coal	4	2
Parting		7

The location on the map is approximate only.

West of the head of Gin Creek the bed is reported to be four feet five inches thick with a two-inch parting two inches below the top, and a one-inch parting one inch above the bottom of the bed.

No sections of the Phillips bed were obtained on Baileys Trace, the bed not having been prospected in recent years, however it is almost certain that it is as valuable in this locality as elsewhere.

At the head of Fawn Branch the Phillips is reported to be four feet two inches thick, with seven inches of clay six inches above the bottom of the bed.

West of Fawn Branch (location 86, elevation 2,470 feet), the bed is reported to be 68 inches thick with the lower eight inches composed of bony coal.

¹Op. cit.

At the head of Pucketts Creek the bed is reported to be four feet eleven inches thick, with six inches of clay seven inches above the bottom of the bed. Analyses may be found on pages 148-149.

Gin Creek, Wax, and associated coal beds.—About 100 feet above the Phillips coal bed there is a coal bed which attains workable dimensions in a few places, but in most of these places it is split by so many shale partings as to be worthless.

The Gin Creek coal bed lies about 200 feet above the Phillips bed. Very little was learned concerning this bed. The bed has never been fully prospected, and nothing has been done with it in recent years so that no sections are available for study. It is probably thin throughout the Straight Creek basin. It occurs high up on the slopes of Little Black Mountain, and consequently has a very limited distribution in the district.

A measurement made at the head of Baileys Trace, elevation 2,590 feet, was reported as follows:

Section of Gin Creek coal bed at the head of Baileys Trace.

	Ft.	In.
Shale.....		4
Coal.....		3
Shale.....	1	8
Coal.....	1	3
Shale.....	2	4
Coal.....		
Coal.....	4	4
Parting.....	1	6

The Wax coal bed lies about 100 feet above the Gin Creek bed and 10 to 60 feet below the No. 10 or Pardee bed. This bed has never been mined in the Straight Creek basin. It has been opened at a number of places along the southern slopes of Little Black Mountain, but the prospect drifts are old and have fallen in so that no sections were studied. The bed is reported to attain a thickness of nearly five feet locally, and in places contains a thin parting in the lower half. The bed is overlain and underlain by shale. On the west side of Gin Creek the bed is reported to be so badly split by shale partings as to make it worthless. Fisher¹ examined the bed at the heads of Baileys Trace and Gin Creek. The sections of the bed in these two localities were found to be very similar. The following section is taken from his report on The Pocket coal district, the location on the map accompanying this report and altitude being approximate:

¹Op. cit.

Section of Wax coal bed at the head of Baileys Trace.

(Location 87, elevation 2,685 feet)

	Ft.	In.
Shale, sandy.		
Coal	3	6
Shale, carbonaceous		1½
Coal	1	1
Coal, impure		4
Coal	4	11
Parting		1½

The bed is reported to be split into two benches on Fawn Branch, the lower one of which is 24 inches thick.

Analyses of the coal from the Wax bed may be found on page 149 of this report.

Pardee coal bed.—The Pardee coal bed, No. 10 of The Pocket, will range from 250 to 350 feet above the Phillips bed. Its outcrop is so high on the slopes of Little Black Mountain that its area in the Straight Creek basin is very small.

It is one of the thickest coal beds in Lee County, averaging seven and one-half feet. Nearly everywhere the bed carries two partings, a clay or shale parting in the upper half and a shale or "rash" parting in the lower half. These partings are thin except locally, where they may become more than a foot thick. The bed is underlain by shale and overlain by massive sandstone or by a few feet of shale which is succeeded above by massive sandstone.

Notwithstanding the attractions of the bed as a mining proposition it has never been worked until recently except for a brief time at the head of Fawn Branch. Its altitude has been the chief obstacle in the development of the bed. At the present time it is being worked on an extensive scale at the head of Baileys Trace, and large operations at the head of Benedict Branch are also planned.

Analyses of the coal from this bed may be found on pages 149-150 of this report.

The bed has been opened at the head of Straight Creek, but the opening has fallen in so that the coal was not seen. The following section represents the reported measurement:

Section of Pardee bed at the head of Straight Creek.

(Location 88, elevation 2,855 feet)

	Ft.	In.
Coal	1	11
Shale		3
Coal		4
Shale		9
Coal	5	5
Coal	7	8
Partings	1	

The bed has been prospected recently at the head of Benedict Branch and shows the following section:

Section of Pardee coal bed at the head of Benedict Branch.

(Location 89, elevation 2,850 feet)

	Ft.	In.
Shale.		
Coal	1	3
Shale	1	6
Coal	5	
		<hr/>
Coal	6	3
Parting	1	6

Northwest of Darbyville the Pardee is reported to be five feet four and one-half inches thick, with four inches of shale three and one-half feet above the bottom of the bed.

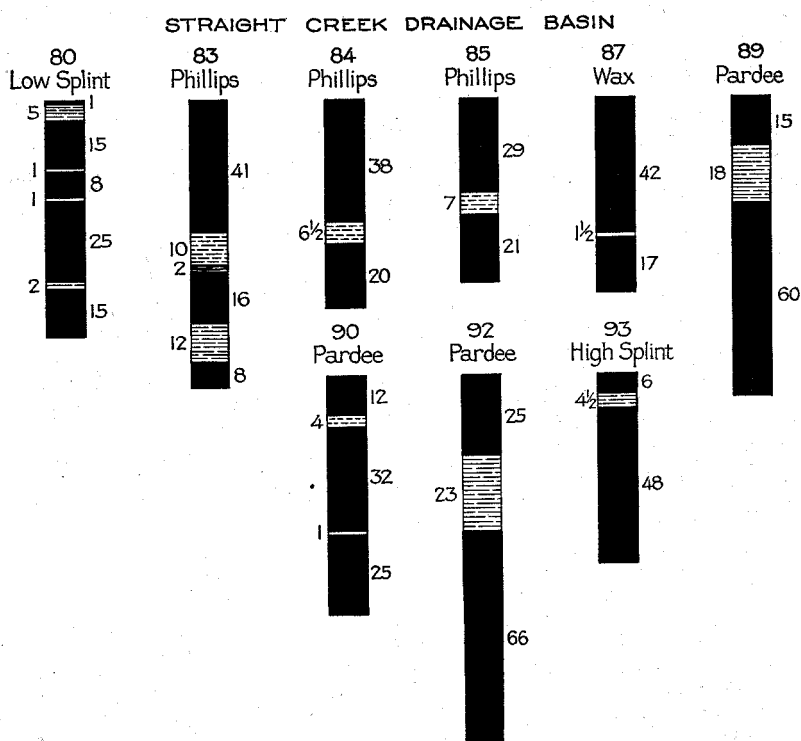


Fig. 9.—Sections of coal beds in the Straight Creek drainage basin.

Fisher examined the Pardee bed on Gin Creek and Baileys Trace. The following sections taken from his report on The Pocket coal district are representative, the first was measured on the left fork of Gin Creek, the second at the head of Baileys Trace:

Section of Pardee coal bed at the head of Gin Creek.

(Location 90, elevation 2,690 feet approximately)

	Ft.	In.
Coal	1	
Clay		4
Coal	2	8
Shale, coaly		1
Coal	2	1
		<hr/>
Coal	5	9
Partings		5

Section of Pardee coal bed at the head of Baileys Trace.

(Location 91, elevation 2,650 feet)

	Ft.	In.
Sandstone, gray	8	
Coal	1	7
Shale, coaly		1½
Coal		3½
Clay, light gray		8
Coal	2	6
Shale, coaly		1½
Coal	2	6
		<hr/>
Coal	6	10½
Partings		11

Across the divide opposite the head of Gin Creek on the Kentucky side, the following measurement has recently been made:

	Ft.	In.
Sandstone		
Shale	3	5
Coal		8
Bone		2
Shale		7
Coal	4	9
		<hr/>
Coal	5	5
Partings		9

A recent measurement made in the butt entry of the Blue Diamond Coal Company's mine at the head of Baileys Trace is as follows:

Section of Pardee coal bed at the head of Baileys Trace.

	Ft.	In.
Coal		6
Coal, bony		4
Coal		5
"Draw slate"		6
Coal	5	
Coal, black, bony	1	4
	<hr/>	
Coal	7	7
Parting		6

On the Kentucky side opposite the head of Baileys Trace the following section was reported:

Section of Pardee coal bed opposite head of Baileys Trace.

	Ft.	In.
Coal	1	
Shale		5
Coal		5
Shale		8
Coal	5	9
Shale	2	4
Coal	3	7
	<hr/>	
Coal	10	9
Partings	3	5

The following measurements of the Pardee bed between Baileys Trace and Fawn Branch were reported:

Sections of Pardee coal bed between Baileys Trace and Fawn Branch.

	Ft.	In.		Ft.	In.
Coal	2		Coal	1	9
Shale		3	Shale		4
Coal		6	Coal		7
Shale	1	10	Shale		3
Coal	5	6	Coal	5	3
Shale	4			<hr/>	
Coal	3		Coal	7	7
	<hr/>		Partings		7
Coal	11				
Partings	6	1			

In the abandoned mine at the head of Fawn Branch the bed shows the following section:

Section of Pardee coal bed at the head of Fawn Branch.

(Location 92, elevation 2,660 feet)		Ft.	In.
Shale		6	
Coal		2	1
Shale		1	11
Coal		5	6
		<hr/>	
Coal		7	7
Parting		1	11

Above the six feet of shale overlying the upper bench of the coal bed at this location there are eight inches of coal which in turn is overlain by four feet of shale succeeded by massive sandstone above.

Morris and High Splint coal beds.—Two beds near the top of the Wise formation and underlying the higher parts of Little Black Mountain remain to be described. The lower one of these is the Morris bed which lies from 400 to 650 feet above the Pardee bed and from 60 to 90 feet below the base of the Harlan sandstone. The bed was not examined, but is reported to be from three to five feet thick, free from partings and composed of blocky coal. It is underlain by shale and sandstone is reported as occurring directly above the coal.

The High Splint bed averages 70 feet above the Morris bed and lies within a few feet of the base of the Harlan sandstone. Occurring only in the highest parts of Little Black Mountain its areal distribution in the Straight Creek basin is extremely limited. The bed has been prospected in a number of places, but has not been mined in Lee County.

The bed has a thickness of four to five feet and consists of firm, massive coal. On the Kentucky side opposite the head of Straight Creek the High Splint bed is reported to be 54 inches thick, with one inch of shale one inch above the bottom of the bed. Fisher¹ reports the following section at the head of Gin Creek:

Section of High Splint coal bed at the head of the left fork of Gin Creek.

(Location 93, elevation 3,425 feet approximately)		Ft.	In.
Sandstone, Harlan.			
Coal			6
Shale, carbonaceous			4½
Coal		4	
		<hr/>	
Coal		4	6
Parting			4½

Analyses of the High Splint coal are given on page 150.

¹Op. cit.

North Fork of Powell River Basin.

General features.—The North Fork of Powell River drains the eastern half of the coal-bearing part of Lee County. The area of its drainage basin is about 60 square miles.

The Lee, Norton, Gladeville, Wise, and Harlan formations comprise the area. The Wise formation lies at the surface in essentially all of the drainage basin, and carries the bulk of the coals. The Lee formation extends far down the northwest flank of Stone Mountain, all of the formation lying on this side of the mountain with the exception of a few feet of the base which lie southeast of the mountain crest. The Lee here possesses the same characters as at Pennington Gap, being divisible into five members, three sandstone and conglomerate beds separated by thick masses of shale. The total thickness of the formation in this part of the county is about 1,600 feet.

The Norton formation succeeds the Lee above, and its outcrop is almost entirely north of the foot of Stone Mountain at the Lee-Wise county line, but two miles west of this line it occupies a position on the lower slope of the mountain flank. The outcrop is wide at the county line where the formation is about 1,400 feet thick, but narrows westward due to decrease in thickness and increase in dip. In the vicinity of Delvale the formation is about 1,500 feet in thickness. West of Delvale the upper part of the formation is missing due to faulting, and in places between Delvale and Purcell it is cut out entirely by the North Fork fault. West of Purcell only the lower 300 to 500 feet of the formation outcrop between the fault and the upper boundary of the Lee formation.

The Norton is composed of alternating sandstone and shale with thin coal beds, the proportion of shale to sandstone being about equal.

The Gladeville sandstone lies directly above the Norton formation and makes a narrow outcrop in general a short distance south of and paralleling closely the course of North Fork. It is 100 to 150 feet thick and composed of massive sandstone layers, the lower part being strongly conglomeratic. West of Purcell it terminates abruptly, having been carried beneath the surface in the movements that produced the North Fork fault.

The Wise formation outcrops continuously from the Gladeville sandstone northward to the Virginia-Kentucky line, only the highest summits of Little Black Mountain lying above it. The formation is about 2,500 feet thick and composed of shale, sandstone, and coal beds. The lower few hundred feet are largely sandstone, the middle of the formation is composed

of shale and sandstone in about equal proportion. Above the middle portion shale predominates, while the extreme upper part is more largely sandstone than shale. West of Purcell the lower part of the formation has been carried beneath the surface in the movement involved in the production of the North Fork fault. Near the mouth of Straight Creek the part thus concealed amounts to from 300 to 400 feet.

Only the basal part of the Harlan formation occurs in this drainage basin, occupying the highest summits of Little Black Mountain. Its horizontal extent is insignificant. It is made up largely of coarse-grained, massive sandstone that forms conspicuous cliffs and ledges.

Structurally that part of the drainage basin south of the Gladeville outcrop and the North Fork fault may be regarded as the northwestern limb of the Powell Valley anticline. Here the dip is north-northwestward and very steep, from Delvale westward being above 60 degrees nearly everywhere. East of Delvale the dips decrease ranging from 20 to 50 degrees. North of the Gladeville sandstone and North Fork fault the dip (north-northwest) is gentle, characteristic of the southeast limb of the Middlesboro syncline of which this area is a part. The North Fork fault, a structural feature of major importance, has already been described.

Many of the characteristics of the formations and of the structure are shown by the generalized columnar section for the eastern half of the coal field, Figure 2, by the local sections, and by the cross-section, Plate II. By far the greater part of the coal of commercial value in the North Fork drainage basin occurs in the Wise formation. This formation carries coal at 20 or more horizons, with a thickness of more than two feet in parts or all of these beds. A number of these beds have long been worked on an extensive scale, and are thick and valuable throughout essentially all of the area of their development within the drainage basin. The more important beds are the Clintwood, Imboden, Kelly, Harlan, Taggart, and Low Splint.

A number of stratigraphic markers occur in the North Fork drainage basin that are important in the location of coal beds and in correlation. The Addington sandstone just above the Clintwood coal bed, and the sandstones that overlie and underlie the Taggart bed are persistent and conspicuous members. The pyritiferous shale parting of the Harlan coal bed, the "rash" cover of the Taggart coal, and the conspicuous bench at the Low Splint horizon make the identification of these beds relatively simple and certain.

COAL BEDS IN THE LEE FORMATION.

Very little is known about the coal beds in the Lee formation in this drainage basin. The extremely rugged surface of Stone Mountain, and its dense forest cover have effectually precluded prospecting, and natural exposures are poor, so that it was quite impossible to locate and examine coal beds in the limited time available for the field study. However both the Big Stone Gap and the Pennington Gap sections of the Lee show coal beds, some of which are doubtlessly persistent for long distances. The beds are thin, and their dip ranges from 30 to 90 degrees, so that they are not feasible mining propositions at the present time. The coal is also of inferior quality, being greatly crushed and the shale adjacent to the coal beds as well as their partings having been mixed with the coal during the movements that tilted the strata and crushed the coal.

COAL BEDS IN THE NORTON FORMATION.

The Norton formation is thick in the eastern part of the North Fork drainage basin, and undoubtedly carries coal beds, some of which are probably the continuation of well known beds that have long been mined in Wise County. Very little was learned regarding these beds in Lee County. There has been no prospecting, and the rugged character of the country, the dense forest growth, and the steep dips of the Norton rocks are highly unfavorable to prospecting and mining.

Valuable coal beds undoubtedly occur in the formation and are a potential resource that will become available when the more accessible coals of the region have become exhausted.

A coal bed three feet thick and vertical in position was found at Pocket where the L. & N. railroad tunnel was driven through Stone Mountain. This bed occurs just above the base of the formation. Another coal bed with similar attitude and thickness occurs several hundred feet higher up in the formation. This bed has been prospected in Pennington Gap and has already been described (page 60, location 1).

COAL BEDS IN THE WISE FORMATION.

The coal beds in the Wise formation are by far the most important in the North Fork drainage basin. They will be described in order proceeding from the lowest upward.

Dorchester coal bed.—This bed lies just above the Gladeville sandstone, and extends from the eastern limit of the county to Purcell where it terminates against the North Fork fault. It ranges in thickness from 26 to 48

inches and is in most places free from partings. Its great range in thickness is due to the movements that deformed the strata of Stone Mountain giving the Dorchester bed a relatively high dip and causing it to "pinch" and "swell." It has been mined only at Purcell.

The bed has been prospected one-half mile south of Mohawk (location 94, elevation 2,080 feet), where it is at least 26 inches thick, the lower part of the bed being concealed. The bloom of the Dorchester bed shows in the Keokee-Olinger road at the crest of the divide one-half mile south of Wells Branch.

At Purcell in the mine of the Marsee Coal Company, the following measurement was made 100 feet north of the drift mouth:

Section of Dorchester coal bed at Purcell.

(Location 95, elevation 1,620 feet)

	Ft.	In.
Shale.		
Clay		21½
"Rash"		1
Coal		10
Coal, fissile		3
Coal	2	3
		<hr/>
Coal	3	4

In this mine the coal is from 28 to 48 inches thick, with a hard, smooth shale floor and a substantial shale roof. Fifty feet of massive sandstone overlie the roof shale.

Lyons coal bed.—The Lyons coal bed lies from 65 to 75 feet above the Gladeville sandstone. It is underlain by a few feet of shale which is separated from the Dorchester bed by 50 feet or more of massive sandstone. The bed has not been extensively mined in Lee County and little is known regarding it. The coal averages three feet in thickness, but the bed is variable, "pinching" and "swelling" in short distances. The dip is 10 to 12 degrees northwest. The Lyons is locally known as the Thompson bed.

A coal bed one-half mile south of Mohawk has been prospected recently. It lies a short distance above the Gladeville sandstone and apparently is the Lyons bed:

Section of Lyons (?) coal bed near Mohawk.

(Location 96, elevation 2,040 feet)

	Ft.	In.
Shale.		
Coal	2	8
Shale		6
Coal	1	6
		<hr/>
Coal	4	2
Parting		6

What is probably the same bed has been opened at Delvale, the following section indicating its character at this place:

Section of Lyons (?) coal bed at Delvale.

(Location 97, elevation 1,920 feet)		Ft.	In.
Shale.			
"Rash"			$\frac{1}{2}$
Coal		1	
Shale			4
Coal			$2\frac{1}{2}$
"Rash"			$\frac{1}{2}$
Coal			9
"Rash"			$\frac{1}{2}$
Sandstone			1
"Rash"			1
Coal		1	$11\frac{1}{2}$
Partings			$4\frac{1}{2}$

At Purcell the Lyons coal bed affords better sections as illustrated in the following measurements:

Sections of the Lyons coal bed at Purcell.

(Location 98, elevation 1,600 feet)		(Location 99, elevation 1,650 feet)	
	Ft. In.		Ft. In.
Shale.		Shale.	
"Rash"	1	Coal	$4\frac{1}{2}$
Coal	7	Shale	$1\frac{1}{2}$
Coal, fissile	$\frac{1}{2}$	Coal	11
Coal	1 10	"Rash" and coal	6
Coal, fissile	2		
Coal	10	Coal	3 $3\frac{1}{2}$
		Parting	$1\frac{1}{2}$
Coal	3 $5\frac{1}{2}$		

Blair coal bed.—The Blair coal bed has been mined at Purcell and prospected recently on Jones Creek. The bed is split into two benches 30 to 35 feet apart. The lower bench is thin with a thick shale parting, the upper bench is thicker and is essentially free from partings. The bed is 70 feet above the Lyons and 140 feet above the Gladeville sandstone. It lies 125 to 150 feet below the Clintwood bed, from which it is separated by sandy shale. The Blair is locally known as the Bentley bed.

Near Crest a prospect (location 100, elevation 2,080 feet), in what is probably the Blair bed was reported to have disclosed five feet of coal, with one inch of clay in the middle of the bed.

On Jones Creek neither bench shows over two and one-half feet of coal. In the vicinity of Purcell the character of the bed is illustrated by the following measurements:

Sections of Blair coal bed near Purcell.

(Location 101, elevation 1,620 feet)

Upper bench

	Ft.	In.
Shale.		1
"Rash"		1
Coal	1	4½
Shale		½
Coal	1	2
<hr/>		
Coal	2	6½
Parting		½

Lower bench.

	Ft.	In.
Sandstone.		
Shale	2	
Coal	1	3
"Rash"		1½
Shale	1	2
"Rash"		2
Coal		7
<hr/>		
Coal	1	10
Parting	1	5½

At the mouth of Wolf Harbor Branch (location 102, elevation 1,530 feet), the upper bench shows in a recent prospect 30 inches of coal free from partings.

Clintwood coal bed.—The Clintwood coal bed, known as the North Fork bed in The Pocket where it has been extensively mined, is a thick and valuable bed throughout its extent in Lee County. Its outcrop is close to the railroad, facilitating the handling of the coal. Its thickness is in few places less than three and one-half feet, and locally it may be nine feet. These factors make it a very desirable bed from the mining standpoint. The coal dips relatively steeply at the outcrop, ranging from eight to twelve degrees, and "pinches" and "swells" in short distances. In less than a mile north of the outcrop the bed flattens out in conformity with the gentle dip of the coal measures and probably maintains a more uniform thickness. Unfortunately little is known of the character of the bed at this distance, as no mining operations have been extended so far from the outcrop.

A parting from three to twelve inches thick is present nearly everywhere. In most places it occurs beneath the middle of the bed.

The Clintwood bed has been mined at a number of places between the county line on the east and Rocklick Branch on the west. It passes below water level a short distance west of Sandlick Branch.

In the mines of the Crest Coal Company at Crest the following measurements were made:

Sections of Clintwood coal bed at Crest.

(Location 103, elevation 2,120 feet)

	Ft.	In.	Ft.	In.
Shale.				
Coal	2		2	6
Coal, fissile		1		1
Coal	1	3	1	4
Shale		3		5
Coal		6		3
Clay		1		4
Coal		10		
"Rash"		3+		4
<hr/>				
Coal	4	8	4	2
Partings		4		9

In this vicinity the bed ranges from four to nine feet in thickness, and in places the partings are lacking.

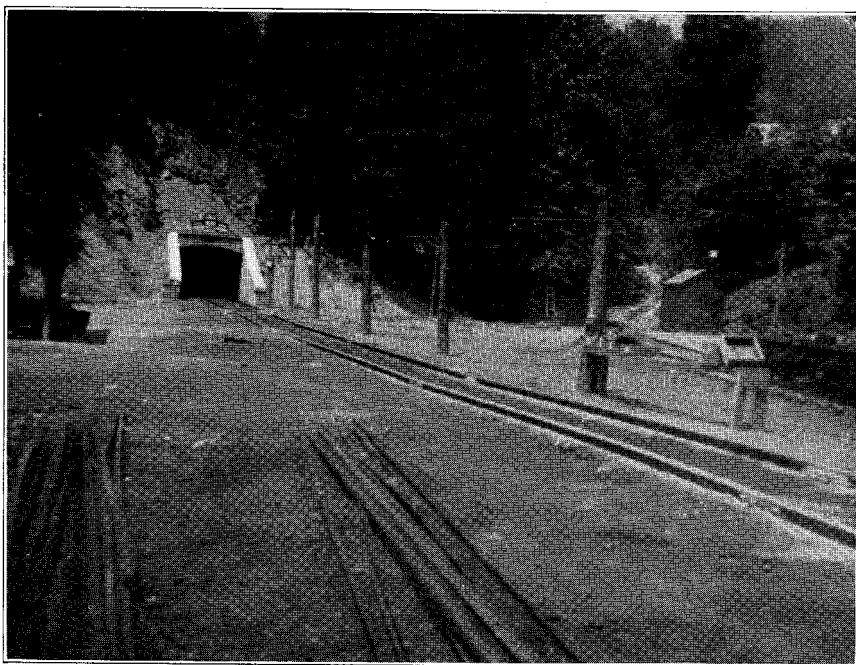
East of the Keokee-Olinger Gap road the bed possesses similar characters:

Section of Clintwood coal bed near Keokee-Olinger Gap road.

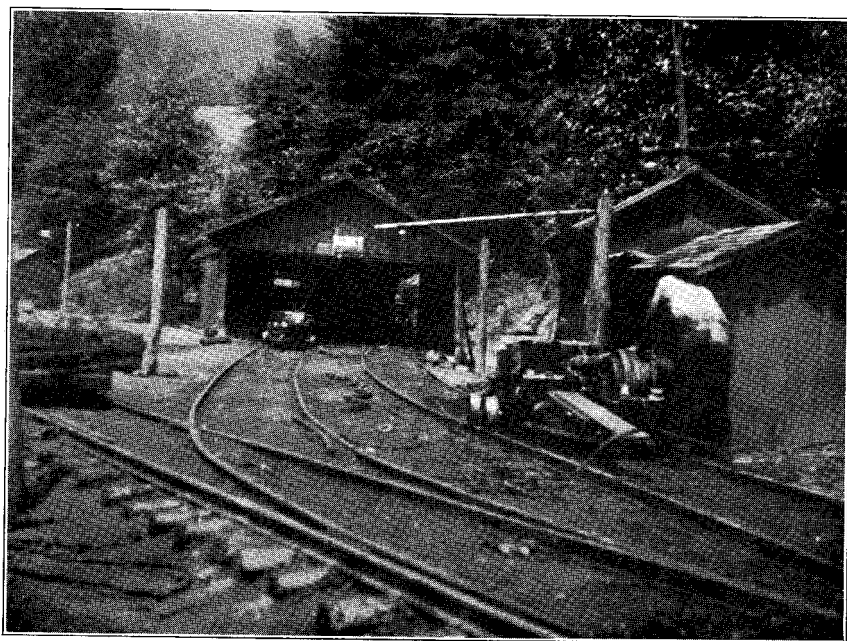
(Location 104, elevation 2,130 feet)

	Ft.	In.
Shale.		
"Rash"		1
Coal	1	9
"Rash"		2
Coal	1	3
"Rash"		3
Coal		10
Clay		2
Coal		2
<hr/>		
Coal	4	
Partings		7

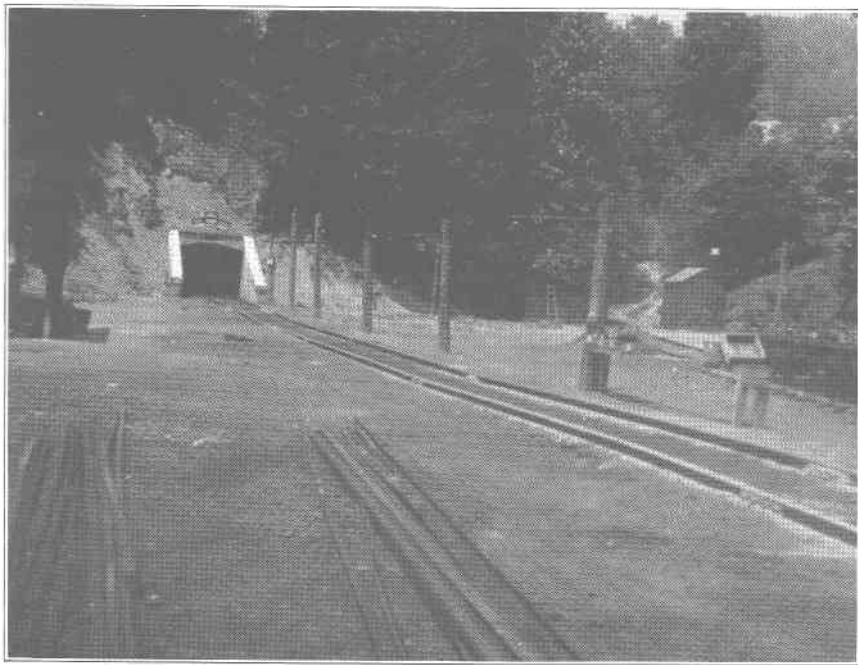
Near Buckles one mile west of Delvale in mines recently developed the bed averages six feet thick and ranges from five to eight and one-half feet, with a parting locally in the lower part of the bed. The following measurement was obtained near the drift mouth:



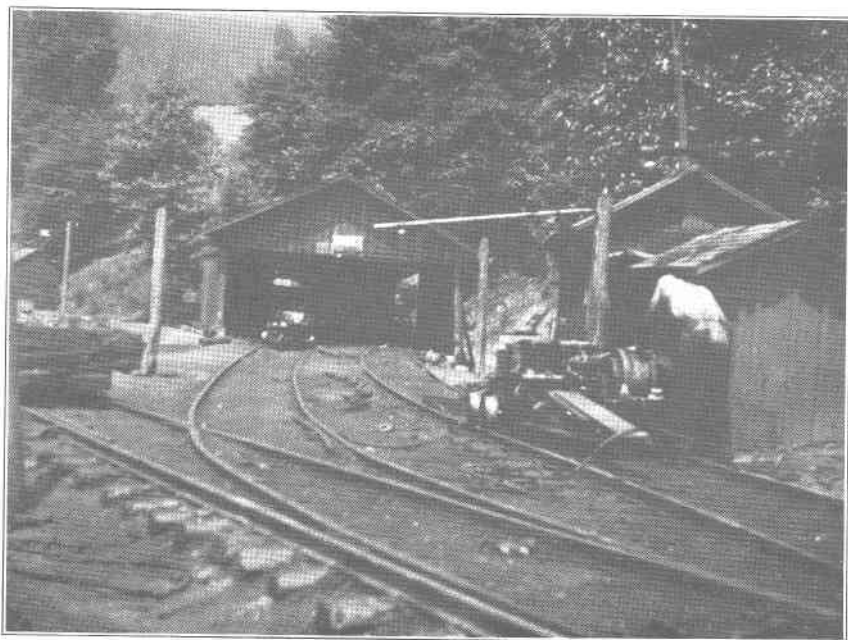
(A) Entrance to No. 3 mine, Harlan coal bed, Stonega Coke and Coal Company, Keokee, Lee County, Virginia.



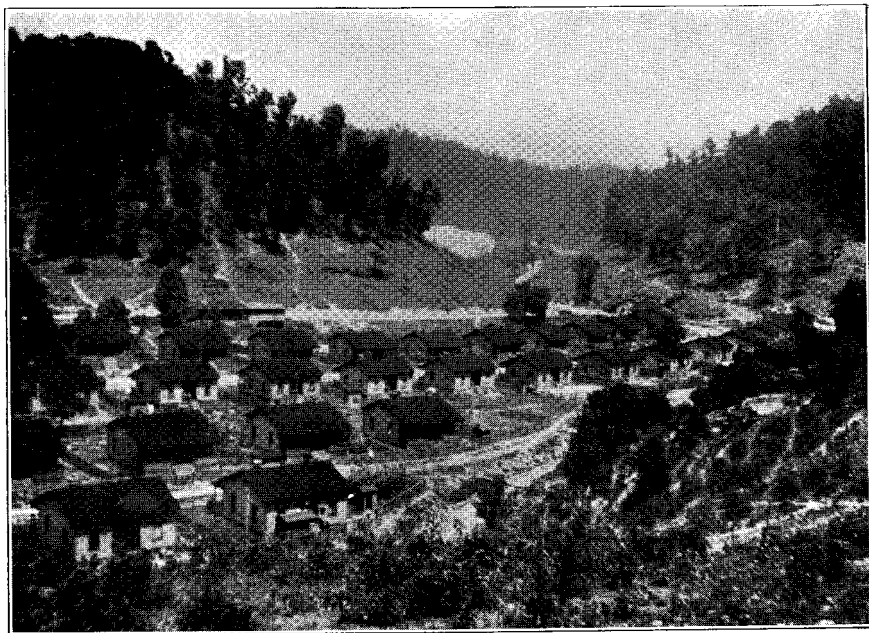
(B) Shop of No. 3 mine, Harlan coal bed, Stonega Coke and Coal Company, Keokee, Lee County, Virginia.



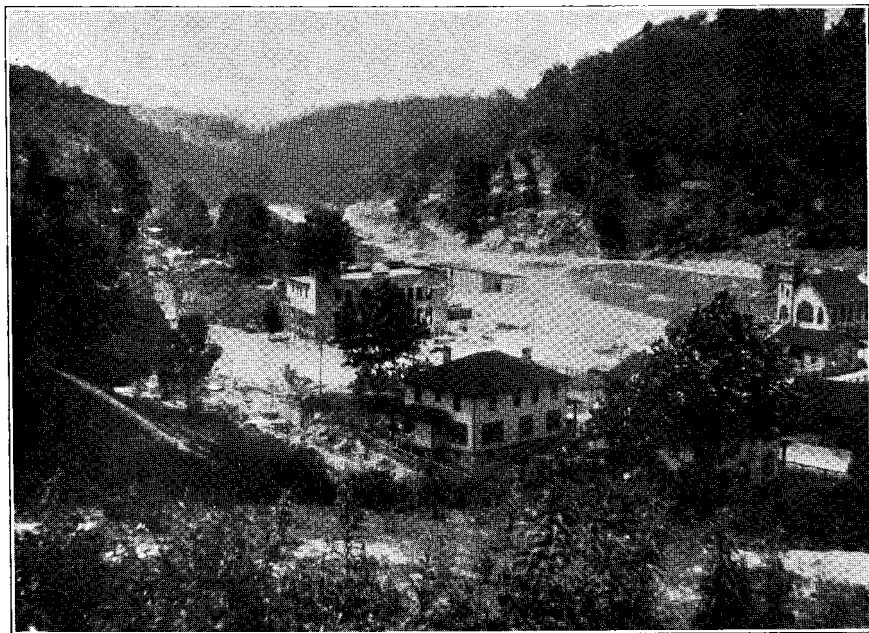
(A) Entrance to No. 3 mine, Harlan coal bed, Stonega Coke and Coal Company, Keokee, Lee County, Virginia.



(B) Shop of No. 3 mine, Harlan coal bed, Stonega Coke and Coal Company, Keokee, Lee County, Virginia.

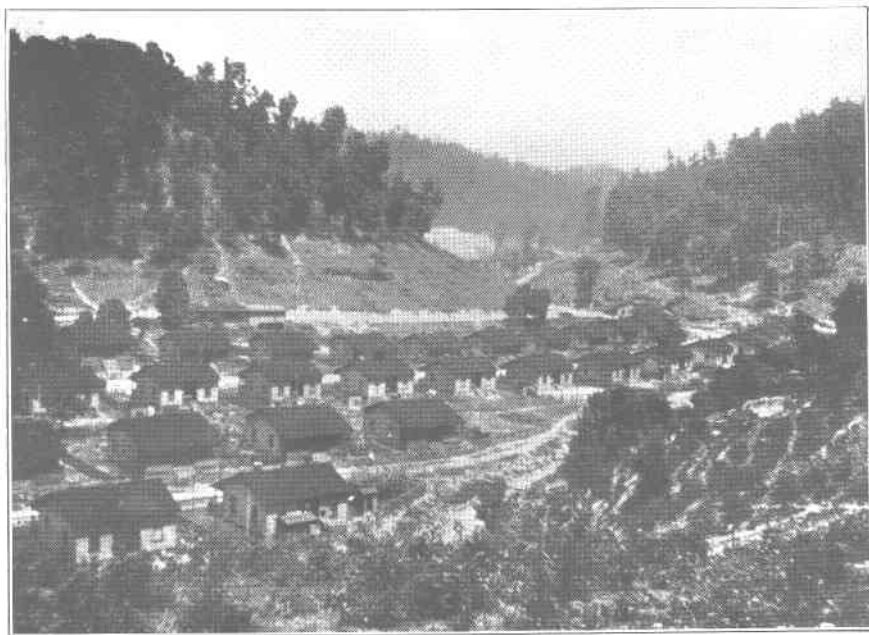


(A)

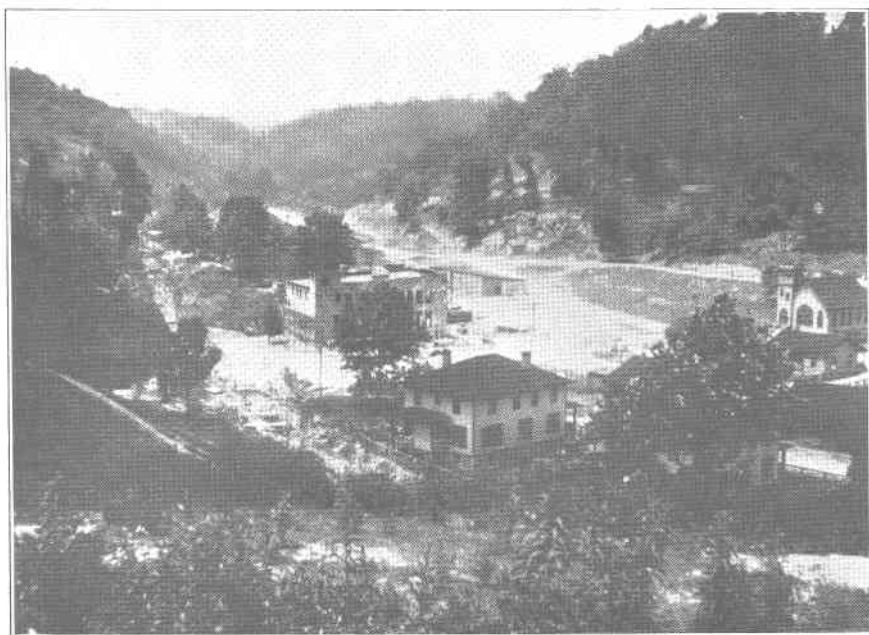


(B)

Views of a typical mining camp in the southwest Virginia coal field. Exeter in western Wise County, just east of the Lee County line.



(A)



(B)

Views of a typical mining camp in the southwest Virginia coal field. Exeter in western Wise County, just east of the Lee County line.

Section of Clintwood coal bed near Buckles.

(Location 105, elevation 2,010 feet)

	Ft.	In.
Shale.	5	1
Coal	1	
"Rash" and clay		2
Coal		
Coal	5	3
Parting	1	

On Reeds Creek (location 106, elevation 1,680 feet), the bed is 58 inches thick with no parting. Farther west on Wolf Harbor Branch there are several mines in which measurements were obtained.

Sections of Clintwood coal bed on Wolf Harbor Branch.

(Location 107, elevation 1,640 feet)

	Ft.	In.
Shale.		
Coal	1	6
Shale		2½
Coal	1	9
Coal	3	3
Parting		2½

(Location 108, elevation 1,720 feet)

	Ft.	In.
Coal		10
"Rash"		3
Coal		6
Shale		5
Coal	1	8
Coal	3	
Partings		8

The bed averages three and one-half feet in this vicinity, and locally is seven feet thick. Analyses of coal from mines in this locality may be found on page 138 of this report.

Near the mouth of Rocklick Branch the following measurements were obtained:

Sections of Clintwood coal bed near Rocklick Branch.

(Location 109, elevation 1,680 feet)

	Ft.	In.
Coal	1	3
Shale		8
Coal	1	6
Clay and carbonaceous shale		3
Coal	1	7
Coal	4	4
Partings		11

(Location 110, elevation 1,680 feet)

	Ft.	In.
Shale	3+	
"Rash"		1
Coal	2	6
Coal	2	6

At the last mentioned location the bed ranges from two to six feet in thickness.

Fifty feet beneath location 110 a thin coal bed shows 20 inches of coal with nine inches of "rash" and clay beneath the coal and three inches of

"rash" above. It is probable that the measurement obtained on Sandlick Branch (location 111, elevation 1,560 feet), is on a bench of this same bed. It shows 23 inches of coal overlying six inches of hard bony coal and "rash."

Coal beds above the Clintwood coal bed.—At Crest a bed of coal lying about 160 feet above the Clintwood is reported to have been prospected several years ago. The bed is said to be from five to six feet thick and free from partings. The location of the old prospect drift is given on the accompanying map (location 112, elevation 2,060 feet).

Another bed lying about 320 feet above the Clintwood and 80 feet below the Imboden, measures 12 inches in the railroad cut at Crest (location 113, elevation 2,110 feet). This bed is reported as being very persistent at about this distance below the Imboden in western Wise County.

Near Delvale (location 114, elevation 1,900 feet), an old prospect was found that shows coal 36 inches thick and free from partings. This bed lies about 200 feet above the Clintwood.

On Jones Creek a bed has been opened at location 115 (elevation 1,750 feet), that is reported to be four feet thick.

Imboden coal bed.—The Imboden is one of the most famous coal beds of southwest Virginia, and has long been mined in Wise County. It underlies a large area in Lee County, but has been developed extensively in only two or three localities. In The Pocket it has been mined for a long time at Maness where it is known as the No. 1 bed.

Like the Clintwood the outcrop of the Imboden is near the railroad, a very favorable factor in its development. It possesses a rather high dip at the outcrop but, like the associated coal measures, flattens out a short distance towards the north. The bed ranges in thickness from two to six and one-half feet, averaging four and one-half feet. It is variable, thinning in short distances to two feet. It may be free from partings locally, and in a short distance partings may occur that render the bed practically worthless.

It has a shale roof and shale floor. The roof shale is incoherent and consequently the roof is difficult to support.

The Imboden lies about 400 feet above the Clintwood from which it is separated by the Addington sandstone and by shale and thin beds of sandstone lying above the Addington sandstone. In the eastern part of Lee County it is from 550 to 625 feet above the Gladeville sandstone. This distance increases toward the west and in The Pocket it averages 600 feet above the Gladeville. It lies about 300 feet below the Harlan coal bed. The fol-

lowing detailed description of the Imboden bed will convey an adequate idea of its characteristics in Lee County. Analyses of the coal may be found on page 138 of this report.

The bed has been prospected recently near Crest where it is reported to be nearly seven feet thick with a three-inch parting of clay near the middle of the bed (location 116, elevation 2,080 feet). One-half mile farther west (location 117, elevation 2,100 feet), the bed is reported to be 39 inches thick below a five-inch parting of clay with 42 inches of coal above.

The Imboden coal bed is apparently not prospected at Mohawk, but the Kelly has been extensively mined. A short distance west of Mohawk (location 118, elevation 2,010 feet), the Imboden is reported to be from four to six feet thick without a parting. At Newton one mile west both beds have been actively mined. The following section illustrates the character of the bed here:

Section of Imboden coal bed at Newton.

(Location 119, elevation 2,020 feet)

	Ft.	In.
Shale.....		11
Coal		$\frac{1}{4}$
Shale		$3\frac{1}{2}$
Coal		1
Shale		$7\frac{1}{2}$
Coal		1
Shale	1	10
Coal		$\frac{1}{4}$
Shale	1	$3\frac{1}{2}$
Coal		$\frac{1}{4}$
Shale	1	5
Coal	6	$4\frac{1}{2}$
Partings		$2\frac{3}{4}$

The dip of the bed in this locality is about 12 degrees northwest.

One-half mile west of Newton (location 120, elevation 2,050 feet), a bed has been prospected that is at about the Imboden horizon. It is reported to be 28 inches thick, and may represent a bench of the Imboden bed.

Near Johnsons Mill (location 121, elevation 2,020 feet), recent drifts in the Imboden bed show the coal to be 34 to 48 inches thick and free from partings. The bed dips 21 degrees toward the northwest in this locality.

At Sigma (location 122, elevation 2,010 feet), the Imboden is reported to be four feet thick with one inch of parting near the middle of the bed.

On Jones Creek the bed has been prospected recently and the following sections were obtained:

Sections of Imboden coal bed on Jones Creek.

(Location 123, elevation 1,830 feet)			(Location 124, elevation 1,730 feet)		
	Ft.	In.		Ft.	In.
Shale	10+		Shale	5+	
Coal	4	1	Coal	3	10
"Rash"		1			
Coal		4			
Shale		4-6			
Coal	1				
<hr/>					
Coal	5	5			
Partings		5-7			

The dip of the bed in this locality is about 12 degrees northwest.

On Reeds Creek the bed is split by a thick clay parting as illustrated in the following section:

Section of Imboden coal bed on Reeds Creek.

(Location 125, elevation 1,680 feet)			Ft.	In.
Coal			2	6
Clay			3	11
"Rash"				2
Clay			1	
Coal			2	4
Shale				2
Coal				10
<hr/>				
Coal			5	8
Partings			5	3

The Imboden has been mined to a small extent about one-half mile above the mouth of Rocklick Branch (location 126, elevation 1,800 feet), where it is about 36 inches thick and free from partings. On Sandlick Branch numerous prospects show that the bed consists of from 31 to 34 inches of clear coal (location 127, elevation 1,700 feet). On Bobs Branch the following section illustrates the character of the bed in recent drifts of the Penn-Lee Coal Company:

Section of Imboden coal bed on Bobs Branch.

(Location 128, elevation 1,620 feet)			Ft.	In.
"Rash"				1
Coal			3	6
Clay				1
"Rash"				5
<hr/>				
Coal			3	6

Kelly and associated coal beds.—A number of coal beds occur a short distance above the Imboden bed, the most important of which is the Kelly. The Kelly coal bed averages about 50 feet above the Imboden, and has been extensively mined at two localities in eastern Lee County. It is a thick bed averaging five feet, but everywhere that the bed has been examined it is split by shale partings. The bed is not known west of Newton. Analyses of the coal from the Kelly bed may be found on page 139.

There is a large operation on the Kelly bed at Mohawk where the following measurements were obtained:

Sections of Kelly coal bed at Mohawk.

(Location 129, elevation 2,050 feet)

Shale.	Ft.	In.	Shale.	Ft.	In.
"Rash"		6	"Rash"		1
Clay	2		Coal	1	8
"Rash"		$\frac{1}{2}$	Shale		2
Coal	4		Coal	1	2
"Rash"		$\frac{1}{2}$	Shale, pyritiferous ..		4
Coal	4	3	Coal	1	
<hr/>			<hr/>		
Coal	4	7	Coal	3	10
Parting		$\frac{1}{2}$	Partings		6

On the railroad three-fourths mile west of Mohawk both the Imboden and Kelly beds have been mined, however the drifts have long since been abandoned. The Kelly is reported to be five feet thick with six inches of parting in the lower half of the bed (location 118, elevation 2,030 feet).

At Newton the Kelly has been actively mined and the following measurement was made a short distance within the entrance of the main drift:

Section of Kelly coal bed at Newton.

(Location 130, elevation 2,010 feet)

Shale.	Ft.	In.
Coal	1	8
"Rash"		$\frac{1}{2}$
Coal		10
Clay		3
"Rash"		$6\frac{1}{2}$
Coal	1	7
<hr/>		
Coal	4	1
Partings		10

A bed, locally known as the Pinhook, has been mined to a slight extent at Mohawk. It averages 50 feet above the Kelly. Massive sandstone overlies the bed and aids directly in its identification. The following section was measured in the mine at Mohawk:

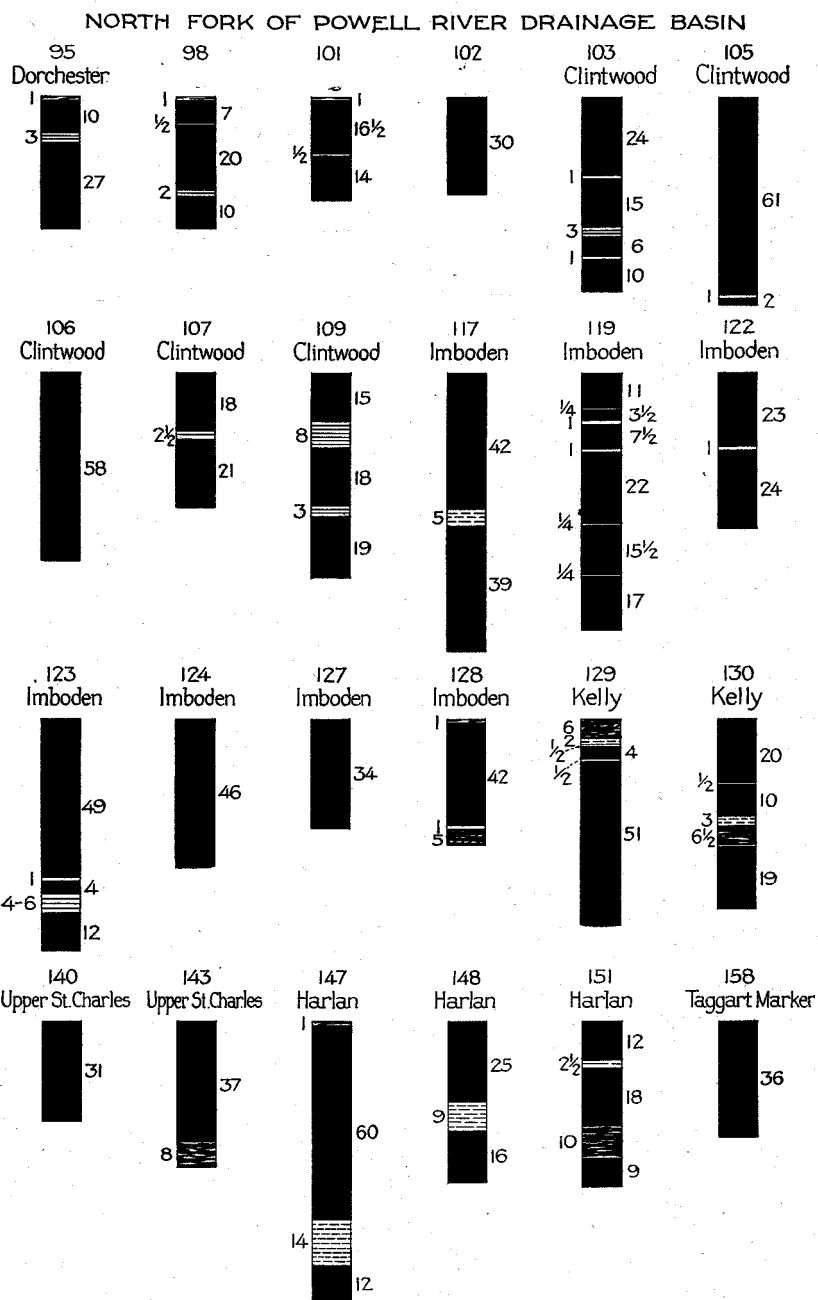


Fig. 10.—Sections of coal beds in the North Fork of Powell River drainage basin.
No. 98 is Lyons, Nos. 101 and 102 Blair.

Section of Pinhook coal bed at Mohawk.

(Location 131, elevation 2,040 feet)

	Ft.	In.
Sandstone.....		2
Shale		2
Coal	2	7
"Rash"		2
Clay		1
Coal		4
Clay		4
Coal		1
Shale		2
Coal		1
Shale		1
Coal		1
Coal	3	2
Partings		10

West of Mohawk the Pinhook has been reported as being split into two benches 18 feet apart, the upper bench averaging three feet in thickness with sandstone overlying the bed, the lower bench averaging two and one-half feet. What may possibly be the Pinhook has been prospected above Newton (location 132, elevation 2,040 feet). The bed is reported to be 36 inches thick with massive sandstone directly overlying the coal.

Two beds lying about 50 feet apart have recently been prospected on the property of Mr. J. J. Gates, northwest of Newton (location 133, elevations 2,120 and 2,150 feet). The upper bed is six and one-half feet thick with 30 inches of shale 18 inches above the bottom of the bed. The lower bed is three feet thick without parting. The latter bed lies about 150 feet above the Kelly coal bed.

A bed has been mined one-half mile north of Bundy on Bundy Creek by the Sigma Coal Company. It is 35 inches thick with one inch of "rash" above the coal (location 134, elevation 1,980 feet). It is possible that this bed is the same as the lower bed of the Gates place, and that this bed and the one above are to be correlated with the Lower and Upper St. Charles beds of The Pocket.

On Cox Creek a bed that has been worked to some extent measures as follows:

Section of coal bed on Cox Creek.

(Location 135, elevation 1,950 feet)

	Ft.	In.
Sandstone	3+	
Shale		7
Coal	1	1
Clay		1½
Coal	1	6
Clay		3
Coal		7
Coal	3	2
Partings		4½

On Jones Creek a number of thin coal beds lie above the Imboden. The lowest one of these beds two miles above the mouth of the creek (location 136, elevation 1,760 feet), shows 16 to 18 inches of coal.

One-half mile north of location 136 on the west side of the stream (location 137, elevation 1,760 feet), a bed three and one-half to four feet thick has recently been opened. The coal lies directly beneath massive sandstone. One-half mile west of location 136, a bed has been opened that is reported to be five feet ten inches thick with five inches of shale near the middle of the bed (location 138, elevation 1,810 feet).

Lower and Upper St. Charles coal beds.—The Lower and Upper St. Charles coal beds have been traced eastward from Straight Creek as far as Cox Creek. East of the latter stream nothing certain is known about these beds, although it is possible, as already suggested (page 103), that they may be the same as the beds which have been prospected at locations 133 and 134. The Upper St. Charles bed lies from 30 to 50 feet above the Lower St. Charles.

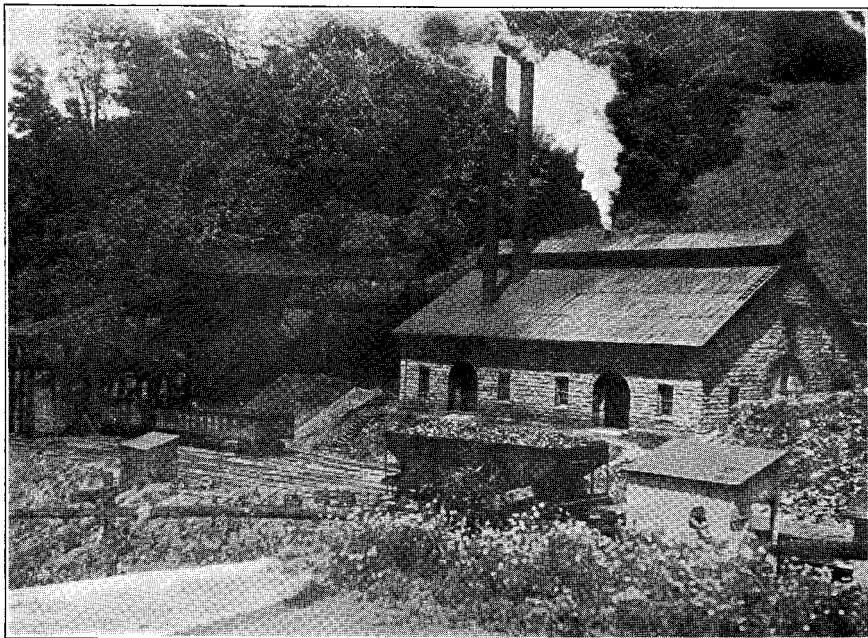
Both beds are thin, in few places measuring over three feet, and the coal of both beds is of inferior quality, being high in ash. Analyses of the coal of these beds may be found on page 139.

On Cox Creek both beds have been opened, showing the following sections:

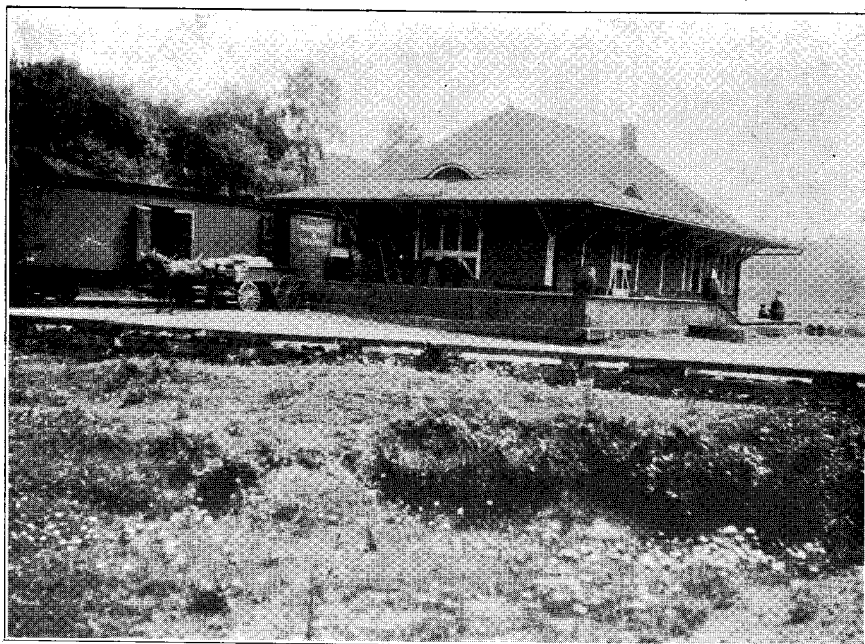
Sections of Lower and Upper St. Charles coal beds on Cox Creek.

(Location 139, elevation 1,940 feet)			(Location 140, elevation 1,960 feet)		
	Ft.	In.		Ft.	In.
Coal	1	1	Sandstone	5+	
Coal, fissile		3	Coal, bony	2	9
Coal		9			
	<hr/>		Coal	2	9
Coal	2	1			

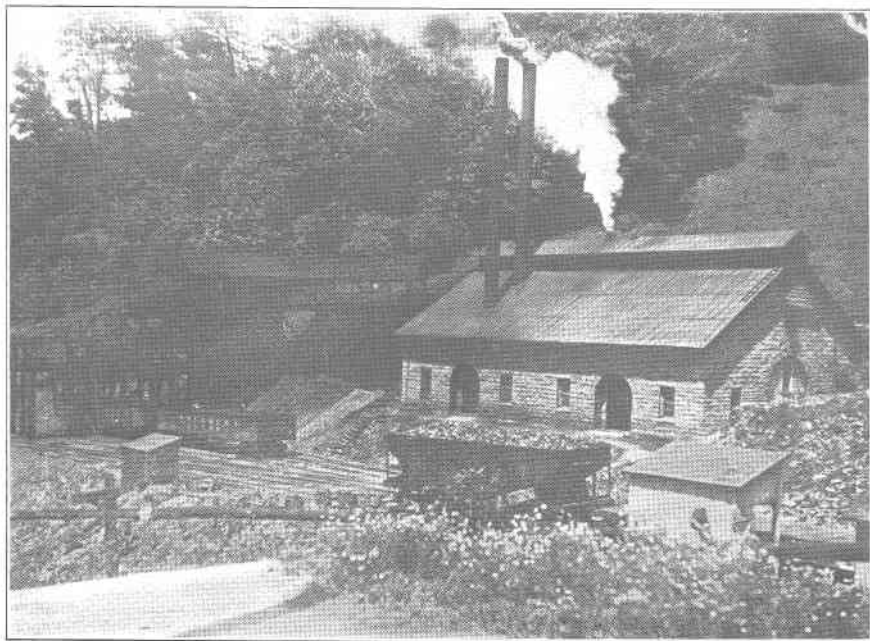
On the west side of Jones Creek (location 141, elevation 1,830 feet), what is probably the Lower St. Charles bed is reported to be four feet thick with six inches of clay about the middle of the bed. On Summers Creek the Lower St. Charles coal bed is 33 inches thick with one inch of sandstone and two inches of "rash" 28 inches above the bottom of the bed (location 142, elevation 1,770 feet). The Upper St. Charles bed near the head of Rocklick Branch was found to be 45 inches thick, the lower eight inches containing "rash" (location 143, elevation 1,780 feet). On Sandlick Branch (location 144, elevation 1,830 feet), the Upper St. Charles



(A) Tipple and power house of Virginia Iron, Coal and Coke Company, near head of Straight Creek, Lee County, Virginia.



(B) Southern Railroad station at Keokee, Lee County, Virginia.



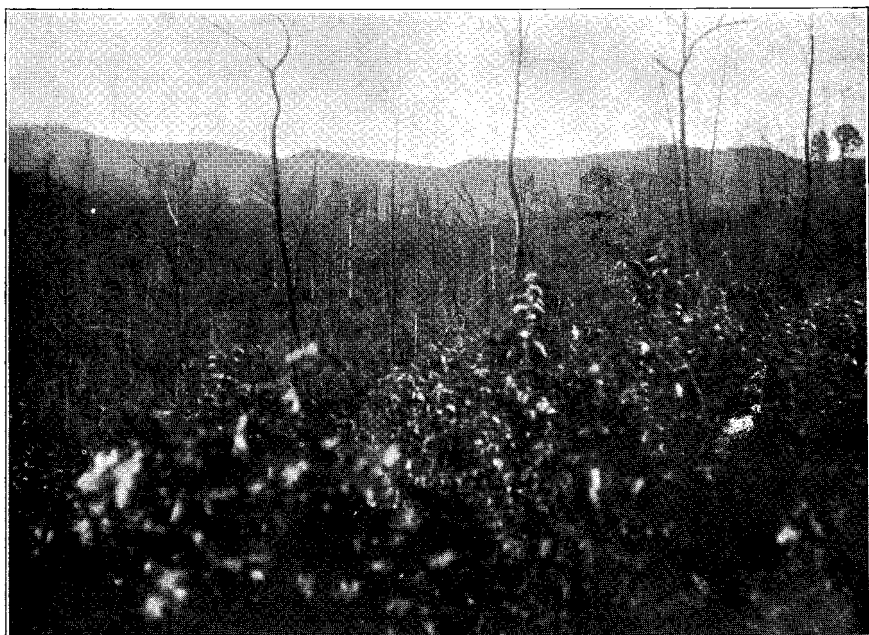
(A) Tipple and power house of Virginia Iron, Coal and Coke Company, near head of Straight Creek, Lee County, Virginia.



(B) Southern Railroad station at Keokee, Lee County, Virginia.

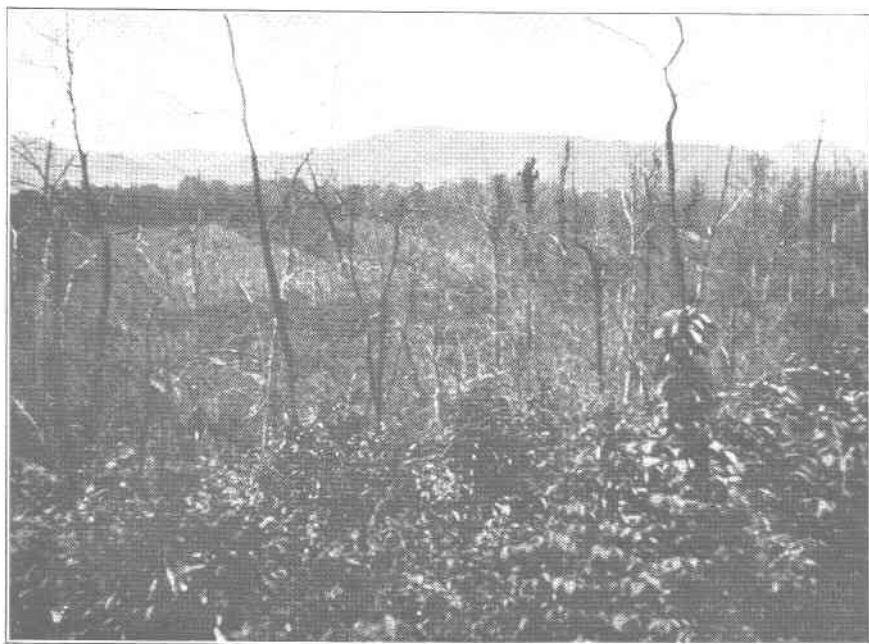


(A)

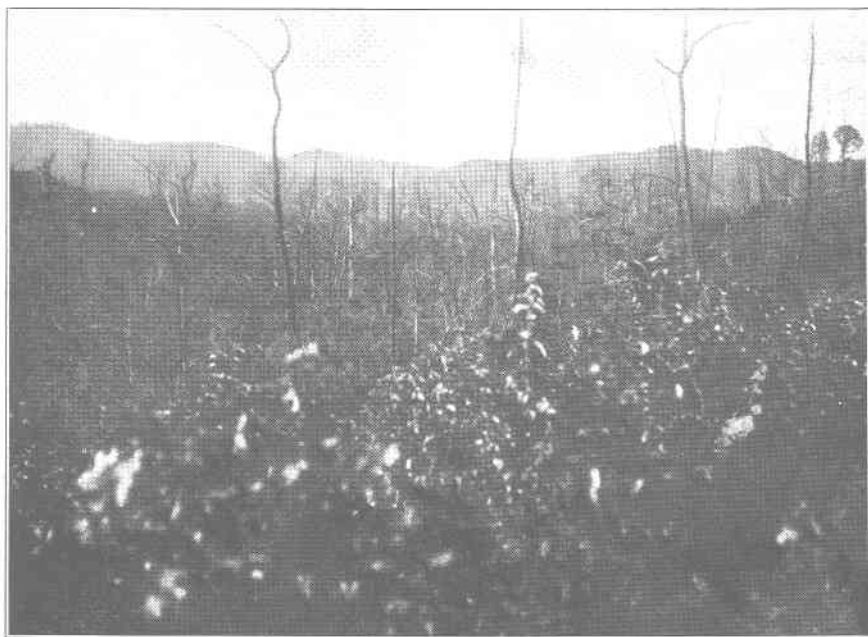


(B)

Burned over forest tracts in Lee County coal field, seeding to undesirable species.



(A)



(B)

Burned over forest tracts in Lee County coal field, seeding to undesirable species.

coal bed is 30 to 35 inches thick; and the Lower St. Charles is 26 to 30 inches thick (location 145, elevation 1,820 feet). Neither bed carries a parting in this locality.

On Bundy Creek a bed lying about 150 feet below the Harlan bed is 33 inches thick with one inch of shale 13 inches below the top and four inches of shale six inches above the bottom of the bed (location 146, elevation 2,000 feet).

Harlan coal bed.—The Harlan is being mined extensively at Keokee where it is known as the Wilson bed. It is the same as the No. 3 bed of The Pocket. It lies from 150 to 250 feet below the Taggart bed and averages 300 feet above the Imboden.

In the eastern part of the North Fork basin it is a thick and valuable bed averaging four to four and one-half feet with a pyritiferous shale parting in the lower half of the bed. In the Jones Creek basin it is so badly split by shale partings as to be essentially worthless. In the basin of Reeds Creek the bed is much more promising from a mining standpoint, having much the same character as at Keokee and farther west in The Pocket.

Analyses of the coal from this bed may be found on pages 139-142 of this report.

The following measurements were made in No. 3 mine at Keokee:

Sections of Harlan coal bed at Keokee.

(Location 147, elevation 2,200 feet)

	Ft.	In.		Ft.	In.
Shale.			Shale.		
"Rash"		1	"Rash" and shaly		
Coal	5		coal	6	
Clay	1	2	Coal	8½	
Coal	1		"Rash"	¼	
			Coal	1	6
Coal	6		"Rash"	¼	
Parting	1	2	Coal	11	
			"Rash"	¼	
			Coal	1	1
			Coal	4	2½
			Partings		¾

One and one-half miles west of Keokee (location 148, elevation 2,150 feet), the Harlan was found to be 50 inches thick with nine inches of clay 16 inches above the bottom. On Cox Creek the bed has recently been opened where the following section was measured:

Section of Harlan coal bed on Cox Creek.

(Location 149, elevation 1,950 feet)

	Ft.	In.
Coal	1	6
"Rash"		1
Coal	1	4
Coal, bone		4
		<hr/>
Coal	3	2
Parting		1

An old opening on Jones Creek near Robbins Chapel afforded the following section:

Section of Harlan coal bed near Robbins Chapel.

(Location 150, elevation 1,860 feet)

	Ft.	In.
Sandstone	5+	
Shale	5	
Coal	1	3
Clay		8
Coal		9
"Rash"		½
Clay	1	4
Coal, fissile		3
Shale		1
"Rash"		1
Clay		1
Coal	1	2
		<hr/>
Coal	3	5
Partings	2	3½

On Reeds and Summers creeks and on Meadow Fork the Harlan coal bed has been prospected at a number of places with sections as follows:

Sections of Harlan coal bed on Reeds and neighboring creeks.

(Location 151, elevation 1,830 feet)

	Ft.	In.
Coal	1	
Shale		2½
Coal	1	6
Coal, bony		10
Coal		9
		<hr/>
Coal	4	1
Parting		2½

(Location 152, elevation 1,780 feet)

	Ft.	In.
Coal		8
Shale		2
Coal	1	2
Coal, bony		6
Coal	1	
		<hr/>
Coal	3	4
Parting		2

(Location 153, elevation 1,850 feet)

	Ft.	In.
Coal		10
Shale		3
Coal	2	9
Coal, bony		9
Coal		7
		<hr/>
Coal	4	11
Parting		3

A prospect on Rocklick Branch in what is probably an upper bench of the bed measured 22 inches thick with three inches of "rash" above the coal (location 154, elevation 1,880 feet). On the west side of Sandlick Branch the Harlan bed yielded the following measurement:

Section of Harlan coal bed on Sandlick Branch.

(Location 155, elevation 1,940 feet)

	Ft.	In.
"Rash"		3
Coal	1	7
Shale, pyritiferous		4
Coal	1	
		<hr/>
Coal	2	7
Parting		4

Coal beds between the Harlan and Taggart coal beds.—A number of thin coal beds occur between the Harlan and Taggart beds, which will now be described. On the east-west county road near Cox Creek (location 156, elevation 1,950 feet), a bed has been prospected that is 27 inches thick with two inches of "rash" 13 inches above the bottom. This bed lies about 35 feet above the Harlan bed.

In the Jones Creek basin a bed has been prospected in a number of places that lies from 20 to 75 feet below the Taggart bed. This bed ranges from 30 to 40 inches in thickness and is probably the same bed that lies within 25 feet of the bottom of the Taggart in the Straight Creek basin. It is the correlative of the Taggart Marker in Wise County. The bed is

thicker in this basin and closely resembles the Taggart so that the two beds may be easily confused. Care has been exercised, however, to properly discriminate the two beds. The following section illustrates the characteristics of this bed:

Section of Taggart Marker coal bed on Jones Creek.

(Location 157, elevation 1,920 feet))

	Ft.	In.
Coal	1	5
"Rash"		1
Coal	1	3
Clay		$\frac{1}{4}$
Coal	2	
<hr/>		
Coal	2	10
Partings		$1\frac{1}{4}$

At location 158 (elevation 1,880 feet), the Taggart Marker measures three feet.

South of the road (location 159, elevation 1,910 feet), the bed measures the same as in location 158, and at location 160 (elevation 1,890 feet), it is 37 inches thick.

On Reeds Creek (location 161, elevation 1,930 feet), the bed is somewhat thicker, measuring $40\frac{1}{2}$ inches with one and one-half inches of shale three inches above the bottom.

Across the creek from the home of Mr. E. L. Bailey, a lower bed has been prospected that measures 18 inches (location 162, elevation 1,875 feet).

On Meadow Fork a thin bed lying 135 feet beneath the Taggart has been opened. A prospect on the northwest road (location 163, elevation 1,840 feet), shows 16 inches of coal with the bottom of the bed concealed. On the road to Big Branch (location 164, elevation 1,830 feet), the bed shows 28 inches of coal free from partings.

Taggart coal bed.—The Taggart coal bed, No. 5 of The Pocket, and the McConnell of the Keokee region, is one of the most valuable coal beds in eastern Lee County and has been extensively mined. It lies from 150 to 250 feet above the Harlan bed, the distance increasing toward the west. Its distance above the Imboden averages 500 to 550 feet, increasing toward the west. In the eastern part of Lee County the Taggart is on an average 1,050 feet above the Gladeville sandstone, but in The Pocket this distance has increased to 1,250 feet.

The Taggart in this drainage basin is uniform in thickness averaging three and one-half to four feet, and is nearly everywhere free from partings. The coal is underlain by hard, smooth shale in most places, and in most places overlain by "rash" which may be one foot or more thick.

Massive sandstone lies just above the coal, and a similar rock occurs within a few feet beneath the bed. These sandstone beds give rise in a number of places to thick ledges and pronounced cliffs.

One of the largest mining operations in Lee County has been located on the Taggart bed at Keokee, from which a large tonnage has been shipped.

Analyses of coal obtained from the Taggart bed in this drainage basin may be found on pages 143-148 of this report.

The character of the bed at Keokee and farther east is illustrated by the following measurements:

Sections of Taggart coal bed in the vicinity of Keokee.

(Location 165, elevation 2,340 feet)

Sandstone.	Ft.	In.
Clay	5	
"Rash"		1½
Coal	11	
Clay, streak		
Coal	5	
Coal, fissile	3	
Coal	3	2
Coal	4	9

(Location 166, elevation 2,330 feet)

Sandstone.	Ft.	In.
Coal	3	2
"Rash"		2
Coal		5
"Rash"		1
Coal		8
Coal	4	3
Partings		3

(Location 167, elevation 2,340 feet)

Sandstone.	Ft.	In.
Shale	2	
"Rash"		1½
Coal	6	
Clay		¼
Coal	6	
Clay		¼
Coal		4½
Clay		¼
Coal	3	10
Coal	5	2½
Partings		¾

(Location 168, elevation 2,360 feet)

	Ft.	In.
Coal	1	6
Clay		3
Coal	1	9½
Coal, fissile		2
Coal	1	7
Coal	5	½
Parting		3

Additional measurements may be found on page 129.

West of Keokee one and one-fourth miles the bed is split by a thick parting as shown in the following measurement:

Section of Taggart coal bed one and one-fourth miles west of Keokee.

(Location 169, elevation 2,300 feet)

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

On Bundy Creek (location 170, elevation 2,120 feet), the Taggart is somewhat thinner, the bed being 37 inches thick with two inches of "rash" 14 inches above the bottom. Near Holmes School (location 171, elevation 2,160 feet), an old prospect partly full of water shows 16 inches of clear coal above the level of the water with two feet of shale overlain by sandstone above the coal. Near Robbins Chapel in a recent prospect (location 172, elevation 2,160 feet), the bed is 45 inches thick, with another bed 20 feet below (Taggart Marker) 30 inches thick. Near the head of

NORTH FORK OF POWELL RIVER DRAINAGE BASIN

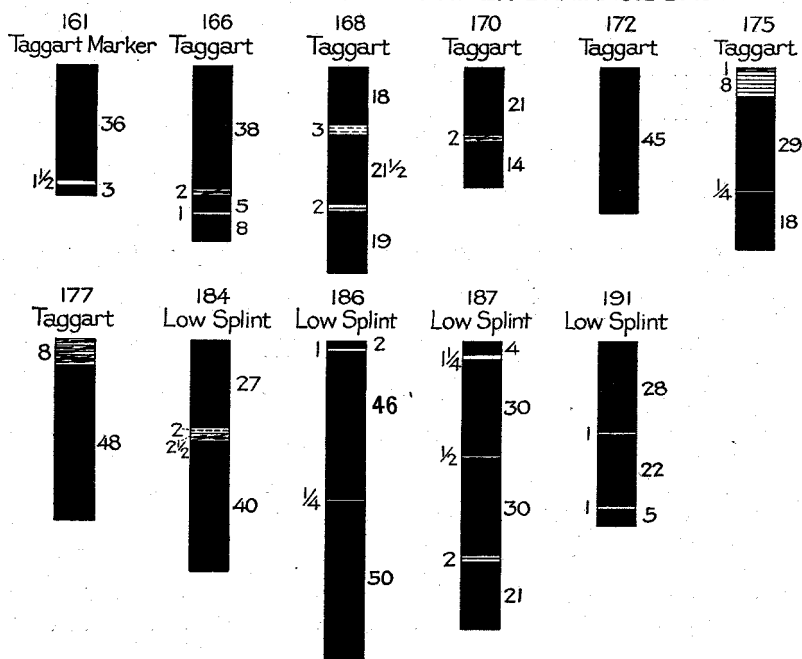


Fig. 11.—Sections of coal beds in the North Fork of Powell River drainage basin.

one of the left branches of Cox Creek the Taggart is 38 inches thick with two inches of shale 18 inches above the bottom (location 173, elevation 2,030 feet). One-half mile west of the Kentucky road (location 174, elevation 1,960 feet), the coal is 37 inches thick with one inch of shale in the middle of the bed. On the left fork of Jones Creek the following measurement was obtained:

Section of Taggart coal bed on the Left Fork of Jones Creek.

	(Location 175, elevation 1,960 feet)	Ft.	In.
"Rash"		1
Shale		8
Coal	2	5
"Rash"		$\frac{1}{4}$
Coal	1	6
<hr/>			
Coal	3	11
Parting		$\frac{1}{4}$

On Reeds Creek (location 176, elevation 1,890 feet), the bed measures three feet in thickness without parting. About one mile southwest of location 176 the Taggart is 48 inches thick with eight inches of shaly coal and "rash" overlying the bed (location 177, elevation 1,960 feet). A short distance southwest on Summers Creek (location 178, elevation 1,960 feet), the bed is reported to be 36 inches thick.

Coal beds above the Taggart coal bed.—In the basin drained by Reeds and Jones creeks several coal beds lying above the Taggart bed have been prospected. One lies from 50 to 100 feet above the Taggart, the second 130 feet above.

West of the Kentucky road three-fourths mile (location 179, elevation 2,000 feet), the lower bed is reported to be 60 inches thick.

On the Left Fork of Jones Creek (location 180, elevation 2,000 feet), the bed is reported to be 11 feet thick with several thick partings. One-half mile farther west the following measurement was obtained:

Coal bed above Taggart bed on Left Fork of Jones Creek.

	(Location 181, elevation 1,990 feet)	Ft.	In.
Sandstone.		
Shale		5
Coal		6
Shale		2
Coal		8
Shale	1	8
Coal		8
"Rash"	1	4
Shale and "rash"	1	
Coal	4	
<hr/>			
Coal	5	10
Partings	4	2

The same bed has been prospected one-half mile farther southwest (location 182, elevation 1,990 feet).

A short distance above location 179 a coal bed has been prospected that measures 36 inches with three feet of shale over the coal succeeded above by a sandstone (location 183, elevation 2,030 feet).

Low Splint coal bed.—The Low Splint coal bed has been mined at Keokee, and at present the large operations at the head of Straight Creek are being extended eastward into the North Fork drainage basin. The bed is generally thick ranging from three and three-fourths to eight and one-half feet, but everywhere carries one or more partings. It lies 200 to 400 feet above the Taggart from which it is separated by sandstone in the lower part of the interval and shale above. It is separated from the Phillips which lies 250 to 350 feet above in this drainage basin by shale and thin beds of sandstone.

The following measurements illustrate its character in the vicinity of Keokee:

Sections of Low Splint coal bed near Keokee.

(Location 184, elevation 2,580 feet)

	Ft.	In.
Shale	5+	
Coal	2	3
Clay		2
"Rash"		2½
Coal	3	4
<hr/>		
Coal	5	7
Parting		4½

(Location 185, elevation 2,600 feet)

	Ft.	In.
Sandstone	5+	
Shale	2	
Coal		2
Shale, pyritiferous		2
Coal	1	5
Shale, black		2½
Coal	1	9
<hr/>		
Coal	3	4
Partings		4½

Near the head of Little Bundy Creek the bed is very thick, as illustrated by the following measurement:

Section of Low Splint coal bed near head of Little Bundy Creek.

(Location 186, elevation 2,450 feet)

	Ft.	In.
Coal		2
Shale		1
Coal	3	10
Shale		$\frac{1}{4}$
Coal	4	2
<hr/>		
Coal	8	2
Parting		$1\frac{1}{4}$

At the head of Cox Creek the following section was reported:

Section of Low Splint coal bed at the head of Cox Creek.

(Location 187, elevation 2,450 feet)

	Ft.	In.
Coal		4
Shale		$1\frac{1}{4}$
Coal	2	8
"Rash"		$\frac{1}{2}$
Coal	2	8
Shale		2
Coal	1	9
<hr/>		
Coal	7	5
Partings		$3\frac{3}{4}$

The Low Splint has been prospected near the top of Little Black Mountain where the road crosses from Jones Creek into Kentucky:

Section of Low Splint coal bed at the head of Jones Creek.

(Location 188, elevation 2,390 feet)

	Ft.	In.
Shale		
"Rash"		3
Coal	2	6
Shale		1
Coal	1	2
Coal, bony		4
Coal		10
<hr/>		
-Coal	4	10
Parting		1

The following measurements were made at the head of Reeds Creek:

Sections of Low Splint coal bed at the head of Reeds Creek.

(Location 189, elevation 2,220 feet)

	Ft.	In.
Coal	1	4
Shale		1
Coal		11
Shale		1
Coal	2	2
Shale		1
Coal		2
<hr/>		
Coal	4	7
Partings		3

(Location 190, elevation 2,180 feet)

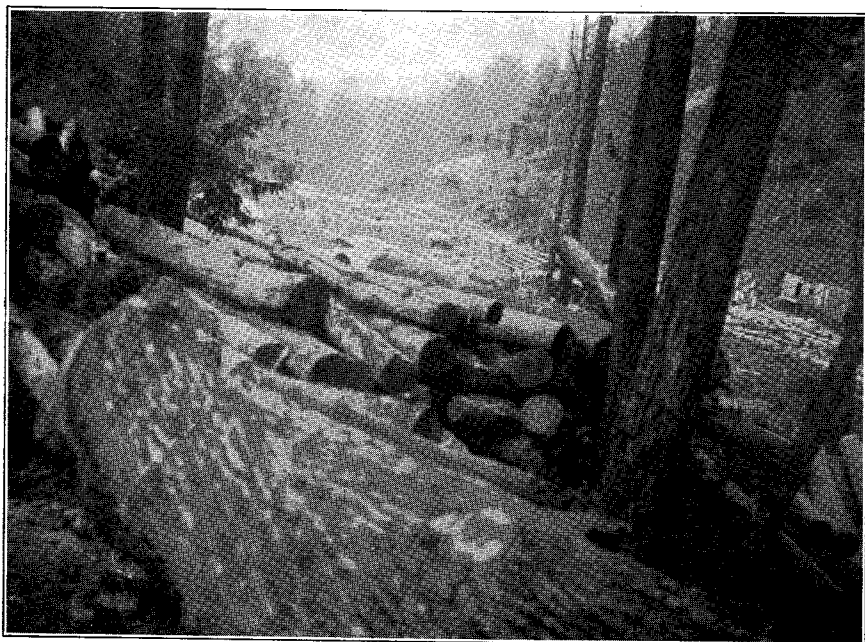
	Ft.	In.
Coal	1	1
Shale		2
Coal	1	2
"Rash"		1
Shale		2
Coal	2	2
<hr/>		
Coal	4	5
Partings		5

(Location 191, elevation 2,200 feet)

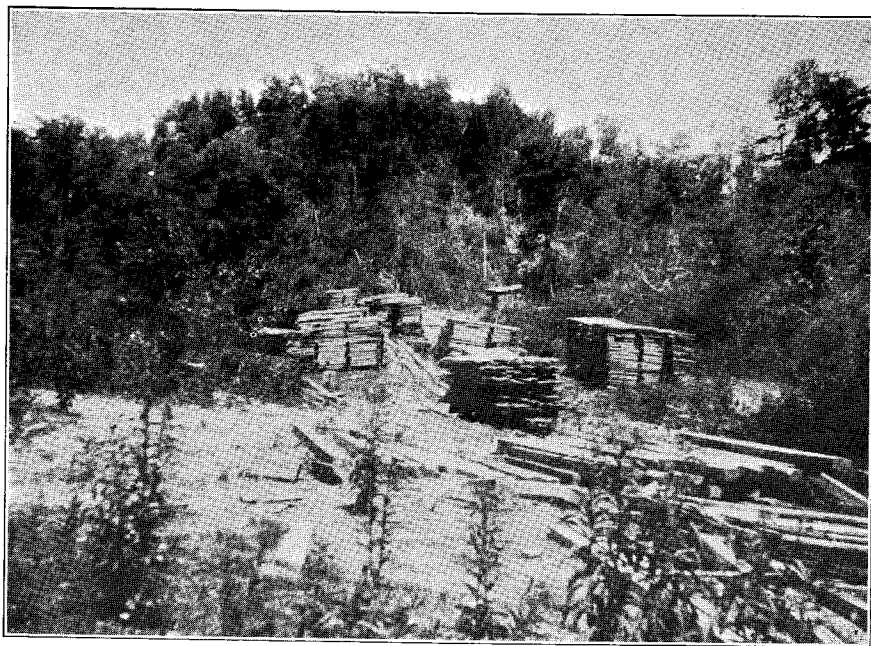
	Ft.	In.
Coal	2	4
Shale		1
Coal	1	10
Clay		1
Coal		5
<hr/>		
Coal	4	7
Partings		2

Higher coal beds.—A number of coal beds occur above the Low Splint, four of which—the Phillips, Pardee, Morris, and High Splint—are well known and widely distributed beds in southwest Virginia and the adjacent part of Kentucky. Little is known regarding them in the North Fork drainage basin for they have not been prospected. The Phillips bed lies about 275 feet above the Low Splint and underlies a considerable area north of Keokee. Between Keokee and Jones Creek its distribution is very small as it underlies only the highest summits of Little Black Mountain.

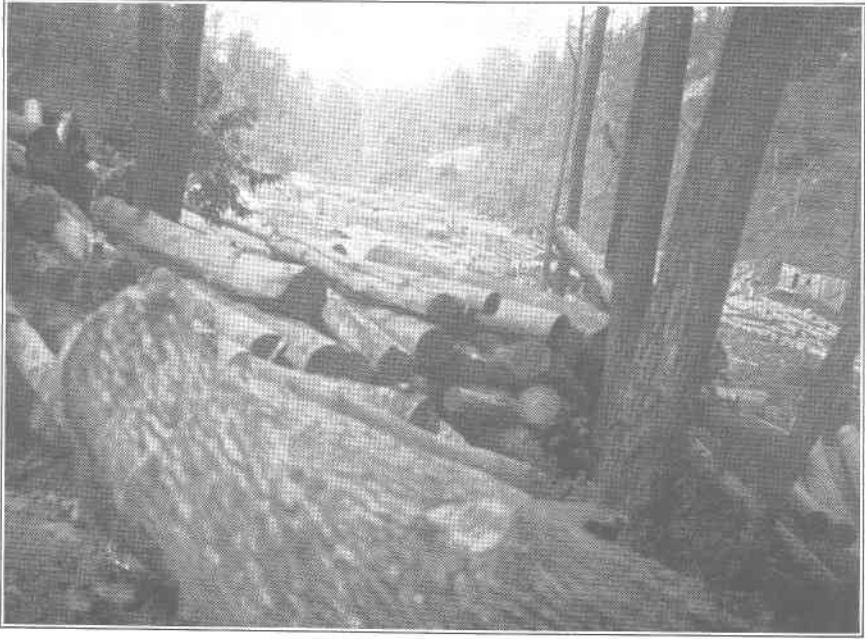
The Pardee bed averages about 400 feet above the Phillips bed. It is close to the top of the mountain north of Keokee, but westward it has been removed by erosion to the vicinity of Reeds Creek where the bed appears again with the increasing altitude of Little Black Mountain.



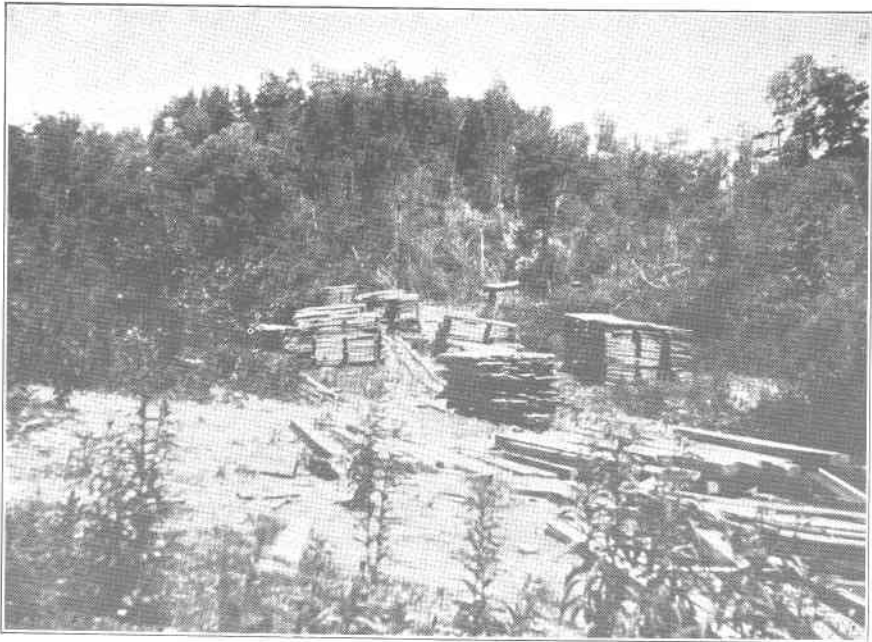
(A) Lumber camp near top of Stone Mountain north of Olinger, Lee County, Virginia.



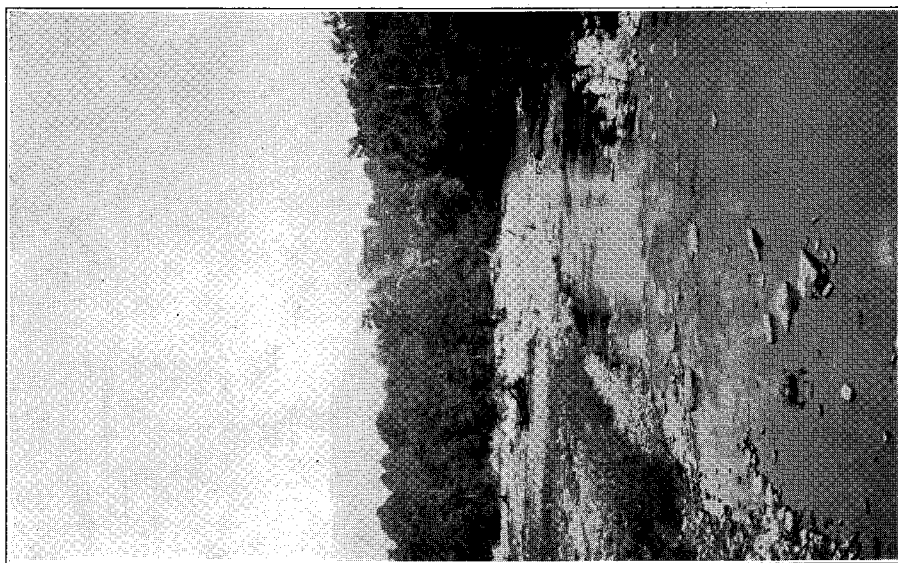
(B) Lumber camp two miles west of Keokee, Lee County, Virginia



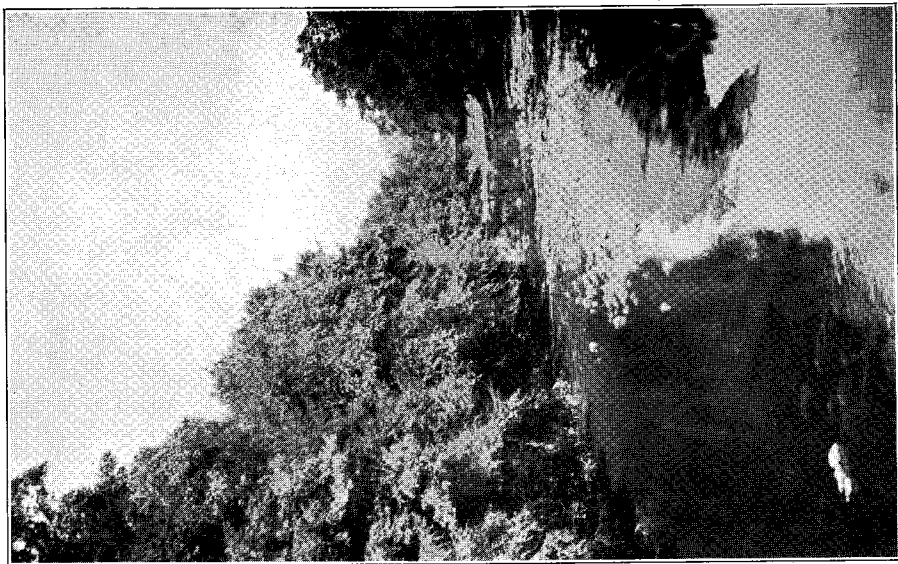
(A) Lumber camp near top of Stone Mountain north of Olinger, Lee County, Virginia.



(B) Lumber camp two miles west of Keokee, Lee County, Virginia



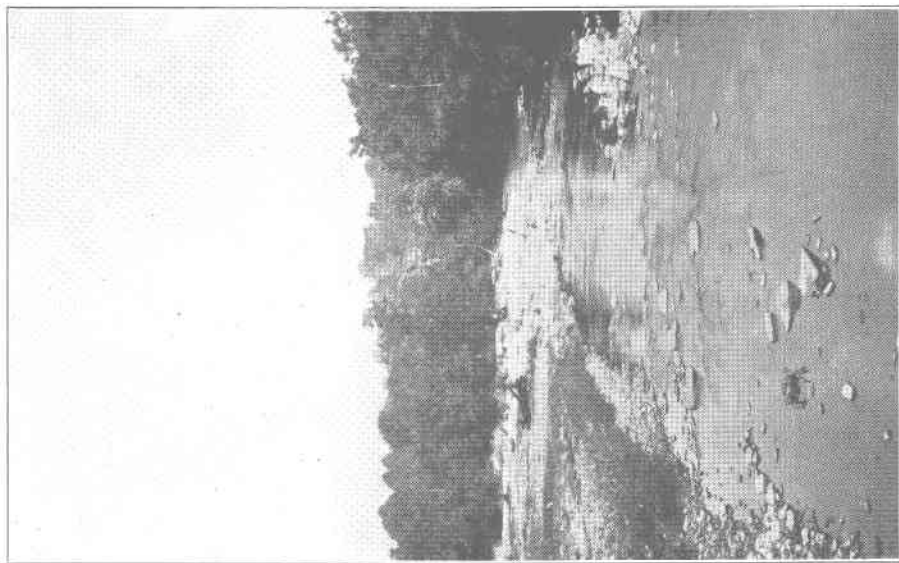
(A)



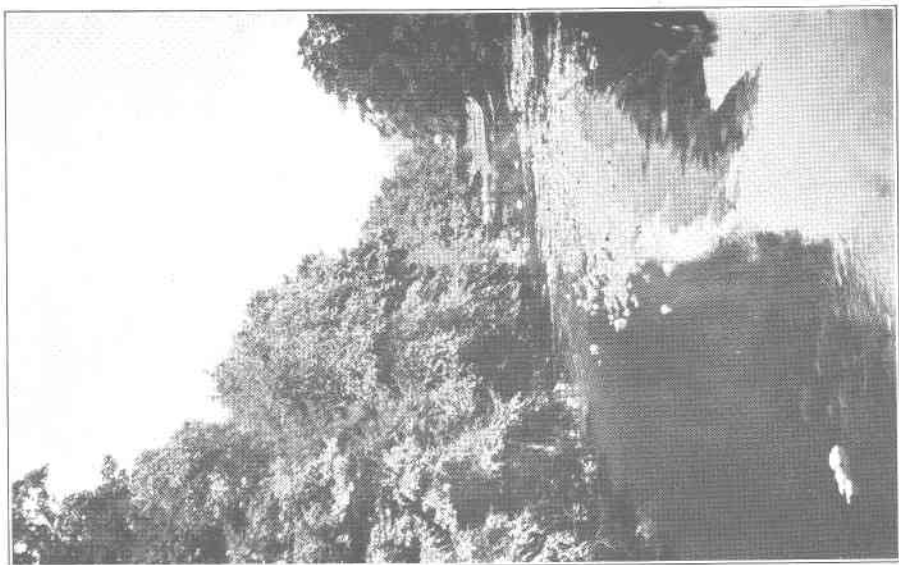
(B)

Views of Powell River near the Wise-Lee county line.

(Photos by J. B. Eby.)



(A)



(B)

Views of Powell River near the Wise-Lee county line.

(Photos by J. B. Eby.)

The Morris and High Splint beds are present only in the highest knobs of Little Black Mountain in this drainage basin, beneath Potato Hill and on the divide between Straight Creek and Reeds Creek. The Morris bed lies about 75 feet beneath the Harlan sandstone and 350 to 500 feet above the Pardee bed. The High Splint lies within a few feet of the base of the Harlan sandstone.

In view of the fact that these higher beds are of workable thickness in the Straight Creek basin, in Wise County to the east, and throughout a large area in eastern Kentucky adjacent to Lee County, it is reasonable to assume that they are of workable thickness also in the North Fork drainage basin.

Powell River Basin.

Powell River drains a large area in Lee County south of Stone Mountain. All of the rocks of this area are older than Carboniferous, and hence not coal-bearing, except those making up the southern flank of Stone Mountain. The lowest rocks of Carboniferous age on this flank of Stone Mountain belong to the Price and Maccrady formation. These are succeeded above by the Newman limestone. These formations contain no coal. The Pennington formation lies above the Newman limestone. This formation carries a number of thin coal beds and, at its top just beneath the Lee sandstone, one thick coal bed which is very persistent, extending from western Russell County through Wise and Lee counties to the Tennessee line and possibly beyond. This coal bed has been mined at Burtons Ford near St. Paul in Russell County, and has been prospected at many places in Wise and Lee counties. In Lee County it is a variable coal bed ranging from three feet up to six and one-half feet in thickness, and dipping at a very high angle.

On the road from Olinger to Olinger Gap (location 192, elevation 2,500 feet), the bed has been prospected but the old drift has fallen in. It is reported to be over three feet thick and free from partings. On the trail across Stone Mountain from Dryden the coal makes a conspicuous bloom just below the mountain crest, and also on the trail across from Purcell the bloom is again prominent and in a similar position.

This bed has been opened on the L. P. Napier farm one and one-half miles southwest of the Pennington - St. Charles road. About one mile farther southwest the coal has been mined to some extent. The following measurement was made in this mine:

Section of coal bed at top of Pennington formation two and one-half miles southwest of Pennington-St. Charles road.

(Location 193, elevation 2,350 feet)		
	Ft.	In.
Shale.		
Coal	1	1
"Rash"		7
Shale		5
Coal	2	6
Shale		3
Sandstone.		
<hr/>		
Coal	3	7
Parting	1	

At this locality the coal is about 200 feet below the top of Stone Mountain. Massive conglomerate is found 18 feet below the bed, and the basal conglomerate member of the Lee formation is 50 feet above the coal. The dip of the coal bed is 78° N. 30 W. The coal is reported to burn well making a hot fire, but the yield in ash is high. The coal is also high in sulphur. In being tilted to its present position the coal of the bed has been somewhat deformed so that it is twisted, broken and curled to a considerable extent.

This bed has also been mined near Ewing where the coal is six and one-third feet thick with no parting. It is about 100 feet below the crest of the mountain. The dip is 23 degrees, N. 25 W. The coal is reported to be of good quality, hard and somewhat splinty.

The Lee formation lies above the Pennington formation and forms the crest and nearly all of the northwest flank of Stone Mountain. It contains no coal of commercial importance on the southeast side of the mountain.

AMOUNT OF ULTIMATELY AVAILABLE COAL.

In the following table estimates are given of the amount of coal in each of the principal beds in Lee County before active mining operations began. In preparing this table consideration has been taken of the fact that actual mining operations in Europe have shown that coal of lower grade than that in Lee County 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 Lee 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 one foot thick. Although carefully prepared, these estimates are necessarily only approximations. The estimates for the lower beds in the northern part of the field are most liable to error, as little data concerning them are available. The calculated totals, though large, are thought to be conservative.

If it be assumed that 70 per cent of the coal may ultimately be recovered, taking all beds, there would be left a possible production of 1,365,000,000 tons. The production for 1923 was 1,024,668 tons. At that rate the coal in Lee County should last 1,300 years. However an estimate of the life of a coal field is merely a guess, for the many factors influencing the rate of production of coal for the field, such as labor and transportation conditions, demand for coal, competition, etc., are difficult of evaluation in making such an estimate. The thicker beds will be mined out first which will be followed by a decrease in output with the mining of the thinner and more inaccessible beds.

Again taking 1,365,000,000 tons as the grand total, representing possible production in Lee County, this amount would be sufficient to last the United States, at the present rate of consumption, two and one-half years. It must be remembered, however, that much of this coal is in beds that are too thin or too far beneath the surface to be profitably mined and sold in competition with coal from more cheaply mined beds now being exploited in the Appalachian coal field. Beds that cannot be used today, however, are certain to be of value in the future.

Estimated amount of ultimately available coal in Lee County coal field.

<i>Coals.</i>	<i>Acres.</i>	<i>Short Tons.</i>
Wise formation:		
High Splint	202	1,636,200
Morris	285	2,052,000
Pardee	1,655	22,342,500
Coal beds between Phillips and Pardee .....	.....	14,220,000
Phillips	3,460	28,026,000
Low Splint	5,871	47,555,100
Taggart	13,000	81,900,000
Taggart Marker	11,000	39,600,000
Coal beds between Harlan and Taggart Marker .....	.....	23,092,500
Harlan	21,766	137,125,800
Coal Beds between Kelly and Harlan .....	.....	130,005,000
Kelly	1,600	11,520,000
Imboden	32,845	192,143,250
Coal beds above Clintwood .....	.....	9,180,000
Clintwood	35,373	254,685,600
Coal beds between Dorchester and Clintwood...	.....	56,070,000
Dorchester	37,503	168,763,500
Norton formation:		
All beds .....	.....	421,632,000
Lee formation:		
All beds .....	.....	311,040,000
Total .....	.....	1,952,589,450

CHARACTERISTICS AND QUALITY OF THE COAL.

ANALYSES.

The quality of the coal in any field is most clearly shown by analyses. In order that these analyses may be of value for purposes of comparison with those of coal in competing fields it is essential that they be made according to standard methods from samples carefully collected at fresh exposures. In the following tables and discussion, therefore, only analyses made by the United States Geological Survey and the United States Bureau of Mines are considered. The tables include not only analyses of samples from Lee County, but also analyses of samples collected from the same beds in adjoining parts of Wise County, Virginia, and Harlan County, Kentucky.

In taking a sample of coal for analysis every effort was made to procure fresh, unweathered coal that would represent as nearly as possible the product of the mine. The bed was faced up and carefully cleaned for a distance of three feet or more on each side of the point selected for sampling, special care being taken to remove all loose fragments of "slate" from the roof and deposited powder smoke from the coal. A uniform cut, of sufficient size to yield about six pounds of coal for each foot of thickness of the bed, was then made from roof to floor. All partings or binders more than three-eighths of an inch thick and all concretions or "sulphur-balls" having a maximum diameter greater than two 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 four pounds remained. The product was placed in a galvanized-iron can, sealed in the mine with adhesive tape, and mailed as soon as possible to the laboratory.

As soon as received at the laboratory the coal was taken from the can, weighed, and allowed to dry at a temperature slightly above normal until its weight became practically constant. It was then reweighed, the difference in weight being the air-drying loss. Because the coal is more stable and more easily handled in the air-dried form, it was analyzed in this condition and the results given under form B (see following tables). Forms A, C, and D were calculated from form B. Form A represents the coal as it is collected. Form C represents the theoretical condition of the coal if all

the moisture were removed, and form D if both moisture and ash were removed. Forms B, C, and D are for special purposes and should not be used in ordinary work.

Description of Samples.

75905.—Sample of Stone Creek coal bed obtained in the mine of the Stone Creek Coal Company, on Stone Creek, location 6 on map, three miles southwest of Maness, Lee County, Virginia, September 4, 1920. Sample was collected in the main entry 150 feet north-northwest of the drift mouth.

Section of Stone Creek coal bed at point sampled in Stone Creek mine.

		75905	
		Ft.	In.
"Draw slate"		0	2½
Coal		1	10½
"Rash"		0	¾
Coal		0	5
Included in sample		2	3¾
Excluded from sample		0	2½

75907.—Sample of Clintwood (North Fork) coal bed collected in No. 1 mine of the Virginia Blue Gem Coal Company, on the Southern railroad three miles east of Maness, Lee County, Virginia, location 108 on map, August 30, 1920. The sample was cut in room 1, off first right entry, off main entry, 400 feet northeast of drift mouth.

Section of Clintwood (North Fork) coal bed at point sampled in Virginia Blue Gem mine.

		75907	
		Ft.	In.
Coal		3	0
Shale		0	4
Coal		3	6
Included in sample		6	6
Excluded from sample		0	4

34978.—Sample of Imboden coal bed collected in No. 1 mine, location 25 on map, of the Penn-Lee Coal Corporation at Maness, Lee County, Virginia, July 22, 1920. The sample was obtained in the third left entry, off main entry; about 150 feet from room 3, and 1,000 feet northeast of drift mouth.

* Not included in sample.

Section of Imboden coal bed at point sampled in Penn-Lee No. 1 mine.

		34978	
		Ft.	In.
Coal	.....	2	3
Coal, bony	.....	0	1
Coal	.....	0	9
Coal, bony	.....	0	1
Coal	.....	0	4
Included in sample	.....	3	6
Excluded from sample	.....	0	0

34979.—Sample of Imboden coal bed collected in No. 4 mine, location 128 on map, of the Penn-Lee Coal Corporation near Maness, Lee County, Virginia, July 22, 1920. The sample was cut in the main entry, 200 feet east-northeast of the drift mouth.

Section of Imboden coal bed at point sampled in Penn-Lee No. 4 mine.

		34979	
		Ft.	In.
Coal	.....	1	1
Coal, bony	.....	0	1
Coal	.....	1	2
Coal, bony	.....	0	1
Coal	.....	1	0
Included in sample	.....	3	5
Excluded from sample	.....	0	0

75972, 75973, 75974, and 75975.—Samples of Imboden coal bed collected in mine No. 2 (Hale) of the Stonega Coke and Coal Company, at Imboden, Wise County, Virginia, September 16, 1920. Sample 75972 was obtained in a recently cut manhole on the left wall of the main line, midway between left entries 7 and 8, 2,000 feet from the drift mouth; sample 75973, about 3,500 feet northwest of the drift mouth at the face of left entry 8, off main entry; and sample 75974 from pillar between rooms 18 and 19, off 6 right entry, off main entry. Sample 75975 was a composite made by mixing samples 75972, 75973, and 75974.

Sections of Imboden coal bed at points sampled in Imboden No. 2 mine.

	75972		75973		75974	
	Ft.	In.	Ft.	In.	Ft.	In.
Coal	2	10	1	11	2	11
Clay and "rash"	*0	3	..	..	*0	4
Coal and clay streaks	..	..	*0	6	..	..
Coal	2	2	3	3	2	2
Included in sample	5	0	5	2	5	1
Excluded from sample	0	3	0	6	0	4

* Not included in sample.

75747, 75748, and 75749.—Samples of Kelly coal bed collected from small local drift mines, location 129 on map, of the Mohawk Coal Company, one mile southeast of Keokee, Lee County, Virginia, August 18, 1920. Sample 75747 was cut in room 1, off straight main entry, 3,500 feet east-northeast of the drift mouth of mine No. 2; sample 75748, 1,200 feet north-east of drift mouth of mine No. 1 at the face of the main dip entry. Sample 75749 was a composite made by mixing samples 75747 and 75748.

Sections of Kelly coal bed at points sampled in mines of the Mohawk Coal Company.

	75747		75748	
	Ft.	In.	Ft.	In.
"Rash"	*0	1	..	..
Coal	1	8	0	2
Shale	*0	2	*0	1
Coal	1	2	1	6
Shale, pyritiferous	*0	4	*0	1
Coal	1	0	1	2
Shale .....	..	..	*0	4½
Coal .....	..	..	0	8
Included in sample	3	10	3	6
Excluded from sample	0	7	0	6½

75909.—Sample of Lower St. Charles coal bed collected in a small drift mine on Big Branch, Lee County, Virginia, location 29 on map, one-half mile east of Straight Creek, August 30, 1920. Sample was obtained from rib of main entry where the first left entry was turned off, 150 feet north-west of drift mouth and 100 feet from outcrop. Sample represents two feet seven inches of coal, the entire thickness of the bed.

75908.—Sample of Upper St. Charles coal bed obtained in No. 1 mine of the Freeheart Coal Company, one-half mile east of Straight Creek on Big Branch, Lee County, Virginia, location 34 on map, August 30, 1920. Sample was collected in room 1, off main entry, 60 feet west of drift mouth.

Section of Upper St. Charles coal bed at point sampled in mine on Big Branch of Straight Creek.

	75908	
	Ft.	In.
Clay	*0	½
Coal	0	4
Shale, pyritiferous	*0	½
Coal	0	2½
Shale, pyritiferous	*0	½
Coal	1	6
Coal, fissile	0	9
Coal	0	4
Included in sample	3	1½
Excluded from sample	0	1½

* Not included in sample.

75906.—Sample of Upper St. Charles coal collected in the mine of the St. Charles Coal Company at St. Charles, Lee County, Virginia, location 36 on map, August 30, 1920. Sample was cut at the face of the main entry, 350 feet southeast of drift mouth.

Section of Upper St. Charles coal bed at point sampled in St. Charles mine.

		75906	
		Ft.	In.
"Draw slate" .....	.....	*0	3
Coal .....	.....	1	2
Coal, shaly .....	.....	1	2
Included in sample .....	.....	2	4
Excluded from sample .....	.....	0	3

75787.—Sample of Harlan coal bed collected in the mine of the Emerald Coal Company near Puckett Creek, one and one-half miles northwest of Maness, Lee County, Virginia, location 47 on map, August 24, 1920. The sample was cut in main entry No. 1, 500 feet south-southeast of the drift mouth.

Section of Harlan coal bed at point sampled in Emerald Coal Company's mine.

		75787	
		Ft.	In.
Coal .....	.....	0	2
Shale, pyritiferous .....	.....	*0	½
Coal .....	.....	*0	½
Shale, pyritiferous .....	.....	*0	½
Coal .....	.....	1	4
Coal, bony .....	.....	0	10
Shale, pyritiferous .....	.....	*0	2½
Coal .....	.....	1	0
"Rash" .....	.....	*0	1½
Coal .....	.....	0	3
Included in sample .....	.....	3	7
Excluded from sample .....	.....	0	5½

75788.—Sample of Harlan coal bed collected in the mine of the Puckett Creek Coal Company on Puckett Creek, location 46 on map, one and one-fourth miles northwest of Maness, Lee County, Virginia, August 24, 1920. The sample was cut at the face of the main entry 400 feet southwest of drift mouth.

* Not included in sample.

Section of Harlan coal bed at point sampled in Puckett Creek mine.

	75788	
	Ft.	In.
Coal	0	2
"Rash"	0	$\frac{1}{8}$
Coal	0	4
Shale, pyritiferous	*0	1
Coal	0	$1\frac{1}{2}$
Shale, pyritiferous	0	$\frac{1}{4}$
Coal	1	4
"Rash"	0	$\frac{1}{8}$
Coal	0	$7\frac{1}{2}$
Shale, pyritiferous	*0	4
Coal	1	6
Coal	*0	3
Included in sample	4	$1\frac{1}{2}$
Excluded from sample	0	8

34981.—Sample of Harlan coal bed collected in the mine of the Black Diamond Coal Company at St. Charles, Lee County, Virginia, location 41 on map, July 23, 1920. Sample was obtained at the face of the second right entry, off the main entry, 600 feet northeast of the drift mouth.

Section of Harlan coal bed at point sampled in Black Diamond Coal Company's mine.

	34981	
	Ft.	In.
Coal	0	$7\frac{1}{2}$
Shale	*0	$\frac{1}{2}$
Coal	0	$3\frac{1}{4}$
Shale	*0	$\frac{1}{4}$
Coal	0	6
Coal, bony	0	10
Coal	0	7
Shale (floor of mine)	*0	2
Coal	*0	8
Included in sample	2	$9\frac{3}{4}$
Excluded from sample		$10\frac{3}{4}$

75675, 75676, and 75677.—Samples of Harlan coal bed collected in mine No. 3 of the Stonega Coke & Coal Company, at Keokee, Lee County, Virginia, location 147 on map, August 17, 1920. Sample 75675 was cut in room 5, off third left entry, off No. 2 main entry, 500 feet northwest of drift mouth; and sample 75676 was cut at face of east main air course, 3,200 feet northwest of drift mouth. Sample 75677 was a composite made by mixing samples 75675 and 75676.

* Not included in sample.

Sections of Harlan coal bed at points sampled in Stonega Coke and Coal Company's No. 3 mine.

	75675		75676	
	Ft.	In.	Ft.	In.
"Rash"	*0	1	..	..
Coal	0	4	0	6
"Rash"	*0	6½	*0	3
Coal	1	4	2	9
"Rash"	*0	½	*0	½
Coal	1	9	0	4
Shale .....	..	..	*0	2
Clay	*0	¼	..	..
Coal	0	1½	*0	1
Shale, pyritiferous	*0	10	*2	2
Coal	1	0	0	3
"Rash" .....	..	..	*0	2
Coal .....	..	..	0	10
Included in sample	4	6½	4	8
Excluded from sample	1	6¼	2	10½

2246.—Sample of Harlan coal bed collected in Morris prospect, near Crab Orchard, Lee County, Virginia, September 30, 1905. The sample was cut from the left rib of the entry, 29 feet 3 inches from the outcrop. The coal had been exposed for some time, the sample being taken to note the effect of weathering on the coal.

Section of Harlan coal bed at point sampled in Morris prospect.

	2246	
	Ft.	In.
Coal	*0	¾
Coal	1	5
"Mother coal"	0	¼
Coal	1	3
Shale, carbonaceous	0	½
Coal	3	0
Shale	*0	½
Coal	*0	1¼
Clay	*1	½
Coal	0	7
"Mother coal"	0	½
Coal	0	9
Included in sample	7	1¼
Excluded from sample	1	3

2268, 2269, and 2420.—Samples of Harlan coal bed collected in Morris prospect, near Crab Orchard, Lee County, Virginia, October 5, 1905. Sample 2268 was cut from the face 16 feet in from the outcrop and sample

* Not included in sample.

2269 was cut 21 feet in from the outcrop. It should be noted that these samples represent weathered coal from near the outcrop. Sample 2420 was taken from run-of-mine coal.

Sections of Harlan coal bed in Morris prospect near Crab Orchard.

	2268		2269	
	Ft.	In.	Ft.	In.
Coal	*0	11	0	11
"Mother coal"	*0	½	0	½
Coal	*0	8	0	8
"Mother coal"	*0	¼	0	¼
Coal	*3	2	3	2
Clay	*1	0	*1	0
Coal	0	6	*0	6
Shale	0 [†]	¼	*0	¼
Coal	0	11	*0	11
Included in sample	1	5¼	4	9¾
Excluded from sample	5	9¾	2	5¼

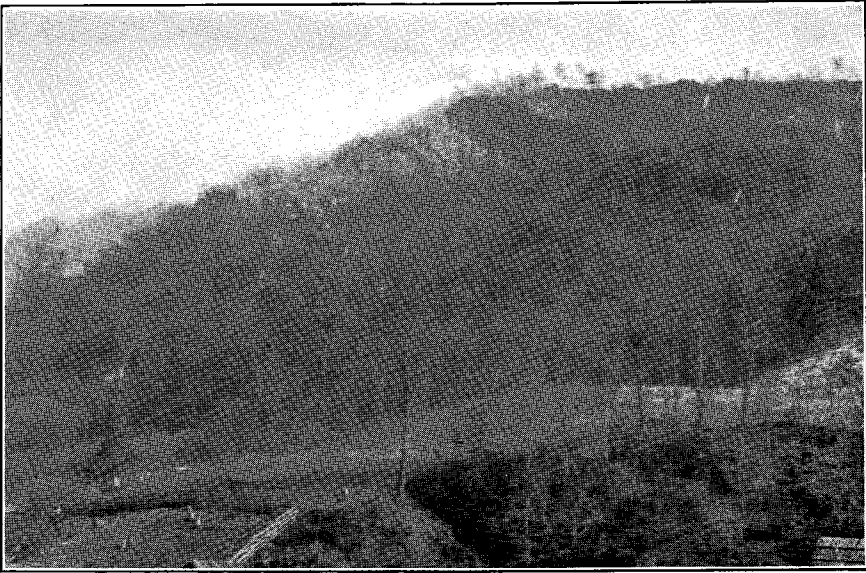
24728, 24729, 24730, 24731, and 24732.—Samples of Harlan coal bed collected from the Clover Fork mine, a drift mine two miles east of Harlan, Harlan County, Kentucky, March 18, 1916. Sample 24728 was cut from 25 pillar, 7 left entry; sample 24729, from face of 7 left air course; sample 24730, from face of 9 left entry; sample 24731, from face of 7 right entry. Sample 24732 was a composite made by mixing samples 24728, 24729, 24730, and 24731.

Sections of Harlan coal bed at points sampled in Clover Fork mine.

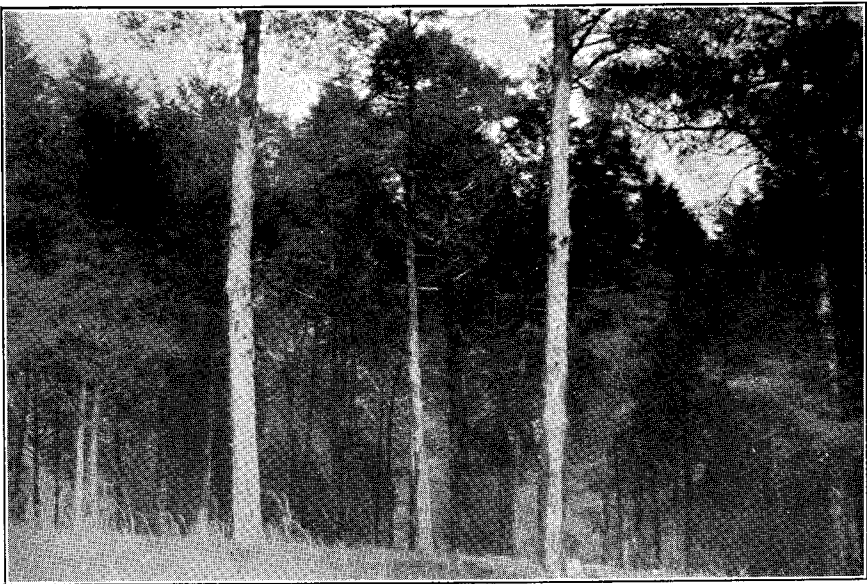
	24728		24729		24730		24731	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Coal	0	4½	0	5½	0	5	0	4
Coal, splint	0	2	0	2	0	1½	0	1¼
Coal	3	1½	3	4½	3	3½	3	2
Included in sample	3	8	4	0	3	10	3	7¼
Excluded from sample ...	0	0	0	0	0	0	0	0

24713, 24714, 24715, 24716, and 24717.—Samples of Harlan coal bed collected from Coxton mine, at Coxton, four miles east of Harlan, Harlan County, Kentucky, March 23, 1916. Sample 24713 was taken from face of room 22 off 1 right entry; sample 24714, from face of room 17 off 4 right entry; sample 24715, from face of 5 left entry; and sample 24716, from face of room 2, off 3 left entry. Sample 24717 was a composite made by mixing samples 24713, 24714, 24715, and 24716.

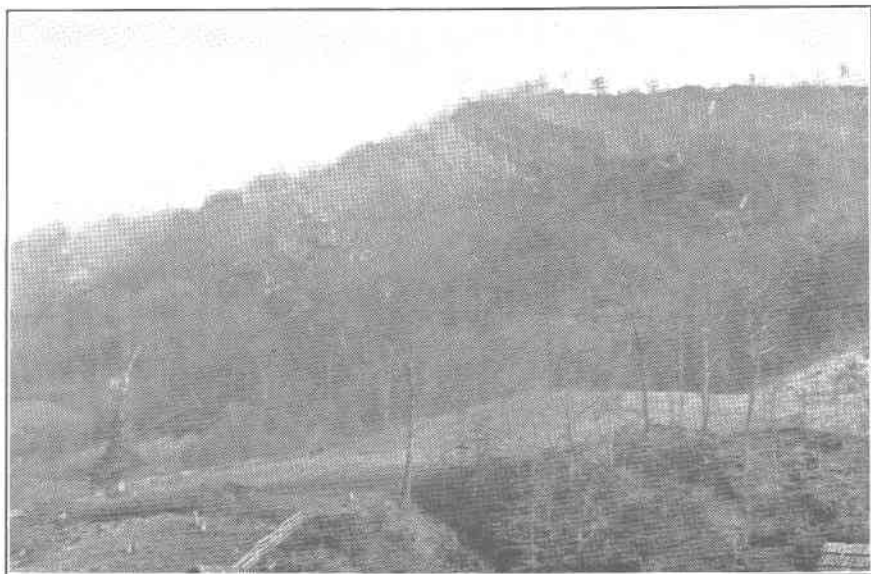
* Not included in sample.



(A) Stone Mountain, looking south from head of Stone Creek.



(B) Red Cedar type, along State highway, west of Jonesville. These large trees will be made into moth-proof chests before long.



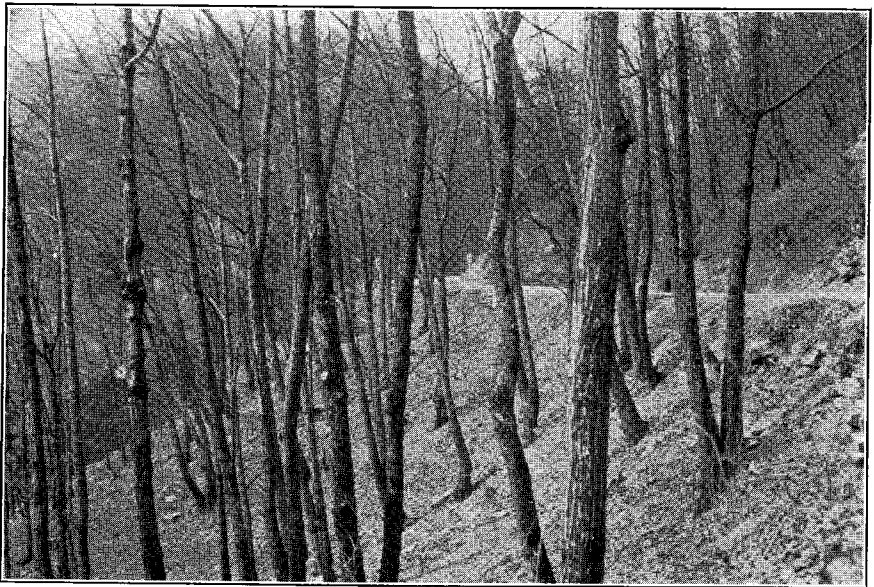
(A) Stone Mountain, looking south from head of Stone Creek.



(B) Red Cedar type, along State highway, west of Jonesville. These large trees will be made into moth-proof chests before long.



(A) Stately white oaks in a church yard near Stickleyville. Showing the size of the original trees on good soil.



(B) A pure, even-aged stand of chestnut near Cumberland Gap. The original trees here were cut during the War between the States, to prevent enemy soldiers from advancing in their shelter.



(A) Stately white oaks in a church yard near Stickleyville. Showing the size of the original trees on good soil.



(B) A pure, even-aged stand of chestnut near Cumberland Gap. The original trees here were cut during the War between the States, to prevent enemy soldiers from advancing in their shelter.

Sections of Harlan coal bed at points sampled in Coxtan mine.

	24713		24714		24715		24716	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Coal	0	5½	0	6	0	5	0	4
Coal, splint	0	3¼	0	3	0	3	0	2½
Coal	3	6½	3	8	3	2½	3	3
Included in sample	4	3¼	4	5	3	10½	3	9½
Excluded from sample	0	0	0	0	0	0	0	0

24633, 24634, and 24635.—Samples of Harlan coal bed collected from Gaston mine one mile east of Harlan, Harlan County, Kentucky, March 14, 1916. Sample 24633 was taken at face of 4 right entry, and sample 24634, at face of main haulage way. Sample 24635 was a composite made by mixing samples 24633 and 24634.

Sections of Harlan coal bed at points sampled in Gaston mine.

	24633		24634	
	Ft.	In.	Ft.	In.
Coal	0	2	0	1½
Coal, splint	0	5	0	2¼
Coal	3	8	3	9
Shale	*0	11	*0	11
Coal	*1	1	*1	1½
Included in sample	4	3	4	¾
Excluded from sample	2	0	2	½

32962 and 32963.—Samples of Taggart Marker coal bed collected in mine of the Stonega Coke and Coal Company at Dunbar, Wise County, Virginia, September 25, 1919. Sample 32962 was collected in room 5, off main entry, 200 feet west of drift mouth; and sample 32963, in room 2, off main entry, 200 feet west of drift mouth.

Sections of Taggart Marker coal bed at points sampled in Dunbar mine.

	32962		32963	
	Ft.	In.	Ft.	In.
Coal	3	6	0	9
Bone	*0	1	..	..
Shale .....	..	..	*0	½
Coal	*0	1	1	2
Shale .....	..	..	*0	½
Coal .....	..	..	0	5
Shale .....	..	..	*0	½
Coal .....	..	..	1	2
Shale, carbonaceous .....	..	..	*0	½
Coal .....	..	..	0	11
Included in sample	3	6	4	5
Excluded from sample	0	2	0	2

* Not included in sample.

34980.—Sample of Taggart coal bed collected in No. 1 mine of the Virginia Lee Company, one and one-fourth miles west-northwest of St. Charles, Lee County, Virginia, location 71 on map, July 23, 1920. Sample was cut in room 19, off 10 left entry, off No. 1 main entry, 5,000 feet west-northwest of drift mouth. Sample represents three feet seven inches of coal, the entire thickness of the bed.

75792, 75793, and 75794.—Samples of Taggart coal bed collected in No. 3 mine of the Old Virginia Coal Company, three miles northeast of St. Charles, Lee County, Virginia, location 61 on map, August 27, 1920. Sample 75792 was cut in room 3, off 1 left entry, off main entry, 500 feet northeast of drift mouth; and sample 75793, in room 6, off 6 left entry, off main entry, one mile northeast of drift mouth. Sample 75794 was a composite made by mixing samples 75792 and 75793.

Sections of Taggart coal bed at points sampled in Old Virginia Coal Company's No. 3 mine.

	75792		75793	
	Ft.	In.	Ft.	In.
"Draw slate"	*0	8	*0	4
Coal	0	9	0	2
"Draw slate" .....	..	..	*0	8
Coal .....	..	..	1	1
"Rash"	*0	½	0	¼
Coal	3	0	0	3½
"Rash" .....	..	..	0	¼
Coal .....	..	..	2	2
Included in sample	3	9	3	9
Excluded from sample	0	8½	1	0

75678, 75679, and 75680.—Samples of Taggart coal bed collected in No. 1 mine of the Stonega Coke & Coal Company, at Keokee, Lee County, Virginia, location 168 on map, August 16, 1920. Sample 75678 was obtained in room 14, off 10 left entry, off 2 main entry, 4,000 feet north-northwest of drift mouth and 600 feet northwest of the Virginia-Kentucky line; and sample 75679, in room 21, off 5 right entry, off 4 main entry, 4,000 feet northwest of drift mouth. Sample 75680 was a composite made by mixing samples 75678 and 75679.

* Not included in sample.

Sections of Taggart coal bed at points sampled in Stonega Coke and Coal Company's No. 1 mine.

	75678		75679	
	Ft.	In.	Ft.	In.
Coal, fissile	0	6	..	..
Coal	0	8½	1	5
"Rash"	0	¼	*0	½
Coal	1	6	2	6½
"Rash"	0	¼	..	..
Coal	0	11	..	..
"Rash"	0	¼	..	..
Coal	1	1	..	..
Included in sample	4	9¼	3	11½
Excluded from sample	0	0	0	½

2248, 2249, and 2476.—Samples of Taggart coal bed collected in a prospect on the Wilson farm, near Crab Orchard, Lee County, Virginia, October 2, 1905. The bed was measured and sampled 72 feet in from the outcrop, sample 2248 was taken from the upper bench, sample 2249 from the lower bench. Sample 2476 was taken from run-of-mine coal.

Sections of Taggart coal bed at point sampled near Crab Orchard.

	2248		2249	
	Ft.	In.	Ft.	In.
Coal (streaks of "mother coal")	1	6		
"Mother coal"	0	¼		
Coal	0	6		
"Mother coal"	0	⅛		
Hard coal	0	9		
"Mother coal"	0	¼		
2248 Coal	0	6		
"Mother coal"	0	¼		
Coal	0	10		
Shale and "mother coal"	0	¼		
Coal	0	2		
"Mother coal"	0	⅛		
Coal	0	9½		
Clay	*0	1		
2249 Coal			1	0
Included in samples	5	1¾	1	0
Excluded from samples	0	1	0	0

2323, 2324, and 2358.—Samples of Taggart coal bed collected in the Darby mine at Darbyville, location 65 on map, three miles north of St. Charles, Lee County, Virginia, October 10, 1905. Sample 2323 was cut in room 18, off butt entry 1, 1,423 feet from drift mouth; and sample 2324 in room 1, off butt entry 3, 901 feet from drift mouth. Sample 2358 was taken from run-of-mine coal.

* Not included in sample.

Sections of Taggart coal bed at points sampled in Darby mine.

	2323		2324	
	Ft.	In.	Ft.	In.
"Draw slate"	0	5	0	9
Coal	1	0	1	0
"Mother coal"	0	¼	0	¼
Coal	2	1	1	8
Included in sample	3	1¼	2	8¼
Excluded from sample	0	5	0	9

6236.—Sample of Taggart coal bed collected in the Darby mine at Darbyville, Lee County, Virginia, location 65 on map, three miles north of St. Charles, June, 1908. The sample was obtained 100 feet from the drift mouth, and represented three feet six inches of coal, the entire thickness of the bed.

82418, 82419, 82420, 82421, and 82422.—Samples collected in the Kirk mine of the Wilma Coal Company, two miles north-northeast of St. Charles, Lee County, Virginia, October 14, 1921. Sample 82418 was cut in room 3, off 1 right entry, off 1 left main entry, 600 feet north of mine mouth. Sample 82419 was cut from rib near face of 4 right entry, off main entry, 500 feet N. 15° E. of mine mouth. Sample 82420 was cut in room 4, off 2 right entry, off 1 left main entry, 900 feet north of mine mouth. Sample 82421 was obtained from the face of No. 2 main entry, 800 feet south of No. 1 pit mouth. Sample 82422 was a composite made by mixing samples 82418, 82419, 82420, and 82421.

Sections of Taggart coal bed at points sampled in Kirk mine.

	82418		82419		82420		82421	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Coal	0	6	0	5¼	0	9¾	..	..
Coal, splint	0	1	0	2	..	..	0	1½
Coal	0	5¾	0	10	..	..	0	7
"Mother coal"	0	¼	0	¼	0	¼	0	½
Coal, splint .....	..	..	..	..	..	..	0	1
Coal	0	1	1	11	0	6	..	..
"Mother coal"	0	½	..	..	0	½	0	¼
Coal	0	4¾	..	..	0	1½	0	9
"Mother coal"	0	¼	..	..	0	½	0	½
Coal	0	1	..	..	1	1½	1	10¾
"Mother coal"	0	1	..	..	0	½	..	..
Coal	1	8½	..	..	0	6½	..	..
Included in sample	3	6	3	4½	3	3	3	6½
Excluded from sample	0	0	0	0	0	0	0	0

* Not included in sample.

82423, 82424, 82425, 82426, and 82427.—Samples of Taggart coal bed collected in No. 3 mine of Bondurant, United Collieries, Inc., one and one-half miles northeast of St. Charles, Lee County, Virginia, October 17, 1921. Sample 82423 was cut from the face of 5 entry, 500 feet southwest of mine mouth. Sample 82424 was cut from the face of 2 cross-entry, off 4 entry, 200 feet south of mine mouth. Sample 82425 was cut from the face of 3 cross-entry, 400 feet southeast of mine mouth. Sample 82426 was cut from the face of 2 entry, 500 feet northeast of mine mouth. Sample 82427 was a composite made by mixing samples 82423, 82424, 82425, and 82426.

Sections of Taggart coal bed at points sampled in Bondurant No. 3 mine.

	82423		82424		82425		82426	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Coal, soft, shaly	0	1½	0	4	..	..	0	7
Coal, splint	0	7	0	6	0	7½	0	6½
Coal	0	2½	0	2¾	..	..	0	5¾
"Mother coal"	0	¾	0	¾	0	1	0	¾
Coal	0	4	0	4½	0	3½	0	1½
Coal, splint	0	1¾	0	2	..	..	0	1
Coal .....	..	0	..	4½	..	..	..	..
"Mother coal"	0	¾	0	¾	0	¾	0	¾
Coal	0	5	0	3	..	..	0	4
"Mother coal"	0	½	0	½	..	..	0	½
Coal	1	1¼	0	4½	..	..	0	2¼
"Mother coal"	0	¾	0	½	..	..	0	¾
Coal	1	¾	0	6½	..	..	0	6
"Mother coal" .....	..	..	0	½	..	..	0	¾
Coal, flinty .....	..	..	..	0	2½	..	..	..
Coal .....	..	0	11¾	2	7	1	6¾	..
Included in sample	4	½	4	3½	3	9¾	4	6
Excluded from sample ...	0	0	0	0	0	0	0	0

82428, 82429, 82430, 82431, and 82432.—Samples of Taggart coal bed collected in the Dominion mine of the United Collieries, Inc., one and one-half miles west-northwest of St. Charles, Lee County, Virginia, October 18, 1921. Sample 82428 was obtained at the face of 8 left entry, off 3 main entry, 3,300 feet N. 15° E. of drift mouth. Sample 82429 was obtained at the face of 2 haulway, off 8 right entry, off 1 main entry, 2,900 feet N. 10° W. of mine mouth. Sample 82430 was obtained from the face of 8 right entry, off 1 main entry, 3,000 feet north of mine mouth. Sample 82431 was obtained in room 1 on right of 7 left entry, off 1 main entry, 2,900 feet N. 30° W. of mine mouth. Sample 82432 was a composite made by mixing samples 82428, 82429, 82430, and 82431.

Sections of Taggart coal bed at points sampled in Dominion mine.

	82428		82429		82430		82431	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Coal	0	7½	0	5¼	0	7½	0	2
Coal, splint	0	1½	..	..	0	1	..	..
Coal	0	1	..	..	0	3½	..	..
"Mother coal"	0	½	0	¼	0	½	0	½
Coal	0	1	0	3¼	0	4½	0	3¾
"Mother coal"	0	½	0	¼	0	½	0	¼
Coal	0	4½	0	8½	0	7¼	0	9½
"Mother coal"	0	¼	0	½	0	¼	0	¼
Coal	1	1	1	½	0	3½	1	5
"Mother coal"	0	½	0	½	0	½	0	½
Coal	0	8¼	0	8½	0	10	0	7
Included in sample	3	2½	3	3½	3	3	3	4¾
Excluded from sample ...	0	0	0	0	0	0	0	0

82433, 82434, 82435, 82436, and 82437.—Samples of Taggart coal bed collected in the Darby mine of the United Coal Mining Company at Darby, Lee County, Virginia, October 31, 1921. Sample 82433 was obtained from the face of air-course on 8-face entry, off 20 butt-entry, 1,900 feet east of mine mouth. Sample 82434 was obtained from the face of 6-face entry, off 20 butt-entry, 3,600 feet S. 60° E. of mine mouth. Sample 82435 was obtained from the face of 9 right entry, off 2 pan wall, 3,500 feet S. 20° E. of mine mouth. Sample 82436 was obtained from room 6, off 1 main entry, 1,000 feet east of mine mouth. Sample 82437 was a composite formed by mixing samples 82433, 82434, 82435, and 82436.

Sections of Taggart coal bed at points sampled in Darby mine.

	82433		82434		82435		82436	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Coal, bone .....	..	..	..	..	..	..	0	½
Coal	1	1	0	5	0	1½	..	..
Coal, splint .....	..	..	0	1	..	..	0	3
"Mother coal"	0	½	..	..	0	¼	..	..
Coal	0	3¾	0	7¾	0	9¾	0	5¼
"Mother coal"	0	¼	0	¾	0	¼	0	¼
Coal	0	9¾	0	3	0	6	1	0
"Mother coal"	0	¼	0	¼	0	¼	0	½
Coal	0	2¼	0	9	0	4½	1	0
"Mother coal"	0	¾	0	½	0	½	..	..
Coal	0	11½	0	11¾	1	6	..	..
Included in sample	3	6	3	3	3	5	2	9½
Excluded from sample ...	0	0	0	0	0	0	0	0

33203, 33204, 33205, 33206, and 33207.—Samples of Taggart coal bed collected in the No. 3 mine of the Stonega Coke and Coal Company, at

Roda, Wise County, Virginia, November 22, 1919. Sample 33203 was cut in room 5, off 4 butt-entry, off 2 left face entry, about one-half mile north of mine mouth. Sample 33204 was cut in room 5, off 3 butt-entry, off 2 left face entry, about one-half mile north of mine mouth. Sample 33205 was cut in room 3, off 2 butt-entry, off left face entry, about one-half mile north of mine mouth. Sample 33206 was cut in room 9, off 2 butt-entry, off 2 left face entry, about one-half mile north of mine mouth. Sample 33207 was a composite made by mixing samples 33203, 33204, 33205, and 33206.

Sections of Taggart coal bed at points sampled in Roda No. 3 mine.

	33203		33204		33205		33206	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Coal	0	2	0	2	0	2	0	2
Bone	*0	½	*0	½	*0	½	*0	½
Coal	0	4	0	4	0	4	0	6
Shale	*0	¼	*0	¼	*0	¼	*0	½
Coal	0	10	1	0	0	9	0	7
Bone	*0	5	*0	4	*0	4	*0	5
Coal, laminated	2	4	2	1	2	10	2	0
Shale	*0	1	*0	¼	*0	½	*0	½
Coal	2	4	2	2	1	0	1	8
Shale .....	..	..	..	..	..	..	*0	½
Coal .....	..	..	..	..	..	..	1	0
Included in sample	6	0	5	9	5	1	5	11
Excluded from sample ...	0	6¾	0	5	0	5¼	0	7

24834, 24835, 24836, 24837, and 24838.—Samples of Taggart coal bed collected in the Benham mine, at Benham, Harlan County, Kentucky, March 30, 1916. Sample 24834 was taken from face at 3 right entry, off 1 left entry, and represented four feet nine inches of coal. Sample 24835 was taken from face of room 3, off 2 right entry, off 2 left entry, and represented five feet two inches of coal. Sample 24836 was taken from face of room 8, off 1 left entry, off 2 right entry, and represented five feet one and one-half inches of coal. Sample 24837 was taken from face of room 7, off 3 left entry, off 1 right entry, and represented five feet seven inches of coal. Each sample represented the thickness of the bed at the place sampled. Sample 24838 was a composite formed by mixing samples 24834, 24835, 24836, and 24837.

75806, 75807, and 75808.—Samples of Low Splint coal bed collected in the mines of the Virginia Iron, Coal and Coke Company, on Straight Creek, three miles northeast of St. Charles, Lee County, Virginia, locations 77 and

* Not included in sample.

78 on map, August 28, 1920. Sample 75806 was obtained in No. 3 mine from the face of the main entry, 1,200 feet northwest of drift mouth; and sample 75807, in No. 2 mine from the face of the main entry, one mile north-northwest of drift mouth. Sample 75808 was a composite made by mixing samples 75806 and 75807.

Sections of Low Splint coal bed at points sampled in Virginia Iron, Coal and Coke Company's mines.

	75806		75807	
	Ft.	In.	Ft.	In.
"Draw slate"	*0	2	..	..
Coal, bony .....	..	..	*0	2
Coal	*0	1	1	4
Shale, carbonaceous, hard	*0	3	..	..
Shale, pyritiferous .....	..	..	*0	½
Coal	1	6	0	3
Shale, pyritiferous, hard	*0	2	..	..
"Rash" .....	..	..	*0	1
Coal	0	8	0	8
Shale	*0	3	..	..
"Rash" .....	..	..	*0	1
Coal	1	6	1	4
Coal, fissile	0	2	..	..
Clay .....	..	..	*0	½
Coal .....	..	..	0	5
Clay .....	..	..	*0	½
Coal .....	..	..	0	6
Coal, fissile .....	..	..	0	1
Included in sample	3	10	4	7
Excluded from sample	0	11	0	5½

75789, 75790, and 75791.—Samples of Phillips coal bed collected in No. 1 mine of the Benedict Coal Corporation, four miles north-northeast of St. Charles, Lee County, Virginia, location 84 on map, August 26, 1920. Sample 75790 was cut at the face of the first left entry, off main entry, 2,000 feet north-northwest of drift mouth; and sample 75789, at the face of the main entry, 2,500 feet east-northeast of drift mouth. Sample 75791 was a composite made by mixing samples 75789 and 75790.

* Not included in sample.

Sections of Phillips coal bed at points sampled in Benedict Coal Corporation's mine.

	75789		75790	
	Ft.	In.	Ft.	In.
"Draw slate"	*0	2	..	..
Coal	2	9	0	8
Shale, pyritiferous	*0	1	0	1/4
Coal	0	2	0	4
Shale, pyritiferous .....	..	..	0	1/4
Coal .....	..	..	2	0
Shale, carbonaceous	*0	3	*0	3
Clay	*0	5	*0	4
Coal	1	1	1	5
Coal, bony	0	2	..	..
Included in sample	4	2	4	5 1/2
Excluded from sample	0	11	0	7

6238.—Sample of Wax coal bed collected in a prospect drift near the head of Gin Creek, four miles north of St. Charles, Lee County, Virginia, June, 1908.

Section of Wax coal bed in Gin Creek opening near Darbyville.

	6238	
	Ft.	In.
Coal	3	5
Bone	*0	1 1/2
Coal	1	3 1/2
Included in sample	4	8 1/2
Excluded from sample	0	1 1/2

6237.—Sample of Pardee coal bed collected in a prospect drift at the head of the left forth of Gin Creek, two miles northwest of Darbyville, Lee County, Virginia, location 90 on map, June, 1908.

Section of Pardee (No. 10) coal bed in Gin Creek prospect near Darbyville.

	6327	
	Ft.	In.
Coal	1	0
Clay	*0	4
Coal	2	8
Shale, coaly	*0	1
Coal	2	1
Included in sample	5	9
Excluded from sample	0	5

84361, 84363.—Sample 84361 from the Pardee coal bed, was collected in the Pardee No. 1 mine of the Blackwood Coal and Coke Company, at

* Not included in sample.

Pardee, Wise County, Virginia, February 18, 1922. The sample was cut from the 4 face entry, 250 feet from first radius. Sample 84363 was a composite obtained by mixing six samples cut in different places in No. 1 mine, one of which was sample 84361.

Section of Pardee coal bed at point sampled in Pardee No. 1 mine.

		84361	
		Ft.	In.
Coal	.....	*1	2
Shale	.....	*0	¾
Coal	.....	1	9
Shale and "rash"	.....	*0	4
Coal	.....	2	2
Shale	.....	*0	½
Coal	.....	1	2
Coal, bony	.....	0	1½
Coal	.....	1	8
Included in sample	.....	6	10½
Excluded from sample	.....	1	6¾

84364, 84366.—Sample 84364, from the Pardee coal bed, was collected in the Pardee No. 4 mine of the Blackwood Coal & Coke Company, at Pardee, Wise County, Virginia, February 18, 1922. The sample was cut in room 11 off 3 left butt, off 1 right entry. Sample 84366 was a composite obtained by mixing two samples cut in different places in No. 4 mine, one of which was sample 84364.

Section of Pardee coal bed at point sampled in Pardee No. 4 mine.

		84364	
		Ft.	In.
Coal	.....	*3	0
Coal	.....	1	4
Shale with sulphur streaks	.....	*0	1
Coal	.....	4	0
Shale	.....	*0	½
Coal	.....	2	1
Included in sample	.....	7	5
Excluded from sample	.....	3	1½

22277, 22278, 22279, and 22280.—Samples of the Pardee coal bed collected in No. 1 mine of the Blackwood Coal and Coke Company, one mile northwest of Pardee, Wise County, Virginia, May 22, 1915. Sample 22277 was cut in 2 right entry, off main three-face entry, 2,500 feet N. 15° W. of mine mouth; sample 22278, from face of main three-face entry, 2,000

* Not included in sample.

feet north of mine mouth; sample 22279, in 6 left entry, off main entry, 2,500 feet northwest of mine mouth. In each instance there was coal left up for roof, above the part sampled. Sample 22280 was a composite made by mixing samples 22277, 22278, and 22279.

Sections of Pardee coal bed at points sampled in Pardee mine.

	22277		22278		22279	
	Ft.	In.	Ft.	In.	Ft.	In.
Coal	*0	4	*0	4	*0	4
Shale	*0	2	*0	2	*0	2
Coal	^b 0	11	^b 0	11	^b 0	11
Coal	7	10	7	8	7	3
Included in sample	7	10	7	8	7	3
Excluded from sample	1	5	1	5	1	5

6239.—Sample of High Splint coal bed collected in a prospect drift at the head of the left fork of Gin Creek, two miles northwest of Darbyville, Lee County, Virginia, location 93 on map, June, 1908.

Section of High Splint (No. 12) coal bed at head of Gin Creek near Darbyville.

	6239	
	Ft.	In.
Coal	0	6
Shale, carbonaceous	*0	4½
Coal	4	0
Included in sample	4	6
Excluded from sample	0	4½

2528.—Sample of High Splint coal bed collected in a prospect drift, one mile south of Gilliam's rock house on Big Black Mountain, Harlan County, Kentucky, October 4, 1905. Sample represents run-of-mine coal.

* Not included in sample.

^b Coal left in roof.

**Analyses of coal samples from mines in and near Lee County.*

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 pages 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.
Stone Creek	Small local mine 1½ miles west of mouth of Stone Creek, Lee Co., Va.	Albert W. Giles....	120	75905	0.7	A B C D	3.0 2.3	40.3 40.5 41.5 43.6	52.1 52.5 53.7 56.4	4.6 4.7 4.8	1.92 1.93 1.98 2.08	..... ..... ..... .....	..... ..... ..... .....	7,590 7,645 7,925 8,220	13,670 13,760 14,000 14,700		
Olinwood (North Fork.)	Small local mine 2½ miles east of Pocket, Va., on Southern Railroad.	D. O. Long	120	75907	0.9	A B C D	3.2 2.3	38.5 39.8 39.8 40.7	56.1 56.6 57.9 59.3	2.2 2.2 2.3	1.69 1.70 1.75 1.79	..... ..... ..... .....	..... ..... ..... .....	7,810 7,880 8,070 8,255	14,000 14,100 14,520 14,860		
Imboden	Mine No. 1, Penn-Lee Coal Corporation, Manass, Va.	Albert W. Giles....	120	34978	0.8	A B C D	2.7 1.9	37.7 38.0 38.7 41.1	54.0 54.5 55.5 58.9	5.59 5.63 5.74	.77 .78 .79 .84	5.45 5.40 5.29 5.61	76.43 77.03 78.53 83.31	1.85 1.86 1.90 2.02	9.91 9.30 7.75 8.22	7,555 7,615 7,760 8,235	13,600 13,700 13,970 14,820
Do	Mine No. 4, Penn-Lee Coal Corporation, Manass, Va.	..... do	121	34979	1.0	A B C D	3.1 2.1	38.3 39.5 39.5 41.2	54.7 55.3 56.5 58.8	3.96 3.90 3.95 3.98	.70 .71 .72 .75	5.51 5.45 5.33 5.55	77.55 78.36 80.01 83.33	1.85 1.87 1.91 1.99	10.53 9.71 8.05 8.38	7,685 7,765 7,925 8,255	13,830 13,980 14,270 14,860
Do	Mine No. 2 (Hale) of the Stonera Coke and Coal Company, at Imboden, Wise Co., Va.	J. Brian Eby	121	75972	1.3	A B C D	2.8 1.5	34.4 34.9 35.4 37.2	58.2 58.9 59.8 62.8	4.6 4.7 4.8	.88 .89 .91 .96	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	7,810 7,915 8,035 8,440	14,060 14,250 14,470 15,100	
Do .....	..... do .....	..... do	121	75973	1.1	A B C D	2.5 1.5	34.8 35.2 35.7 37.7	57.4 57.9 58.8 62.3	5.3 5.4 5.5	.85 .86 .87 .92	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	7,770 7,855 7,975 8,435	13,980 14,140 14,360 15,180	
Do .....	..... do .....	..... do	121	75974	0.9	A B C D	2.8 1.9	33.4 33.7 34.4 36.1	59.2 59.7 60.9 63.9	4.6 4.7 4.7	.79 .80 .81 .85	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	7,765 7,835 7,990 8,335	13,980 14,110 14,380 15,060	

*A brief summary of the methods used by the United States Bureau of Mines in the analysis of coal samples, and the meaning of the terms "proximate analysis," "ultimate analysis," "fixed carbon," "volatile matter," etc. used in this table, may be found in the following publications: Lord, N. W., and others, Analyses of coals in the United States, with descriptions of mine and field samples, collected between July 1, 1904, and June 30, 1910, Bulletin 23, Bureau of Mines, 1912, pp. 10-32.
Fieldner, A. C., and others, Analyses of mine and car samples of coal collected in the fiscal years 1913 to 1916, Bulletin 123, Bureau of Mines, 1918, pp. 5-15.

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.
Imboden	Mine No. 2 (Hale) of the Stonega Coke and Coal Company, at Imboden, Wise Co., Va.	J. Brian Eby.....	121	75975	1.1	A	2.6	34.1	58.4	4.90	.88	5.21	78.37	1.52	9.02	7,770	13,980
						B	1.6	34.5	59.0	4.95	.89	5.25	79.23	1.54	8.14	7,855	14,140
						C	.....	35.1	59.9	5.03	.90	5.16	80.48	1.56	6.87	7,975	14,360
						D	.....	36.9	63.1	.....	.95	5.43	84.74	1.64	7.24	8,400	15,120
Kelly	Mine No. 2, Mohawk Coal Co., Keokee, Va.	Albert W. Giles....	122	75747	1.2	A	2.9	36.0	54.6	6.5	.88	.....	.....	.....	.....	7,560	13,610
						B	1.7	36.4	55.2	6.7	.89	.....	.....	.....	.....	7,650	13,770
						C	.....	37.1	56.2	6.7	.91	.....	.....	.....	.....	7,780	14,010
						D	.....	39.7	60.3	.....	.98	.....	.....	.....	.....	8,345	15,020
Do	Mine No. 1, Mohawk Coal Co., Keokee, Va.	..... do	122	75748	1.8	A	3.4	35.2	54.8	6.6	.77	.....	.....	.....	.....	7,490	13,490
						B	1.7	35.9	55.7	6.7	.78	.....	.....	.....	.....	7,625	13,730
						C	.....	36.5	56.7	6.8	.80	.....	.....	.....	.....	7,755	13,960
						D	.....	39.1	60.9	.....	.86	.....	.....	.....	.....	8,320	14,980
Do	do .....	..... do	122	75749	1.5	A	3.3	35.1	55.1	6.53	.84	5.36	75.95	1.68	9.64	7,530	13,560
						B	1.8	35.6	56.0	6.63	.85	5.28	77.08	1.71	8.45	7,645	13,760
						C	.....	36.2	57.0	6.75	.87	5.17	78.52	1.74	6.95	7,785	14,010
						D	.....	38.9	61.1	.....	.93	5.54	84.20	1.87	7.46	8,350	15,030
Lower St. Charles (No. 2.)	Small local mine ¼-mile east of the mouth of Big Branch of Straight Creek, near St. Charles, Va.	Albert W. Giles....	122	75909	0.7	A	2.8	38.0	53.5	5.7	2.06	.....	.....	.....	.....	7,580	13,550
						B	2.1	38.3	53.9	5.7	2.08	.....	.....	.....	.....	7,585	13,650
						C	.....	39.1	55.0	5.9	2.12	.....	.....	.....	.....	7,750	13,950
						D	.....	41.5	58.5	.....	2.25	.....	.....	.....	.....	8,230	14,820
Upper St. Charles (No. 2A.)	Small local mine ¼-mile east of Straight Creek on Big Branch, near St. Charles, Va.	..... do	122	75908	0.7	A	3.6	31.9	53.1	11.4	.61	.....	.....	.....	.....	6,960	12,530
						B	2.8	32.2	53.5	11.5	.61	.....	.....	.....	.....	7,010	12,620
						C	.....	33.1	55.1	11.8	.63	.....	.....	.....	.....	7,215	12,990
						D	.....	37.5	62.5	.....	.71	.....	.....	.....	.....	8,185	14,730
Do	Small local mine at St. Charles, Va.	..... do	123	75906	0.8	A	3.3	33.1	53.7	9.9	.62	.....	.....	.....	.....	7,145	12,860
						B	2.5	33.4	54.1	10.0	.63	.....	.....	.....	.....	7,205	12,970
						C	.....	34.2	55.5	10.3	.64	.....	.....	.....	.....	7,390	13,300
						D	.....	38.1	61.9	.....	.71	.....	.....	.....	.....	8,235	14,830
Harlan	Mine of Emerald Coal Co. on Lick Branch of Puckett Creek, 1½ miles north-west of Manass, Va.	Albert W. Giles....	123	75737	1.3	A	3.2	38.2	48.6	10.0	3.74	.....	.....	.....	.....	7,075	12,730
						B	1.9	38.7	49.3	10.1	3.79	.....	.....	.....	.....	7,165	12,900
						C	.....	39.5	50.2	10.3	3.86	.....	.....	.....	.....	7,310	13,160
						D	.....	44.0	56.0	.....	4.39	.....	.....	.....	.....	8,145	14,660

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.	Subpur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.
Harlan	Mine of Puckett Creek Coal Co. on Puckett Creek, 1 1/4 miles northwest of Manass, Va.	Albert W. Giles	123	75758	1.4	A B C D	8.3 1.9 C D	38.1 38.6 39.4 43.2	50.0 50.8 51.7 56.8	8.6 8.7 8.9	2.84 2.88 2.94 3.23	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	7,945 7,845 13,490 8,220	13,040 13,220 13,430 14,730
Do	Mine No. 1, Black Diamond Coal Co., St. Charles, Va. do	124	34981	0.9	A B C D	2.4 1.5 C D	36.1 36.5 37.1 43.2	47.6 48.0 48.7 56.8	13.87 14.00 14.22	2.70 2.73 2.77 3.23	4.97 4.92 4.82 5.62	83.18 83.83 89.88 81.46	1.35 1.36 1.38 1.61	8.93 8.16 6.93 8.08	6,840 6,965 12,620 8,175	12,320 12,430 12,620 14,710
Do	Mine No. 3, Stonega Coke and Coal Co., Keokee, Va.	..... do	124	75675	0.7	A B C D	2.4 1.7 C D	39.5 39.8 40.5 42.5	53.5 53.9 54.8 57.5	4.6 4.6 4.7	2.42 2.44 2.48 2.60	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	7,800 7,855 7,995 8,385	14,040 14,140 14,390 15,100
Do	do	..... do	124	75676	1.1	A B C D	2.7 1.6 C D	40.8 41.2 41.9 44.4	51.0 51.6 52.4 55.6	5.5 5.6 5.7	2.21 2.23 2.27 2.41	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	7,675 7,760 7,885 8,390	13,810 13,970 14,190 15,050
Do	do do	124	75677	0.9	A B C D	2.5 1.6 C D	39.8 40.2 40.8 43.1	52.7 53.1 54.0 56.9	5.05 5.10 5.18	2.34 2.36 2.40 2.53	5.47 5.42 5.33 5.62	77.25 77.95 79.21 83.54	1.27 1.28 1.30 1.37	8.62 7.89 6.58 6.94	7,945 7,815 7,945 8,375	13,940 14,070 14,390 15,080
Do	Morris prospect, Crab Orchard, Va.	J. S. Burrows, J. W. Groves, and W. J. von Borries.	125	2246	2.6	A B C D	4.7 2.2 C D	34.2 35.1 35.9 37.7	56.5 58.0 59.2 62.3	4.6 4.9 4.9	2.55 2.62 2.68 2.82	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
Do	do	..... do	125	2268	4.2	A B C D	5.7 1.6 C D	34.4 35.9 36.5 39.9	51.8 54.0 54.9 60.1	8.1 8.5 8.6	2.31 2.41 2.45 2.68	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	7,285 7,605 7,725 8,455	13,120 13,910 15,220
Do	do	..... do	125	2269	4.4	A B C D	6.6 2.2 C D	33.5 35.1 35.9 37.6	55.5 58.1 59.4 62.4	4.4 4.6 4.7.....	.80 .84 .86 .90	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.
Harlan	MORRIS prospect, Crab Orchard, Va.	J. S. Burrows, J. W. Groves, and W. J. von Borries.	125	2420	2.4	A	4.1	34.9	56.3	4.73	1.20	5.32	76.59	1.24	10.92	7,680	13,880
						B	1.7	35.8	57.7	4.85	1.23	5.17	78.47	1.27	9.01	7,870	14,170
						C	.....	36.4	58.7	4.98	1.25	5.08	79.83	1.29	7.62	8,065	14,410
						D	.....	38.3	61.7	.....	1.32	5.34	83.97	1.36	8.01	8,420	15,160
Do	Small drift mine 2 miles east of Harlan, Harlan Co., Ky.	E. B. Sutton	126	24728	.4	A	2.0	39.3	55.6	3.1	.78	.....	.....	.....	.....	7,985	14,380
						B	1.7	39.4	55.8	3.1	.78	.....	.....	.....	.....	8,015	14,430
						C	.....	40.1	56.8	3.1	.80	.....	.....	.....	.....	8,150	14,670
						D	.....	41.4	58.6	.....	.83	.....	.....	.....	.....	8,415	15,160
Do	do	do	126	24729	2.1	A	3.8	37.1	56.6	2.5	.67	.....	.....	.....	.....	7,900	14,220
						B	1.7	37.9	57.8	2.6	.68	.....	.....	.....	.....	8,075	14,530
						C	.....	38.6	58.8	2.6	.70	.....	.....	.....	.....	8,215	14,790
						D	.....	39.6	60.4	.....	.72	.....	.....	.....	.....	8,435	15,180
Do	do	do	126	24730	1.7	A	3.4	37.4	56.5	2.7	.82	.....	.....	.....	.....	7,910	14,240
						B	1.7	38.1	57.4	2.8	.83	.....	.....	.....	.....	8,045	14,490
						C	.....	38.7	58.5	2.8	.85	.....	.....	.....	.....	8,190	14,740
						D	.....	39.8	60.2	.....	.87	.....	.....	.....	.....	8,425	15,170
Do	do	do	126	24731	1.7	A	3.3	37.5	56.2	3.0	.61	.....	.....	.....	.....	7,880	14,180
						B	1.7	38.1	57.2	3.0	.62	.....	.....	.....	.....	8,015	14,420
						C	.....	38.8	58.1	3.1	.63	.....	.....	.....	.....	8,150	14,670
						D	.....	40.0	60.0	.....	.65	.....	.....	.....	.....	8,410	15,140
Do	do	do	126	24732	1.8	A	3.6	37.2	56.5	2.71	.70	5.54	79.61	1.61	9.83	7,900	14,220
						B	1.7	37.9	57.6	2.76	.71	5.44	81.09	1.64	8.36	8,050	14,490
						C	.....	38.6	58.6	2.81	.73	5.33	82.55	1.67	6.91	8,190	14,750
						D	.....	39.7	60.3	.....	.75	5.48	84.94	1.72	7.11	8,430	15,170
Do	Small drift mine at Coxton, 4 miles east of Harlan, Harlan Co., Ky.	do	126	24713	2.0	A	3.7	36.4	56.2	3.7	1.30	.....	.....	.....	.....	7,815	14,070
						B	1.7	37.2	57.4	3.7	1.33	.....	.....	.....	.....	7,975	14,360
						C	.....	37.8	58.4	3.8	1.35	.....	.....	.....	.....	8,110	14,600
						D	.....	39.3	60.7	.....	1.40	.....	.....	.....	.....	8,435	15,180
Do	do	do	126	24714	1.5	A	2.8	37.9	55.8	3.5	.83	.....	.....	.....	.....	7,880	14,190
						B	1.3	38.5	56.6	3.6	.84	.....	.....	.....	.....	8,000	14,400
						C	.....	39.0	57.4	3.6	.85	.....	.....	.....	.....	8,165	14,590
						D	.....	40.5	59.5	.....	.88	.....	.....	.....	.....	8,410	15,130

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.
Harlan	Small drift mine at Cox-ton, 4 miles east of Harlan, Harlan Co., Ky.	E. B. Sutton	126	24715	1.8	A	3.1	37.0	56.6	3.3	.87	.....	.....	.....	.....	7,870	14,160
						B	1.3	37.7	57.6	3.4	.89	.....	.....	.....	.....	8,010	14,420
						C	.....	38.2	58.4	3.4	.90	.....	.....	.....	.....	8,120	14,610
						D	.....	39.5	60.5	.....	.93	.....	.....	.....	.....	8,400	15,130
Do	do	do	126	24716	1.3	A	3.0	36.9	57.1	3.0	.70	.....	.....	.....	.....	7,980	14,280
						B	1.7	37.4	57.9	3.0	.71	.....	.....	.....	.....	8,085	14,470
						C	.....	38.1	58.9	3.0	.72	.....	.....	.....	.....	8,180	14,720
						D	.....	39.3	60.7	.....	.74	.....	.....	.....	.....	8,435	15,190
Do	do	do	126	24717	1.6	A	3.2	37.2	56.3	3.31	.93	5.48	78.91	1.67	9.70	7,860	14,150
						B	1.6	37.8	57.2	3.37	.95	5.39	80.23	1.70	8.36	7,990	14,380
						C	.....	38.4	58.2	3.42	.96	5.30	81.50	1.72	7.10	8,115	14,610
						D	.....	39.8	60.2	.....	.99	5.49	84.39	1.78	7.35	8,405	15,130
Do	Small drift mine 1 mile east of Harlan, Harlan Co., Ky.	do	127	24633	1.6	A	3.2	37.5	56.4	2.9	.52	.....	.....	.....	.....	7,910	14,240
						B	1.6	38.1	57.3	3.0	.53	.....	.....	.....	.....	8,040	14,470
						C	.....	38.8	58.2	3.0	.54	.....	.....	.....	.....	8,175	14,710
						D	.....	40.0	60.0	.....	.56	.....	.....	.....	.....	8,425	15,170
Do	do	do	127	24634	1.4	A	3.0	37.9	56.5	2.6	.60	.....	.....	.....	.....	7,960	14,330
						B	1.6	38.5	57.3	2.6	.61	.....	.....	.....	.....	8,075	14,540
						C	.....	39.1	58.3	2.6	.62	.....	.....	.....	.....	8,210	14,780
						D	.....	40.2	59.8	.....	.64	.....	.....	.....	.....	8,430	15,180
Do	do	do	127	24635	1.5	A	3.3	37.8	56.2	2.68	.57	5.59	79.63	1.68	9.85	7,950	14,310
						B	1.8	38.5	57.0	2.72	.58	5.50	80.85	1.71	8.64	8,070	14,530
						C	.....	39.1	58.1	2.77	.59	5.40	82.34	1.74	7.16	8,220	14,800
						D	.....	40.3	59.7	.....	.61	5.55	84.69	1.79	7.36	8,455	15,220
Taggart Marker	Mine of Stonega Coke and Coal Co. at Dunbar, Wise Co., Va.	Chester K. Wentworth.	127	32962	1.0	A	2.0	36.5	58.8	2.72	.75	5.83	81.70	1.49	7.96	8,130	14,630
						B	1.1	36.8	59.4	2.75	.76	5.82	82.50	1.50	7.17	8,210	14,770
						C	.....	37.2	60.0	2.78	.77	5.87	83.37	1.52	6.29	8,295	14,980
						D	.....	38.3	61.7	.....	.79	5.42	86.75	1.56	6.48	8,530	15,380
Do	do	do	127	32963	1.4	A	2.6	35.1	59.3	2.98	.61	5.33	81.42	1.34	8.32	8,030	14,460
						B	1.3	35.6	60.1	3.02	.62	5.24	82.59	1.36	7.17	8,145	14,670
						C	.....	36.0	60.9	3.06	.63	5.18	83.63	1.38	6.12	8,250	14,850
						D	.....	37.2	62.9	.....	.65	5.34	86.27	1.42	6.32	8,510	15,320

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.
Taggart	Mine No. 1, Virginia Lee Co., 1½ miles northwest of St. Charles, Va.	Albert W. Giles...	128	34980	0.7	A B C D	2.8 2.1 37.3 38.1	56.9 57.3 58.5 60.6	8.38 8.35 3.43	5.43 5.39 5.27	.53 .53 .55	78.69 79.24 80.94	1.45 1.46 1.49	10.57 10.08 8.82	7,740 7,795 7,960	13,980 14,080 14,330	
Do	Mine No. 3, Old Virginia Coal Co., 3 miles northeast of St. Charles, Va.	..... do	128	75792	1.0	A B C D	3.1 2.2 39.7 41.0	55.3 55.8 57.1 59.0	3.1 3.2 3.2.....	.....	.60 .61 .62 .64	.....	.....	8.62 8.81	8,245 8,245	14,840
Do	do .....	..... do	128	75793	1.5	A B C D	3.8 2.3	56.3 57.2 58.5 59.9	2.2 2.2 2.3	.....	.76 .77 .81	.....	.....	.....	7,815 7,980 8,120	14,070 14,280 14,620
Do	do do	128	75794	1.2	A B C D	3.4 2.2 39.4 40.5	55.9 56.6 57.9 59.5	2.57 2.60 2.6678 .79 .81 .83	5.60 5.53 5.40 5.55	78.80 79.77 81.57 83.80	1.52 1.54 1.57 1.61	10.73 9.77 7.99 8.21	8,310 8,085 14,560 14,960	14,060
Do	Mine No. 1, Stonega Coke and Coal Co., Keokee, Va.	Albert W. Giles...	128	75678	1.8	A B C D	3.6 1.9	57.8 58.8 59.9 62.9	4.5 4.6 4.8	.....	.67 .68 .69 .72	.....	.....	.....	7,640 7,775 7,925	13,750 14,000 14,260
Do	do .....	..... do	128	75679	0.8	A B C D	2.9 2.2 36.3 38.0	57.5 57.9 59.2 62.0	4.3 4.4 4.5	.....	.78 .79 .80 .84	.....	.....	.....	8,320 7,800 7,860	14,970 14,040 14,140
Do	do do	128	75680	1.3	A B C D	3.2 1.9 35.2 35.9	57.5 58.3 59.4 62.3	4.57 4.63 4.7274 .75 .76 .80	5.46 5.39 5.28 5.54	77.97 78.97 80.52 84.51	1.40 1.42 1.45 1.52	9.86 8.84 7.27 7.63	7,735 7,835 7,990 8,385	13,930 14,110 14,880 15,100
Do	Prospect on Wilson farm near Crab Orchard, Lee Co., Va.	J. W. Groves and W. J. von Borries	129	2248	1.9	A B C D	3.9 2.0	57.0 58.1 59.3 62.6	5.0 5.2 5.3	.....	.90 .92 .94 .99	.....	.....	.....	7,705 7,855 8,020 8,465	13,870 14,140 14,440 15,240

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.
Taggart	Prospect on Wilson Farm near Crab Orchard, Lee Co., Va.	J. W. Groves and W. J. von Borries.	129	2249	5.0	A	6.8	33.0	53.3	1.9	.68	.....	.....	.....	.....	.....	.....
						B	1.9	34.5	61.3	2.0	.72	.....	.....	.....	.....	.....	.....
						C	.....	35.4	62.5	2.1	.73	.....	.....	.....	.....	.....	.....
						D	.....	36.2	63.8	.....	.75	.....	.....	.....	.....	.....	.....
Do	do	do	129	2476	1.9	A	3.4	35.1	55.9	5.53	.92	5.19	77.02	1.42	9.87	7,740	13,930
						B	1.5	35.8	57.0	5.69	.93	5.08	78.51	1.45	8.34	7,890	14,200
						C	.....	36.4	57.9	5.77	.95	4.99	79.69	1.47	7.13	8,010	14,410
						D	.....	38.6	61.4	.....	1.01	5.29	94.58	1.56	7.56	8,500	15,300
Do	Drift mine at Darbyville, Va.	do	129	2323	1.9	A	3.9	34.9	58.2	3.0	.34	.....	.....	.....	.....	7,860	14,140
						B	2.0	35.6	59.3	3.1	.35	.....	.....	.....	.....	8,010	14,420
						C	.....	36.3	60.5	3.2	.35	.....	.....	.....	.....	8,175	14,720
						D	.....	37.5	62.5	.....	.36	.....	.....	.....	.....	8,445	15,200
Do	do	do	129	2324	1.5	A	3.5	37.1	56.9	2.5	.50	.....	.....	.....	.....	.....	.....
						B	2.1	37.6	57.7	2.6	.50	.....	.....	.....	.....	.....	.....
						C	.....	38.4	59.0	2.6	.52	.....	.....	.....	.....	.....	.....
						D	.....	39.5	60.5	.....	.53	.....	.....	.....	.....	.....	.....
Do	do	do	129	2353	2.0	A	4.4	36.9	54.4	4.33	.79	5.25	76.99	1.32	11.32	7,745	13,940
						B	2.4	37.7	55.5	4.42	.80	5.13	78.56	1.35	9.74	7,900	14,220
						C	.....	38.6	56.9	4.53	.83	4.99	80.49	1.38	7.78	8,095	14,570
						D	.....	40.4	59.6	.....	.87	5.22	84.31	1.45	8.15	8,480	15,260
Do	do	C. A. Fisher	130	6236	1.4	A	3.4	34.4	53.8	3.39	.58	5.25	77.98	1.29	11.51	7,850	14,130
						B	2.0	34.9	59.7	3.44	.59	5.16	79.09	1.31	10.41	7,965	14,330
						C	.....	35.6	60.9	3.51	.60	5.04	80.74	1.34	8.77	8,130	14,630
						D	.....	36.9	63.1	.....	.62	5.22	83.68	1.39	9.09	8,425	15,170
Do	Kirk mine, Wilma Coal Company, 2 miles north-east of St. Charles, Va.	W. A. Forrester..	130	82418	1.9	A	3.3	36.4	53.5	1.8	.42	.....	.....	.....	.....	7,845	14,120
						B	1.4	37.1	59.6	1.9	.43	.....	.....	.....	.....	8,000	14,400
						C	.....	37.6	60.5	1.9	.43	.....	.....	.....	.....	8,115	14,610
						D	.....	38.3	61.7	.....	.44	.....	.....	.....	.....	8,270	14,890
Do	do	do	130	82419	2.1	A	3.4	36.6	53.3	1.7	.44	.....	.....	.....	.....	7,880	14,180
						B	1.3	37.4	59.5	1.8	.45	.....	.....	.....	.....	8,050	14,490
						C	.....	37.9	60.3	1.8	.46	.....	.....	.....	.....	8,160	14,690
						D	.....	38.6	61.4	.....	.47	.....	.....	.....	.....	8,310	14,960

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.
Taggart	Kirk mine, Wilma Coal Company, 2 miles north-east of St. Charles, Va.	W. A. Forrester..	130	82420	2.1	A	3.4	37.1	57.1	2.4	.48	.....	.....	.....	.....	7,810	14,060
						B	1.3	37.9	58.3	2.5	.49	.....	.....	.....	.....	7,980	14,370
						C	.....	38.4	59.1	2.5	.50	.....	.....	.....	.....	8,085	14,550
						D	.....	39.4	60.6	.....	.51	.....	.....	.....	.....	8,295	14,930
Do	do	do	130	82421	2.3	A	3.7	35.9	58.3	2.1	.47	.....	.....	.....	.....	7,820	14,080
						B	1.4	36.8	59.7	2.1	.48	.....	.....	.....	.....	8,005	14,410
						C	.....	37.3	60.5	2.2	.49	.....	.....	.....	.....	8,125	14,530
						D	.....	38.1	61.9	.....	.50	.....	.....	.....	.....	8,305	14,950
Do	do	do	130	82422	2.1	A	3.6	36.7	57.6	2.06	.48	5.66	78.97	1.44	11.39	7,840	14,110
						B	1.5	37.5	58.9	2.10	.49	5.54	80.69	1.47	9.71	8,010	14,430
						C	.....	38.1	59.8	2.14	.50	5.46	81.92	1.49	8.49	8,130	14,600
						D	.....	38.9	61.1	.....	.51	5.58	83.71	1.52	8.68	8,310	14,900
Do	No. 3 mine of Bondurant, United Collieries, Inc., 1½ miles northeast of St. Charles, Va.	..... do	131	82423	2.6	A	4.1	36.3	56.5	3.1	.46	.....	.....	.....	.....	7,600	13,810
						B	1.4	37.3	58.1	3.2	.47	.....	.....	.....	.....	7,880	14,180
						C	.....	37.8	58.9	3.3	.48	.....	.....	.....	.....	7,995	14,390
						D	.....	39.1	60.9	.....	.50	.....	.....	.....	.....	8,265	14,890
Do	do	do	131	82424	2.5	A	4.1	36.2	56.1	3.6	.44	.....	.....	.....	.....	7,625	13,730
						B	1.6	37.2	57.5	3.7	.45	.....	.....	.....	.....	7,820	14,080
						C	.....	37.8	58.5	3.7	.46	.....	.....	.....	.....	7,950	14,310
						D	.....	39.3	60.7	.....	.48	.....	.....	.....	.....	8,265	14,880
Do	do	do	131	82425	2.7	A	4.3	36.0	57.8	1.9	.54	.....	.....	.....	.....	7,775	13,990
						B	1.7	36.9	59.4	2.0	.55	.....	.....	.....	.....	7,965	14,380
						C	.....	37.6	60.4	2.0	.56	.....	.....	.....	.....	8,120	14,620
						D	.....	38.4	61.6	.....	.56	.....	.....	.....	.....	8,290	14,920
Do	do	do	131	82426	2.0	A	3.8	36.6	57.5	2.1	.43	.....	.....	.....	.....	7,905	14,050
						B	1.9	37.3	58.7	2.1	.44	.....	.....	.....	.....	7,990	14,330
						C	.....	38.0	59.8	2.2	.45	.....	.....	.....	.....	8,115	14,610
						D	.....	38.9	61.1	.....	.46	.....	.....	.....	.....	8,295	14,930
Do	do	do	131	82427	2.5	A	4.2	36.0	57.2	2.73	.51	5.67	78.08	1.41	11.60	7,715	13,890
						B	1.8	36.9	58.6	2.80	.52	5.54	80.04	1.45	9.65	7,910	14,240
						C	.....	37.5	59.6	2.85	.53	5.44	81.47	1.47	8.24	8,050	14,590
						D	.....	38.6	61.4	.....	.55	5.60	83.86	1.51	8.48	8,290	14,920

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.
Taggart	Dominion mine, United Collieries, Inc., 1½ miles west-northwest of St. Charles, Va.	W. A. Forrester..	131	82428	1.6	A	3.4	36.5	57.7	2.4	.44	.....	.....	.....	.....	7,855	14,140
						B	1.8	37.1	58.6	2.5	.45	.....	.....	.....	.....	7,980	14,360
						C	.....	37.8	59.7	2.5	.46	.....	.....	.....	.....	8,130	14,630
						D	.....	38.7	61.3	.....	.47	.....	.....	.....	.....	8,335	15,000
Do	do	do	131	82429	1.4	A	3.2	37.1	57.3	2.4	.41	.....	.....	.....	.....	7,840	14,110
						B	1.8	37.6	58.1	2.5	.42	.....	.....	.....	.....	7,950	14,310
						C	.....	38.3	59.2	2.5	.42	.....	.....	.....	.....	8,065	14,570
						D	.....	39.3	60.7	.....	.43	.....	.....	.....	.....	8,305	14,950
Do	do	do	131	82430	1.6	A	3.4	36.9	57.1	2.6	.48	.....	.....	.....	.....	7,830	14,090
						B	1.8	37.5	58.0	2.7	.40	.....	.....	.....	.....	7,960	14,330
						C	.....	38.2	59.1	2.7	.50	.....	.....	.....	.....	8,100	14,530
						D	.....	39.3	60.7	.....	.51	.....	.....	.....	.....	8,330	14,930
Do	do	do	131	82431	1.7	A	3.4	36.5	57.8	2.8	.50	.....	.....	.....	.....	7,810	14,060
						B	1.7	37.2	58.8	2.8	.51	.....	.....	.....	.....	7,950	14,310
						C	.....	37.8	59.9	2.3	.52	.....	.....	.....	.....	8,060	14,560
						D	.....	38.7	61.3	.....	.53	.....	.....	.....	.....	8,285	14,910
Do	do	do	131	82432	1.6	A	3.3	37.1	57.2	2.36	.49	5.68	79.25	1.50	10.72	7,825	14,080
						B	1.8	37.6	58.2	2.40	.50	5.60	80.52	1.52	9.46	7,950	14,310
						C	.....	38.4	59.2	2.44	.51	5.49	81.98	1.55	8.03	8,065	14,570
						D	.....	39.3	60.7	.....	.52	5.63	84.03	1.59	8.23	8,295	14,930
Do	Darby mine of United Coal Mining Co. at Darbyville, Va.	do	132	82433	2.3	A	4.1	36.6	57.4	1.9	.43	.....	.....	.....	.....	7,815	14,070
						B	1.8	37.5	58.8	1.9	.44	.....	.....	.....	.....	8,000	14,400
						C	.....	38.2	59.9	1.9	.45	.....	.....	.....	.....	8,150	14,670
						D	.....	38.9	61.1	.....	.46	.....	.....	.....	.....	8,310	14,930
Do	do	do	132	82434	2.3	A	4.2	36.9	57.2	1.7	.43	.....	.....	.....	.....	7,820	14,080
						B	1.9	37.8	58.6	1.7	.44	.....	.....	.....	.....	8,005	14,410
						C	.....	38.5	59.7	1.8	.45	.....	.....	.....	.....	8,160	14,690
						D	.....	39.2	60.8	.....	.46	.....	.....	.....	.....	8,305	14,950
Do	do	do	132	82435	2.4	A	4.1	37.5	56.7	1.7	.44	.....	.....	.....	.....	7,860	14,150
						B	1.7	38.4	58.2	1.7	.45	.....	.....	.....	.....	8,030	14,450
						C	.....	39.1	59.2	1.7	.46	.....	.....	.....	.....	8,195	14,750
						D	.....	39.8	60.2	.....	.47	.....	.....	.....	.....	8,345	15,020

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.
Taggart	Darby mine of United Coal Mining Co. at Darbyville, Va.	W. A. Forrester..	132	82486	1.4	A B C D	3.4 1.9	37.2 37.8 38.5 39.4	57.3 58.1 59.3 60.6	2.1 2.2 2.2.....	.45 .46 .47 .48	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	7,820 7,935 8,060 8,275	14,080 14,280 14,560 14,890
Do	do	do	132	82487	2.1	A B C D	4.0 1.9	36.6 37.6 38.3 39.1	57.8 58.6 59.7 60.9	1.91 1.95 1.9948 .49 .50 .51	5.73 5.61 5.51 5.62	79.14 80.86 82.41 84.08	11.83 9.66 8.12 8.29	7,810 7,980 8,135 8,300	14,060 14,360 14,640 14,940
Do	Mine No. 3 of the Stonega Coke and Coal Co., at Roda, Wise Co., Va.	C. K. Wentworth	132	33208	1.0	A B C D	2.2 1.2	34.7 35.0 35.4 36.3	60.8 61.4 62.2 63.7	2.3 2.4 2.4.....	.53 .59 .60 .60	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	8,150 8,280 8,360 8,540	14,670 14,810 14,960 15,370
Do	do	do	132	33204	.8	A B C D	2.0 1.2	35.2 35.5 35.9 36.8	60.4 60.9 61.7 63.2	2.4 2.4 2.4.....	.50 .50 .51 .52	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	8,165 8,230 8,335 8,540	14,700 14,810 15,000 15,370
Do	do	do	132	33205	.8	A B C D	2.0 1.3	34.7 35.0 35.4 36.1	61.4 61.7 62.6 63.9	1.9 2.0 2.0.....	.49 .49 .50 .51	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	8,195 8,255 8,360 8,530	14,750 14,860 15,050 15,350
Do	do	do	132	33206	.7	A B C D	2.0 1.3	35.6 35.8 36.3 37.1	60.2 60.6 61.4 62.9	2.2 2.3 2.3.....	.51 .51 .52 .53	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	8,190 8,250 8,360 8,555	14,740 14,850 15,050 15,400
Do	do	do	132	33207	.8	A B C D	2.1 1.3	34.9 35.2 35.6 36.4	60.9 61.4 62.1 63.6	2.18 2.20 2.2354 .54 .55 .56	5.32 5.27 5.20 5.32	82.79 83.46 84.54 86.47	1.51 1.52 1.54 1.58	7.66 7.01 5.94 6.07	8,160 8,230 8,335 8,525	14,690 14,810 15,000 15,350
Do	Drift mine at Benham, Harlan Co., Ky.	F. B. Sutton	133	24834	.8	A B C D	2.6 1.9	36.8 37.1 37.8 38.7	58.5 59.0 60.0 61.3	2.1 2.1 2.2.....	.53 .53 .54 .55	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	8,100 8,165 8,320 8,505	14,580 14,700 14,980 15,310

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.
Taggart	Drift mine at Benham, Harlan Co., Ky.	E. B. Sutton	133	24835	.6	A B C D	2.6 2.0	37.2 37.5 38.3 39.0	83.4 83.7 89.9 61.0	1.8 1.8 1.8 .....	.51 .51 .52 .53	.....	.....	.....	.....	8,125 8,170 8,340 8,495	14,690 14,710 15,010 15,290
Do .....	..... do .....	..... do	133	24836	.8	A B C D	2.7 1.9	37.0 37.3 38.0 38.9	53.1 53.6 59.8 61.1	2.2 2.2 2.2 .....	.48 .48 .49 .50	.....	.....	.....	.....	8,095 8,160 8,320 8,510	14,570 14,680 14,980 15,320
Do .....	..... do .....	..... do	133	24837	.7	A B C D	2.6 1.8	37.8 38.1 38.3 40.0	56.7 57.2 58.3 60.0	2.9 2.9 2.9 .....	.52 .52 .53 .55	.....	.....	.....	.....	8,045 8,105 8,260 8,510	14,490 14,590 14,870 15,320
Do .....	..... do .....	..... do	133	24838	.7	A B C D	2.5 1.8	37.5 37.8 38.5 39.4	57.6 58.0 59.1 60.6	2.35 2.37 2.41 .....	.52 .52 .53 .54	5.56 5.52 5.42 5.55	80.94 81.53 83.01 85.06	1.52 1.53 1.56 1.60	9.11 8.53 7.07 7.25	8,105 8,165 8,310 8,515	14,590 14,700 14,960 15,330
Low Splint	Mine No. 3, Virginia Iron, Coal and Coke Co., 3 miles northeast of St. Charles, Va.	Albert W. Giles...	133	75806	1.4	A B C D	3.7 2.4	35.1 35.5 36.4 39.2	54.3 55.1 56.4 60.8	6.9 7.0 7.2	1.10 1.12 1.14 1.23	.....	.....	.....	.....	7,400 7,500 7,680 8,275	13,320 13,500 13,830 14,890
Do .....	..... do .....	..... do	133	75807	1.1	A B C D	3.3 2.3	35.2 35.6 36.4 40.4	52.1 52.6 53.9 59.6	9.4 9.5 9.7	1.02 1.03 1.06 1.17	.....	.....	.....	.....	7,105 7,180 7,350 8,140	12,790 12,920 13,230 14,660
Do .....	..... do .....	..... do	133	75808	1.2	A B C D	3.5 2.3	35.2 35.6 36.5 39.8	53.3 54.0 55.2 60.2	8.05 8.15 8.34	1.10 1.11 1.14 1.24	5.19 5.11 4.97 5.42	73.24 74.14 75.87 82.77	1.71 1.73 1.77 1.93	10.71 9.76 7.91 8.64	7,360 7,360 7,520 8,265	13,070 13,230 13,540 14,770
Phillips	Mine No. 1, Benedict Coal Corp., 4 miles north-east of St. Charles, Va.	Albert W. Giles...	134	75789	1.5	A B C D	3.8 2.4	36.6 37.2 38.1 40.8	53.2 54.0 55.3 59.2	6.4 6.4 6.6 .....	.77 .78 .80 .86	.....	.....	.....	.....	7,465 7,520 7,700 8,245	13,330 13,540 13,860 14,840

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages where coal sections that yielded the samples are described.	Laboratory No.	Air-drying loss.	Form of analysis.	Proximate.				Ultimate.				Heating value.		
											Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.
							Moisture.	Volatile matter.	Fixed carbon.	Ash.							
Phillips	Mine No. 1, Benedict Coal Corp., 4 miles northeast of St. Charles, Va.	Albert W. Giles	134	75790	1.2	A	3.7	34.4	52.0	9.9	.72	.....	.....	.....	.....	7,080	12,740
						B	2.5	34.8	52.7	10.0	.73	.....	.....	.....	.....	7,165	12,900
						C	.....	35.7	54.0	10.3	.75	.....	.....	.....	.....	7,350	13,230
						D	.....	39.8	60.2	.....	.84	.....	.....	.....	.....	8,195	14,750
Do	do	do	134	75791	1.4	A	3.8	35.5	52.7	8.04	.80	5.12	73.14	1.78	11.12	7,235	13,020
						B	2.4	36.0	53.5	8.15	.81	5.04	74.15	1.80	10.05	7,335	13,200
						C	.....	36.9	54.8	8.35	.83	4.80	75.97	1.85	8.11	7,515	13,520
						D	.....	40.3	59.7	.....	.91	5.34	82.80	2.02	8.84	8,200	14,760
Wax (No. 9)	Small drift mine on Gin Creek, 1½ miles northwest of Darbyville, Va.	C. A. Fisher	135	6238	2.1	A	4.4	36.0	53.6	5.93	.76	5.19	71.95	1.25	14.87	7,425	13,390
						B	2.4	36.8	54.7	6.11	.77	5.07	73.49	1.28	13.28	7,580	13,650
						C	.....	37.6	56.1	6.26	.80	4.92	75.29	1.31	11.42	7,770	13,980
						D	.....	40.2	59.8	.....	.85	5.25	80.32	1.40	12.18	8,200	14,920
Pardee	Small drift mine on Gin Creek, 2 miles northwest of Darbyville, Va.	do	135	6237	3.1	A	5.3	32.7	53.2	8.80	.75	5.13	70.39	1.36	13.57	7,100	12,780
						B	2.3	33.7	54.9	9.08	.78	4.94	72.64	1.40	11.16	7,325	13,190
						C	.....	34.5	56.2	9.29	.79	4.79	74.34	1.44	9.35	7,495	13,500
						D	.....	38.0	62.0	.....	.87	5.28	81.95	1.59	10.31	8,265	14,880
Do	Pardee No. 1 mine, Blackwood Coal and Coke Co., at Pardee, Wise Co., Va.	J. Brian Eby	135	84361	1.6	A	2.4	35.7	55.8	6.1	.90	.....	.....	.....	.....	7,680	13,830
						B	.8	36.3	56.7	6.2	.90	.....	.....	.....	.....	7,805	14,050
						C	.....	36.7	57.0	6.3	.90	.....	.....	.....	.....	7,870	14,160
						D	.....	39.1	60.9	.....	1.00	.....	.....	.....	.....	8,395	15,110
Do	do	do	135	84363	1.8	A	2.5	35.2	56.1	6.2	.90	5.3	77.1	1.7	8.8	7,640	13,750
						B	.7	35.9	57.0	6.4	1.00	5.2	78.5	1.7	7.2	7,780	14,000
						C	.....	36.1	57.5	6.4	1.00	5.2	79.1	1.7	6.6	7,835	14,110
						D	.....	38.6	61.4	.....	1.00	5.6	84.6	1.9	6.9	8,370	15,070
Do	Pardee No. 4 mine, Blackwood Coal and Coke Co., at Pardee, Wise Co., Va.	do	136	84364	4.3	A	5.1	32.5	56.4	6.0	.80	.....	.....	.....	.....	7,345	13,210
						B	.8	34.0	58.9	6.3	.80	.....	.....	.....	.....	7,670	13,810
						C	.....	34.2	59.4	6.4	.80	.....	.....	.....	.....	7,735	13,920
						D	.....	36.5	63.5	.....	.90	.....	.....	.....	.....	8,260	14,860
Do	do	do	136	84366	2.8	A	3.6	33.7	56.2	6.5	.90	5.3	75.7	1.6	10.0	7,485	13,470
						B	.8	34.7	57.8	6.7	1.00	5.1	77.9	1.7	7.6	7,700	13,860
						C	.....	35.0	58.2	6.8	1.00	5.0	78.5	1.7	7.0	7,760	13,970
						D	.....	37.5	62.5	.....	1.00	5.4	84.2	1.8	7.6	8,325	14,980

Analyses of coal samples from mines in and near Lee County—Contd.

Coal bed.	Name and location of mine.	Collector.	Text pages 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.
Pardue	No. 1 mine of Blackwood Coal and Coke Co., 1 mile northwest of Pardee, Wise Co., Va.	T. K. Harnsberger	136	22277	1.4	A	3.0	35.9	55.5	5.6	.78	.....	.....	.....	.....	7,760	13,970
						B	1.6	36.4	56.3	5.7	.79	.....	.....	.....	.....	7,875	14,170
						C	.....	37.0	57.2	5.8	.80	.....	.....	.....	.....	8,000	14,400
						D	.....	39.3	60.7	.....	.85	.....	.....	.....	.....	8,490	15,290
Do	do	do	136	22278	1.3	A	2.9	36.1	56.2	4.8	.94	.....	.....	.....	.....	7,810	14,060
						B	1.6	36.6	56.9	4.9	.95	.....	.....	.....	.....	7,915	14,250
						C	.....	37.2	57.9	4.9	.97	.....	.....	.....	.....	8,045	14,480
						D	.....	39.2	60.8	.....	1.02	.....	.....	.....	.....	8,460	15,290
Do	do	do	136	22279	1.1	A	2.7	36.3	54.5	6.5	1.37	.....	.....	.....	.....	7,690	13,850
						B	1.6	36.8	55.1	6.5	1.39	.....	.....	.....	.....	7,780	14,000
						C	.....	37.3	56.0	6.7	1.41	.....	.....	.....	.....	7,905	14,230
						D	.....	40.0	60.0	.....	1.51	.....	.....	.....	.....	8,470	15,230
Do	do	do	136	22280	1.3	A	2.9	36.1	55.4	5.61	1.05	5.49	78.17	1.67	8.01	7,755	13,960
						B	1.6	36.6	56.1	5.68	1.06	5.42	79.19	1.69	6.96	7,855	14,140
						C	.....	37.2	57.0	5.77	1.08	5.32	80.46	1.72	5.65	7,980	14,370
						D	.....	39.5	60.5	.....	1.15	5.65	85.38	1.83	5.99	8,470	15,240
High Splint	Small local mine at head of Gin Creek, 2 miles northwest of Darbyville, Va.	C. A. Fisher	137	6239	3.1	A	5.5	36.0	51.9	6.61	1.24	5.19	71.47	1.12	14.37	7,285	13,110
						B	2.5	37.2	53.5	6.82	1.28	5.00	73.76	1.16	11.98	7,515	13,530
						C	.....	38.1	54.9	6.99	1.31	4.86	75.62	1.19	10.04	7,705	13,870
						D	.....	41.0	59.0	.....	1.41	5.21	81.31	1.28	10.79	8,285	14,910
Do	Prospect drift 1 mile south of Gilliam's rockhouse on Big Black Mountain, 15 miles from Louisville & Nashville Railroad, Ky.	J. S. Burrows	137	2528	2.8	A	4.4	35.0	56.9	3.70	.67	5.16	77.44	1.57	11.46	7,735	13,920
						B	1.6	36.0	58.6	3.81	.69	4.99	79.67	1.61	9.23	7,960	14,220
						C	.....	36.6	59.5	3.87	.68	4.89	80.97	1.64	7.94	8,060	14,560
						D	.....	38.1	61.9	.....	.73	5.09	84.23	1.71	8.24	8,415	15,140

TABLE OF FUSION POINTS OF THE ASH OF LEE COUNTY COAL.

The following table gives the fusion points of the ash from the coal samples collected in Lee County during the summer of 1920.¹

By softening temperature is meant the temperature at which the cone ash fuses down to a spherical lump. Softening interval is the difference between the softening temperature and the temperature at which the first rounding or bending of the apex of the cone takes place, and flowing interval is the difference between the softening temperature and the temperature at which the ash has reached a fluid condition as shown by spreading out over the base in a flat layer.

Lab. No.	Name of coal bed.	Mine.	Softening Temp. Degrees F.	Softening Int. Degrees F.	Flowing Int. Degrees F.
75907	Clintwood (North Fork)	Va. Blue Gem No. 1..	2060	120	160
75905	Stone Creek	Stone Creek Coal Co..	2160	230	230
34978	Imboden	Penn-Lee No. 1	2800	80	50
34979	Imboden	Penn-Lee No. 4	2710	60	30
75747	Kelly	Mohawk No. 2	2730	190	...
75748	Kelly	Mohawk No. 2	2680	120	60
75749	Kelly	Mohawk No. 1	2630	130	50
75909	Lower St. Charles	Tomlinson Fuel Co....	2110	230	170
75908	Upper St. Charles	Freeheart Coal Co....	3000	200	...
75906	Upper St. Charles	St. Charles Coal Co...	3000	210	...
75787	Harlan	Emerald Coal Co....	2280	320	170
75788	Harlan	Puckett Creek Coal Co..	2330	320	20
34981	Harlan	Black Diamond No. 1.	2465	425	185
75675	Harlan	Stonega No. 3	2110	150	110
75676	Harlan	Stonega No. 3	2020	110	320
34980	Taggart	Va. Lee No. 1	2100	80	60
75792	Taggart	Old Va. Coal Co. No. 3.	2110	80	50
75793	Taggart	Old Va. Coal Co. No. 3.	2110	120	180
75679	Taggart	Stonega No. 1	2570	240	50
75806	Low Splint	Va. Iron, Coal & Coke Co. No. 3	2630	220	110
75789	Phillips	Benedict Coal Co. No. 1.	2660	220	80
75790	Phillips	Benedict Coal Co. No. 1.	2740	...	...

TESTS.

General Statement.

Samples of coal from the Harlan and Taggart coal beds near Crab Orchard, and from the Taggart coal bed at Darbyville, were subjected to tests in the fuel-testing plants of the United States Geological Survey to deter-

¹ The determinations were made by the U. S. Bureau of Mines at Pittsburgh.

mine their value for commercial purposes. The samples represented run of mine coal and were used in making steaming, producer gas, and coking tests at St. Louis, Missouri. The chemical composition of mine samples of the coals is shown in the table of analyses on a previous page.

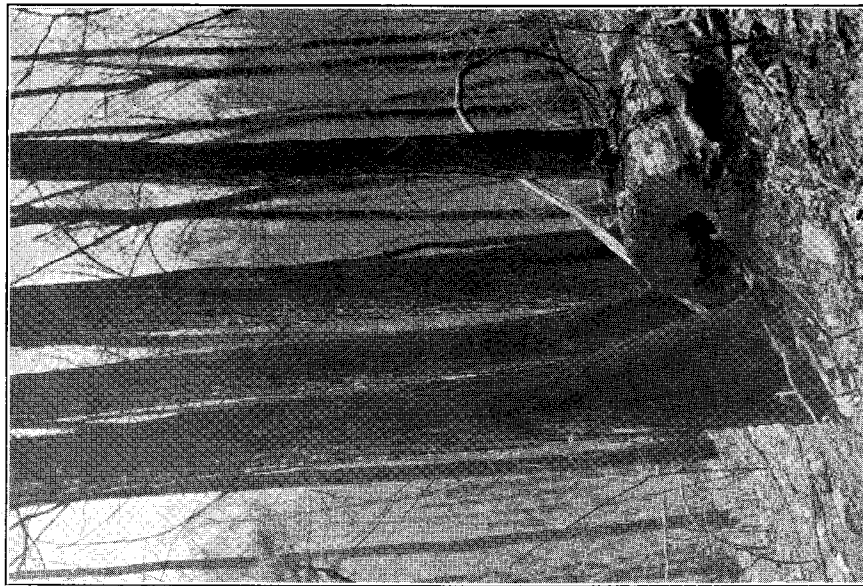
On the succeeding pages the essential results of these tests are summarized in a manner intended to show briefly the adaptability of the coals to the uses for which they were tested. Further information regarding types of testing apparatus used, conditions under which tests were made, etc., may be had by referring to the publications cited in the footnotes.

The tests emphasize the excellent qualities of the coals tested. The generally low ash and wide range in fuel ratio (fixed carbon divided by volatile matter) make available, in Lee County, coals suited to almost any commercial use. The Taggart is one of the best known coking coals of Wise County, and for many years it was coked at Keokee, but the ovens are now abandoned. The Imboden is also a coal possessing excellent coking qualities. The Pishel test¹ applied to the coal beds above the Taggart indicates that their coals will coke.

Tests of Coal from Harlan Coal Bed.

The coal for the following tests was taken from the H. C. Morris prospect, a small prospect hole or country bank, near Crab Orchard, Lee County, Virginia. The coal was loaded into wagons and hauled to the Louisville and Nashville Railroad, a distance of about seven miles. The sample was taken from near the outcrop. Chemical analyses of this coal may be found on pages 140-141 of this report, Laboratory Numbers 2246, 2268, 2269, and 2420.

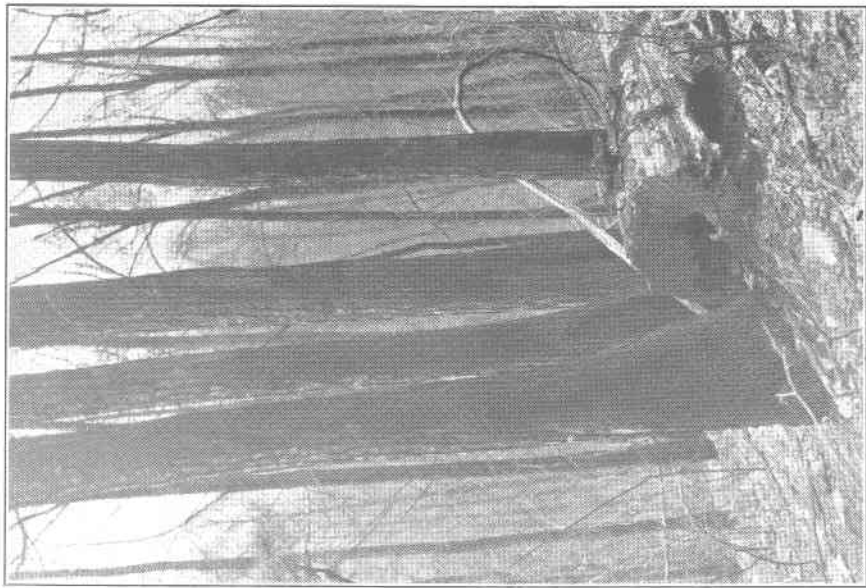
¹The Pishel test is as follows: Pulverize in an agate mortar a small quantity of the coal to be tested until it will pass through a 100-mesh sieve. Pour out the pulverized coal and observe the condition of the mortar and pestle. With some coals the mortar and pestle will be deeply covered with a coating of coal dust, which adheres so strongly to the agate surface that it is removed with difficulty. With other coals there will be only a thin film of coal dust adhering to the mortar and pestle, while with still others both mortar and pestle will be nearly as clean after the coal is pulverized as they were before the operation began. The degree of adhesion seems to coincide with the coking qualities of the coal. If it adheres strongly the coal will probably make excellent coke; if it adheres only slightly the coal possesses coking qualities to only a slight extent, if at all; and if the mortar shows no coating of dust the coal is to be regarded as noncoking.



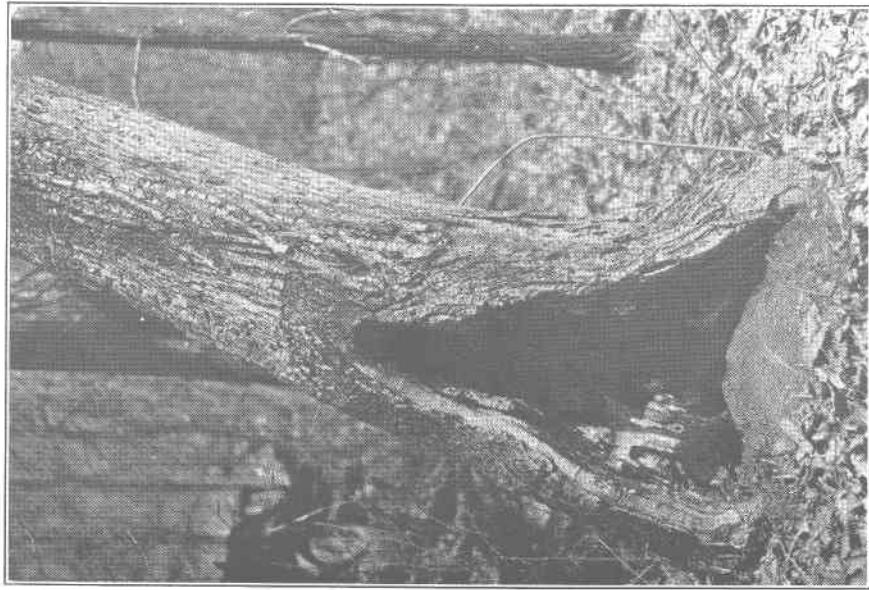
(A) Four chestnut trees in a clump, all injured by fire years ago. Decay enters at such fire-scars, hence the butts of such trees must be wasted.



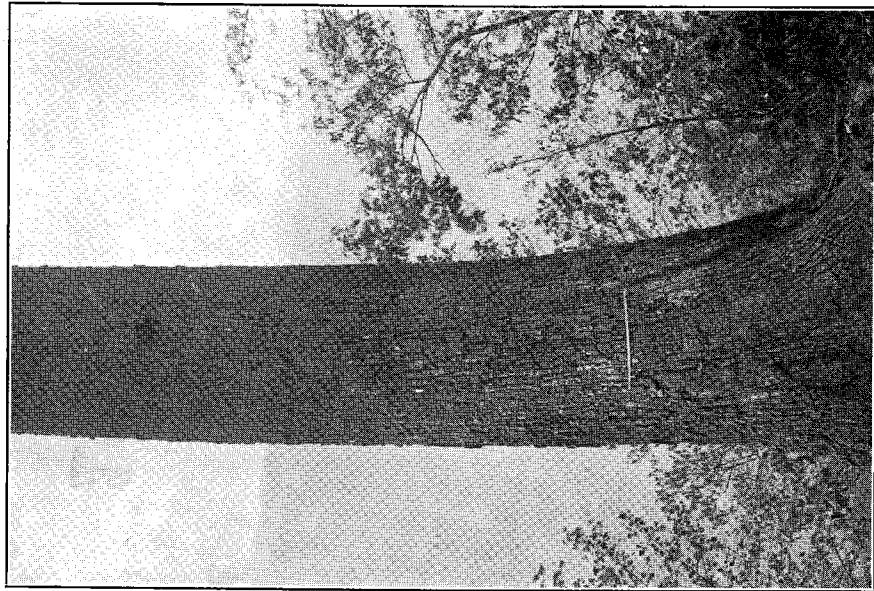
(B) A poplar tree damaged by fire. A good example of the "swell-butted trees with blackened cat-faces" mentioned on page 24.



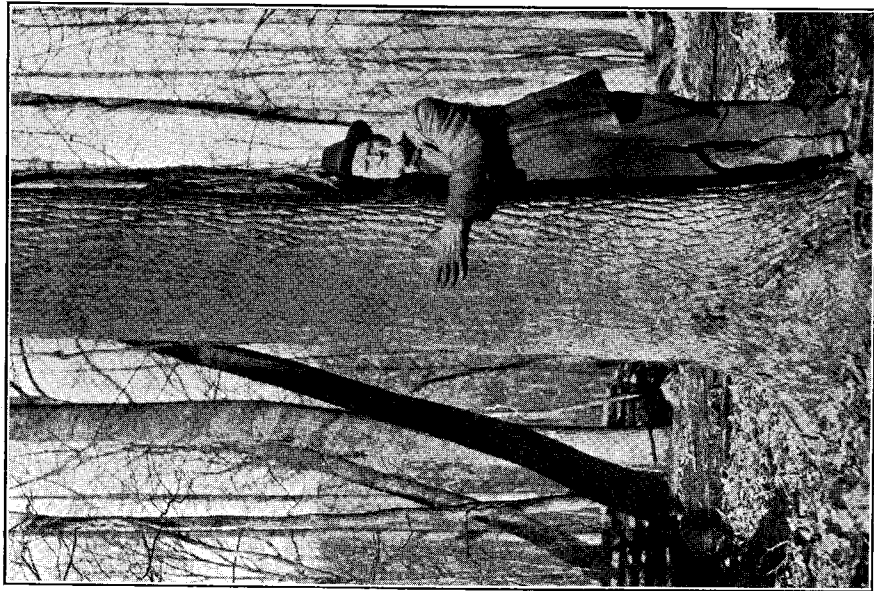
(A) Four chestnut trees in a clump, all injured by fire years ago. Decay enters at such fire-scars, hence the butts of such trees must be wasted.



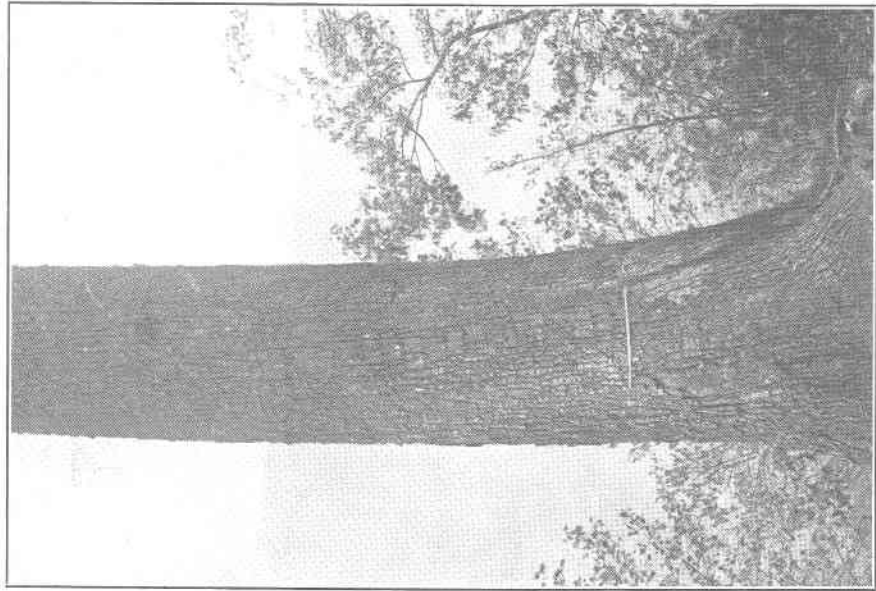
(B) A poplar tree damaged by fire. A good example of the "swell-butted trees with blackened cat-faces" mentioned on page 24.



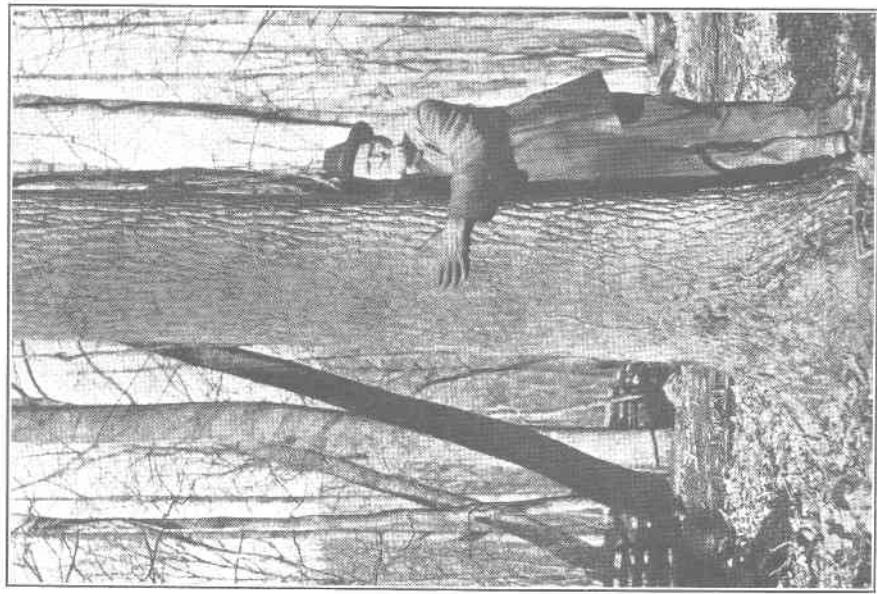
(A) A veteran chestnut-oak four feet in diameter, on Powell Mountain near Stickleyville. A remnant of the "First Forest."



(B) A yellow poplar forty-three years old and twenty inches in diameter. The man in the picture, R. L. Kirk, Stone Creek, hoed corn where this tree stands only forty-three years before the picture was taken.



(A) A veteran chestnut-oak four feet in diameter, on Powell Mountain near Stickleyville. A remnant of the "First Forest."



(B) A yellow poplar forty-three years old and twenty inches in diameter. The man in the picture, R. L. Kirk, Stone Creek, hoed corn where this tree stands only forty-three years before the picture was taken.

STEAMING TESTS.¹

Test 281.—Size as shipped, run of mine. Size as used, over 1 inch, 30 per cent; $\frac{1}{2}$ -inch to 1 inch, 21.3 per cent; $\frac{1}{4}$ -inch to $\frac{1}{2}$ -inch, 17.5 per cent; under $\frac{1}{4}$ -inch, 31.2 per cent. Duration of test, 9.75 hours. Kind of grate, rocking.

Test 282.—Size as shipped, run of mine. Size as used, over 1 inch, 25.4 per cent; $\frac{1}{2}$ -inch to 1 inch, 21.6 per cent; $\frac{1}{4}$ -inch to $\frac{1}{2}$ -inch, 19.4 per cent; under $\frac{1}{4}$ -inch, 33.6 per cent. Duration of test, 9.83 hours. Kind of grate, rocking.

Summary of steaming tests.

	Test 281.	Test 282.
Heating value of coal B. t. u. per lb. dry coal	14,281	14,198
Force of draft:		
Under stack damper inch water	0.41	0.38
Above fire do	.14	.11
Furnace temperature °F.	2,637	2,542
Dry coal used per square foot of grate surface per hour pounds	18.35	18.57
Equivalent water evaporated per square foot of water-heating surface per hour pounds	3.29	3.29
Percentage of rated horsepower of boiler developed	92.2	92.3
Water apparently evaporated per pound of coal as fired pounds	7.95	7.82
Water evaporated from and at 212° F.:		
Per pound of coal as fired do	9.54	9.39
Per pound of dry coal do	10.01	9.89
Per pound of combustible do	10.78	10.72
Efficiency of boiler, including grate per cent	67.69	67.27
Coal as fired:		
Per indicated horsepower hour pounds	2.96	3.01
Per electrical horsepower hour do	3.66	3.72
Dry coal:		
Per indicated horsepower hour do	2.82	2.86
Per electrical horsepower hour do	3.49	3.53

¹ Breckenridge, L. P., Kreisinger, Henry, and Ray, W. T., Steaming tests of coals. Bur. Mines Bull. 23, 1912, pp. 68-69, 82, 96-97, 111, 126-127, 141, 183-184.

Holmes, J. A., Preliminary report on the operating of the fuel-testing plant of the United States Geological Survey at St. Louis, Missouri, 1905. U. S. Geol. Survey Bull. 290, 1906, pp. 26-27, 186-193, 196-199.

Proximate analyses of coal as used.

	Test 281.	Test 282.
Moisture	4.62	5.05
Volatile matter	33.85	32.82
Fixed carbon	55.92	56.05
Ash	5.61	6.08
	100.00	100.00
Sulphur	1.08	1.09

Ultimate analyses figured on dry basis.

	Test 281.	Test 282.
Carbon ^a	79.12	78.67
Hydrogen ^a	5.03	5.00
Oxygen ^a	7.56	7.50
Nitrogen ^a	1.28	1.28
Sulphur	1.13	1.15
Ash	5.88	6.40
	100.00	100.00

PRODUCER-GAS TEST.¹

Test 77.—Size as shipped, run of mine. Size as used, not determined.
Duration of test, 50 hours.

Average electrical horsepower	196.2
Average B. t. u. gas, per cubic foot	164.4
Total coal fired, pounds	14,100

^a Figured from car sample.

¹ Fernald, R. H. and Smith, C. D., Resumé of producer-gas investigations. Bur. Mines Bull. 13, 1911, pp. 211, 276, 282, 288, 294, 300, 306, 312.

Holmes J. A., op. cit., p. 188.

Summary of producer-gas test.

(Coal consumed in pounds per horsepower per hour.)

	Test 77.		
	Coal as fired.	Dry coal.	Combustible.
In producer engine:			
Per electrical horsepower:			
Available for outside purposes	1.51	1.43	1.33
Developed at switchboard	1.44	1.35	1.26
Per brake horsepower:			
Available for outside purposes	1.29	1.21	1.13
Developed at engine	1.22	1.15	1.07
In producer plant (including fuel equivalent of auxiliary power):			
Per electrical horsepower:			
Available for outside purposes	1.61	1.52	1.42
Developed at switchboard	1.53	1.44	1.34
Per brake horsepower:			
Available for outside purposes	1.37	1.29	1.20
Developed at engine	1.30	1.23	1.14

Analysis of coal as fired.

	Test 77.
Moisture	5.72
Volatile matter	31.93
Fixed carbon	55.91
Ash	6.44
	100.00
Sulphur	1.08

Analysis of gas (per cent by volume).

	Test 77.
Carbon dioxide (CO ₂)	10.0
Carbon monoxide (CO)	19.7
Hydrogen (H ₂)	14.9
Methane (CH ₄)	3.6
Nitrogen (N ₂)	51.8
	100.00

COKING TESTS.¹

In the following summary of coking tests, test 191 shows the results of a test on coal from the famous Pittsburgh bed at Connellsville, Pennsylvania, which is included in the table to serve as a standard for comparison.

Summary of coking tests.

	Test 191.	Test 64.	Test 65.	Test 67.	Test 68.	Test 77.
Duration of test .....hours	47	71	36	36	67	65
Specific gravity, real	1.97	1.80	1.79	1.83	1.81	1.87
Specific gravity, apparent .....	.98	.93	.91	.95	.94	.84
Weight per cubic foot, dry pounds	60.92	57.11	56.65	59.13	58.06	52.27
Weight per cubic foot, as re- ceived (wet) .....pounds	92.13	87.06	87.21	89.08	88.01	86.56
Percentage coke	50.00	52.00	51.00	52.00	52.00	45.00
Percentage cells	50.00	48.00	49.00	48.00	48.00	55.00
Six-foot drop test, percentage over 2-inch mesh:						
1	93.50	95.50	92.50	89.00	91.00	93.00
2	85.50	90.50	85.00	80.50	80.00	89.00
3	79.50	85.50	78.50	71.00	72.00	82.00
4	75.00	80.50	74.50	67.00	67.00	78.00
Weight of coal, dry .....pounds	11,429	13,202	9,556	9,505	13,325	13,385
Weight of coke, dry do	7,937	8,941	6,727	5,867	8,570	9,487
Weight of breeze, dry do	367	409	255	423	588	313
Percentage coke	69.45	67.72	70.40	61.73	64.32	70.88
Percentage breeze	3.21	3.09	2.67	4.45	4.41	2.34
Total percentage yield	72.66	70.81	73.07	66.18	68.73	73.22

Analyses of coal as charged and resulting coke.

	Test 191.		Test 64.		Test 65.	
	Coal.	Coke.	Coal.	Coke.	Coal.	Coke.
Moisture	4.29	0.33	5.70	1.52	4.44	1.23
Volatile matter	29.92	.15	32.52	.99	33.44	1.67
Fixed carbon	58.22	88.54	56.15	89.20	56.27	89.24
Ash	7.58	10.98	5.63	8.29	5.85	7.86
Sulphur .....	.91	.87	.98	.88	1.13	.94
Phosphorus .....	.....	.0104	.....	.....	.....	.....

¹ Holmes, J. A., op. cit., p. 189.

Moldenke, Richard, Belden, A. W., Delamater, G. R., Washing and coking tests of coal and cupola tests of coke conducted by the United States fuel-testing plant at St. Louis, Mo., January 1, 1905, to June 30, 1907. U. S. Geol. Survey Bull. 336, pp. 25, 33-34, 43, 54, 55, 57.

Test 191, remarks.—Coke light gray and silvery color; cell structure small but coke not dense; metallic ring; breakage good; uniform size; good heavy coke.

Test 64, remarks.—Light gray; hard heavy coke; high yield due to deposited carbon.

Test 65, remarks.—Light gray and silvery; good heavy coke; high yield due to deposited carbon.

Analyses of coal as charged and resulting coke.

	Test 67.		Test 68.		Test 77.	
	Coal.	Coke.	Coal.	Coke.	Coal.	Coke.
Moisture	4.95	0.21	4.82	0.30	4.40	0.20
Volatile matter	34.21	.89	33.21	1.16	35.09	.80
Fixed carbon	55.86	90.99	56.95	90.85	55.24	91.52
Ash	4.98	7.91	5.02	7.69	5.27	7.48
Sulphur	1.12	1.01	1.10	.97	1.05	1.02
Phosphorus .....	.....	.....	.....	.....	.....	.....

Test 67, remarks.—Light gray and silvery; coke not so good as that from ground charge; cross breakage increased and breeze much larger, but good coke; results would justify installation of disintegrating machinery; high yield due to deposited carbon.

Test 68, remarks.—Light gray and silvery; large percentage of breeze due to not grinding coal before charging; loss by breakage also increased from same cause; good hard heavy coke; high yield due to deposited carbon.

Test 77, remarks.—Light gray and silvery; good hard heavy coke; high yield due to deposited carbon.

Tests of Coal from Taggart Coal Bed near Crab Orchard.

The coal for the following tests was taken from a prospect near the "big opening" on the Wilson farm, near Crab Orchard, Lee County, Virginia. The sample which was run-of-mine, was loaded in wagons and hauled to the Louisville and Nashville railroad, a distance of about 7 miles. The

sample was taken from the face about 75 feet from the outcrop. Chemical analyses of this coal may be found on pages 143-144 of this report, Laboratory Numbers 2248, 2249, and 2476.

STEAMING TESTS.¹

Test 247.—Size as shipped, run of mine. Size as used, over 1 inch, 49.6 per cent; $\frac{1}{2}$ -inch to 1 inch, 23 per cent; $\frac{1}{4}$ -inch to $\frac{1}{2}$ -inch, 12.4 per cent; under $\frac{1}{4}$ -inch, 15 per cent. Duration of test, 8 hours. Kind of grate, plain.

Test 251.—Size as shipped, run of mine. Size as used, over 1 inch, 45 per cent; $\frac{1}{2}$ -inch to 1 inch, 23.6 per cent. Duration of test, 8 hours. Kind of grate, plain.

Test 256.—Size as shipped, run of mine. Size as used, over 1 inch, 28.9 per cent; $\frac{1}{2}$ -inch to 1 inch, 18.9 per cent; $\frac{1}{4}$ -inch to $\frac{1}{2}$ -inch, 15 per cent; under $\frac{1}{4}$ -inch, 37.2 per cent. Duration of test, 8.43 hours. Kind of grate, rocking.

Test 258.—Size as shipped, run of mine. Size as used, over 1 inch, 31.8 per cent; $\frac{1}{2}$ -inch to 1 inch, 19 per cent; $\frac{1}{4}$ -inch to $\frac{1}{2}$ -inch, 16.9 per cent; under $\frac{1}{4}$ -inch, 32.3 per cent. Test run on an ordinary Frost fire-tube boiler. Duration of test, 7 hours. Kind of grate, rocking.

Test 260.—Size as shipped, run of mine. Size as used, over 1 inch, 49.5 per cent; $\frac{1}{2}$ -inch to 1 inch, 23.3 per cent; $\frac{1}{4}$ -inch to $\frac{1}{2}$ -inch, 12.6 per cent; under $\frac{1}{4}$ -inch, 14.6 per cent. Duration of test, 9.87 hours. Kind of grate, rocking.

¹ Breckenridge, L. P., etc., op. cit.
Holmes, J. A., op. cit.

Summary of steaming tests.

	Test 247.	Test 251.	Test 256.	Test 258.	Test 260.
Heating value of coal, B. t. u. per lb., dry coal	14,443	14,285	14,317	14,254	14,497
Force of draft:					
Under stack damper inch water	0.44	0.41	0.44	0.23	0.34
Above fire do	.10	.10	.15	.20	.13
Furnace temperature °F.	2,548	2,515	2,673	(*)	2,671
Dry coal used per square foot of grate surface per hour pounds	18.52	17.71	18.24	.....	18.02
Equivalent water evaporated per square foot of water-heating surface per hour pounds	3.71	3.41	3.13	.....	3.13
Percentage of rated horsepower of boiler developed	104.0	95.60	87.6	^b 110.0	87.7
Water apparently evaporated per pound of coal as fired pounds	8.21	7.82	7.67	6.96	7.79
Water evaporated from and at 212° F.:					
Per pound of coal as fired pounds	9.76	9.32	9.16	8.26	9.35
Per pound of dry coal do	10.02	9.65	9.56	8.57	9.68
Per pound of combustible do	10.74	10.45	10.45	9.45	10.38
Efficiency of boiler, including grate, per cent	67.00	65.24	64.48	58.06	64.48
Coal as fired:					
Per indicated horsepower hour. pounds	2.90	3.03	3.09	3.42	3.02
Per electrical horsepower hour. do	3.58	3.75	3.81	4.23	3.73
Dry coal:					
Per indicated horsepower hour. do	2.82	2.93	2.96	3.30	2.92
Per electrical horsepower hour. do	3.48	3.62	3.65	4.07	3.61

Proximate analyses of coal as used.

	Test 247.	Test 251.	Test 256.	Test 258.	Test 260.
Moisture	2.56	3.37	4.22	3.60	3.34
Volatile matter	35.34	33.75	33.48	33.56	36.14
Fixed carbon	56.72	56.41	56.11	56.23	56.04
Ash	5.38	6.47	6.19	6.61	4.48
Sulphur	100.00 .98	100.00 .82	100.00 .82	100.00 .85	100.00 .85

* Too low for pyrometer.

^b Approximately.

Ultimate analyses figured on dry basis.

	Test 247.	Test 251.	Test 256.	Test 258.	Test 260.
Carbon ^a	79.86	79.00	79.18	78.82	80.74
Hydrogen ^a	5.01	4.95	4.96	4.94	5.05
Oxygen ^a	7.12	7.04	7.08	7.05	7.21
Nitrogen ^a	1.48	1.46	1.46	1.45	1.49
Sulphur	1.01	.85	.86	.88	.88
Ash	5.52	6.70	6.46	6.86	4.63
	100.00	100.00	100.00	100.00	100.00

PRODUCER-GAS TEST.¹

Test 78.—Size as shipped, run of mine. Size as used, over 1 inch, 74 per cent; ½-inch to 1 inch, 11 per cent; ¼- to ½-inch, 6 per cent; under ¼-inch, 9 per cent. Duration of test, 50 hours.

Average electrical horsepower	197.5
Average B. t. u. gas, per cubic foot	169.0
Total coal fired, pounds	12,950

Summary of producer-gas test.

(Coal consumed in pounds per horse-power per hour.)

	Test 78.		
	Coal as fired.	Dry coal.	Combustible.
In producer engine:			
Per electrical horsepower:			
Available for outside purposes	1.39	1.36	1.28
Developed at switchboard	1.31	1.28	1.20
Per brake horsepower:			
Available for outside purposes	1.18	1.15	1.09
Developed at engine	1.11	1.09	1.02
In producer plant (including fuel equivalent of auxiliary power):			
Per electrical horsepower:			
Available for outside purposes	1.47	1.43	1.35
Developed at switchboard	1.38	1.35	1.27
Per brake horsepower:			
Available for outside purposes	1.25	1.22	1.14
Developed at engine	1.17	1.15	1.08

^a Figured from car sample.

¹ Holmes, J. A., op. cit., p. 192.

Fernald, R. H. and Smith, C. D., op. cit., pp. 211, 276.

Analysis of coal as fired.

	Test 78.
Moisture	2.36
Volatile matter	36.40
Fixed carbon	55.44
Ash	5.80
	100.00
Sulphur .....	.67

Analysis of gas (per cent by volume).

	Test 78.
Carbon dioxide (CO ₂)	8.2
Carbon monoxide (CO)	22.2
Hydrogen (H ₂)	13.0
Methane (CH ₄)	3.6
Nitrogen (N ₂)	53.0
	100.0

WASHING TEST ¹

Test 134.—Size as shipped, run of mine. Size as used, crushed to 2 inches. Jig used, Stewart modified.

Raw coal	pounds	28,000
Washed coal	do	24,550
Refuse	do	3,450

Analyses.

	Test 134.	
	Raw coal.	Washed coal.
Moisture	3.35	6.39
Volatile matter	35.13	.....
Fixed carbon	55.94	.....
Ash	5.58	3.95
Sulphur .....	.92	.88

¹ Holmes, J. A., op. cit., p. 192.

COKING TESTS.¹

In the following summary of coking tests, test 191 shows the results of a test on coal from the famous Pittsburgh bed at Connellsville, Pennsylvania, which is included in the table to serve as a standard for comparison.

Summary of coking tests.

	Test 191.	Test 63.	Test 69.	Test 70.
Duration of test .....hours	47	51	48	40
Specific gravity, real	1.97	1.87	1.85	1.87
Specific gravity, apparent .....	.98	.85	.93	.80
Weight per cubic foot, dry .....pounds	60.92	52.88	57.23	49.68
Weight per cubic foot, as received (wet). do	92.13	87.17	88.43	85.23
Percentage coke	50.00	45.00	50.00	43.00
Percentage cells	50.00	55.00	50.00	57.00
Six-foot drop test, percentage over 2-inch mesh:				
1	93.50	95.00	88.50	93.50
2	85.50	81.50	81.00	89.50
3	79.50	78.50	73.50	83.50
4	75.00	73.00	68.00	67.50
Weight of coal, dry .....pounds	11,429	11,534	11,537	9,404
Weight of coke, dry .....do	7,937	7,499	7,264	6,069
Weight of breeze, dry .....do	367	290	430	293
Percentage coke	69.45	65.02	62.97	64.54
Percentage breeze	3.21	2.51	3.73	3.12
Total percentage yield	72.66	67.53	66.70	67.66

Analyses of coal as charged and resulting coke.

	Test 191.		Test 63.		Test 69.		Test 70.	
	Coal.	Coke.	Coal.	Coke.	Coal.	Coke.	Coal.	Coke.
Moisture	4.29	0.33	3.88	0.25	3.86	0.69	5.96	0.45
Volatile matter .	29.92	.15	34.11	1.08	34.13	.93	34.17	1.23
Fixed carbon ...	58.22	88.54	57.01	91.25	56.39	90.33	56.03	92.25
Ash	7.58	10.98	5.00	7.42	5.62	8.05	3.84	6.07
Sulphur .....	.91	.87	1.02	.68	.79	.65	.91	.69
Phosphorus ....	.....	.0104	.....	.....	.....	.....	.....	.....

Test 191, remarks.—Coke light gray and silvery color; cell structure small but coke not dense; metallic ring; breakage good; uniform size; good heavy coke.

¹ Holmes, J. A., op. cit., p. 193.

Moldenke, Richard, Belden, A. W., Delameter, G. R., op. cit., pp. 25, 34, and 43.

Test 63, remarks.—Light gray and silvery; good foundry coke; large draft, giving more intense heat, would probably give better coke; used small draft at first to hold charge as long as possible.

Test 69, remarks.—Light gray and silvery; good heavy coke; breeze content large, due to not grinding coal; not as good as coke from ground charge; high yield due to deposited carbon.

Test 70, remarks.—Light gray and silvery; good hard coke; washing does not improve coke enough to warrant the expense; high yield due to deposited carbon.

Tests of Coal from Taggart Coal Bed at Darbyville.

The coal for the following tests was taken from the Darby mine at Darbyville, Lee County, Virginia. The sample consisted of lump coal over 1½-inch bar screen. Chemical analyses of this coal may be found on page 144 of this report, Laboratory Numbers 2323, 2324, 2358, 6236.

STEAMING TESTS.¹

Test 240.—Size as shipped, over 1½ inches. Size as used, over 1 inch, 46.5 per cent; ½-inch to 1 inch, 21.9 per cent; ¼-inch to 1 inch, 12.9 per cent; under ¼-inch, 18.7 per cent. Duration of test, 9.70 hours. Kind of grate, plain.

Test 248.—Size as shipped, over 1½ inches. Size as used, over 1 inch, 46.1 per cent; ½-inch to 1 inch, 20.4 per cent; ¼-inch to ½-inch, 12.5 per cent; under ¼-inch, 21.0 per cent. Duration of test, 8.02 hours. Kind of grate, plain. Limestone spread over grate at start.

Test 254.—Size as shipped, over 1½ inches. Sizes as used, over 1 inch, 62.6 per cent; ½-inch to 1 inch, 15.4 per cent; ¼-inch to ½-inch, 7.9 per cent; under ¼-inch, 14.1 per cent. Duration of test, 10 hours. Kind of grate, plain. Limestone spread over grate at start.

Test 245 (coal mixed with coal from mine No. 3, Pennsylvania Coal & Coke Company, Ehrenfeld, Cambria County, Pennsylvania).—Size as shipped, over 1½ inches and run of mine. Size as used, over 1 inch, 44.8 per cent; ½-inch to 1 inch, 13.6 per cent; ¼-inch to ½-inch, 9.3 per cent; under ¼-inch, 32.3 per cent. Coals mixed. Duration of test, 7.82 hours. Kind of grate, plain.

¹ Breckenridge, L. P., etc., op. cit.
Holmes, J. A., op. cit.

Summary of Steaming Tests.

	Test 240.	Test 248.	Test 254.	Test 245.
Heating value of coal.....B. t. u. per lb. dry coal	14,558	14,677	14,414	14,476
Force of draft:				
Under stack damper .....inch water	0.53	0.46	0.44	0.45
Above fire .....do	.22	.11	.13	.12
Furnace temperature .....°F.	2,224	2,483	2,582	2,338
Dry coal used per square foot of grate surface per hour .....pounds	15.73	17.14	18.0	17.14
Equivalent water evaporated per square foot of water-heating surface per hour ...pounds	3.04	3.48	3.46	3.06
Percentage of rated horsepower of boiler de- veloped .....pounds	85.10	97.50	96.9	85.7
Water apparently evaporated per pound of coal as fired .....pounds	7.83	8.23	7.76	7.27
Water evaporated from and at 212° F.:				
Per pound of coal as fired .....pounds	9.33	9.81	9.22	8.66
Per pound of dry coal .....do	9.66	10.18	9.62	8.93
Per pound of combustible .....do	10.39	10.86	10.20	9.81
Efficiency of boiler, including grate.....per cent	64.08	66.98	64.45	59.57
Coal as fired:				
Per indicated horsepower hour .....pounds	3.03	2.88	3.07	3.27
Per electrical horsepower hour .....do	3.74	3.56	3.79	4.03
Dry coal:				
Per indicated horsepower hour .....do	2.93	2.78	2.94	3.17
Per electrical horsepower hour .....do	3.61	3.43	3.63	3.91

Proximate analyses of coal as used.

	Test 240.	Test 248.	Test 254.	Test 245.
Moisture	3.40	3.62	4.13	2.99
Volatile matter	36.01	35.84	36.18	28.16
Fixed carbon	55.87	56.58	56.09	63.30
Ash	4.72	3.96	3.60	5.55
	100.00	100.00	100.00	100.00
Sulphur .....	.49	.44	.44	.70

Ultimate analyses figured on dry basis.

	Test 240.	Test 248.	Test 254.	Test 245.
Carbon ^a	80.44	81.15	81.44	81.24
Hydrogen ^a	4.99	5.03	5.05	4.46
Oxygen ^a	7.79	7.86	7.89	6.45
Nitrogen ^a	1.38	1.39	1.40	1.41
Sulphur .....	.51	.46	.46	.72
Ash	4.89	4.11	3.76	5.72
	100.00	100.00	100.00	100.00

^a Figured from car sample.

PRODUCER-GAS TEST.¹

Test 74.—Size as shipped, over 1½ inches. Size as used, not determined. Duration of test, 50 hours.

Average electrical horsepower	196.3
Average B. t. u. gas, per cubic foot	167.2
Total coal fired, pounds	12,200

Summary of producer-gas test.

(Coal consumed in pounds per horsepower per hour.)

	Test 74.		
	Coal as fired.	Dry coal.	Combustible.
In producer engine:			
Per electrical horsepower:			
Available for outside purposes	1.31	1.28	1.24
Developed at switchboard	1.24	1.21	1.18
Per brake horsepower:			
Available for outside purposes	1.12	1.09	1.05
Developed at engine	1.06	1.03	1.00
In producer plant (including fuel equivalent of auxiliary power):			
Per electrical horsepower:			
Available for outside purposes	1.38	1.35	1.31
Developed at switchboard	1.31	1.27	1.24
Per brake horsepower:			
Available for outside purposes	1.17	1.14	1.11
Developed at engine	1.11	1.08	1.05

Analysis of coal as fired.

	Test 74.
Moisture	2.72
Volatile matter	36.79
Fixed carbon	57.72
Ash	2.77
	100.00
Sulphur .....	.42

¹ Holmes, J. A., op. cit.

Fernald, R. H., and Smith, C. D., op. cit., pp. 211, 276.

Analysis of gas (per cent by volume).

	Test 74.
Carbon dioxide (CO ₂)	7.5
Carbon monoxide (CO)	23.5
Hydrogen (H ₂)	13.8
Methane (CH ₄)	3.3
Nitrogen (N ₂)	51.9
	100.0

COKING TESTS.¹

In the following summary of coking tests, test 191 shows the results of a test on coal from the famous Pittsburgh bed at Connellsville, Pennsylvania, which is included in the table to serve as a standard for comparison.

Summary of coking tests.

	Test 191.	Test 62.
Duration of test	47	36
Specific gravity, real	1.97	1.84
Specific gravity, apparent .....	.98	.83
Weight per cubic foot, dry	60.92	51.70
Weight per cubic foot, as received (wet)	92.13	85.99
Percentage coke	50.00	45.00
Percentage cells	50.00	55.00
Six-foot drop test, percentage over 2-inch mesh:		
1	93.50	93.50
2	85.50	87.00
3	79.50	82.50
4	75.00	77.00
Weight of coal, dry	11,429	9,613
Weight of coke, dry	7,937	6,262
Weight of breeze, dry	367	241
Percentage coke	69.45	65.14
Percentage breeze	3.21	2.51
Total percentage yield	72.66	67.65

¹ Holmes, J. A., op. cit., p. 199.

Moldenke, Richard, etc., op. cit., pp. 25, 34, 43.

Analyses of coal as charged and resulting coke.

	Test 191.		Test 62.	
	Coal.	Coke.	Coal.	Coke.
Moisture	4.29	0.33	3.87	0.16
Volatile matter	29.92	.15	36.39	1.14
Fixed carbon	58.22	88.54	55.60	92.90
Ash	7.58	10.98	4.14	5.80
Sulphur .....	.91	.87	.39	.42
Phosphorus .....	.....	.0104	.....	.....

Test 191, remarks.—Coke light gray and silvery color; cell structure small but coke not dense; metallic ring; breakage good; uniform size; good heavy coke.

Test 62, remarks.—Light gray and silvery; fine-fingered coke; breaks in long, thin pieces; light-weight coke.

CUPOLA TESTS OF COKE.¹

The samples of coke made in the tests described above were subjected to 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, etc., op. cit.

Summary of cupola tests.

	Connellsville coke.	Coke test 64.	Coke test 65.	Coke test 67.	Coke test 68.	Coke test 77.	Coke test 63.	Coke test 69.	Coke test 70.	Coke test 80.						
	Test 19.	Test 24.	Test 78.	Test 69.	Test 186.	Test 59.	Test 183.	Test 31.	Test 92.	Test 178.	Test 158.	Test 52.	Test 171.	Test 172.	Test 32.	Test 34.
CHARGES (Pounds)—																
1 Coke bed	220	200	200	200	190	200	190	180	180	195	220	200	180	180	200	190
2 Pig iron	660	600	600	600	570	600	570	540	540	585	920	300	720	720	600	570
3 Scrap	220	200	200	200	190	200	190	180	180	195	920	300	720	720	200	190
4 Coke	53	58	58	58	60	58	60	62	63	59	87	58	49	80	58	60
5 Pig iron	398	413	413	413	420	413	420	427	428	417	520	550	570	570	413	420
6 Scrap	138	138	138	138	140	138	140	142	143	139	520	550	570	570	138	140
7 Coke	53	58	58	58	60	58	60	62	63	59	86	58	49	80	58	60
8 Pig iron	398	413	413	413	420	413	420	427	428	416	520	550	570	570	413	420
9 Scrap	138	138	138	138	140	138	140	142	143	139	520	550	570	570	138	140
10 Coke	52	57	57	57	60	57	60	63	62	59	86	57	49	80	57	60
11 Pig iron	397	412	412	412	420	412	420	428	427	416	520	550	570	570	412	420
12 Scrap	132	137	137	137	140	137	140	143	142	139	520	550	570	570	137	140
13 Coke	52	57	57	57	60	57	60	63	62	58	86	57	48	80	57	60
14 Pig iron	397	412	412	412	420	412	420	428	427	416	520	550	570	570	412	420
15 Scrap	132	137	137	137	140	137	140	143	142	138	520	550	570	570	137	140
TOTALS (Pounds)—																
Coke	430	430	430	430	430	430	430	430	430	430	375	430	375	500	430	430
Pig iron	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	3,000	3,000	3,000	3,000	2,250	2,250
Scrap	750	750	750	750	750	750	750	750	750	750	800	800	800	800	750	750
Ratio of iron to coke	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	8%	7%	8%	6%	7%	7%
Maximum blast pressure (oz.)	2,470	1,418	1,763	1,873	2,007	1,816	2,019	2,253	1,882	1,900	2,153	1,989	2,256	2,475	2,104	2,356
Iron poured (lbs.)	2,470	2,220	2,183	1,827	2,300	2,122	2,314	2,433	2,012	2,414	2,480	2,474	2,542	2,680	2,380	2,478
Iron melted (lbs.)	283	485	625	965	231	261	391	322	786	248	318	301	255	122	578	287
Iron recovered (lbs.)	20	46	87	60	59	55	88	58	67	84	43	52	58	107	56	33
Coke recovered (lbs.)	8.2	9.88	6.40	6.98	11.30	7.23	9.93	7.50	6.78	11.27	6.40	7.50	6.76	6.40	6.40	7.83
Melting loss (per cent)	6.02	5.78	6.36	4.94	6.20	6.72	5.90	6.57	5.90	6.98	7.50	6.54	8.02	6.82	5.96	6.24
Melting ratio (iron to coke)	5.489	3.098	4.366	4.182	4.881	4.361	4.207	4.460	3.658	5.003	4.819	4.948	5.101	5.956	4.181	4.180
Melting rate (lbs. per hour)	10.57	8.53	10.01	10.22	8.49	8.00	11.04	8.31	8.12	9.32	11.00	7.42	10.43	8.45	10.19	8.56
Blast on at	A. M.	A. M.	A. M.	A. M.	P. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	A. M.	A. M.	P. M.	A. M.	A. M.
Iron running	11.03	9.01	10.09	10.33	3.59	3.10	11.10	3.37	8.22	3.59	11.06	7.54	10.57	3.55	10.29	9.01
WEIGHT AND TIME OF EACH LADLE—																
1 lb.	175	97	68	69	56	69	80	83	85	101	85	47	97	40	95	104
at	11.07	9.12	10.13	10.38	4.02	3.14	11.19	3.45	8.27	4.03	11.13	7.57	11.01	3.69	10.34	9.08
2 lbs.	115	73	131	106	108	68	108	75	52	100	103	66	95	62	76	101
at	11.11	9.15	10.15	10.41	4.05	3.17	11.23	3.48	8.27	4.07	11.13	7.57	11.05	4.02	10.34	9.10
3 lbs.	185	77	106	47	89	98	89	81	129	114	55	88	108	116	90	105
at	11.13	9.18	10.17	10.41	4.08	3.20	11.23	3.49	8.29	4.09	11.14	8.04	11.06	4.02	10.35	9.11
4 lbs.	150	95	87	81	92	78	66	102	76	97	88	83	102	72	80	101
at	11.14	9.19	10.22	10.42	4.08	3.20	11.24	3.50	8.29	4.08	11.17	8.04	11.06	4.03	10.36	9.13
5 lbs.	220	98	130	47	77	66	82	114	123	57	116	96	96	91	108	100
at	11.16	9.20	10.22	10.42	4.09	3.23	11.25	3.51	8.34	4.10	11.17	8.05	11.07	4.05	10.37	9.14
6 lbs.	150	95	136	101	86	101	108	79	135	88	112	83	118	101	97	113
at	11.18	9.21	10.23	10.46	4.13	3.23	1.25	3.52	8.34	4.12	11.18	8.09	11.07	4.05	10.39	9.16

	Connellsville coke.		Coke test 64.		Coke test 65.		Coke test 67.		Coke test 68.		Coke test 71.		Coke test 63.		Coke test 69.		Coke test 70.		Coke test 62.	
	Test 19.	Test 24.	Test 78.	Test 69.	Test 186.	Test 59.	Test 188.	Test 31.	Test 92.	Test 178.	Test 158.	Test 52.	Test 171.	Test 172.	Test 32.	Test 34.				
WEIGHT AND TIME OF EACH LADLE (Contd.)—																				
7 lbs.	225	91	88	77	103	86	66	91	91	95	93	77	106	128	93	89				
at	11.19	9.22	10.26	10.46½	4.13½	3.25	11.26	3.54	8.35	4.12½	11.20	8.09½	11.08	4.06	10.40	9.18				
8 lbs.	155	89	136	56	76	106	68	104	121	95	100	74	90	76	110	92				
at	11.22	9.23	10.26½	10.47	4.14	3.25½	11.28	3.55	8.29	4.13	11.20½	8.10	11.09	4.08	10.41	9.18½				
9 lbs.	255	83	151	103	88	54	87	81	144	87	116	74	111	89	94	101				
at	11.24	9.24	10.27	10.49	4.16	3.26	11.28½	3.56	8.30½	4.15	11.21	8.12	11.09½	4.08½	10.42	9.19				
10 lbs.	155	89	79	78	118	84	71	103	88	118	86	88	96	119	88	104				
at	11.26	9.26	10.29	10.49½	4.16½	3.28	11.29	3.56½	8.40	4.16½	11.23	8.12½	11.10	4.09	10.43	9.20½				
11 lbs.	250	80	116	84	93	102	133	101	118	101	104	111	104	75	109	88				
at	11.27	9.28	10.29½	10.50	4.20	3.28½	11.31	3.57	8.41	4.17	11.23½	8.13	11.11	4.10	10.44	9.21				
12 lbs.	125	63	129	97	88	62	128	71	96	138	113	71	111	101	92	102				
at	11.28	9.29	10.30	10.52	4.20½	3.29	11.31½	3.58	8.42	4.17½	11.24	8.14	11.11½	4.10½	10.45	9.23				
13 lbs.	170	81	97	80	137	81	118	97	88	60	79	98	98	120	97	96				
at	11.29	9.30	10.33	10.52½	4.21	3.31	1.32	3.58½	8.48	4.18	11.26	8.14½	11.12	4.11	10.46	9.24				
14 lbs.	140	84	113	86	77	95	85	90	124	74	101	96	82	76	98	93				
at	11.30	9.32	10.33½	10.53	4.23	3.31½	1.34	4.01	8.45½	4.21	11.26½	8.15	11.13	4.12	10.47	9.24½				
15 lbs.	100	98	100	93	87	68	70	88	137	96	117	63	109	101	98	83				
at	11.34	9.33	10.34	10.55	4.23½	3.32	11.34½	4.02	8.49	4.21½	11.27	8.16	11.13½	4.12½	10.49	9.27				
16 lbs.	56	56	71	75	121	72	91	78	83	83	76	96	99	116	97	87				
at	11.35	9.41½	10.38	10.55½	4.24	3.33	11.35	4.04	8.53	4.22	11.28	8.16½	11.14	4.13	10.50	9.27½				
17 lbs.	64	45	82	30	82	97	77	104	137	106	95	109	78	97	84	83				
at	11.36	9.44	10.39	10.56	4.25	3.33½	11.38	4.05	8.54	4.25	11.29½	8.17	11.15	4.13½	10.52	9.28				
18 lbs.	73	73	87	73	87	51	71	97	68	65	110	54	106	91	100	103				
at	11.01	9.45½	11.01	11.02	4.25½	3.34	11.38½	4.06	8.55	4.25½	11.29	8.19	11.15½	4.14	10.53	9.29½				
19 lbs.	88	88	88	88	52	69	91	95	89	81	70	88	97	99	89	89				
at	11.02	9.46	11.02	11.02	4.26	3.35	11.39	4.08	8.56	4.26	11.31	8.19½	11.16	4.14½	10.55	9.29				
20 lbs.	92	92	92	92	79	92	75	98	98	111	96	98	67	93	125	101				
at	11.03	9.47	11.03	11.03	4.27	3.35½	11.40	4.10	8.57	4.27	11.31½	8.20	11.17	4.17	10.56	9.30				
21 lbs.	68	68	68	68	61	72	68	81	83	83	88	74	101	95	14	101				
at	11.04	9.48	11.04	11.04	4.28½	3.37	11.40½	4.11	8.58	4.28	11.32	8.22	11.17½	4.17½	10.56½	9.30½				
22 lbs.	83	83	83	83	123	83	82	92	92	49	104	95	104	121	149	74				
at	11.05	9.49	11.05	11.05	4.31	3.37½	11.41	4.12	8.59	4.31	11.33	8.23	11.18	4.18	11.01	9.31				
23 lbs.	97	97	97	97	43	77	65	94	78	83	104	52	104	104	93	78				
at	11.06	9.50	11.06	11.06	4.32	3.40	11.42	4.12½	8.60	4.32	11.36½	8.23	11.20	4.20	9.35	9.35				
24 lbs.	69	69	69	69	60	60	69	74	74	51	99	92	51	99	92	97				
at	11.07	9.51	11.07	11.07	4.33	3.41	11.43	4.13	8.61	4.33	11.37	8.24	11.22	4.20½	9.36	9.36				
25 lbs.	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	66				
at	11.08	9.52	11.08	11.08	4.34	3.41	11.44	4.14	8.62	4.34	11.38	8.25	11.23	4.21	9.37	9.37				
Time melting (minutes)	27	27	29	29	33	31	33	33	33	29	31	30	25	27	32	36				

REMARKS:

Test 19. Iron hot.
 Test 24. Iron hot after third ladle.
 Test 78. Temperature of iron medium.
 Test 69. Temperature of iron medium.
 Test 198. Iron hot.
 Test 56. Temperature of iron medium.

Test 183. Iron hot.
 Test 31. Iron very hot and fluid; blast off 4 minutes.
 Test 92. Temperature of iron medium.
 Test 178. Iron hot.
 Test 183. Iron hot.

Test 52. Iron hot; all pig iron used to determine effect of sulphur.
 Test 171. Iron hot.
 Test 172. Iron hot.
 Test 32. Iron very hot and fluid.
 Test 34. Iron very hot and fluid.

SUMMARY.

The following tables have been compiled in order to bring together in one place the essential things brought out in the preceding elaborate table of analyses, and to compare the Lee County coals with the coals of competitive or possibly competitive fields.

Table I shows the ash, sulphur and B. t. u. content of each coal represented in the preceding table of analyses. In each case the figures have been taken from the A or "as received" analysis. Table II is a synopsis of the averages of the moisture, fixed carbon, ash, sulphur, and B. t. u.'s compiled from the A or "as received" analyses of the preceding general table of analyses, for each important coal bed of Lee County, together with averages of analyses for the corresponding coal beds of adjacent coal fields. Table III is designed for the purpose of comparing the analyses of important Lee County coals with analyses of typical coals from other fields that are at present competing or may compete at some future time with Lee County coals.

From an inspection of the following tables, it will be seen that the Lee County coals are of high bituminous rank with low moisture content. The fixed carbon ranges from about 52 to nearly 60 per cent. The ash with few exceptions is relatively low. The sulphur with the exception of one coal is below two per cent and in the majority of beds less than one per cent.

In some cases the analyses may not represent the full rank or the real heating value of the coals. This is likely to be true of those coals represented by only one or two analyses. A number of these beds have been little more than prospected as yet, so that the samples had to be taken from small local or country mines, and were necessarily few in number as the beds were being worked in only one or two localities.

Table I.

Table showing ash, sulphur and B. t. u.'s for each sample of coal complete analyses of which have been given in the preceding table of analyses.

Coal bed.	Lab. No.	B. t. u.'s.	Ash.	Sulphur.	Field.
Stone Creek	75905	13,670	4.6	1.92	Lee Co., Va.
Clintwood	75907	14,060	2.2	1.69	Lee Co., Va.
Imboden	34978	13,600	5.6	.77	Lee Co., Va.
Imboden	34979	13,830	3.9	.70	Lee Co., Va.
Imboden	75972	14,060	4.6	.88	Wise Co., Va.
Imboden	75973	13,990	5.3	.85	Wise Co., Va.
Imboden	75974	13,980	4.6	.79	Wise Co., Va.
Imboden	75975	13,980	4.9	.88	Wise Co., Va.
Kelly	75747	13,610	6.5	.88	Lee Co., Va.
Kelly	75748	13,490	6.6	.77	Lee Co., Va.
Kelly	75749	13,560	6.5	.84	Lee Co., Va.
Lower St. Charles	75909	13,550	5.7	2.06	Lee Co., Va.
Upper St. Charles	75908	12,530	11.4	.61	Lee Co., Va.
Upper St. Charles	75906	12,860	9.9	.62	Lee Co., Va.
Harlan	75787	12,730	10.0	3.74	Lee Co., Va.
Harlan	75788	13,040	8.6	2.84	Lee Co., Va.
Harlan	34981	12,320	13.9	2.70	Lee Co., Va.
Harlan	75675	14,040	4.6	2.42	Lee Co., Va.
Harlan	75676	13,810	5.5	2.21	Lee Co., Va.
Harlan	75677	13,940	5.0	2.34	Lee Co., Va.
Harlan	2246	.....	4.6	2.55	Lee Co., Va.
Harlan	2268	13,120	8.1	2.31	Lee Co., Va.
Harlan	2269	.....	4.4	.80	Lee Co., Va.
Harlan	2420	13,830	4.7	1.20	Lee Co., Va.
Harlan	24728	14,380	3.1	.78	Harlan Co., Ky.
Harlan	24729	14,220	2.5	.67	Harlan Co., Ky.
Harlan	24730	14,240	2.7	.82	Harlan Co., Ky.
Harlan	24731	14,180	3.0	.61	Harlan Co., Ky.
Harlan	24732	14,220	2.7	.70	Harlan Co., Ky.
Harlan	24713	14,070	3.7	1.30	Harlan Co., Ky.
Harlan	24714	14,190	3.5	.83	Harlan Co., Ky.
Harlan	24715	14,160	3.3	.87	Harlan Co., Ky.
Harlan	24716	14,280	3.0	.70	Harlan Co., Ky.
Harlan	24717	14,150	3.3	.93	Harlan Co., Ky.
Harlan	24633	14,240	2.9	.52	Harlan Co., Ky.
Harlan	24634	14,330	2.6	.60	Harlan Co., Ky.
Harlan	24635	14,310	2.7	.57	Harlan Co., Ky.
Taggart Marker	32962	14,630	2.7	.75	Wise Co., Va.
Taggart Marker	32963	14,460	3.0	.61	Wise Co., Va.
Taggart	34980	13,930	3.3	.53	Lee Co., Va.
Taggart	75792	14,140	3.1	.60	Lee Co., Va.
Taggart	75793	14,070	2.2	.76	Lee Co., Va.

Coal bed.	Lab. No.	B. t. u.'s.	Ash.	Sulphur.	Field.
Taggart	75794	14,060	2.6	.78	Lee Co., Va.
Taggart	75678	13,750	4.5	.67	Lee Co., Va.
Taggart	75679	14,040	4.3	.78	Lee Co., Va.
Taggart	75680	13,930	4.6	.74	Lee Co., Va.
Taggart	2248	13,870	5.0	.90	Lee Co., Va.
Taggart	2249	.....	1.9	.68	Lee Co., Va.
Taggart	2476	13,930	5.6	.92	Lee Co., Va.
Taggart	2323	14,140	3.0	.34	Lee Co., Va.
Taggart	2324	.....	2.5	.50	Lee Co., Va.
Taggart	2358	13,940	4.3	.79	Lee Co., Va.
Taggart	6236	14,130	3.4	.58	Lee Co., Va.
Taggart	82418	14,120	1.8	.42	Lee Co., Va.
Taggart	82419	14,180	1.7	.44	Lee Co., Va.
Taggart	82420	14,060	2.4	.48	Lee Co., Va.
Taggart	82421	14,080	2.1	.47	Lee Co., Va.
Taggart	82422	14,110	2.1	.48	Lee Co., Va.
Taggart	82423	13,810	3.1	.46	Lee Co., Va.
Taggart	82424	13,730	3.6	.44	Lee Co., Va.
Taggart	82425	13,990	1.9	.54	Lee Co., Va.
Taggart	82426	14,050	2.1	.43	Lee Co., Va.
Taggart	82427	13,890	2.7	.51	Lee Co., Va.
Taggart	82428	14,140	2.4	.44	Lee Co., Va.
Taggart	82429	14,110	2.4	.41	Lee Co., Va.
Taggart	82430	14,090	2.6	.48	Lee Co., Va.
Taggart	82431	14,060	2.3	.50	Lee Co., Va.
Taggart	82432	14,080	2.4	.49	Lee Co., Va.
Taggart	82433	14,070	1.9	.43	Lee Co., Va.
Taggart	82434	14,080	1.7	.43	Lee Co., Va.
Taggart	82435	14,150	1.7	.44	Lee Co., Va.
Taggart	82436	14,080	2.1	.45	Lee Co., Va.
Taggart	82437	14,060	1.9	.48	Lee Co., Va.
Taggart	33203	14,670	2.3	.58	Wise Co., Va.
Taggart	33204	14,700	2.4	.50	Wise Co., Va.
Taggart	33205	14,750	1.9	.49	Wise Co., Va.
Taggart	33206	14,740	2.2	.51	Wise Co., Va.
Taggart	33207	14,690	2.2	.54	Wise Co., Va.
Taggart	24834	14,580	2.1	.53	Harlan Co., Ky.
Taggart	24835	14,620	1.8	.51	Harlan Co., Ky.
Taggart	24836	14,570	2.2	.48	Harlan Co., Ky.
Taggart	24837	14,490	2.9	.52	Harlan Co., Ky.
Taggart	24838	14,590	2.6	.52	Harlan Co., Ky.
Low Splint	75806	13,320	6.9	1.10	Lee Co., Va.
Low Splint	75807	12,790	9.4	1.02	Lee Co., Va.
Low Splint	75808	13,070	8.1	1.10	Lee Co., Va.
Phillips	75789	13,330	6.4	.77	Lee Co., Va.
Phillips	75790	12,740	9.9	.72	Lee Co., Va.
Phillips	75791	13,020	8.0	.80	Lee Co., Va.
Wax	6238	13,360	6.0	.76	Lee Co., Va.
Pardee	6237	12,780	8.8	.75	Lee Co., Va.
Pardee	22277	13,970	5.6	.78	Wise Co., Va.

Coal bed.	Lab. No.	B. t. u.'s.	Ash.	Sulphur.	Field.
Pardee	22278	14,060	4.8	.94	Wise Co., Va.
Pardee	22279	13,850	6.5	1.37	Wise Co., Va.
Pardee	22280	13,960	5.6	1.05	Wise Co., Va.
Pardee	84361	13,380	6.1	.90	Wise Co., Va.
Pardee	84363	13,750	6.2	.90	Wise Co., Va.
Pardee	84364	13,210	6.0	.80	Wise Co., Va.
Pardee	84366	13,470	6.5	.90	Wise Co., Va.
High Splint	6239	13,110	6.6	1.24	Lee Co., Va.
High Splint	2528	13,920	3.7	.67	Harlan Co., Ky.

Table II.

Averages of analyses of each coal for which analyses have been given in the preceding table of analyses.

Name of coal bed and number of samples.	Moisture.	Fixed carbon.	Ash.	Sulphur.	B. t. u.'s.	Field.
Stone Creek (1)	3.0	52.1	4.6	1.92	13,670	Lee Co., Va.
Clintwood (1)	3.2	56.1	2.2	1.69	14,060	Lee Co., Va.
Imboden (2) .....	.9	54.4	4.7	.74	13,720	Lee Co., Va.
Imboden (4)	2.7	58.3	4.8	.85	14,000	Wise Co., Va.
Kelly (3)	3.2	54.8	6.5	.83	13,550	Lee Co., Va.
Lower St. Charles (1)	2.8	53.5	5.7	2.06	13,550	Lee Co., Va.
Upper St. Charles (2)	3.5	53.4	10.6	.62	12,700	Lee Co., Va.
Harlan (10)	3.8	52.4	6.9	2.31	13,350	Lee Co., Va.
Harlan (13)	3.2	56.3	3.0	.76	14,230	Harlan Co., Ky.
Taggart Marker (2)	2.3	59.1	2.9	.68	14,550	Wise Co., Va.
Taggart (34)	3.7	57.2	2.8	.55	14,030	Lee Co., Va.
Taggart (5)	2.1	60.7	2.2	.52	14,710	Wise Co., Va.
Taggart (5)	2.6	57.9	2.3	.51	14,570	Harlan Co., Ky.
Low Splint (3)	3.5	53.2	8.1	1.07	13,060	Lee Co., Va.
Phillips (3)	3.8	52.6	8.1	.76	13,030	Lee Co., Va.
Wax (1)	4.4	53.6	6.0	.76	13,360	Lee Co., Va.
Pardee (1)	5.3	53.2	8.8	.75	12,780	Lee Co., Va.
Pardee (8)	3.1	55.8	5.9	1.00	13,760	Wise Co., Va.
High Splint (1)	5.5	51.9	6.6	1.24	13,110	Lee Co., Va.
High Splint (1)	4.4	56.9	3.7	.67	13,920	Harlan Co., Ky.

A brief survey of Table II reveals the fact that the Taggart is the best coal in Lee County. It is a high rank coal, leading the other coals in fixed carbon, and is exceeded only slightly by the Clintwood (North Fork) coal in calorific value, and is very low in ash and sulphur content. Nevertheless it is somewhat inferior to the coal of the same bed in Wise and Harlan counties. It is excellently adapted for railroad fuel, domestic use, coking, steam-raising, and for the production of illuminating gas. The Clintwood coal shows low ash, high fixed carbon and high heating value, but its sulphur is also relatively high. The Imboden (No. 1) is also a valuable coal with about the same ash and sulphur content as the same bed possesses in Wise County, however its fixed carbon, and hence fuel rank, is appreciably lower. It is highly satisfactory for bunker coal, coking, and railroad fuel. The Kelly compares favorably with the Imboden but is higher in ash. The Upper St. Charles (No. 2A) is high in ash and low in heating value, a fact that is recognized throughout the field. The Lower St. Charles (No. 2) is a better coal than the Upper St. Charles, but is relatively high in sulphur. The Harlan (No. 3) coal is high in sulphur and relatively high in ash, and low in fixed carbon. It is decidedly inferior in these respects to the Harlan coal of Kentucky. The Low Splint and Phillips (No. 7) coals are very similar in character as revealed by the analyses, and are inferior to the Clintwood, Imboden and Taggart coals. The single analysis of the Pardee (No. 10) is probably insufficient on which to base a generalization, however the large number of analyses made from coal collected from this bed at Pardee, Wise County, shows that the coal of this bed is slightly inferior in rank to many of the southwest Virginia coals, however the coal is hard, making excellent lump coal, and is largely used as domestic fuel. The single analysis of the High Splint (No. 12) indicates that it is considerably inferior to the coal of the same bed in Harlan County, Kentucky.

Table III.

Analyses of coals from Lee County compared with those of the best coal from competing or possibly competitive fields.

Field.	Name of bed.	Ash.	Sulphur.	B. t. u.'s.
Lee Co., Va.	Imboden ...	4.7	.74	13,720
Lee Co., Va.	Harlan	6.9	2.31	13,350
Lee Co., Va.	Taggart	2.8	.55	14,030
Lee Co., Va.	Low Splint .	8.1	1.07	13,060
Lee Co., Va.	Phillips	8.1	.76	13,030
Lee Co., Va.	Pardee	8.8	.75	12,780
Averages		6.6	1.03	13,330
Pocahontas, Va.		4.0	.63	14,630
Pocahontas, W. Va.		4.9	.44	14,620
New River, W. Va.		4.8	.72	14,460
Kanawha Valley, W. Va.		8.3	.70	13,300
Logan Co., W. Va.		5.7	1.24	14,070
Thacker, W. Va.		6.3	.95	13,900
Georges Creek, Md.		7.5	.80	14,200
Somerset Co., Pa.		8.2	2.46	14,110
Cambria Co., Pa.		6.0	.84	14,540
Connellsville, Pa.		10.6	.97	13,330
Hocking Valley, O.		4.4	.54	12,250
Letcher Co., Ky.		3.6	.60	14,090
Jellico, Ky.-Tenn.		3.2	1.36	13,680
Oliver Springs, Tenn.		5.0	.87	13,600
Birmingham, Ala.		6.0	.64	14,190
Cahaba Basin, Ala.		7.2	.76	13,650
Averages		6.2	.93	13,870

An examination of Table III in which a comparison is made between Lee County coals and coals of other eastern coal regions, makes it evident that the coals of Lee County are superior to the coals of certain of these

regions and inferior to others. It is apparent that the West Virginia coals are in the main higher in rank than the Lee County coals. In ash and sulphur content the Lee County coals compare very closely with the coals of West Virginia. The Virginia coals on the other hand yield a larger proportion of lump coal which may even permit grading by sizes with small waste in dust and slack, while the West Virginia coals of the New River and Pocahontas fields are friable so that they yield a large proportion of slack.

The Lee County coals are much lower in rank and lower in calorific value than the Georges Creek, Maryland, coal, but are also appreciably lower in ash. They are somewhat higher in ash and sulphur than the Hocking Valley coals, and also considerably higher in calorific value. They find close comparison with the Connellsville coal of Pennsylvania, having essentially the same rank, but the Lee County coals are somewhat lower in ash. The latter coals are inferior to the Cambria and Somerset coals in efficiency, however they will average lower in ash and sulphur than the coals of the Somerset field.

The Virginia coals are slightly higher in sulphur, higher in ash, and lower in fixed carbon, i. e., in rank, than the coals of Letcher County, Kentucky. They compare very favorably with the coals of the Jellicoe and Oliver Springs fields, being about the same in fixed carbon, a trifle higher in ash but lower in sulphur content.

The Alabama coals vary greatly in quality. At some localities the fuel is clearly of higher rank and heating power than the Lee County coals, though they are as high and many even higher in sulphur. The ash content averages about the same in the coals of both regions. Many of the Alabama coals will average but little higher in calorific value.

THE FORESTS OF LEE COUNTY, VIRGINIA

By HARRY LEE BAKER.

LOCATION AND AREA.

Lee County is situated in the extreme southwest corner of Virginia, forming the "plow-point," the narrow wedge between Kentucky and Tennessee. It lies immediately west of Scott and Wise Counties. Its area is approximately 285,440 acres, as given by the U. S. Census.

TOPOGRAPHY AND DRAINAGE.

The topography of Lee County is quite similar to that found throughout the Alleghany Mountains in southwestern Virginia. North of Powell River the mountains are steep and often precipitous, while the valleys and ridges are narrow. South of this river the mountains are not so high, the slopes are often only moderately steep and the valleys are somewhat broader. Potato Hill, two miles north of Keokee, a peak on Little Black Mountain, is the highest point in the county, having an elevation of 3,732 feet. The lowest altitude is slightly under 1,200 feet and is found on Powell River at the point where it flows across the State line into Tennessee. This gives a maximum relief of approximately 2,530 feet. The one large area of level or gently rolling land extends through the central portion of the county in close proximity to Powell River.

At least 80 per cent of Lee County is drained by Powell River and its tributaries. Powell River flows into Clinch River near Clinton, Tennessee. Most of the balance of Lee County, which lies south of Powell Mountain, is drained by Blackwater Creek, also a tributary of Clinch River having its confluence with that stream but a few miles southward in Tennessee. A small area located southeast of Newman Ridge is drained by some small creeks which flow into Clinch River.

CLIMATE AND SOIL.

The average rainfall for Lee County is about 47 inches per year. The maximum temperature is reported as 100° Fahrenheit, while the approximate minimum is 25° below zero. The mean annual temperature is about

50°. There are few protracted periods of zero weather. Thick ice is unusual and a snow blanket remains on the ground but a few days. The snow is rarely more than six inches deep.

The soils of Lee County are of residual origin. Most of the Powell River valley is a limestone formation. In this section of Lee County the soils are, in general, quite fertile. North of Stone Mountain in the Pocket Country, or coal-bearing section, the underlying rocks are mostly shale or sandstone. Here the land is not highly productive from an agricultural standpoint, being composed mostly of sand-loam or gravel soils. In the Wallen and Blackwater Creeks section of the county sand-loam and clay-loam predominate, although there are portions of these watersheds underlain with a limestone formation, which produce fair agricultural crops.

POPULATION.

Lee County has a population of approximately 30,000, according to the 1920 Census. In the vicinity of the large coal mines, located near St. Charles and Keokee, the population is quite dense, and is dependent almost entirely upon the coal-mining business. The balance of the county, south of Stone and Cumberland Mountains, supports a scattered but rather dense population which is chiefly dependent upon agriculture, although no small part of the population is dependent to some extent upon the timber industry.

TRANSPORTATION FACILITIES.

Two railroads traverse the county in such a way as to best serve the coal, agricultural and timber industries. A branch of the Louisville and Nashville Railroad, connecting with the main line at Corbin, Kentucky, and ending at Norton, Virginia, runs through the center of Lee County in an east to northeasterly direction. This railroad makes connections with the Southern and with the Interstate Railroad at Appalachia and with the Norfolk and Western at Norton. A branch line runs from Pennington Gap to the St. Charles coal fields, where a second connection is made with the Southern Railway. A branch of the Southern Railway, which connects with the main line at Bristol, serves the coal fields in Lee County from Crest, near Keokee, to St. Charles.

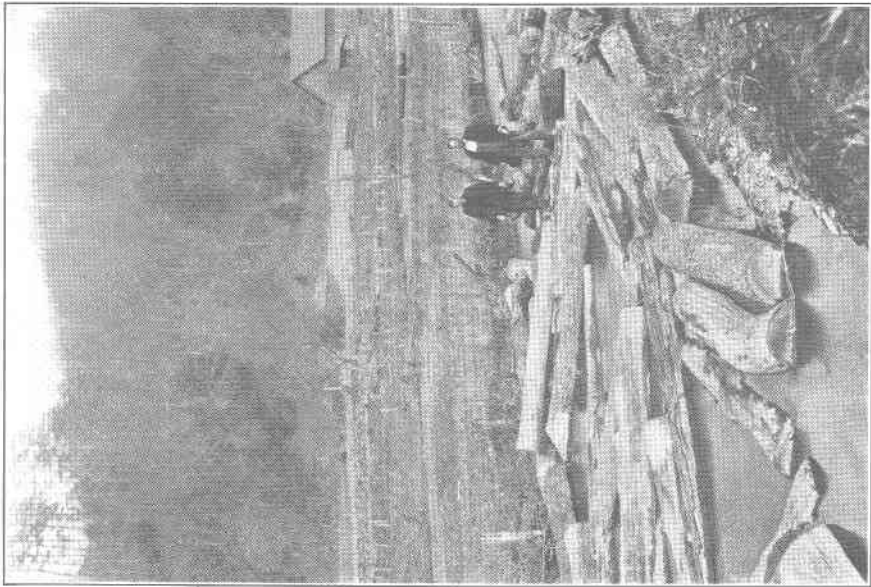
A macadam highway parallels the Louisville and Nashville Railroad from the east to the west end of the county. Short stretches of macadam road connect with this main highway but are not sufficient in extent to



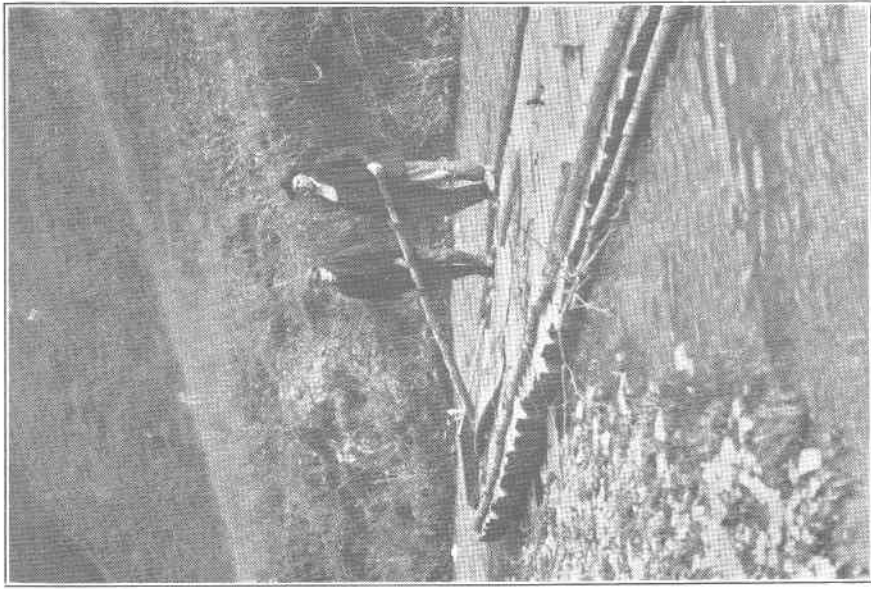
(A) Waiting for high water. Blackwater Creek, 1924. These logs will be driven to Clinch River and rafted on to the saw-mills at Chattanooga, Tenn.



(B) The way railroad ties have been rafted on Blackwater Creek for years. At the left J. M. Russell, the first Chief Forest Warden for Lee County.



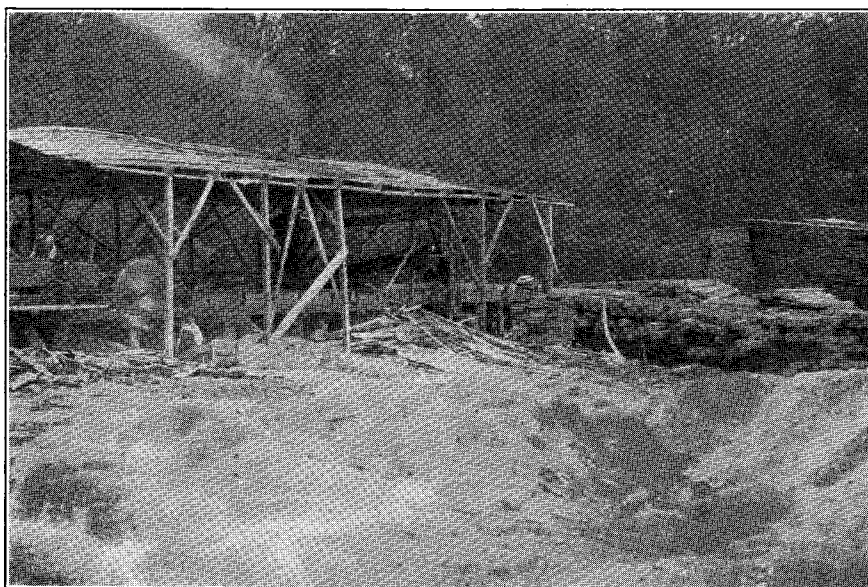
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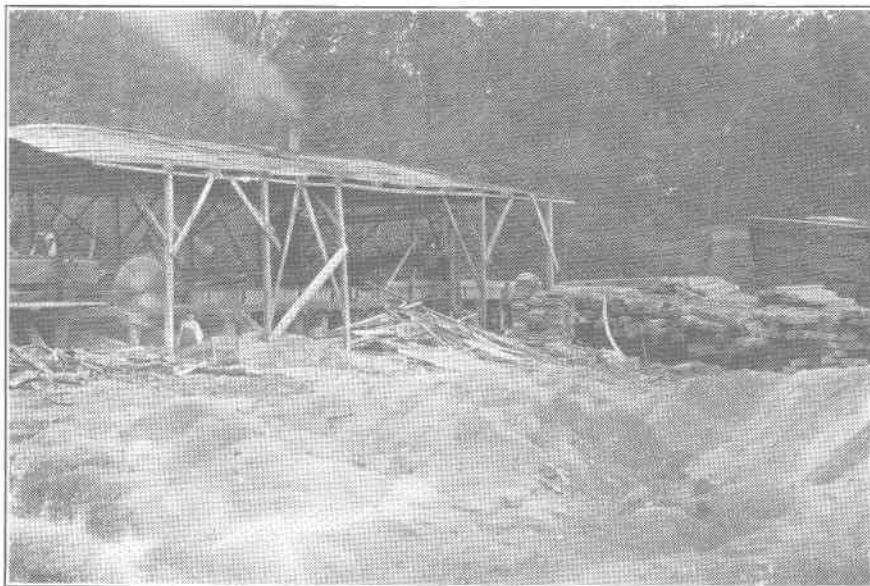
(A) Roots and all! An example of present-day utilization of black walnut timber. Taken at Ben Hur Station.



(B) Circular saw-mill, near Sticklelyville, property of R. J. Carter. There were forty-eight such saw-mills (forty-three of them in operation) in Lee County in 1923.



(A) Roots and all! An example of present-day utilization of black walnut timber. Taken at Ben Hur Station.



(B) Circular saw-mill, near Stickleyville, property of R. J. Carter. There were forty-eight such saw-mills (forty-three of them in operation) in Lee County in 1923.

greatly facilitate wagon and motor transportation. A macadam roads leads from Appalachia, in Wise County, to Keokee. Dirt roads exceed by far the macadam roads in total mileage. While many of the dirt roads are well located and graded they become badly rutted during the wet season of the year, at which time hauling is carried on with extreme difficulty. During the summer and early fall Lee County, as a whole, has quite good wagon and motor roads.

It is feasible to drive or raft logs down Powell River and Blackwater Creek during high water.

INDUSTRIAL FEATURES.

Coal-mining is the chief industry in the Pocket Country, where no less than 25 coal companies carried on mining operations during the year 1923. Here, also, the timber industry is important. Some lumber is manufactured, but railroad and mining ties and mining props are the most important timber products. The cultivated acreage is small and the farms are scattered. Most of the farmers in this section are dependent to a large extent upon the coal-mining and timber industry, i. e., they are employed a part of the year away from their farms.

In the Powell River valley, the central portion of the county, agriculture is the chief industry. Underlain as it is with the limestone formation, the soils are very fertile. Bluegrass thrives in this section, which has led to a specialized stock business in many instances. Diversified farming, however, is the prevailing practice in this agricultural section.

The timber industry, although secondary to agriculture and coal-mining, continues to be an important activity. The volume of the timber business for the year 1923 amounted to 22,895,000 board feet, having a total value of \$506,453. This subject is more fully discussed under the headings, "History of Timber Removal" and "Present Day Timber Business."

COMMON FOREST TREES.

There follows a list of the forest trees commonly found in Lee County:

<i>Common or Local Name.</i>	<i>Scientific Name.</i> <i>(Sargent's Manual,</i> <i>2nd Edition.)</i>
Pitch Pine or Black Pine	<i>Pinus rigida</i> Mill.
Spruce Pine (Scrub Pine)	<i>Pinus virginiana</i> Mill.
Hemlock	<i>Tsuga canadensis</i> Carr.
Red Cedar	<i>Juniperus virginiana</i> L.
White Walnut or Butternut	<i>Juglans cinerea</i> L.
Black Walnut	<i>Juglans nigra</i> L.
Bitternut Hickory	<i>Carya cordiformis</i> K. Koch (formerly <i>Hicoria minima</i> Britt.)
Scaly Bark or Shell-Bark Hickory ..	<i>Carya ovata</i> K. Koch (formerly <i>Hicoria ovata</i> Britt.)
Whiteheart or White Hickory	<i>Carya alba</i> K. Koch (formerly <i>Hicoria alba</i> Britt.)
River Birch (Red Birch)	<i>Betula nigra</i> L.
Black Birch	<i>Betula lenta</i> L.
Ironwood (Hop Hornbeam)	<i>Ostrya virginiana</i> K. Koch.
Hornbeam	<i>Carpinus caroliniana</i> Watt.
Beech	<i>Fagus grandifolia</i> Ehrh.
Chestnut	<i>Castanea dentata</i> Borkh.
White Oak	<i>Quercus alba</i> L.
Post Oak	<i>Quercus stellata</i> Wang. (formerly <i>Q. minor</i> Sarg.)
Chestnut Oak	<i>Quercus montana</i> Willd. (formerly <i>Q. prinus</i> L.)
Red Oak (northern) or "water oak".	<i>Quercus borealis maxima</i> Ashe (formerly <i>Q. rubra</i> Du Roi, not L.)
Scarlet or Spanish Oak	<i>Quercus coccinea</i> Muench.
Black Oak	<i>Quercus velutina</i> Lam.
Pin Oak	<i>Quercus palustris</i> Muench.
Black Jack Oak	<i>Quercus marilandica</i> Muench.
White or American Elm	<i>Ulmus americana</i> L.
Slippery Elm (Red Elm)	<i>Ulmus fulva</i> Michx.
Hackberry	<i>Celtis occidentalis</i> L.
Red Mulberry	<i>Morus rubra</i> L.
Cucumber Tree	<i>Magnolia acuminata</i> L.
Yellow Poplar or Tulip Tree	<i>Liriodendron tulipifera</i> L.
Sassafras	<i>Sassafras officinale</i> N and E.
Black or Sour Gum	<i>Nyssa sylvatica</i> Marsh.
Sycamore or Buttonwood	<i>Platanus occidentalis</i> L.
Black Cherry (Wild Cherry)	<i>Prunus serotina</i> Erh.
Redbud or Judas Tree	<i>Cercis canadensis</i> L.
Black Locust (Yellow Locust) ..	<i>Robinia pseudacacia</i> L.
Holly	<i>Ilex opaca</i> Ait.
Sugar Maple	<i>Acer saccharum</i> Marsh.
Red Maple	<i>Acer Rubrum</i> L.
Buckeye	<i>Aesculus octandra</i> var. <i>virginica</i>
Basswood or Linden or Lin	<i>Tilia</i> (species not determined).
Dogwood	<i>Cornus florida</i> L.
Persimmon	<i>Diospyros virginiana</i> L.
White Ash	<i>Fraxinus americana</i> L.

All of the above listed trees serve some useful purpose. Those of the greatest commercial importance are mentioned under other headings.

FOREST TYPES.

The forest types recognized in Lee County are as follows:

- (1) Ridge type.
- (2) Slope type.
- (3) Cove type.
- (4) Bottomland type.
- (5) Red Cedar type.

These types are not clearly defined on the ground. A moist slope on the north side of the mountain commonly will support trees ordinarily found in the cove type on a south exposure, where the soil, light, altitude and drainage factors are similar. Site quality is an important factor which largely determines the various tree types. The Bottomland and Red Cedar types are more clearly defined on the ground than are the other three types, since their favored sites are not inclined to blend far into one another, or into the other three types.

Ridge type.—This type occurs on the tops of the ridges and spurs and on the upper slopes having southern exposures. The dominant species of this type are chestnut and chestnut oak or rock oak. Associated commonly with them are northern red oak, black oak, scarlet or Spanish oak, black-jack oak and pitch pine or black pine. The soil is usually thin and shallow, resulting in small water-storing capacity, and this fact, together with the rapid evaporation due to the open nature of the stand and the consequent exposure to the wind and sun, makes the trees short and scrubby and of no great importance as saw-timber. Tree growth is very slow, especially after the sapling and pole stages. There will be a greater profit in managing these lands for mining timbers, chestnut extract-wood, cordwood and chestnut oak tan-bark than for lumber, as these products can be grown on a shorter rotation than lumber and the period of most rapid growth is thus utilized.

Slope type.—Probably 50 per cent of the forest area of Lee County is included in this type. Hence, from a commercial standpoint, it is the most important type. The principal species of this type is the white oak. Associated with it on the lower elevations are yellow poplar, hemlock, post oak, black locust, persimmon, beech, basswood, cucumber, buckeye, white ash, black birch, hickory and hard maple. On the upper slopes northern red oak, black oak, pin oak, rock oak, spruce pine and chestnut are commonly found. This type is well adapted to the production of merchantable saw-

timber, particularly the lower slopes. Hence, every care should be exercised to insure the restocking of cutover lands in this type with the more desirable species.

White oak and its associated species reach their best development on the northern exposures. This may be attributed mainly to soil conditions, as evaporation is less on these northern slopes than on the southern exposures.

Cove type.—The principal species in this type is the yellow poplar. Associated with it in the coves are the cucumber tree, basswood, white oak, northern red oak, white ash, buckeye, hickory, hard maple, black walnut, beech and black gum. This type, while it comprises only about 15 per cent of the forest area of the county, affords soil conditions that produce the best development of the species growing in it, and the most valuable grades of lumber are produced under these conditions. Practically all the virgin poplar in the county has been cut, but the rapid growth of this species in these coves is shown by the relatively high percentage of merchantable poplar that is being logged at the present time. Unlike the chestnut, which often forms pure stands on the ridges, poplar occurs singly, averaging about six or eight trees per acre. It reaches its best development at the heads of coves with northern exposures. The cucumber tree is hardly less important in this type and its propagation at all times should be favored. The cucumber tree is often sold as poplar, as their woods are very similar.

Bottomland type.—This type occurs in close proximity to the larger streams. It does not comprise over five per cent of the forest area of the county and is of relatively small commercial importance. Hemlock predominates, and associated with it are sycamore, beech, red maple, slippery elm, white elm, river birch, and to a lesser extent cucumber, basswood and yellow poplar. Only the hemlock, river birch and sycamore reach their best development in this type. Holly is commonly found in the openings near the larger streams.

Red Cedar type.—Southwest of Jonesville, in close proximity to Powell River, is a stretch of level country peculiar in that the limestone bedrock is often exposed or but sparingly covered with a shallow layer of soil. Although the thin soil is rich, the frequent rock exposures make cultivation for farm crops next to impossible. A large proportion of this country is covered with a forest growth. Red cedar predominates, and attains sufficient size to permit of logging operations. Its most common associates are northern red oak, white oak, hickory and black walnut. This type does not comprise over five per cent of the total forest area. While most of the merchantable

timber has been removed, the future possibilities of this type should not be overlooked. Red cedar makes very valuable lumber and is used extensively by the farmers for fence posts and fence rails.

THE FIRST FOREST.

The first white settlers in Lee County found no open country. Lee County was one vast virgin forest. Stately white oak trees three and four feet in diameter abounded everywhere on the rich valley land. Large black walnut trees with straight trunks clear of branches for fifty or sixty feet were common. Yellow poplars five to eight feet in diameter and free of branches for eighty or one hundred feet commonly towered above all other trees, the tip of the crowns terminating one hundred and fifty or one hundred and seventy-five feet above the ground. Many other species were associated with these magnificent specimens of the forest. Chestnut, cucumber, buckeye, ash, maple, chestnut oak and many other valuable trees were scattered over the rich valley lands and mountain slopes, now cleared and cultivated.

The size and quality of the timber varied according to those factors which influenced tree growth. Steep, dry exposures on the mountain slopes and ridges did not support such a large percentage of the more valuable trees. In general, the quantity and quality of timber on an acre of ground in the high mountains were much lower than for the average acre in the lowlands. Just how many thousand board feet of timber were to be found on the average acre of ground in the early days in the various types of forest will always be a matter of conjecture. Some of the older citizens venture the statement that the best forests averaged as high as 40,000 board feet per acre, the poor lands about 5,000 per acre, and that the general average was about 12,000 per acre. An estimate for a tract of timber cut in 1923, from which the poplar and walnut had been removed years ago, is as follows: Poplar and walnut removed in the past, 2,000 board feet per acre; extract-wood and timber cut for lumber in 1923, 9,000 board feet per acre; cordwood left on the ground, 1,000 board feet per acre; total, 12,000 board feet per acre. A stand of virgin timber cut in 1923 averaged as follows: 6,000 board feet per acre of white oak and 2,000 per acre of poplar and walnut. The remaining stand of mixed timber is estimated at 2,000 per acre, giving a total of 10,000 board feet per acre. These estimates cover areas which are believed to be below the average for the original lowland virgin forest. The better sites years ago undoubtedly supported stands of timber averaging at least 12,000 board feet per acre and the poorer sites about 4,000 per acre.

All classes of land considered, the virgin forest of Lee County probably averaged about 7,000 board feet per acre. The county, having a total area of 285,440 acres, supported a stand of timber estimated at 2,000,000,000 board feet. If the very low value of ten dollars per thousand board feet were placed upon this vast forest heritage, and if no timber had ever been cut, the timber resources of Lee County to-day would be worth \$20,000,000. In this connection it should be remembered that the stumpage prices to-day for first quality poplar, walnut and oak, such as was removed years ago, are very high. Average stumpage values for the kind and quality of timber remaining in the forest to-day do not apply in this calculation.

HISTORY OF TIMBER REMOVALS.

Timber a menace to the early settlers.—In the early days timber was considered a menace, for the farmer's biggest problem was to get rid of it. Almost his first acts were to build a home out of logs and to hew out an opening in the forest sufficient in size to permit raising a little garden truck for his family. The forests abounded with wild game and the streams with fish, so that the farmer did not have to depend entirely upon what he could raise to support his family. He could fish and hunt and thereby provide food to supplement that raised on his small farm. Because of this fact, there was no need for a large acreage of cleared land. Then, too, it required a great deal of labor to fell trees averaging perhaps two feet in diameter, cut them into logs and snake or roll the logs into piles for burning. The work of clearing land and burning logs was a slow process. The settlers were not numerous. Accordingly, the timber supply was but slowly reduced. At the end of the War between the States it is estimated that less than ten per cent of the area of Lee County had been cleared.

Timber cutting at Cumberland Gap during the War between the States.—It may be of interest to the reader to here make note of the fact that the Confederate and Union armies cut down every tree on a large area in Virginia, opposite Cumberland Gap, a strategic point at the extreme western end of Lee County, near the corner of three states, Kentucky, Tennessee and Virginia. The reason for cutting all of the timber was to make it impossible for the enemy to advance, using the timber as a protection against rifle fire. This area has now grown up to scrub pine or spruce pine, pitch or black pine, chestnut and various oaks. The parky stand is interesting for the reason that the trees are of an even age and because of its attractiveness from a scenic viewpoint. In some places there are pure stands of chestnut

or pitch pine timber averaging about 10 inches in diameter, with 180 trees per acre. Assuming that this old battleground was not fully restocked before 1870, five years after the war, gives an estimated age of 54 years for these stands. They appear on steep, dry slopes and on high, dry ridges overlooking Cumberland Gap where the soil is very light. The rate of tree growth here in Cumberland Gap is believed to be fairly representative of most areas in Lee County which are classed as belonging to the Ridge type.

First logging business.—Not long after the War between the States, probably about 1870, a new industry sprang up in Lee County. Yellow poplar and black walnut timber of the highest quality was in demand when located near the banks of Powell River. Three saw-mills are known to have been the most common purchasers of timber. They were located at Clinton near the forks formed by Powell and Clinch Rivers, at Kingston, near the forks of Clinch and Holston Rivers and at Chattanooga on Tennessee River. Logs cut in Lee County could be floated down Powell River or Blackwater Creek to any of these mills. For the first four or five years, the logs were run in strings. A few logs are known to have been driven, but not with great success. Later, it became the custom to build rafts. The usual practice was to place the logs in the water, side by side, and to bind them together by running poles along each end of the logs, which were securely fastened by wooden pins or spikes. Butt cuts of poplar sometimes would not float by themselves. However, bound and pinned as they were between high-floating logs, they were as easily transported to the mills as other timber. In later years, when red and white oak and hickory were marketable, it was also necessary to bind this class of timber securely to the other logs, as they would not float alone. Long oars were installed at each end of the rafts.

The average raft contained about 35,000 board feet of timber and the largest ones contained as much as 60,000 feet. Most of them ranged between 100 and 150 feet in length. After a rise of six feet in Powell River, the rafts were turned loose and, through the use of the oars, were guided down the swift streams to the mills. It took four days to raft logs to Clinton, six days to Kingston and nine or ten days to Chattanooga. Rafting was undertaken at all seasons of the year, although less frequently during the summer months when flood waters were not so common. Rafting could be successfully conducted on Powell River up to a point approximately five miles above Jonesville. As it became the practice to truck logs to the river bank, the zone of logging activity gradually broadened and extended up Powell River eight or ten miles above Jonesville. The logging and rafting

business was at its height between 1880 and 1890. Thereafter, following the completion of the Louisville and Nashville Railroad in 1891, this business rapidly declined. The last rafts are reported to have been sent down Powell River in 1919.

The practice on Blackwater Creek was to drive logs in blocks—small rafts—or singly, down to Clinch River, where they were made into large rafts and floated to the mills below. Ties have been rafted down this creek for a number of years. This industry is still carried on to a limited extent on Blackwater Creek (1924). In 1923 30,000 board feet of logs were driven to Chattanooga.

Early and present stumpage values.—A great deal of timber was cut by the settlers on lands destined to be cleared for farming. Money was scarce and timber was plentiful. Under such conditions, about all that could be realized out of logging operations was a low wage. After the going wages were deducted from the returns but a few cents, at most, could be considered as having been received for stumpage. This was in the early days after the War between the States, when timber values were exceedingly low. The first stumpage prices ranged between 25 cents and 50 cents per tree for walnut, poplar, cucumber and ash. As the best timber scaled about 2,000 board feet per tree, this gave a stumpage of from 13 cents to 25 cents per thousand board feet. By 1884 this same kind of timber was bringing a maximum of \$1.00 per tree. Stumpage prices have been on the increase ever since, so that to-day the best specimens—far more inaccessible than the timber for which stumpage quotations have just been given—will bring the following prices:

Mixed timber	\$ 4.00 to \$ 6.00	per thousand board feet
Oak	5.00 to 15.00	per thousand board feet
Poplar, Cucumber, Ash and Buckeye	8.00 to 20.00	per thousand board feet
Walnut	40.00 to 100.00	per thousand board feet
Mining timber	1c to 2c	per linear foot

Utilization of timber.—It has been shown that in the early days timber values were exceedingly low, and that by 1884 the maximum market quotation was \$1.00 per tree for the best specimens. As late as 1895, along the Louisville and Nashville Railroad, which had been completed in 1891, we have reports which indicate but slight increases in stumpage values. As a rule, people are wasteful when materials are abundant. Under such conditions the public could demand the highest quality of lumber. The mill owner and lumber dealer in turn insisted

upon nothing but select logs and lumber. Only a straight, sound log free from knots could be sold. The sawyers would cease cutting logs when the first limbs were reached, so that the trees were only utilized down to about 24 inches in diameter. The balance of the tree was allowed to rot or was cut up and the logs rolled into piles to dry, later to be burned. The same fate befell a great deal of the mixed timber, for which there was no demand on the lumber market. Slightly defective, crooked and limby poplar and walnut trees very often ended up in the log pile along with the mixed timber, where they were reduced to ashes.

How many millions of feet of timber went up in smoke will never be known. The one gratifying feature about this terrible waste is that the people of Lee County are beginning to look with concern upon the wasteful methods of the past. It is not uncommon for a resident of Lee County to volunteer some such statement as "If that fine walnut, poplar and oak timber which was burned up and wasted by my father and me, when I was a boy, could be standing on my place to-day, I would be a rich man." Such appreciation of the reckless waste of the past and of present timber values seems to be shared by a large number of citizens to-day. Timber utilization has improved until at this time the waste is not so appalling. It is estimated that fully 75 per cent of the timber reported in table number 7 as cut in 1923 would have been wasted in the early days.

The timber products business.—Before the advent of the Louisville and Nashville Railroad, the demand for lumber was very limited, as most buildings were constructed of logs. One or two small waterpower saw-mills supplied the local demand. Saw-log timber was the only important timber product for which there was a market. After the completion of the railroad, several saw-mills began operations and the lumber business became the big industry of Lee County. A demand gradually developed for railroad ties, white oak staves, hemlock and chestnut oak tan-bark, chestnut extract-wood, chestnut and red cedar posts, poles and piling, pulpwood and mining timbers. Just when the climax in this business was reached is difficult to determine. The lumber business has been on the wane for at least 15 years. The stave business has also been on the decline, although the reported output for 1923 is not at all representative, as there has been a temporary decline in the market since the war. The market remains firm for the balance of the above mentioned products, and it is hardly possible to state that there is a general decline in production. Many people are inclined to believe that the timber business is practically extinct at the present time,

but the following analysis of the present day timber business in Lee County shows most conclusively that the lumber and timber products business continues to be an important industry.

PRESENT-DAY TIMBER BUSINESS.

Lumber industry.—At the present time (March, 1924), 48 small circular saw-mills are located in Lee County. In 1923 43 of these mills were operated. Most of them are of the portable or semi-portable type. Gasoline engines furnish the power for two of the mills and one mill is run by water power. The power for the remaining 45 saw-mills is furnished by steam engines having capacities ranging between 8 and 35 horsepower.

Table No. 1.

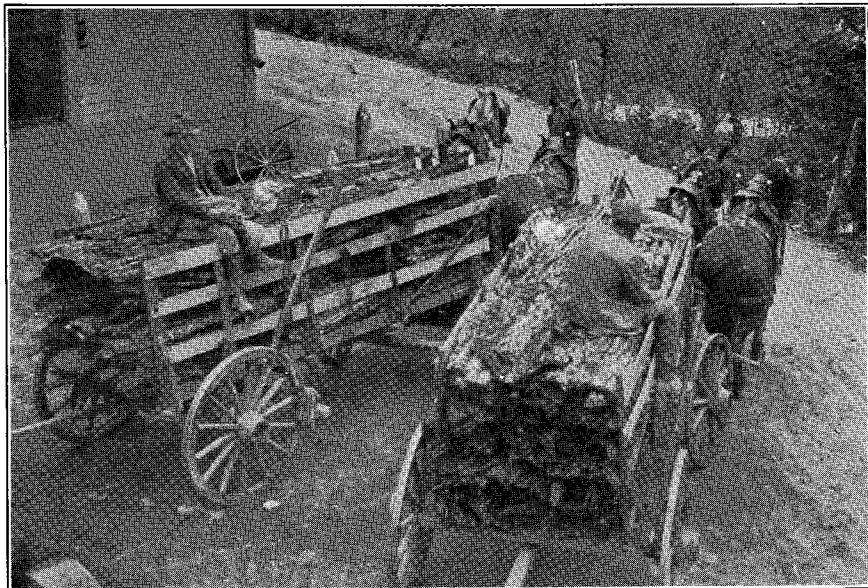
CLASSIFIED ANNUAL CUT OF SAW-MILLS IN LEE COUNTY. 1923.

<i>Number of Mills.</i>	<i>Daily Capacity in Board Feet.</i>	<i>Days Operated (Average.)</i>	<i>Annual Cut (Board Feet).</i>
37	Under 5,000	43	5,534,000
4	5 to 10,000	47	1,367,000
2	Over 10,000	70	1,678,000
Totals 43			8,579,000

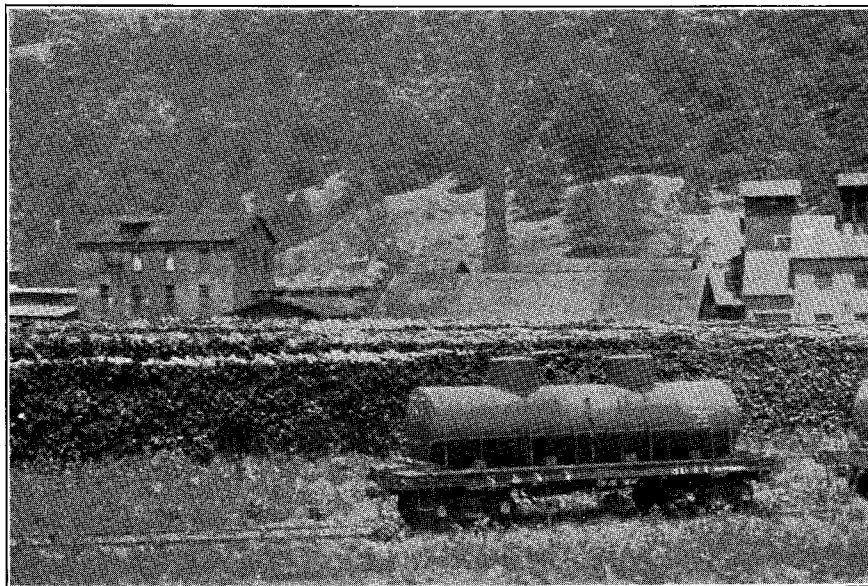
Average cut per mill, 199,511 board feet.

A few of the saw-mills appear to have been established for the purpose of realizing upon the investments in certain tracts of timber, or to meet the demand for railroad ties, brattice lumber, coke slats, mine rails, oak export logs and common rough lumber. Such mills usually operate quite steadily until the tracts of timber are cut out, and are owned by parties who devote a considerable portion of their time to the lumber business. There are about 8 such saw-mills in the county which operated quite steadily in 1923 and averaged over 600,000 board feet per mill, three times as much as the average for all mills.

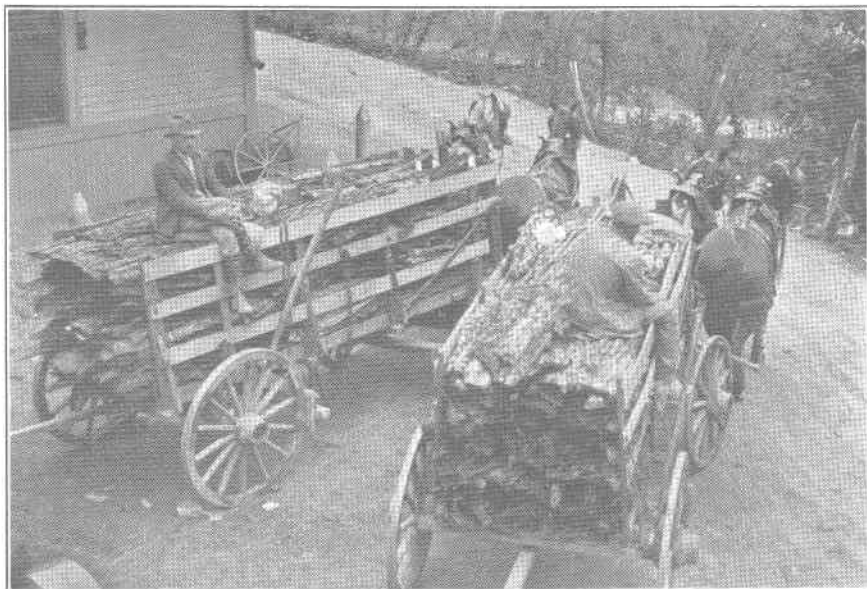
Most of the remaining saw-mills in the county are owned by farmers who work at some phase of the logging and lumbering business when there is little urgent work to be done on their farms. They obtain cheap lumber for their own use, do some custom sawing and meet the demand for sawed



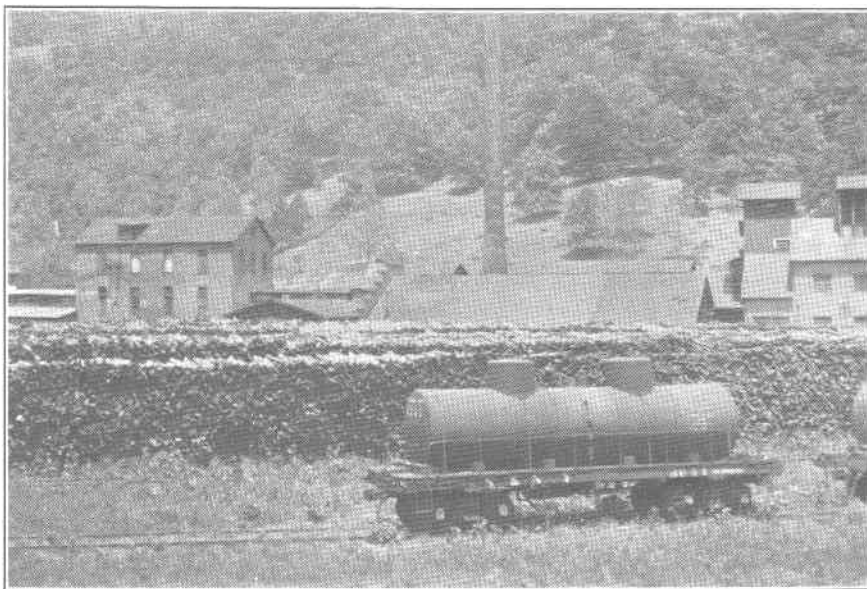
(A) Chestnut oak tan bark ready to be loaded on cars at Ben Hur Station for shipment to the extract plant at Big Stone Gap. These farmers have found profitable employment for themselves and their teams at a time when it is not possible to work on the farm.



(B) An extract plant near Big Stone Gap (in Wise County). Five hundred and twenty-six car loads of chestnut extract-wood, valued at \$40,502 were shipped to this plant from Lee County in 1923.



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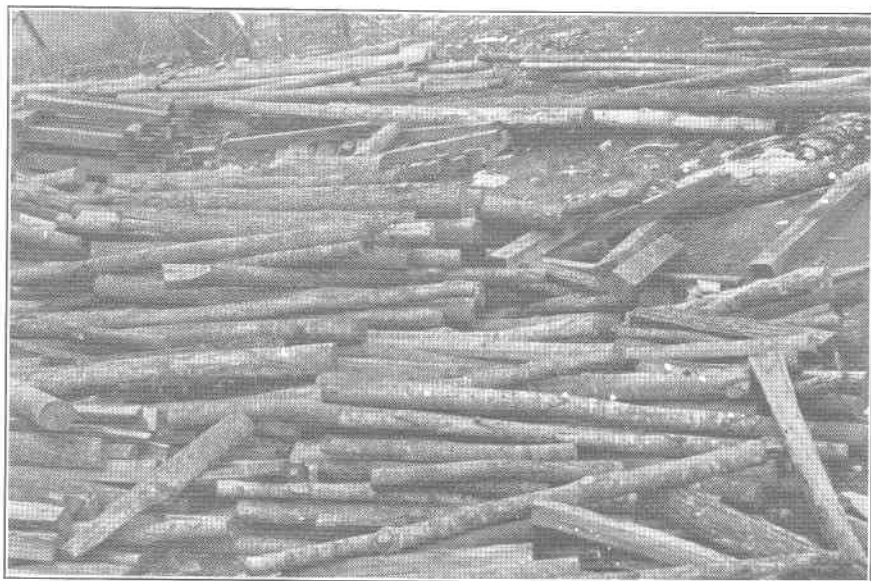
(A) Forty-, forty-five- and fifty-foot chestnut poles with eight- and nine-inch tops which are almost exactly forty, forty-five and fifty years old, respectively—Wheeler Station.



(B) Mining timbers, double length, ready to be shipped from Ben Hur Station. Mining timbers by the hundreds of thousands—the equivalent of 2,738,000 board feet and valued at \$50,000—were manufactured in Lee County in 1923.



(A) Forty-, forty-five- and fifty-foot chestnut poles with eight- and nine-inch tops which are almost exactly forty, forty-five and fifty years old, respectively—Wheeler Station.



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ties and rough lumber. With them the saw-mill business is secondary to agriculture. Their chief concern is to obtain remunerative employment for their own labor and for their teams during slack periods on their farms. As indicated in Table Number 1, they operated their mills an average of about 43 days per year. However, the total period of employment amounted to approximately 120 days per year, as it was necessary to devote additional time to the woods operations and to the work of hauling lumber and ties to the railroad. Thirty-seven small saw-mills having an average daily capacity of 3,500 feet manufactured 5,534,000 board feet of timber. Allowing \$15.00 per thousand for the work, excluding investment and profit, gives an average annual pay-roll per mill of \$2,103. This money usually is paid to five laborers, mostly farmers, each one of whom works approximately 144 days per year and receives an average of \$432.00 per man. This statement applies principally to the smaller saw-mills run intermittently by farmers.

Table No. 2.
KIND, QUANTITY AND VALUE OF SAW-MILL PRODUCTS.
1923.

<i>Name of Product.</i>	<i>Board Feet.</i>	<i>Value F. O. B. Station.</i>	<i>Value in Dollars</i>
*Railroad Ties	1,748,000	\$ 1.00 per tie.	\$ 62,440
*Oak Lumber	1,540,000	35.00 per M bd. ft.	53,900
‡Mixed Lumber	1,176,000	22.00 per M bd. ft.	25,872
Hemlock Lumber ...	378,000	20.00 per M bd. ft.	7,560
Poplar Lumber	368,000	50.00 per M bd. ft.	18,400
Coke Slats	160,000	.04 each.	1,280
Mine Rails	77,000	23.50 per M bd. ft.	1,809
‡Chestnut Lumber ..	75,000	20.00 per M bd. ft.	1,500
Basswood and Buckeye Lumber ..	42,000	40.00 per M bd. ft.	1,680
Spruce Pine Lumber	40,000	20.00 per M bd. ft.	800
Red Cedar Lumber ..	18,000	60.00 per M bd. ft.	1,080
Totals	5,622,000	.....	176,321
Mixed Rough Lbr. ...			
Sold Locally	2,957,000	20.00 per M bd. ft.	59,140
Totals	8,579,000 ft. b. m.	.....	\$235,461

* Most railroad ties are sawed from chestnut oak, white oak or post oak. When the total cut of the saw-mills is considered by species, the railroad tie item materially affects the oak percentage.

‡ Mixed lumber is largely chestnut, but was not billed as such at the railroad stations. Chestnut is one of the principal products of the mills, although not so indicated in the above table.

The percentage of outputs of the principal species of sawed timber are approximated in Table Number 3.

Table No. 3.

**PERCENTAGE OF LUMBER CUT BY SPECIES.
1923.**

The Oaks	46 per cent
Chestnut	29 per cent
Poplar	6 per cent
Hemlock	5 per cent
Other species	14 per cent
	<hr/>
	100 per cent

Note: There is a strong demand for walnut and poplar in the form of saw-logs. Walnut logs bring from \$50 to \$250 per thousand board feet and poplar logs from \$25 to \$70 per thousand on board cars. Ordinarily these species of timber are considered too valuable to be cut into rough lumber. The lumber output of these valuable species of timber is very limited, which accounts for the fact that they are not listed in Table 3.

As stated in Table 2, the total output of all classes of saw-mills in 1923 amounted to 8,579,000 board feet, having a total value of \$235,461. After deducting the items of stumpage, investment, interest and profit, there still remains a large sum which went directly into the pockets of the laboring classes. While the mills in Lee County are operated for but short periods and have a low average daily capacity, it is evident that they contribute materially to the welfare of the communities in which they are located.

The saw-log industry.—Although the tracts of timber merchantable for saw-logs are scarce and quite inaccessible, the strong demand for poplar, walnut, hickory and oak logs continues to be an inducement for timbermen to go to great expense to supply the demand. This applies particularly to poplar and walnut logs, which brought the high prices noted above. In 1923 161 carloads of poplar logs, scaling 805,000 board feet, valued at \$40,250, were shipped out of the county. The walnut saw-log business amounted to 43 carloads or 215,000 board feet, valued at \$17,200. In 1923 1,200,000 board feet of saw-log timber was either shipped on the railroads or driven and rafted out of Lee County, having a total value of \$63,450. This timber was of a high average grade and found its way to furniture, veneer, automobile, wagon and wood mosaic factories in Tennessee, Ohio, Michigan and Pennsylvania.

Table No. 4.

**THE SAW-LOG BUSINESS.
1923.**

<i>Shipped on Railroads.</i>		<i>Average Value Per M Bd. Ft.</i>	<i>Value.</i>
Poplar	805,000 board feet	\$50	\$40,250
Walnut	215,000 board feet	80	17,200
Hickory	105,000 board feet	30	3,150
Oak	45,000 board feet	40	1,800
	1,170,000 board feet	.....	\$62,400
Driven or Rafted Poplar and Oak	30,000 board feet	35	1,050
	1,200,000 board feet	.....	\$63,450

Mining timber industry.—During recent years a strong demand has developed for mining timbers of all kinds. About 25 companies were engaged in the coal-mining business in 1923. At least 95 per cent of the total output was mined by 14 of these coal companies. Practically all of the companies contract with timbermen to manufacture their mining timbers on properties controlled by them and in close proximity to the mines. Some companies have specifications and prices for all sizes of timbers used, such as long, medium and short props, room, entry and door ties, sprags, lagging and specials. Since there are no uniform specifications, records or prices, it has been found most practicable to combine the items under the four headings shown in Table Number 5.

Table No. 5.
PRODUCTION OF MINING TIMBERS.
1923.

<i>Kind and Range in Specifications.</i>	<i>Number and Range in Prices.</i>	<i>Average Contract Price.</i>	<i>Value.</i>
Props 4" to 8" x 3½' to 6'	204,624 5c to 12c	8c	\$16,370
Ties 3½" to 5" x 5½'	102,497 10c to 23c	14c	14,350
Capboards 1½" x 6" x 18"	104,923 7c to 1½c	1c	1,049
Miscellaneous linear feet 6" diam.	10,297 3c to 5c	4c	412
Equivalent to	1,970,000 board feet	Total	32,181
Mining timbers shipped out of County	127,920	14c	17,909
Equivalent to	762,000 board feet		
Total board feet, equivalent	2,738,000	Total value	50,090
Average value per thousand board feet			18.30

The coal-mining industry has been on the increase for several years and the indications are that the output will be much greater in the future. The peak in production probably will not be reached for a number of years. This means that there will be a steady and an increased demand for mining-timbers for years to come. Already we find that the landowners are appraising stands of small trees at prices similar to those accepted but a few years ago as proper when only large timber merchantable for saw-logs was considered. Rarely do we find a landowner who does not wish to protect his small timber—the mining props and ties of the future—from forest fires.

Fuel wood.—Approximately 3,000 families in Lee County use wood for heating or cooking purposes. In submitting this figure allowance has been made for about 1,000 homes in which coal is the chief fuel used. While many of the 3,000 families may burn some coal, careful observations and inquiries have lead to the conclusion that a great deal of wood is either burned alone or mixed with coal for heating purposes. Many people who use coal in their grates or furnaces prefer dry wood for cooking purposes,

as it gives a quick fire and is much cleaner than coal. As much as 10 cords of fuel are consumed each year in some homes where only wood is used. Approximately three-fourths of the above mentioned 3,000 families are dependent entirely upon wood for fuel. Five cords per family per year is believed to be a conservative fuel consumption figure. On this basis 15,000 cords of fuel are burned each year, which, using the conservative converting factor of 400 board feet per cord, is the equivalent of about 6,000,000 board feet, in spite of the fact that most of the cordwood consists of sticks that are too small to make much lumber. These 15,000 cords of fuel, at \$5.00 per cord, are worth \$75,000.

Fence posts manufactured and used at home.—The average farm containing approximately 80 acres of land is estimated to have at least 320 rods of fence in which posts are used. It is estimated that the posts will last, on the average, 15 years. Assuming one post per rod, we have a depreciation of 21 posts per year per farm. Allowing for new construction, the average per farm would amount to at least 25 posts per year. On the basis of 3,000 farms the yearly fence post consumption, over and above those recorded as shipped on the railroads, amounts to 75,000 posts, the equivalent of at least 375,000 board feet. At 15 cents per post this home industry is worth \$11,250 per year to the farmers. "A penny saved is a penny earned." In fact, they would have to pay 30 or 35 cents per post for a foreign product.

Miscellaneous timber products.—There is a strong demand for timber products not manufactured by saw-mills, such as chestnut extract-wood, chestnut oak and hemlock tanbark, pulpwood, locust and red cedar fence posts, chestnut poles and split white oak staves. In 1923 this business amounted to an equivalent of 4,003,500 board feet, having a value f. o. b. cars of \$73,202.

Many farmers manufacture their chestnut trees into extract-wood. During slack periods on the farm and at such times as the roads are not too muddy to prevent hauling heavy loads, they truck the extract-wood to the railroad stations, where it is loaded out and shipped to the plant at Big Stone Gap. In 1923 135 cars (11 long cords, 4' x 5' x 8', per car) of extract-wood were billed out of Ben Hur station and 107 cars from Rose Hill for the same period. Extract-wood in smaller amounts was shipped from 13 of the 15 railroad stations in Lee County. The aggregate shipment of this product amounted to 526 carloads, 5,786 long cords, the equivalent of 3,616,200 board feet, at 625 feet per cord, which at \$7.00 per cord had a value of \$40,502.

Table No. 6.

**MISCELLANEOUS TIMBER PRODUCTS BUSINESS (SHIPPED
ON THE RAILROADS).
1923.**

<i>Name of Product.</i>	<i>Common Unit Measure Amount.</i>	<i>Board Feet Equivalent.</i>	<i>Value, Dollars.</i>
Chestnut Extract Wood	6,786 cords	3,616,200	\$40,502
Chestnut Oak and Hemlock tan bark	770 cords	.....	11,550
Red Cedar and Locust fence posts.....	42,000 pieces	210,000	14,700
Chestnut poles	1,260 pieces	75,600	4,410
Pulpwood	150 cords	93,700	1,500
Split staves	4,000 pieces	8,000	540
Totals .....	.....	4,003,500	73,202

Note: These figures would be greatly increased if the mining timbers, fuel wood and fence posts consumed in the county were considered. The above table includes only products shipped from railroad stations.

Table No. 7.

**TOTAL TIMBER BUSINESS FOR LEE COUNTY.
1923.**

<i>Industries.</i>	<i>Feet Board Measure.</i>	<i>Value.</i>
Saw-mill products	8,579,000	\$235,461
Fuel wood	6,000,000	75,000
Miscellaneous	4,003,500	73,202
(shipped on railroads)		
Mining timbers	2,738,000	50,090
Saw-logs	1,200,000	63,450
Fence posts (made and used locally)	375,000	11,250
Totals	22,895,500	508,453

Profit and investment.—The total timber business in Lee County in 1923 amounted to 22,695,500 board feet, having a value of \$508,453, an average of \$22.21 per thousand board feet for all classes of timber products. Most of this money was paid to residents of Lee County. The total receipts, of course, cover the usual items of labor, stumpage, profits to lumber and timber buyers and interest on capital invested in saw-mills and equipment. However, many forest products, such as saw-logs, extract-wood, mining timbers, pulpwood, tanbark and ties were sold by the producers direct to

the consumers, so that the profits to the middleman represent but a small per cent of the total receipts. Many producers of miscellaneous forest products did not figure on profits. They were interested in obtaining fair returns for their labor, in clearing land with some return for their efforts, in receiving stumpage for standing timber or in obtaining cheap building materials for their own use. The items of profit and investment are difficult to determine. They are estimated at 15 per cent, which, based on the average value per thousand of \$22.21, amounts to \$3.32 per thousand. Stumpage is estimated to average \$4.00 per thousand. On this basis \$76,018 were received as profits or interest and \$91,582 for stumpage. It should be remembered that most of this total of \$167,600 was paid to the people of Lee County.

Thrift for the farmer and other forest workers.—On the basis of the above estimates, \$7.32 per thousand went to pay for stumpage, profits or interest. The balance of the operating cost amounts to \$14.80 per thousand and may be considered as the labor item. At \$14.80 per thousand 22,895,500 board feet of timber give a total labor cost of \$338,853. The farmers and other laborers in the county received this amount of money and were that much more able to meet their usual living expenses and to pay their taxes.

At \$4.00 per day it is estimated that the lumber, saw-log, mining timber and miscellaneous timber products industries provided 84,713 man days of labor. According to Table 8, 219 different individuals shipped timber products on the railroads. Approximately 6 of the 43 operating saw-mills in 1923 did not ship ties or lumber. It is estimated that each of these saw-mills and each of the above mentioned shippers employed an average of 4 men for at least a portion of the year, or a total of 900 men. Approximately thirty men were employed all or part of the year at manufacturing mining props and ties, which were not shipped on the railroads, and four men at cutting logs which were driven to the mouth of Blackwater Creek and rafted down Clinch and Tennessee Rivers to Chattanooga. This gives a total of 930 men who were employed for at least a portion of the year. They averaged approximately 91 days' work per man, each one receiving \$364, on the average.

General Benefits.—These calculations have been made in order that the reader may have some conception of what the timber industry means to the people of Lee County. The figures for 1923 are believed to be fairly representative. This industry once ranked first in the county. It has been on the decline for a number of years and now ranks third from a volume of business

standpoint, being generally considered as secondary to the agricultural and coal-mining industries. Regardless of this fact, the timber industry continues to play an important part in the economic life of the people of Lee County. An income of \$506,448 per year which directly benefits at least 930 laborers and many others certainly tends to create a more thrifty condition than would otherwise prevail. The timber industry offers diversified work for many farmers and other laborers and thereby increases the family income; it provides labor for teams that would otherwise be idle; it stimulates business in the county as a whole and helps to create a more thrifty condition for all classes of people.

So much for the economics of the present day timber business. The figures indicate that it is an industry which means much to the people of Lee County and which should be encouraged. The question is how long will it last? It has been on the decline for a number of years. Will it recede into insignificance as an industry? The answer rests entirely with the land-owners and other citizens. A forest is a factory producing timber. Nature works quietly but steadily. The mountain slopes, not suitable for agriculture, will produce vast quantities of merchantable timber within the lifetime of man, provided that the ravages of forest fires are reduced to the minimum. The possibilities of a sustained timber industry equal to that of the present day are discussed later under the heading, "Possibilities of a Sustained Annual Yield."

AREA AND CLASSIFICATION OF LAND.

Virgin forest.—Few virgin forests remain. They are confined to widely scattered tracts, usually of very limited area. This is especially true when poplar, black walnut, white oak, cucumber, buckeye, white ash and hickory are considered. The country has been combed for this class of timber. Many farm forests appear to be virgin in nature, but upon close inspection are found to support a virgin growth of only the less desirable species of trees, the more desirable species having been cut some time ago. The area of virgin forest can only be approximated. It is estimated at 5,000 acres, or about 1.8 per cent of the total area of Lee County.

Farm forest area.—According to the Agricultural Census Report for 1920, there are 2,908 farms in Lee County, having a total area of 230,591 acres. The cultivated area, together with the land set aside for pasture purposes, amounts to 149,467 acres. Of the remaining 81,124 acres that are listed by the Census as parts of farms, 76,380 acres, or 33 per cent of the

Table 8.
VOLUME OF TIMBER PRODUCTS BUSINESS FOR LEE COUNTY.
1923.
As shown by carload shipments from Railroad Stations.

SHIPPING POINT.	LUMBER.										SAW-LOGS.					MISCELLANEOUS FOREST PRODUCTS.										TOTALS.
	Number of Shippers.	Bass- wood and Buckeye.	Hemlock.	Cedar.	Oak.	Poplar.	Chestnut.	Pine.	Mixed.	Walnut.	Oak.	Poplar.	Hickory.	Extract Wood.	Tanbark.	Mine * Ties and Props.	Pulp- wood.	Fence Posts.	Railroad Ties.	Poles.	Coke Slats.	Mine Rails.	Split Staves.			
Wheeler	4				17	1		1					3	21		1	1		8	10				125		
Caylor	14											62		135	8				1	1				162		
Ewing	17				1					3		17		58	2		1	3	5					79		
Rose Hill	31				42	7			7	6	1	4	14	107	22		3	15	23	10				261		
Hagan	10											3		22	1	6	2	1	7	1				43		
Hubbard Spring	28				14		1			7	1	20	1	39	6	4	4	14						112		
Ocoonita	10													11	4	6				12				33		
Ben Hur	29				17	9			31	11	7	43		92	8	35	1	9	20	1			1	285		
Pennington	21			1	7	5			1	9		1	3	9		2	2		33					73		
Dryden	7				2				2	5		5		7		1	1							23		
Olinger	4				1					2				1										4		
Jasper	10																							32		
Harvey	4															32								10		
Keeoke	25	3	21		9			1	41					21	2	10			9	1	16	7		199		
St. Charles	5								2					3	2	64			5					15		
"Pick Ups" (Not billed out)																3			112					112		
Total Number Cars ...	219	3	21	1	110	23	5	2	84	43	9	161	21	526	55	164	15	42	223	36	16	7	1	1,568		
Average Carload		14M	18M	18M	14M	16M	15M	20M	14M	5M	5M	5M	5M	11	14	780*	10†	1,000	280	35‡	2,000	11M	4,000			
Total Shipped		42M	378M	18M	1540M	368M	75M	40M	76M	215M	45M	805M	105M	5,786	770	127,920	150	42,000	62,440	1,260	32,000	77M	4,000	\$ 11,563M		
Unit Value f. o. b. cars.		\$40	\$20	\$60	\$35	\$50	\$20	\$20	\$22	\$80	\$40	\$50	\$30	\$7	\$15	\$.14	\$10	\$.35	\$1	\$3.50	\$.04	\$23.50	\$135			
Total Values		\$1,680	\$7,560	\$1,080	\$53,900	\$18,400	\$1,500	\$800	\$25,872	\$17,200	\$1,800	\$40,250	\$3,150	\$40,502	\$11,550	\$17,909	\$1,500	\$14,700	\$62,440	\$4,410	\$1,280	\$1,809	\$540	\$329,832		

Note: The following products were manufactured in Lee County but do not appear in the above table, as they were not shipped on the railroads:

	Board Feet or Equivalent.	Value.
Lumber sold locally	2,957,000	\$ 59,140
Sawlogs driven	30,000	1,050
Mining timbers manufactured at coal mines	1,970,000	32,181
Fuel wood	6,000,000	75,000
Fence posts manufactured where used	375,000	11,200
Total not shipped on railroads	11,332,000	\$178,621
Total shipped on railroads	11,563,000	329,832
Total for county	22,895,000	\$508,453

* Approximately 10% consisted of mining ties averaging 1,500 pieces per car and 90% consisted of mining props and collars averaging 700 pieces. A general average of 780 pieces per car.

† Extract wood and pulp wood are measured by the "long" cord—4' x 5' x 8'.

‡ Average length of poles—30 feet.

§ Miscellaneous products reduced to a board-foot basis by suitable converting factors for inclusion in this total.

M The conventional abbreviation for "1,000 board feet measure."

farm area, are classified as woodland, and 4,744 acres, or two per cent of the farm area, are classified as "other unimproved land," meaning brush or waste land. The average farm of 79 acres has about 26 acres of forest and about two acres of brush land. Some farms have little or no timberland while others have a large acreage. Most frequently the farm forests occur where the soil is light and rocky or where the ground is too steep for successful cultivation, and often extend to the tops of the ridges or mountains.

Cut-over land.—The farm forest and brush land area of 81,124 acres is considered as cut-over land, but for convenience has been discussed in the preceding paragraph. In addition to this area there are 49,840 acres of cut-over land owned by a few coal companies and individuals. This gives a total area of cut-over lands amounting to about 130,964 acres.

Table No. 9.

CLASSIFIED ACREAGE.

	<i>Virgin Forest (acres).</i>	<i>Cutover Forests (acres).</i>	<i>Cleared Land (acres).</i>	<i>Per Cent Total Area of County.</i>
Agricultural land			149,467	52.4
Farm forests (culled) and brush land in farms		81,124		28.4
Cutover land (other than the farm forests)		49,840		17.4
Virgin timber	5,000			1.8
Totals	5,000	130,964	149,467	100.
Forested area		135,964		47.6
Cleared area		149,467		52.4
Totals		285,440		100.

CONDITION OF THE FORESTS, WITH SUGGESTIONS FOR
MANAGEMENT.

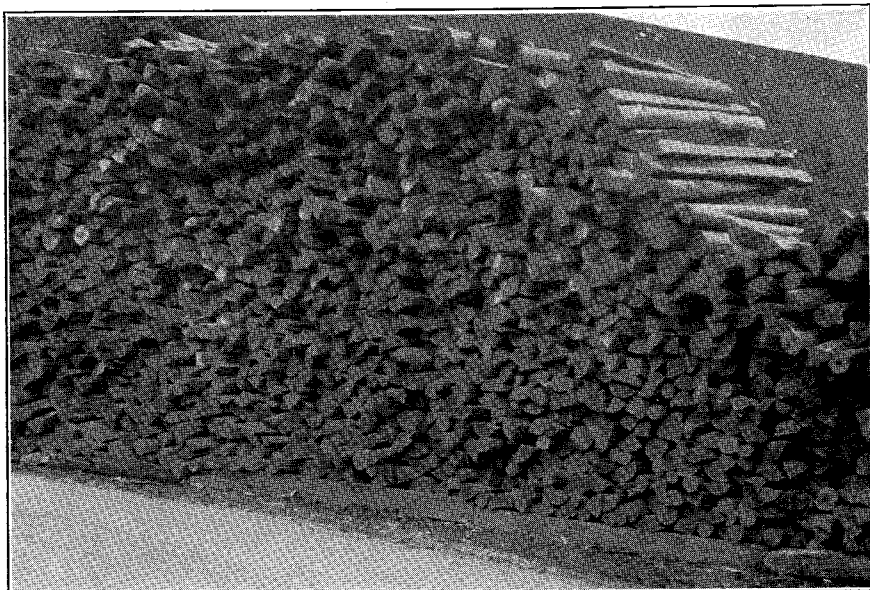
Virgin forests.—The virgin forests, representing less than 1.8 per cent of the present forest area, are over-mature. The average annual loss in old wood, due to center-rot and wind-throw, probably exceeds the average annual growth of new wood. At least these forests are at a standstill. While the volume for any given stand remains constant or is growing less, there is a gradual increase in the investment. The yearly land tax, compound interest and other items of expense slowly but steadily increase the investment.

If the forest is not increasing in volume, the owner's only hope to profitably realize on his investment from now on is to obtain much higher stumpage prices at some future time. There is some risk connected with such a plan. In general, it may safely be said that it is financially advisable to remove the over-mature timber from these virgin forests under a cutting plan which will guarantee that the area will be restocked with desirable species of timber.

Cut-over lands, including farm forests and brush lands.—The cut-over land area is estimated at 130,973 acres. It includes the area covered by farm forests, brush lands, lands restocked with trees of all age-classes and those areas over which are scattered large trees which remain from the original virgin forests. This large timber often consists of valuable species of trees, such as poplar, walnut, hickory and white oak. Years ago when the first logging took place, this timber was mostly under 20 inches in diameter and therefore was not considered worth cutting. In the last 20 to 50 years these trees have increased in size and are now merchantable. Matured hemlock, pine, chestnut, chestnut oak and other trees considered valueless, regardless of size, when the first logging operations took place, are also commonly scattered through the forests. Much of the 1923 cut came from scattered trees found on cut-over lands.

For convenience, the farm forest portion of the cut-over lands is divided into two classes: (1) Small patches of timber surrounded by cleared land, often in close proximity to the homes of the owners. (2) Large wooded areas, extending high up on the mountains, which adjoin other forests. The latter class of woodlands most frequently are menaced by forest fires, and their condition will be discussed later along with the other cut-over lands.

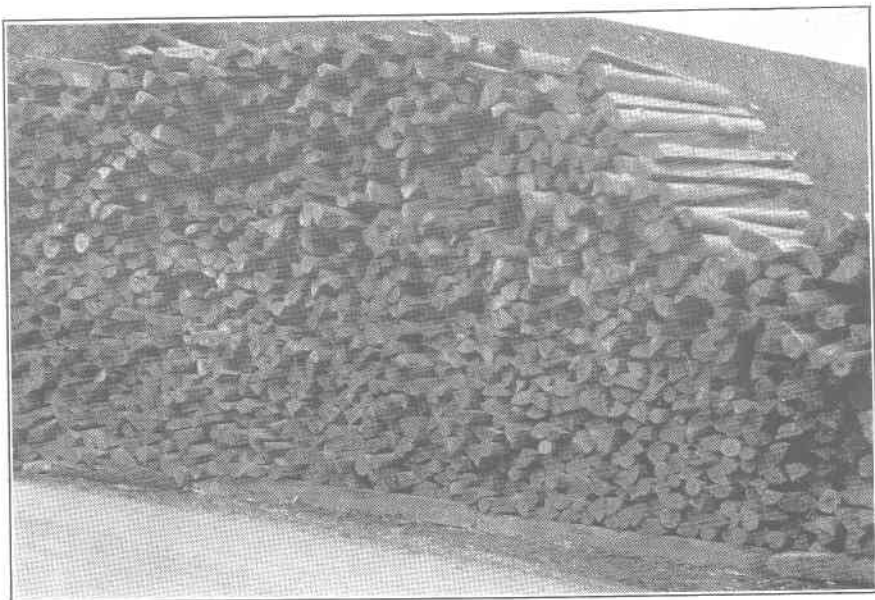
There is less danger of forest fires in the small patches of woods. When a fire does occur the owner usually places it under control before much damage is done. There are few blank spaces or large openings and the forest floor is abundantly covered with decayed leaves and branches. The humus content of the soil is high and it is uniformly moist and mellow and more fertile than would be the case if the forest floor were burned over periodically. The conditions for forest growth are most favorable, except for the cutting methods. Large, mature timber that should be cut is frequently found. It is increasing in size but slowly, if at all. The growth of the smaller timber is retarded, as it is shaded by the spreading crowns of the larger trees. Competition of this understory of young timber with the large dominant trees for soil food and moisture is also a serious handicap to its rapid growth. There is a serious need for the removal of the large,



(A) Pulpwood, for paper-making. Ben Hur Station.



(B) An average run of logs, Rose Hill Station. Two hundred and thirty-four carloads of walnut, oak, poplar and hickory saw-logs were shipped out of Lee County in 1923.



(A) Pulpwood, for paper-making. Ben Hur Station.



(B) An average run of logs, Rose Hill Station. Two hundred and thirty-four carloads of walnut, oak, poplar and hickory saw-logs were shipped out of Lee County in 1923.

mature timber from many farm forests in order to provide for a thrifty growth of the young stands. Within a few years the increased yield would more than offset the loss in timber removed.

Very often we find an even-aged forest, not dominated by large trees, where the timber is not evenly spaced. Two or more trees frequently occupy a space where it would be better to have but one. If the farmer, when cutting mining timbers, fuel wood and other forest products, would practice the same kind of thinning as he does when he thins out a row of beets or parsnips in his garden, he would obtain a far greater yield from his woods. The "weed trees", such as beech, ironwood, persimmon, dogwood, slow-growing oaks and many other trees, should be removed to improve the productive capacity of many farm forests.

It has previously been shown that approximately 33 per cent of the land owned by farmers is covered with a forest growth. These lands are taxed and represent substantial investments. They will yield revenue according to how they are managed. If they are allowed to produce slow-growing trees of low quality, the volume and financial yields will be greatly reduced. They will represent non-productive or almost non-productive investments. It may even be necessary for the agricultural land to carry the tax burden which properly should be paid by the farm forest. If a certain line of merchandise in a department store does not "pay out" or "stand on its own feet" the merchant may substitute goods which will sell at a profit. The farmer, however, cannot dispose of the forest located on his non-agricultural land. He must keep it. His only chance to make this land pay taxes and interest is to make it produce timber. There are many important matters for the farmer to consider in connection with the improvement of his farm woods which cannot be discussed here. More detailed information can be obtained by reading bulletin Number 12, entitled "Farm Forestry in Virginia." This bulletin may be obtained from the Chief Forest Warden of the county or upon application to the State Forester.

Varied conditions prevail in connection with the balance of the cut-over lands. Many fields abandoned years ago have been restocked with desirable species of trees and are in most thrifty condition. A field abandoned 43 years ago on Stone Creek now supports a forest of 100 trees per acre, 6 to 20 inches in diameter, averaging 12 inches in diameter. There are approximately 8 poplar trees per acre now merchantable, estimated by an experienced timber purchaser to average 900 board feet per tree. The trees, as a whole, are increasing in diameter at the rate of one-half inch per year. Many other trees will be in the merchantable class within the next ten

years, although it may not be financially advisable to cut the timber during this period. The species of trees found in this stand are poplar, white and black walnut, white ash, hickory, chestnut, white and black oak, hard maple, lin, locust, black gum, beech and dogwood. This stand is fairly representative of many even-aged stands of timber which have established themselves upon abandoned fields. Pure stands of yellow poplar are quite common in such situations.

The balance of the cut-over lands supports forests of all age-classes. Where the ravages of forest fires are not evident the young trees have long, clean boles, and are quite free from defects. The well shaded forest floor is quite open. The soil is mellow and moist and is greatly enriched by decayed organic matter. Here the condition of the forest is uniformly satisfactory. These thrifty stands most commonly are found on the north slopes and in damp, inaccessible or protected places where forest fires have not occurred. Unfortunately, the conditions are reversed on those portions of the cut-over area which have frequently been visited by forest fires.

THE FOREST-FIRE MENACE.

Fully 75 per cent of all the cut-over lands in the county have at some time been burned over. In fact, it is difficult to select an acre in the woods, even in the virgin forests, in which charred snags or swell-buttressed trees with blackened cat-faces cannot be found. Charcoal is always good evidence that fire has been present. The forest-fire menace is well known to many settlers who have repeatedly fought fires to keep their rail fences and buildings from burning up. The forests are full of evidence, not only that fires have occurred in the past, but that they have done an estimatable damage. Large scraggly trees with low-spreading crowns bear evidence that they have grown up in openings. They have had plenty of uneven side light, which has caused them to develop in this manner. A big percentage of the wood is found in the limbs. The trunks are short and will provide little select lumber. Upon examining the bases of these trees, we most frequently find blackened cat-faces, evidence that they were injured by forest fires when young. Very often these trees are diseased, insect-infested or hollow. They are either valueless or produce low grades of lumber, and are expensive to log. Numerous trees can be found on many areas in all parts of the county similar to the ones just described. The probabilities are that their surrounding associates in the young forest were killed by fire. Wind-throw resulted, which provided the openings in which these trees were permitted to

grow, there to dominate an understory of second-growth. They are worth little in themselves and take up space in the forest which would grow several tall, straight trees, if fires were kept out. Where repeated fires have occurred the humus content of the soil is negligible. In contrast to the damp, mellow and moist soil found in the closed forest we find a less fertile exposed mineral soil which is dry and packed.

An experienced lumberman always hesitates to begin operations in fire-killed timber, because he knows that the yield per acre and quality of the timber will be greatly reduced. It costs him just as much to log low-grade hollow logs as it does to log sound, high quality timber. Practically all lumbermen and the older settlers, who have had ample opportunity to make observations concerning the ravages of forest fires, believe that the forest fire problem is the most serious of all timber management problems in Lee County.

It is difficult to estimate the damage resulting from forest fires of the past. We do know, however, that, if fires had not occurred, there would be more trees per acre, that they would be straight and tall and of much higher quality and that the individual trees would grow much faster in a close stand where the soil is kept fertile, mellow and moist.

In many cases removal cuttings and thinnings can be made to advantage on these cut-over lands. While good silvicultural practice should be encouraged, it should be remembered that all efforts along this line will be of no avail, if forest fires are allowed to burn through the woods. At least 75 per cent of the problem of the landowners who are interested in keeping their woodlands productive is the problem of forest-fire protection. Trees propagate themselves naturally. Fair yields can be obtained, if forest fires are kept out of the woods.

POSSIBILITIES OF A SUSTAINED ANNUAL YIELD.

Most of the timber which is manufactured into fence posts, poles, pulpwood and mining timbers is obtained from young trees. These products in 1923 amounted to 3,492,300 board feet. The balance of the total cut, or 19,403,200 board feet, was mostly obtained from mature timber which formed a part of the original virgin forests. It is estimated that an average of 1,000 board feet per acre of merchantable, mature timber remains on the cut-over lands. This area of about 135,964 acres then supports approximately 135,964,000 board feet of mature timber. To this must be added 5,000 acres of virgin timber at 7,000 board feet per acre, or 35,000,000 board feet. In

round numbers then the total available, merchantable, mature timber amounts to 171,000,000 board feet. If this timber is cut at the rate of 19,403,200 board feet per year, it will all be gone within nine years. It should be remembered that these estimates apply to the mature trees which remain from the virgin forests, and that of the total yearly output, approximately 12,000,000 board feet will be manufactured from the less valuable trees into fuel or extract wood; also that the yearly average cut of this class of timber will gradually be reduced, so that some virgin timber will remain for many years yet to come. Practically speaking, however, the present day output of mature timber can be maintained for about nine years. It is believed that the output of posts, poles, pulpwood and mining timbers, most of which comes from the young trees, will be sustained during this period, and may increase sufficiently to offset the decline in the cut of the mature timber.

The indications are that a balance has been struck between agricultural and forest acreage. In other words, in 1934 or on any assumed future date, there will be approximately 135,000 acres of forest land in Lee County. To obtain a yearly cut of 23,000,000 board feet, an amount slightly in excess of the cut for 1923, would mean that the average acre of land would have to yield 170 board feet per year, the equivalent of 1,000 board feet in 5.9 years or 10,000 board feet in 59 years.

Information is not available concerning the average annual growth of the present day forests in Lee County for the various sites and types. We do know, however, that the conditions in general are favorable for tree growth. There is a long growing-season, the soil depth and fertility average up well with other forest regions and there is an abundance of moisture. It is not uncommon to find poplar and chestnut trees that have laid on annual rings for several years one-half inch in width. This amounts to a diameter growth of one inch per year, as the rings, of course, occur on both sides of the center of the tree. The best specimens show a growth of three-fourths of an inch on a side or $1\frac{1}{2}$ inches of diameter growth per year. However, for the average run of the fast-growing species of timber, such as poplar, chestnut, locust and walnut, the average annual diameter growth amounts to about one-half inch per year, or one-fourth of an inch on a side. A butt cut of walnut log was observed which attained a diameter of 36 inches in 54 years, somewhat above the average in rate of growth. Measurements of representative chestnut poles found in the yard at Rose Hill station resulted in the following data: length $22\frac{1}{2}$ feet, average top diameter $6\frac{3}{4}$ inches, average butt diameter $10\frac{1}{2}$ inches, ages 34, 37, 27, 27, 36, 27, 26, 33, and

32, an average of 31 years. In each case 3 years were added to offset the age of the seedling before it reached the stump height. From these figures it appears that 22½ foot chestnut poles can be grown in 31 years. Chestnut poles, 40, 45 and 50 feet long, found at Wheeler station, having 8 and 9 inch tops, averaged almost exactly 40, 45 and 50 years, respectively. Ring counts on chestnut and oak mining timbers, split and round, found on Straight Creek, resulted in the figures shown in Table Number 10.

Table No. 10.

RATE OF GROWTH OF MINING TIMBERS ON AN AVERAGE SITE.

	<i>Diameter in Inches.</i>										<i>Age in Years.</i>
	4	5	6	7	8	9	10	12	14	16	
Chestnut	14	16	17	18	23	24	27	33	37	38	
Oak.....	17	22	28	37	46	56	67	72	.....	.....
(Mostly Chestnut Oak.)											

Note: Three years were added in each case to make allowance for the age of the seedlings up to stump height.

The above statements are intended simply to give a general idea concerning the rate of tree growth, as casually observed, and show quite conclusively that timber grows rapidly in Lee County. On the best sites it is believed that saw-log timber can be matured in 60 years, that good 40-foot poles can be grown in 40 years and that a mining timber crop will mature in 35 years. The reader should realize that the above figures apply to the age of the merchantable timber from the seedling stage to maturity and that there are thousands of acres in Lee County supporting stands of timber which are 10, 20, 30 or more years beyond the seedling stage.

The probable number of years that timber cutting will have to be deferred for a given stand is represented by the difference between the probable date of maturity and the present age of the stand. If poplar, chestnut, hickory and walnut increase in diameter at the rate of one-half inch per year—one-fourth of an inch on a side—it is evident that 10-inch trees will be 15 inches in diameter within 10 years and 20 inches in diameter within 20 years. This assumed condition is believed to be conservative for the fast growing species for the average sites on which they are found. For the oaks and other slow-growing trees these figures should be

about doubled, as they grow about one-half as fast as the above mentioned species of timber. The possibilities of the extensive stands of timber which have reached the pole stage are of great importance.

Conservative yield estimates for well-managed stands of timber in other regions range between 250 and 1,500 board feet, or between one-half cord and 3 cords per acre per year, the higher figures applying only to limited areas with rapid-growing species, favorable soil conditions and good forest management. The possibilities of tree-growth are well summarized by Professor J. S. Illick, Chief of the Branch of Research in the Pennsylvania Department of Forests and Waters, in Bulletin Number 30, entitled, "The Forest Situation in Pennsylvania," in which he says, "The Pennsylvania Department of Forest and Waters' estimate of forest growth—one cord per acre per year—is conservative compared with the growth of well-managed European forests in which growing conditions are in many cases less favorable than in Pennsylvania."

The conservative estimate of one cord (about 500 board feet) per acre per year used by Professor Illick applies to the future, when the forests in Pennsylvania will be managed better than in this day and age. We are here concerned primarily with the probabilities of a sustained yield for perhaps the next 50 years. For the Lee County cut-over land, then, proper allowance must be made for existing blank spaces caused by forest fires; also for the retarded growth of young stands which are dominated by scraggly, broad-crowned trees that bear the scars of past wars waged by forest fires. Our estimates must be further reduced to cover the areas of low production belonging to the ridge type. Since all other conditions are favorable for tree growth, an estimate of actual present growth in Lee County is believed to be conservative when placed at 250 board feet (about one-half cord) per acre per year. It has previously been shown that an annual increment of 170 board feet per acre per year will sustain the present-day cut of 23,000,000 board feet. If an annual growth of 250 board feet per acre per year is obtained from 135,000 acres, an industry amounting to 33,750,000 board feet per year can be sustained, an increase of 47 per cent over the present-day timber business. With better management of the forests, the timber business could be materially increased.

Not only is it good business to protect the forests from fires and otherwise to encourage their perpetuation, but plain necessity demands that an abundance of cheap fuel, building materials and other timber products be made available for the future. The people of Lee County cannot afford to to ship in fuel wood, fence posts, rough building materials and other forest

products, when they can be grown at home. The coal-mining industry of the future will be in need of large quantities of cheap mining timbers. If it becomes necessary to ship them in from outside points, the operating cost will be materially increased. Timber is growing scarce in adjoining states. The freight cost must be considered jointly with the probable increases in values of timber products, due to the scarcity of timber everywhere. The forests of Lee County are an important natural resource. They share with water-power the distinction of being the only commercial natural resource that is capable of perpetuation. Every mineral is subject to exhaustion, but the supply of wood may be forever renewed.

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