

VIRGINIA GEOLOGICAL SURVEY

UNIVERSITY OF VIRGINIA

THOMAS LEONARD WATSON, PH. D.
DIRECTOR

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The Coal Resources
and General Geology of the
Pound Quadrangle
in Virginia

BY
CHARLES BUTTS

PREPARED IN COÖPERATION WITH THE
UNITED STATES GEOLOGICAL SURVEY

CHARLOTTESVILLE
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LETTER OF TRANSMITTAL

VIRGINIA GEOLOGICAL SURVEY,
UNIVERSITY OF VIRGINIA,
CHARLOTTESVILLE, March 16, 1914.

*To His Excellency, Hon. Henry C. Stuart, Governor of
Virginia, and Chairman of the State Geological Commission.*

SIR:—I have the honor to transmit herewith for publication, as Bulletin No. IX of the Virginia Geological Survey Series of Reports, a report on "The Coal Resources and General Geology of the Pound Quadrangle in Virginia," by Mr. Charles Butts of the U. S. Geological Survey.

This report has been prepared by the Virginia Geological Survey in coöperation with the U. S. Geological Survey. Under the coöperative agreement of the State and Federal Surveys the entire region of Pennsylvanian coals in southwest Virginia, approximating 1,550 square miles of territory embracing the whole or parts of Tazewell, Buchanan, Dickenson, Wise, Russell, Scott, and Lee counties, is being studied and mapped both topographically and geologically, in detail.

The present report is the first to be published under this coöperative plan; and, in view of the author's conclusions as to the quantity and quality of coal, the report should prove of much value in the development of the coals of the quadrangle. The coal is bituminous and of excellent quality. Mining conditions seem highly favorable and the region should, with development, become one of the principal coal-producing centers of the central Appalachian coal field.

Respectfully submitted,

THOMAS L. WATSON,

Director.

THE COAL RESOURCES AND GENERAL GEOLOGY OF THE POUND QUADRANGLE IN VIRGINIA

BY CHARLES BUTTS.

INTRODUCTION.

The Pound quadrangle includes parts of Pike and Letcher counties, Kentucky, and Wise and Dickenson counties, Virginia. It is located a few miles northwest of the Toms Creek coal field, in the territory between the great Pocahontas coal field on the northeast and the Big Stone Gap field on the southwest. Until recently the region was entirely undeveloped and little information concerning it was available. It has not, however, escaped the attention of coal operators, and some of the largest corporations have been acquiring lands in this region with a view to active development. Within the last three years railroad communication with the outside world has been established, and on the Kentucky side fourteen shipping mines are in active operation. On the Virginia side only one large mine has been operated, but doubtless others will be established in the near future.

The number of coal beds in the quadrangle is probably greater than elsewhere in the Appalachian coal field, and in the thickness and extent of its beds the area will compare favorably with most others in that field. These factors, combined with the excellent quality of the coal, insure the area a prominent place among the future fuel-producing centers of the Appalachian province.

The geologic examination of the Virginia portion of the Pound quadrangle was carried on in 1911 jointly by the Virginia Geological Survey and the United States Geological Survey. The United States Geological Survey had charge of all field work, but it was ably assisted by men and money supplied by the Virginia Geological Survey. An accurate contoured topographic map of the quadrangle was made and this will be ready for distribution as soon as it is engraved.

In the survey of the Virginia part of the quadrangle the writer was ably assisted by D. D. Condit and Wilbur A. Nelson, both of whom represented the Virginia Geological Survey. The Clinchfield Coal Corporation, which has extensive holdings in Wise, Dickenson, Buchanan, and Russell counties, Virginia, has contributed invaluable data dealing with triangulation surveys, coal-outcrop surveys, diamond-drill borings, etc.

Extensive prospecting by the same company has opened several of the more important coal beds to more thorough examination. The Virginia Coal and Iron Company, operating in Wise County, Virginia, has also made many openings and has contributed maps of outcrop surveys which have been of great assistance. The Estillville and Bristol folios of the United States Geological Survey, by M. R. Campbell, and United States Geological Survey Bulletin 348, by R. W. Stone, have also been drawn upon for any material that could be used in the preparation of this report.

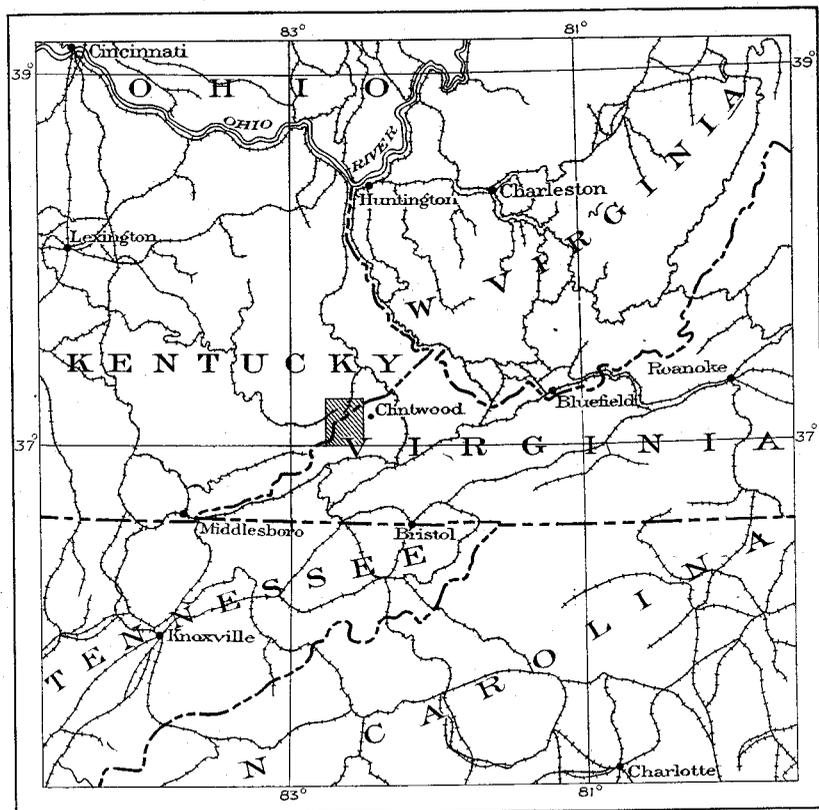


FIG. 1. Index map showing the location of the Pound quadrangle.

As shown by the key map, figure 1, the Pound quadrangle, which coincides with the southeastern quarter of the old Whitesburg 30-minute quadrangle, lies partly in eastern Kentucky and partly in southwestern Virginia. The line between the two states follows the crest of Pine

Mountain nearly to the west boundary of the quadrangle, where it turns south along the watershed between Cumberland and Pound rivers. The quadrangle is bounded on the north and south by the parallels of $37^{\circ} 15'$ and 37° , respectively, and on the east and west by the meridians of $82^{\circ} 30'$ and $82^{\circ} 45'$. Its area is about 240 square miles, lying entirely in the Appalachian coal region.

TOPOGRAPHY.

RELIEF.

The surface of the country is hilly or even mountainous, the maximum range of altitude from Pound River to Black Mountain being 2,300 feet. Pine Mountain, with peaks that reach 3,500 feet above sea-level, crosses the northern half of the area from northeast to southwest, and Black Mountain, whose summit is 3,800 feet above the sea, 1,800 feet above Roaring Fork, and 1,550 feet above Guests River, is located in the southwestern part of the quadrangle. These mountains are the dominant features of the region. Buck Knob and Bowlecamp Knob, at an altitude of about 1,500 feet above Indian Creek, are also commanding objects in the landscape.

The northwest slope of Pine Mountain is an escarpment 1,500 to 2,000 feet high, and, as the crest is scarcely a mile from the valleys at the foot of the slope, a very bold and striking front is presented. The southeast slope of the mountain, approximately a dip slope on the Lee sandstone, is more gentle, the total descent being somewhat less and the distance to the foot nearly twice as great as on the northwest side.

The quadrangle is deeply dissected by the streams, the valleys of which are deep, narrow, and V-shaped. The slopes are very steep and rise 500 to 1,000 feet to the ridge crests, which are commonly only a few feet broad and many of which are capped with heavy cliff-forming sandstone. Even the larger streams have very narrow flood plains, and many of them have none at all. Probably 5 per cent would be a liberal estimate for the total area of flat land in the quadrangle. The ridges and valleys trend in irregular directions over most of the Virginia portion of the quadrangle.

DRAINAGE.

The principal streams in the Virginia area are Pound River, including North and South forks, which traverses the quadrangle from southwest to northeast near the middle; Roaring Fork, Powell River, and Guests River,

in the southwestern part; Indian Creek, which flows due north through the middle of the southern part of the quadrangle and joins Pound River at Pound; and Birchfield Creek, in the southeastern part, which joins Cranes Nest River, a tributary of Pound River, just outside of the eastern margin of the quadrangle.

Pound River is the largest stream. It is doubtful whether any of the smaller streams or even Pound River carries much water in times of prolonged drought.

The Virginia part of the Pound quadrangle includes parts of two drainage basins. The area drained by Pound River and its tributaries, including Indian and Birchfield creeks, belongs to the Ohio-Big Sandy basin; that drained by Guests and Powell rivers to the Tennessee-Clinch basin.

ACCESSIBILITY.

In a potential mining country like this area the matter of transportation and consequently the conditions affecting railroad construction are of the first importance. The nearest main lines of railroad are the Norfolk and Western Railway and the Louisville and Nashville Railroad at Norton, about 4 miles south of the quadrangle; the Louisville and Nashville Railroad at Pineville, Kentucky; the Chesapeake and Ohio Railway along the Big Sandy River in Kentucky; and the Carolina, Clinchfield and Ohio Railroad, now being extended from Dante, Virginia, to Elkhorn City, Kentucky, near the "Breaks of Sandy."

The country herein described is still poorly provided with transportation facilities. The territory drained by Guests River could easily be reached by a railroad from Norton, but the Pound River drainage area presents serious obstacles to railroad construction. To build a railroad from the south would involve steep grades or an expensive tunnel at the head of Indian Creek. The railroad now existing along Indian Creek is a narrow-gauge road built to haul logs from Pound River to a sawmill at Glamorgan, where it connects with the standard-gauge road to Norton. A branch line from the Carolina, Clinchfield and Ohio Railroad up Pound River would, on account of the narrow and crooked valley, be expensive to construct and operate. The area drained by the upper part of Pound River and its tributary Indian Creek could perhaps be most advantageously reached by a line from the Louisville and Nashville Railroad at Pineville, Kentucky, following Cumberland River and crossing the low divide at Flat Gap. A railroad just beyond the southwest corner of the quadrangle connects with

the Interstate Railroad at Blackwood a few miles to the south and follows Roaring and Whitley forks to the Pardee mine. It seems perfectly feasible to build a spur up the main branch of Roaring Fork to the base of Black Mountain. The territory tributary to Birchfield Creek and Georges Fork can apparently be best reached from the Carolina, Clinchfield and Ohio Railroad along Pound and Cranes Nest rivers. The northwestern part of the area along Pound River is nearest to the Baltimore and Ohio Railroad at Jenkins, but, owing to the intervening Pine Mountain, this railroad can be of little service to the Virginia region except in the matter of travel and light traffic.

STRATIGRAPHY.

GENERAL STATEMENT.

The rocks outcropping in the Pound quadrangle belong to the Devonian and Carboniferous systems. The Devonian rocks, the lowest and oldest exposed in the quadrangle, outcrop only on the west escarpment of Pine Mountain in Kentucky and consist of about 800 feet of dark to black shale, the lower part of which is classed as Chattanooga black shale and the upper part of which is included in the Grainger shale in reports on adjoining quadrangles. The Carboniferous system is represented by the Mississippian series below and the Pennsylvanian series ("Coal Measures") above. Each of these series is made up of a number of formations, which are described below.

MISSISSIPPIAN SERIES.

The Mississippian series in this area is 1,500 to 1,600 feet thick and comprises three subdivisions, which, in ascending order, are the upper part of the Grainger shale, the Newman limestone, and the Pennington shale. The upper part of the Grainger shale is composed chiefly of green shale and brownish sandstone, but in the upper 50 feet there is considerable red sandstone. The Mississippian part of the formation occurring in this area appears to be 400 to 500 feet thick. The Grainger is overlain by the Newman limestone, about 300 feet thick, which is oolitic and thick bedded in the lower half, but thinner bedded and with only a few oolitic layers in the upper half. The Newman is overlain by the Pennington shale, which is about 800 feet thick and is composed of red and green shale, thin-bedded, fine-grained green sandstone, and one persistent stratum of hard, siliceous sandstone 100 feet thick.

The Mississippian rocks outcrop only on the northwest front of Pine Mountain in Kentucky, and dip southeastward under the coal measures in Virginia. The Mississippian part of the Grainger shale is partly exposed on the Pound Gap road and on the Blowing Rock road 2 or 3 miles beyond the east margin of the quadrangle. The red sandstone layers are especially well shown on the Blowing Rock road at the part known as the "Red Winds." The Newman limestone is exposed on the Pound Gap road and outcrops as a cliff along much of the mountain front. The Pennington shale is fairly well exposed on the Pound Gap road immediately west of the summit. Near the road its siliceous sandstone member outcrops as a cliff and half a mile or so north of the road it makes another cliff known as the Raven Rock. The Pennington shale was penetrated at a depth of about 2,000 feet in diamond-drill boring No. 1 on Cranes Nest River near the mouth of Lick Fork, a short distance east of the quadrangle. (See Pl. I.)

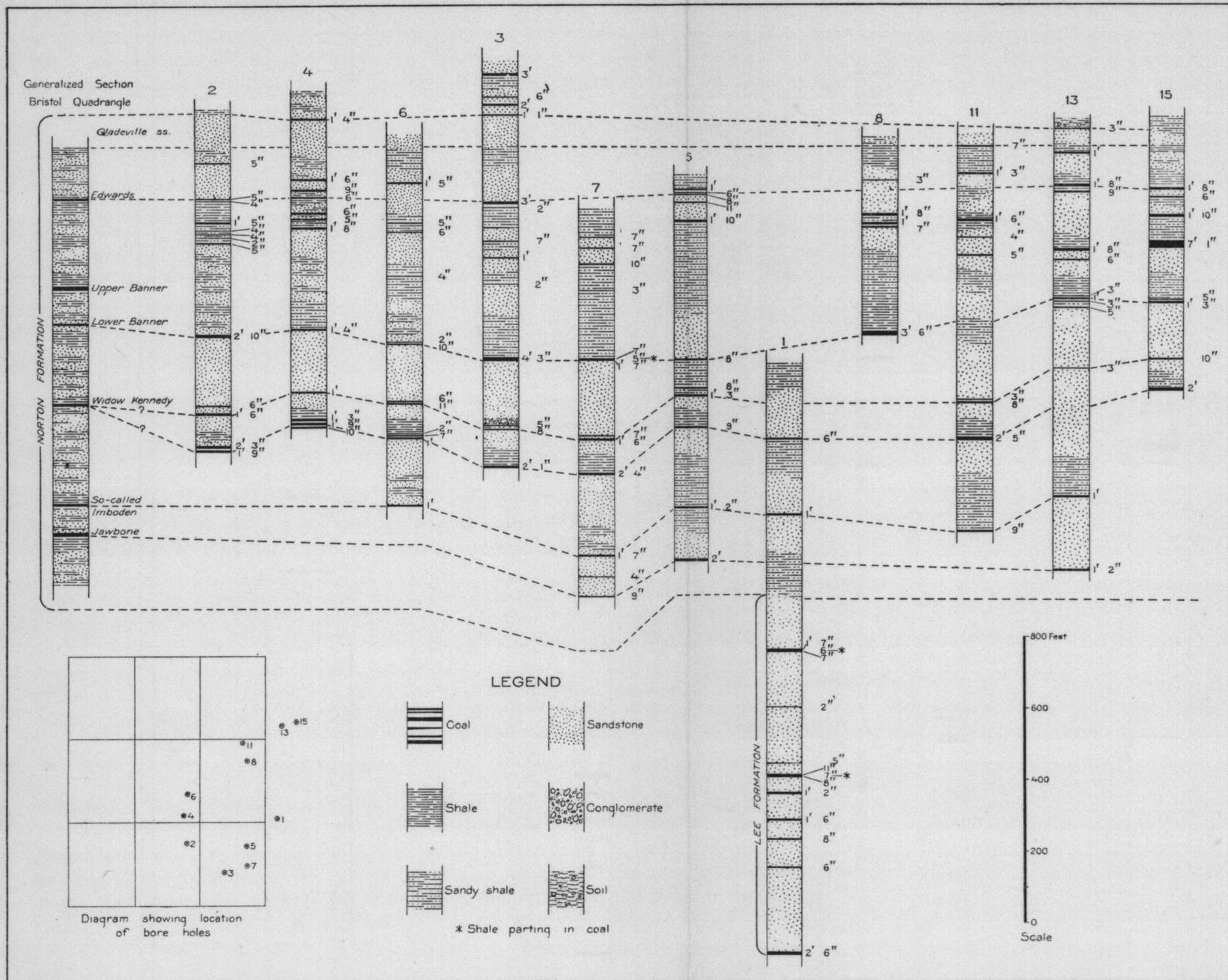
PENNSYLVANIAN SERIES.

The Pennsylvanian series in this area is 4,800 feet thick and consists of shale and sandstone containing 46 or more coal beds. These rocks, all of Pottsville age, were divided by Campbell¹ into the following formations, named in ascending order: Lee conglomerate, Norton formation, Gladeville sandstone, Wise formation, and Harlan sandstone. The character of the rocks, the sequence of formations, and the number, position, and succession of coal beds are shown in the columnar section accompanying this report (Pl. III). This section is partly generalized, but the section of the Lee is taken from the log of a bore hole on Cranes Nest River just outside the east margin of the quadrangle, and the part of the section of the Wise formation above the Bolling (5-foot) coal beds and the section of the Harlan sandstone were measured at the head of South Fork of Pound River, the section extending from the base of Black Mountain to the summit. The Black Mountain section of the Pennsylvanian is probably the thickest in the Appalachian province outside of the Coosa and Cahaba troughs in Alabama.

LEE FORMATION.

The Lee formation, as delimited by the writer in the log of the well boring on Cranes Nest River (sec. 1, Pl. I) is 1,030 feet thick. It is predominantly sandstone, which at the top and bottom of the formation is

¹Campbell, M. R., *Geology of the Big Stone Gap coal field of Virginia and Kentucky*: U. S. Geol. Survey Bull. 111, pp. 33-36, 1893.



Sections of diamond drill holes in the Pound quadrangle and vicinity and generalized section of the Norton formation in the Bristol quadrangle. The holes were drilled and the records furnished by the Clinchfield Coal Corporation, and bear the serial numbers of the company.

conglomeratic. At the base is about 230 feet of massive conglomeratic sandstone. This sandstone forms the crest of Pine Mountain, where it outcrops for long distances as a cliff. Above the basal sandstone is 250 feet of alternating shale and sandstone, in which are six coal beds at about equal stratigraphic intervals and from 6 inches to 2 feet 2 inches thick. Three of the beds are workable, being 1 foot 2 inches, 1 foot 6 inches, and 2 feet 2 inches thick. Above this group of coal beds the well log shows 550 feet of sandstone with a 2-inch coal bed 225 feet above its base and a 1-foot 7-inch bed 400 feet above its base, the two beds being 700 and 875 feet, respectively, above the bottom of the formation. The upper 160 feet of the Lee is a hard, siliceous conglomeratic sandstone, the pebbles being small and scattered. This stratum, dipping southeastward, forms the lower part of the southeast slope of Pine Mountain, and its outcrop on the slope is marked by a subordinate ridge or line of knobs parallel with the general direction of the crest of the mountain.

The Lee formation outcrops in a zone about 2 miles wide which extends diagonally across the quadrangle from the northeast corner. Its base forms the crest of Pine Mountain, and, owing to the southeastward dip, successively higher beds of the formation are encountered in descending the southeast slope. In reality the presence of a mountain ridge here is determined by the inclined beds of this hard, resistant sandstone and conglomerate. Besides this main area of outcrop, the Lee is exposed in a long, narrow area low down on the northwest escarpment of Pine Mountain, in contact with the Devonian rocks or with the Mississippian part of the Grainger shale on the east, and with coal-bearing rocks, in part probably equivalent to the Wise formation, on the west. This narrow area is an outcrop of a segment of the Lee, which was broken off and thrust upward along a fault, as described in the section on geologic structure. The massive sandstone strata of the formation are well exposed in the "Breaks of Sandy," 12 miles northeast of the Pound quadrangle, where the Lee forms canyon walls nearly 1,000 feet high.

NORTON FORMATION.

A fairly reliable determination of the thickness of the Norton formation is made by combining the upper part of the bore-hole section on Cranes Nest River (sec. 1, Pl. I) with the surface section of a high knob immediately adjacent to the hole. The contact between the Lee and the Norton, as the log is interpreted, is 879 feet above the sea and the horizon of the bottom of the Gladeville sandstone, which is the top of the Norton for-

mation, is approximately 2,070 feet above the sea. The thickness of the Norton is therefore 1,191 feet.

The character of the Norton formation is well shown in the group of bore-hole sections in Plate I, from which the generalized columnar section of the formation in this quadrangle is taken. Its most striking feature is the variability in the number and position of the coal beds, a feature which makes it difficult to give a satisfactory, brief, general description of the formation. In general the formation is made up of shale and sandstone, with coal beds, the more important of which are approximately 190, 320, 410, 560, 730, and 930 feet above the bottom. Eighty feet below the Gladeville is a conglomeratic sandstone 50 feet thick, which may prove to be the same as the Bearwallow conglomerate of the Tazewell quadrangle, 30 miles east of this area.

In the Pound quadrangle the Norton formation outcrops in a belt about $1\frac{1}{2}$ miles wide extending diagonally across the quadrangle parallel to Pine Mountain and bounded roughly on the northwest by the base of the mountain and on the southeast by Pound River. Along the river it dips beneath younger rocks and is under cover as far as Cranes Nest River and Birchfield Creek, where it is again exposed, forming the lower part of the valley walls. There is also a narrow area along the upper course of Indian Creek. The formation disappears beneath Sand Ridge and Black Mountain and is concealed in the southern part of the quadrangle, but it outcrops several miles south of the quadrangle along the southern margin of the coal field.

Correlation of Coal Beds.

The correlation of the Norton coals of this area with the Norton coals of the southern margin of the Virginia coal field as classified by Campbell¹ is more fully discussed on page 19 and only a brief statement of conclusions need be given here. The coal bed at a point 190 feet above the bottom of the Norton formation is the Jawbone, the one at 320 feet is the so-called Imboden, the coal at 410 feet apparently does not appear in the Bristol section, the coal at 560 feet is equivalent to the Widow Kennedy bed, and the coal bed at 730 feet above the bottom of the formation is the Lower Banner bed. The Upper Banner coal is not present unless it is represented by the group of thin coals 250 to 270 feet below the Gladeville sandstone, including the 7-foot bed in well No. 15, east of the quadrangle.

¹Campbell, M. R., *Geology of the Big Stone Gap coal field of Virginia and Kentucky*; U. S. Geol. Survey Bull. 111, pp. 33-36, 1893; U. S. Geol. Survey, *Geol. Atlas, Estillville folio* (No. 12), 1894; *Bristol folio* (No. 59), 1899.

The Edwards-Imboden horizon is represented by another group of thin coals 150 feet below the Gladeville sandstone. The coal just below the Gladeville sandstone appears to be the Yellow Creek bed mined east of Wise, 2 miles south of this quadrangle.

Nearly all the coal beds of the Norton formation, except the thick bed in boring No. 15 (Pl. I), are less than 3 feet thick, and most of them are less than 2 feet thick. Several of the bore-hole sections show a number of thin coal streaks associated with the thicker beds, and this suggests that owing to rapid sedimentation the continuity of accumulation of vegetal matter in this area was more or less interrupted during the period of coal formation, and that such conditions resulted in the deposition of a number of thin beds instead of one thick bed, such as occurs at the same horizon at Toms Creek, Norton, etc., along the southern margin of the Virginia coal field, although the total accumulation of vegetal matter may have been about equal in both areas.

GLADEVILLE SANDSTONE.

The Gladeville sandstone was named by Campbell from Gladeville, now Wise, a town 2 miles south of the quadrangle, which is built on the sandstone. It underlies Sand Ridge and is exposed on Steele Fork of Cranes Nest River, on Cranes Nest River, and on Birchfield and Indian creeks. It underlies Bowlecamp Knob, and a few feet of the top of the stratum outcrops along Mullin and Dotson forks of Bowlecamp Creek as far as Pound River. It is also exposed on Camp Creek and Georges Fork. The outcrop follows the general course of Pound River across the quadrangle, the sandstone rising northwestward toward Pine Mountain and underlying only the higher knobs near the river. It is a very persistent bed and exceedingly serviceable as a key rock. On the map its outcrop is shown by the stipple pattern between the lines representing the outcrops of the Glamorgan and Yellow Creek coal beds or their horizons.

At Wise the Gladeville sandstone is hard, white, and siliceous and appears to be about 100 feet thick. In the region north of Sand Ridge, however, it is less purely siliceous and thinner than at Wise; it contains more argillaceous matter and more feldspar and mica, and its thickness does not exceed 60 feet.

WISE FORMATION.

The Wise formation includes the mass of shale and sandstone 2,070 feet thick, including many coal beds, lying between the Gladeville sand-

stone below and the Harlan sandstone above. It includes at least nineteen distinct coal beds and probably others that have not yet been discovered. The Wise formation constitutes the surface rock in most of that portion of the quadrangle lying south of Pound River. North of the river it also caps some hills and ridges, and southeast of Birchfield Creek it occurs only on the hills, the Norton formation outcropping in the valley bottoms and well up on the hillsides.

Glamorgan coal.—Immediately above the Gladeville sandstone is the Glamorgan coal, named from Glamorgan, just beyond the south margin of the quadrangle, where the bed is mined. It attains its maximum known thickness in the hills south of the heads of Birchfield Creek and Dotson Fork, northeast of Glamorgan. On Birchfield Creek and Dotson Fork the bed is divided by partings, but generally includes one bench 2 feet or more thick. Along Pound River northeast of Pound a persistent thickness of 2½ to 3 feet is shown at numerous openings, but here also the bed contains several partings.

Above the Glamorgan coal is 200 feet of shale and sandstone containing five coal beds. The sandstone is highly siliceous, hard, and white and differs in these respects from the prevailing type of sandstone in this region, which is softer and more highly feldspathic and micaceous. The sandstone bed at the top, just above the uppermost of the five coal beds (Clintwood coal) and in places in contact with that bed, is especially noteworthy, for it is persistent over a large area and either outcrops as a ledge or makes a distinct shelf along the hillside, by which the position of the outcrop of the underlying coal can be determined. All these sandstones and associated coal beds are exposed along the road on Guests River from the south margin of the quadrangle to a point 1½ miles north of Lipps. The first important coal bed above the Glamorgan occurs 60 feet above the Gladeville sandstone. The bed is 2 feet or more thick and appears to persist over the southeastern quarter of the quadrangle.

Blair coal.—About 40 feet above the bed last described is a coal bed here named the Blair, because it has been opened by a man of that name on Lick Branch of Indian Creek 3 miles above the mouth. This coal is also persistent in the southeastern part of the quadrangle and appears to range from 2 to 5 feet in total thickness.

Clintwood coal.—One hundred feet above the Blair coal, or 200 feet above the Gladeville sandstone, is the Clintwood coal, named from the town of Clintwood, about 1½ miles east of the quadrangle. On Georges Creek and Lick Fork of Cranes Nest River the Clintwood is 6 to 12 feet thick,

including partings; elsewhere it is thinner, though persistent throughout the quadrangle. As noted above, everywhere in the quadrangle the Clintwood is overlain by a sandstone 20 to 40 feet thick, which either rests upon the coal bed or is separated from it by only a few feet of shale.

Above the sandstone just mentioned there is in certain localities a coal bed reaching 2 feet in maximum thickness. It is succeeded by 150 to 200 feet of soft shale, which over a large area is followed by 50 feet or so of coarse feldspathic and micaceous sandstone.

Bolling coals ("Five-foot bed").—At the top of the coarse micaceous sandstone, or about 250 feet above the Clintwood coal, is the lower of two coal beds separated by 20 to 40 feet of shale. The upper coal bed is designated the "Five-foot bed" on the outcrop maps of the Clinchfield Coal Corporation, but the name Bolling is here applied to both beds because they have been opened near the head of Pound River by several persons of that name. The Lower Bolling coal is 18 inches to 4 feet thick and the Upper Bolling is 18 inches to 5 feet thick. These coal beds underlie Black Mountain, Buck Knob, and Bowlecamp Knob, and their horizon is a little below the tops of several knobs and ridges in the southeast corner of the quadrangle. Above the Upper Bolling is 50 to 80 feet or more of coarse micaceous sandstone which for long distances outcrops as a low cliff or forms a low escarpment. This sandstone persists throughout the area underlain by the Bolling coals. On South Fork of Pound River the coarse sandstone is overlain by about 140 feet of shale and sandstone, capped by a 40-foot bed of sandstone.

Standiford coals.—Within 100 feet above the Bolling coals are one or more thin coal beds, and about 260 feet above these coals are two beds 20 feet apart, which are here called the Standiford coals because they are mined near the head of South Fork of Pound River by a man of that name. At the type locality the Lower Standiford coal is 2 feet 6 inches and the Upper about 3 feet thick. These coals appear to underlie the Black Mountain and Buck Knob region, but it is probable that they have been removed by erosion in the country farther east except possibly in a small area near the top of Bowlecamp Knob.

Taggart coal.—On South Fork of Pound River the 90 to 100 feet of beds above the Standiford coals are apparently for the most part sandstone, at the top of which are two coal beds, separated by 6 feet of shale, the upper bed 3 feet and the lower 2 feet 6 inches thick. On Roaring Fork of Powell River the name Taggart is applied to a bed believed to be the equivalent of this double bed, and that name is adopted here. On Roaring

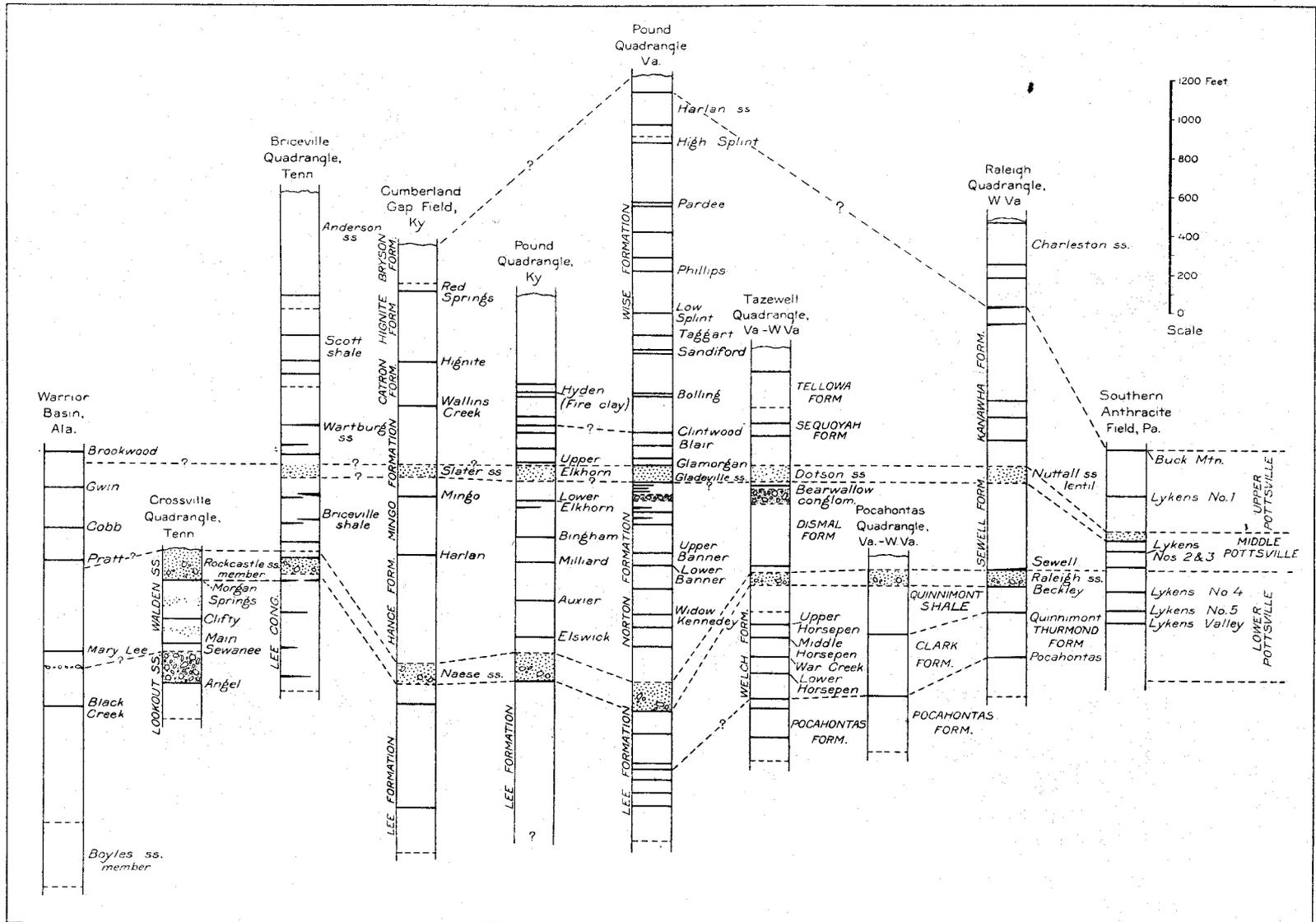
Fork the bed, which has been thoroughly prospected, is double at some points, and one section examined by the writer has four coal beds in a space of about 75 feet, as shown in section 98 (page 46). It is supposed that at least the upper two beds of this section, which are separated by 20 feet of shale and sandstone, represent the Taggart horizon. At most points where this coal has been prospected only one bench is recorded, either because only one bench is present or because only one of two or more benches possibly present was discovered.

Low Splint coal.—The name Low Splint is applied to a coal bed about 200 feet above the Taggart on the head of Roaring Fork. At the head of South Fork of Pound River is a bed, 160 feet above the Taggart, opened on the George Phillips place, which is correlated with the Low Splint. It appears to be persistent and to range in thickness from $2\frac{1}{2}$ to 4 feet, but being high in the hills it is present only in Black Mountain and Buck Knob. It is probably the Buck Knob bed of the Clinchfield Coal Corporation.

Phillips coal.—The Low Splint bed is succeeded by 260 feet of shale and sandstone in which no coal was seen in this region and at the top of which is a coal bed named the Phillips coal, because it has been opened at the Ambrose Phillips place, at the head of South Fork of Pound River, where it is reported to be 26 inches thick and to be all coal.

In the 390-foot interval between the Phillips and the Pardee coal beds at the head of South Fork of Pound River are shale and sandstone with thin coal beds as follows: At 80 feet above the Phillips is an 18-inch bed of coal, 210 feet above is a 1-foot bed, 225 feet above is a 2-foot bed, and 340 feet above the Phillips, or 50 feet below the Pardee bed, is a 6-inch coal. Between 210 and 225 feet above the Phillips coal is an 8-inch limestone bed, which is the only limestone seen in the entire Pennsylvanian section except some nodules in the shales on Elkhorn Creek in Kentucky.

Pardee (Limestone) coal.—At 390 feet above the Phillips bed, or 1,670 feet above the Gladeville sandstone, is the Pardee bed, which is mined at Pardee, just west of the southwest corner of the quadrangle. This is the Limestone coal bed of the Kentucky Geological Survey reports and the Parsons bed of the Virginia Coal and Iron Company. At Pardee and for a mile or two to the east within the Pound quadrangle the bed contains about 10 feet of solid coal, but farther east and northeast it is in places divided by thick partings into two or three benches. It is 2,800 to 3,100 feet above sea-level, and, therefore, lies near the summit of Black Mountain and its radiating spurs. Above the Pardee bed is about 100 feet of shale overlain by rather coarse grained but flaggy sandstone 300 feet thick.



Sections showing the correlation of the Pottsville formations along the east side of the Appalachian coal field.

High Splint coal.—The High Splint coal is 400 feet above the Pardee bed and is a genuine splint coal 4 to 5 feet thick. It is so high in the hills that it underlies only a small area on Black Mountain.

HARLAN SANDSTONE.

Above the High Splint coal appears to be several feet of shale, overlain by a massive cliff-making sandstone, in places conglomeratic, which is 40 feet thick and which is taken as the basal stratum of the Harlan sandstone. Extending from the High Splint coal bed to the top of the highest summits of Black Mountain, the Harlan sandstone is a little over 400 feet thick. It is mostly coarse, thick-bedded to massive sandstone but contains shale beds and at least two coals of unknown thickness, fragments only being seen at two places. One of these coal beds is 100 feet and the other 300 feet above the High Splint bed.

GENERAL CORRELATION.

From incomplete paleobotanic studies, David White refers all the coal measures of Virginia and easternmost Kentucky and the region extending southwestward into Alabama to the lowest division or Pottsville group of the Pennsylvanian series. The type locality of the Pottsville group is Pottsville, in the southern anthracite field of Pennsylvania. The Pottsville is for convenience subdivided by White into lower, middle, and upper Pottsville, the subdivisions being based primarily on the presence in each of certain distinctive species of fossil plants. Some of the subdivisions of the Pottsville may be distinguished over large areas by lithologic character—as, for example, the Lee formation in Virginia and Tennessee, which is shown by paleobotanic evidence to coincide nearly if not completely with the lower Pottsville. In certain places, where the subdivisions are not lithologically distinct, the boundary between any two may be marked by a particular stratum which is widely identifiable. This is especially true where one of the formations marks an extension of the sea over the land. Thus throughout the southern part of the Virginia and West Virginia coal fields the boundary between the lower and middle Pottsville as paleobotanically determined is approximately marked by the Raleigh sandstone. Where lithology fails as a criterion for fixing boundaries or where occurrences are, as in coal fields or separate basins, far apart, it is necessary to resort to the evidence afforded by the fossil plants.

The probable stratigraphic equivalence of the Pottsville formations and coal beds in the Pound quadrangle to those of other areas along the eastern

border of the Appalachian coal fields is indicated in the plate of sections, Pl. II. In this table the correlations of formations and beds between districts or basins outside of the vicinity of the Pound quadrangle are based on partial studies of the fossil floras by White¹ and are regarded by him as provisional and subject to revision when either the paleobotanic material of the formations is more completely studied or, where possible, the beds are stratigraphically traced from point to point in detail and the depositional characteristics of the formations are more fully recognized. The correlations of the formations and beds in and near the Pound quadrangle are made by the present writer.

As already noted, the Lee formation is of lower Pottsville age. This formation extends southwestward into Tennessee and is equivalent to the Lookout and the greater part of the Walden sandstone of southern Tennessee. On the northeast the Lee corresponds to the Pocahontas, Welch, and Raleigh formations of the Tazewell quadrangle; the Pocahontas, Clark, Quinnimont, and Raleigh formations of the Pocahontas quadrangle; the Thurmond, Quinnimont, and Raleigh formations of the Raleigh quadrangle, and approximately to the lower 800 feet of the Pottsville of the southern anthracite field of Pennsylvania, including the "Lykens No. 4" coal.

The Norton formation is classed by White as middle Pottsville, and the overlying Gladeville sandstone is regarded by him as probably near the horizon of the Corbin conglomerate lentil of the Lee formation as the strata are mapped in the London (Ky.) folio, covering an area 75 miles due west of the Pound quadrangle. The Gladeville seems to represent the Slater sandstone member of the Mingo formation of the Cumberland Gap region and lies within the limits of the Wartburg sandstone in the Wartburg quadrangle, Tennessee. On the northeast the Gladeville is supposed to be represented by the Dotson sandstone of the Tazewell quadrangle and the Nuttall sandstone lentil at the top of the Sewell formation in the Raleigh quadrangle. The Sharon conglomerate member of the Pottsville (upper Pottsville) of western Pennsylvania is also regarded as lying at about the same stratigraphic horizon, though it may possibly be higher. While it is not maintained that the sandstone beds at the different points named are parts of one continuous stratum or that they are at exactly the same stratigraphic horizon and of precisely the same age, it is fairly well established on stratigraphic and paleobotanic grounds that they do not vary greatly from the same horizon and age throughout.

¹U. S. Geol. Survey, Prof. Paper 71, pp. 444-445, 1912.

Southwest of the Virginia coal field the Norton formation is represented by beds between the Rockcastle conglomerate member and the base of the Corbin conglomerate lentil of the Lee formation as mapped in the London folio, by the Hance and the lower three-fifths of the Mingo formation of the Cumberland Gap region, and by the Briceville shale and possibly by the lower part of the Wartburg sandstone of the Briceville and Wartburg quadrangles, in Tennessee. On the northeast the Norton is correlated with the Dismal and Bearwallow formations of the Tazewell quadrangle; with all of the Sewell formation below the Nuttall sandstone member in the Raleigh quadrangle; and with that part, 200 feet thick, of the Pottsville of the southern anthracite field extending roughly from 370 to 570 feet below the Buck Mountain coal bed and including near the middle the Lykens coal beds Nos. 2 and 3.

The Wise formation is shown by its fossil plants to be of upper Pottsville age. It contains the greater part at least of the Breathitt formation of the London quadrangle, Kentucky. It also includes the Bryson, Hignite, and Catron formations and probably the upper two-fifths of the Mingo formation of the Cumberland Gap field, and the upper part of the Wartburg, the Scott, and at least the greater portion of the Anderson formations of the Wartburg and Briceville quadrangles. Beds of Wise age are included in the Sequoyah and Tellowa formations of the Tazewell quadrangle, the Kanawha formation of the Raleigh quadrangle, and the upper 370 feet of the Pottsville of the southern anthracite field. The Kanawha formation, which, together with the Nuttall sandstone member of the Sewell formation, presents the most typical section of the upper Pottsville, apparently contains also, in southern West Virginia, the equivalent of the lower part of the Harlan sandstone of the Estillville quadrangle.

GEOLOGIC STRUCTURE.

As used here the term geologic structure means the attitude and arrangement of the rocks considered as extensive strata composing the earth's crust. Stratified rocks are deposited in a nearly horizontal attitude. In most of the Pound quadrangle, however, they are not now horizontal but very gently inclined, while in some places, as along the west escarpment of Pine Mountain, they dip steeply. There are also breaks, called faults, which extend to great depths and along which the strata on one side have been raised to higher levels than the corresponding strata on the other side or even thrust clear over on top of them.

Pine Mountain fault.—The Pine Mountain fault is the major structural feature of the region. It extends in a nearly straight line diagonally across the quadrangle near but somewhat above the west base of Pine Mountain in Kentucky. The fault is compound. There are two breaks, which, for the purpose of description, may be considered as having occurred at different times. By the earlier break a thin wedge of conglomeratic sandstone of the Lee formation, extending from the west side of the quadrangle northeastward to the vicinity of Jewel, at the mouth of Marshall Branch, was thrust into contact with rocks 1,200 feet higher than the top of the Lee. Also in the northwest corner of the quadrangle and extending a mile beyond its edge is a mass of hard siliceous conglomeratic sandstone of the Lee in a vertical attitude which has been pushed, probably by the earlier fault, half a mile westward over the flat-lying rocks stratigraphically 1,000 feet or more above the top of the Lee. Later another break occurred along which the displacement varies. On the west side of the quadrangle the Mississippi part of the Grainger shale is in contact with the wedge of the Lee formation brought up by the earlier fault; three miles east of the west margin the fault brings the Devonian black shale into contact with the Lee, and in the northwest quarter of the quadrangle the movement was so great that the upper 800 feet or so of the black shale has been thrust clear over the earlier fault plane and is in contact with Pennsylvanian rocks 2,000 feet above the base of the Lee, the total displacement here being about 4,000 feet. Sections A B, C D, E F, Pl. III, illustrate the structural and stratigraphic relations brought about by these faults.

Pound syncline.—From Pine Mountain the rocks dip southeastward to an axis that follows the general course of Pound River and is named the Pound syncline. The southeastward dip on the west escarpment of Pine Mountain is generally steep, but ranges from 20° to nearly vertical. Along the crest of Pine Mountain the dip is 20° to 40° ; at the east base it is 10° , and thence it diminishes gradually to zero at the axis of the Pound syncline.

Buck Knob anticline and Indian Creek syncline.—In the southeastern part of the quadrangle, south of the Pound axis, the rocks have a general northwest dip toward that axis, but this general dip is interrupted by a subordinate anticline that extends nearly north and south through Buck Knob and is called the Buck Knob anticline. The existence of this low anticline involves a corresponding syncline, here named the Indian Creek syncline, the axis of which is parallel to the anticline and to Indian Creek, lying from half a mile to 1 mile to the west. On the east side of this

syncline steep dips occur locally. At Glamorgan the dip is 10° W., and three-quarters of a mile farther north, at the intersection of the highway with the tramroad, it is 40° W. On the west side of Indian Creek, 5 miles above the mouth, the Clintwood coal and overlying sandstone dip 10° W. On the Buck Knob axis north of the knob the Bolling coals are about 2,200 feet above the sea; on the Indian Creek axis they are about 2,000 feet, the eastward dip being 200 feet in 2 miles; on the Pound axis west of Dewey the same coals are about 1,900 feet above the sea, giving a westward dip from the Buck Knob to the Pound axis of 300 feet. Apparently both the Indian Creek and Buck Knob folds flatten out and become imperceptible east of Dewey. Both axes rise toward the south, but maintain the same relative height in the quadrangle, the Bolling coals on the south margin being, as nearly as can be determined, 2,700 feet above sea level on the Buck Knob anticline and 2,500 feet in the Indian Creek syncline.

Summary.—Aside from the comparatively minor effect of these subordinate axes, the general structure of the Virginia part of the quadrangle is that of a broad and comparatively shallow unsymmetrical trough. At the southeast corner of the quadrangle the Gladeville sandstone is 2,500 feet above the sea, and it descends thence to about 1,500 feet above the sea along the Pound axis, the average dip being about 1° . Along the crest of Pine Mountain the Gladeville would, if restored, lie 5,000 feet above the sea, so that the total descent is 3,500 feet from the crest of the mountain to the axis of the Pound syncline, an average dip of 18° .

DETAILED DESCRIPTION OF COAL BEDS.

A comprehensive idea of the number, thickness, and sequence of the coal beds in the Virginia part of the Pound quadrangle can be obtained by an examination of the generalized columnar section (Pl. III).

COALS OF THE LEE FORMATION.

In this area very little is known of the coal of the Lee formation, which outcrops only along the southeast slope of Pine Mountain, being elsewhere deep beneath overlying formations and penetrated at only one point by a diamond-drill boring. On the outcrop along the eastern slope of Pine Mountain the surface is heavily timbered. No prospecting appears to have been done in this forbidding belt, and as natural exposures, if any, of the coal beds are rare, the chance of examining the beds is very remote indeed. Only in the Pound Gap road, where the Lee has been exposed in road making and by the wear incident to a highway, was any coal seen in outcrop.

However, considerable coal is known to exist in the Lee in beds 14 inches or more thick and at a depth not exceeding 2,000 feet. The most definite knowledge of the number, thickness, and stratigraphic relations of these beds is derived from the record of a drill hole on Cranes Nest River 1 mile east of the quadrangle, a short distance below the mouth of Lick Fork. (See Pl. I, section 1, in which details of the beds are shown.) In this well a coal 2 feet 6 inches thick is shown to lie near the base of the Lee formation, and eight beds 2 inches to 2 feet 2 inches thick are shown within the Lee. Six of these beds are grouped in the 300 feet just below the middle of the formation. As shown in the plate of correlation sections (Pl. II), the Pocahontas coal appears to be represented in this group of beds.

On the Pound Gap road five beds are exposed. In the well section the greater number of beds is grouped just below the middle of the formation; in the road section the greater number, so far as shown, seems to be rather above the middle of the formation.

The lowest bed, imperfectly exposed in the Pound Gap road section 500 feet east of the summit, at location No. 1¹, is about 200 feet above the base of the Lee and seems to be 2½ feet thick. Farther down on the east slope of the mountain, in the vicinity of the abandoned narrow-gage railroad station, four beds are exposed at stations Nos. 2, 3, 4, and 5. At No. 2 the following section was measured:

Section of coal bed on Pound Gap road, No. 2.

	Ft. in.
Coal, dirty	6
Clay	1
Coal, dirty	8
Clay, white.	1 3

At No. 3 just at the old railroad station the section is as below.

*Section of coal bed at narrow-gage railroad station on Pound Gap road,
No. 3.*

	Ft. in.
Shale and sandstone.....	10
Clay, carbonaceous	7
Coal	3
Clay, carbonaceous	2
Coal	2
Shale	20

¹Numbers refer to locations on the map.

The carbonaceous clay at this point is crowded with fern pinnules.

Five hundred feet nearly east of station No. 3, at No. 4, a bed has been prospected superficially and 18 inches of clean coal was seen. This bed is probably but a short distance above the bed at No. 3. At location No. 5, near No. 4, another bed 3 inches thick and 20 feet above the bed at No. 4 is exposed.

COALS OF THE NORTON FORMATION.

The coal beds of the Norton formation are the principal beds mined along the southern margin of the Virginia coal field from Dump Creek to Big Stone Gap, but in the Pound quadrangle they are not so well developed as farther south, as is shown by diamond-drill borings in the south-east quarter of the quadrangle and by the few exposures known along the outcrop of the formation between Pound River and Pine Mountain.

Sections of the diamond-drill borings are shown on Plate I (p. 7). The wells are too few and too widely separated to give full information regarding the coal beds, but they seem to afford a fairly reliable indication of the general condition and possibilities of the Norton coals in the eastern half of the quadrangle. They reveal numerous coal beds, but most of the beds are only a few inches thick. Every well, however, shows one or more beds 14 inches or over thick and less than 1,000 feet below the surface. In a few wells thicker beds were penetrated, as a bed 2 feet 10 inches thick at a depth of 629 feet in well No. 2; one 4 feet 3 inches thick at 832 feet in well No. 3; one 2 feet 5 inches thick at 847 feet in well No. 11; and one 7 feet 1 inch thick at 351 feet in well No. 15, which is, however, 2 miles east of the quadrangle. Details of the section of the thicker beds are shown in the figures. The ultimately workable coal is therefore considerable, although such coal will not be available until after the thicker and more accessible coal beds of the country are exhausted.

The identification of the individual coal beds of these sections and their correlation with the coals of the Norton formation along the southern margin of the field, where the beds seem to be more constant in number and position, are rather uncertain. For the purpose of comparison with the better-known section to the south the generalized (average) section from the Bristol folio is given on Plate I. The tentative correlations are indicated by the broken lines on the plate of sections. The sections are arranged on the horizon of the bottom of the Gladeville sandstone, which is identified throughout the region with a reasonable degree of certainty. All the coals recognized in the Bristol region appear to be present in the

Pound quadrangle, except, perhaps, the Upper Banner, which is the most valuable bed in the Bristol quadrangle. The Jawbone and so-called Imboden beds appear to be persistent but thin. Two persistent beds 100 feet apart occur near the Kennedy horizon and it is uncertain which is the true Kennedy. The Lower Banner is persistent and at some points is of considerable thickness, as in boring No. 3. It is more generally thin or so broken by partings as to be worthless. In borehole No. 3 the section is as follows:

Section of Lower Banner coal in drill hole No. 3, Birchfield Creek.

Shale.	Ft. in.
Coal	3 6
Clay	3
Coal	6
	4 3

In boring No. 8 the bed is 3 feet 6 inches thick but is intimately mixed with shale and worthless.

It is possible that the persistent group of thin coals below the Edwards coal or group represents the Upper Banner, which is separated from the Lower Banner by more than twice the thickness of rocks separating the two beds on the southern outcrop of the Norton formation. If this rather doubtful supposition is correct, the 7-foot bed in boring No. 15 might be regarded as representing the Upper Banner coal.

The upper group of thin beds represents the Edwards or true Imboden horizon. In boring No. 3 this group is 3 feet thick, with a thin parting; elsewhere it is widely parted.

At only a few points in the quadrangle or just outside its eastern and western margins were exposures of any of the coals of the Norton formation seen. On Rumley Creek about 2 miles north of Flat Gap postoffice, at location No. 6, a bed of clean coal 2 feet thick has been opened and worked on a small scale. About 2 miles south of Osborne Gap, toward the east side of the quadrangle, at locations Nos. 7, 8, and 9, coal is exposed indicating beds 18 inches in thickness; and about 1 mile farther east, at No. 10, is a blossom indicating a thin coal. All these coals seem to be in the lower half of the Norton formation. On Cumberland River half a mile beyond the western margin of the quadrangle a bed 30 inches thick, all coal, has been worked on the Ira Sturgill place. On Pine Creek three-fourths of a mile west of the east boundary of the quadrangle, at location No. 11, a bed 1 foot 9 inches thick is exposed at creek level. These out-

crops are apparently about in the middle of the Norton formation and the bed possibly represents one of the Banner coals.

On the North Fork of Pound River about 1 mile west of Donkey (No. 12), a bed is opened having the following section:

Section of coal bed 1 mile west of Donkey, No. 12.

	Ft.	in.
Shale.		
Coal	10	
Bone		3
Coal	1	9
Sandstone.		
	2	10

At station No. 13, half a mile west of No. 12, two thin coal streaks are exposed in the bottom of a ravine. These coals appear to be 150 to 200 feet below the Gladeville sandstone and thus at the Edwards or Imboden horizon.

Yellow Creek coal.—Half a mile beyond the western margin of the quadrangle a coal just under the Gladeville sandstone shows the following section:

Section of Yellow Creek coal bed on Cumberland Valley Road.

	Ft.	in.
Sandstone.		
Coal		5
Clay		1
Coal	2	4
Clay.		
	2	10

The same bed is exposed at the schoolhouse a mile west of Flat Gap (No. 14), where the section is as given below:

Section of Yellow Creek coal bed at schoolhouse on Cumberland River one-half mile west of Flat Gap, No. 14.

	Ft.	in.
Sandstone.		
Coal		5½
Shale		2
Coal		9
Clay.		
	1	4½

The same bed has also been opened on a branch 1 mile northeast of Flat Gap postoffice (No. 15) but could not be seen. It has also been

exposed in grading the railroad along North Fork of Pound River 2 miles southwest of Donkey, at No. 16, where it has the following section:

Section of coal bed 2 miles southwest of Donkey, No. 16.

	Ft.	in.
Coal	1	1
Clay	1	½
Coal	6	
	1	8½

This bed is in the position of the Yellow Creek coal mined at Wise.

The only other locality at which Norton coals are known in outcrop sufficiently near this quadrangle to be considered here is on the new road between Wise and Clintwood 1½ miles south of Cranes Nest River, one-third of a mile east of the quadrangle, where the coals have been exposed in grading. Nine coal beds are exposed in a vertical distance of about 350 feet below the Gladeville sandstone, but only one bed, at about 250 feet below the sandstone, is of much importance. Its section is given below.

Section of coal on new Wise-Clintwood road about 2 miles south of Cranes Nest River.

	Ft.	in.
Shale.		
Coal	10	
Clay	4	½
Coal	1	6
Sandstone floor.		
	2	8½

Most of the other beds are thin and worthless. This section is in full agreement with the upper part of the diamond-drill sections.

The facts in hand appear to warrant the conclusion that while the Norton coals of this quadrangle are of less value than those along the southern margin of the Virginia coal field, there are yet considerable areas of workable coal in the various beds known by drilling to underlie the area. Exploitation of these coals, however, can be safely undertaken only after the location and extent of the workable areas have been determined by thorough prospecting with the diamond drill.

COALS OF THE WISE FORMATION.

The Wise formation contains a greater amount of coal in workable beds than any of the other formations of the quadrangle. The Wise and all its

coal beds are present in full thickness only in Black Mountain, in the southwest corner of the quadrangle, because a progressively greater thickness of the formation has been eroded eastward from that area.

Glamorgan coal.—Immediately above the Gladeville sandstone is the Glamorgan coal bed, named from the town of Glamorgan, just south of the quadrangle, opposite the head of Indian Creek, where it is mined. The bed is best developed in the hills north and northeast of Glamorgan. In the Glamorgan mine, which extends 7,000 feet northeastward toward Birchfield and Dotson creeks, the bed is divided into two benches by a parting which is a quarter of an inch thick at 7,000 feet from the mouth, 1 inch thick at 6,000 feet, 10 feet or so at 1,000 feet, and 30 feet at the mine mouth. At 7,000 feet from the mine mouth the bed has the following section:

Section of Glamorgan coal bed in the Glamorgan mine 7,000 feet from mouth.

	Ft.	in.
Shale roof.		
Coal ($\frac{1}{4}$ -inch parting near middle) ¹	3	8
Bone		1
Coal ²		7
Shale.		4
		4

Section in same mine 6,000 feet from mouth.

	Ft.	in.
Shale roof.		
Coal ²	1	9
Bone		1
Coal ²	1	10
Bone		1½
Coal ²		8
	4	5½

¹Included in sample for analysis No. 15101, p. 54.

²Included in sample for analysis No. 15100, p. 54.

On account of the split described above only the lower bench of the bed is mined in the first 1,000 feet along the main entry of the Glamorgan mine, and nowhere else in the quadrangle is the bed known to be as thick as in the deeper part of the mine. On the new Wise-Clintwood road near the eastern margin of the quadrangle (No. 17) the bed is 2 feet 1 inch thick.

On Indian, Dotson, and Birchfield creeks and on the forks of Bowlecamp Creek the Glamorgan coal is 1 foot 6 inches to 2 feet 6 inches thick including partings.

On Birchfield Creek 2 miles above the mouth of Dotson Fork, at locations Nos. 18 and 19, the bed is 1 foot 9 inches and 2 feet 4 inches thick respectively. On the west side of Indian Creek three-fourths of a mile below Riley School (No. 20) the bed has been opened and shows the following sections:

Section of Glamorgan coal on Indian Creek three-fourths of a mile below Riley School, No. 20.

Shale.	Ft. in.
Clay with coal streaks.....	4
Coal	2
	<hr/>
	2 4

The clay with coal streaks in the roof is a common characteristic of the bed northeast of Pound.

Along the lower course of Indian Creek, in the vicinity of Pound, and on the lower courses of the three forks of Bowlecamp Creek the Glamorgan bed is split up into two or three thin beds of no value. Toward the head of Dotson Fork of Bowlecamp Creek (Nos. 21 and 22) it is in better condition, as shown by the following sections, which show also its variability within short distances:

Sections of the Glamorgan bed near the head of Dotson Fork of Bowlecamp Creek, Nos. 21 and 22.

No. 21.

Shale.	Ft. in.
Coal	1 6
Shale	8
Coal	6
Interval	2
	<hr/>

Sandstone (Gladeville).

No. 22.

Sandstone.	Ft. in.
Coal	2 2½
Shale	2
Coal	2
Clay.	
	<hr/>
	2 6½

The bed was not seen along the lower part of Birchfield Creek or on Lick Fork, though its presence in the vicinity of Kilgores is revealed by prospect pits, Nos. 23 and 24, in which a thin bed is indicated.

Northeast of Pound along Pound River and on Georges Creek the bed is of workable thickness, as shown by sections Nos. 25 to 28.

Section of Glamorgan coal on Mill Creek 1 mile northeast of Pound, No. 25.

Shale.	Ft.	in.
Coal		6
Clay	1	2
Coal		10½
Bone		2
Coal		3
	<hr/>	
	2	11½

Section of Glamorgan coal on Georges Fork, No. 26.

Shale.	Ft.	in.
Coal		5½
Bone		1½
Clay		1
Coal	1	
Clay		1
Coal		8½
Clay.	<hr/>	
	2	5½

Section of Glamorgan coal on Camp Creek near mouth, No. 27.

Shale.	Ft.	in.
Coal		6½
Clay	1	4
Coal	3	2
Clay		½
Coal		¾
Clay.	<hr/>	
	5	1¾

Section of Glamorgan coal one-half mile north of Pound River opposite the mouth of Camp Branch, No. 28.

Shale.	Ft.	in.
Coal		3
Rash		2
Coal	2	4
Clay.	<hr/>	
	2	9

These sections indicate the range in the thickness and make-up of the bed in this part of the quadrangle. It shows improvement northeastward as far as Freeling, a mile or so east of the quadrangle.

Along the North Fork of Pound River southwest of Pound to a point within 2 miles of Flat Gap post office the presence of the Glamorgan coal is shown by several exposures and openings, but so far as definite knowledge of it could be obtained it is not of workable thickness.

Coal bed 50 to 70 feet above the Gladeville sandstone.—From 50 to 70 feet above the Gladeville sandstone is a coal bed that is generally 2 feet or a little more in thickness over a considerable area. This bed is known on Guests River for a mile north of the quadrangle boundary, on the South Fork of Pound River to the vicinity of Dewey, on the forks of Bowlecamp Creek, and along the new Wise-Clintwood road. On the North Fork of Pound River 2 miles north of Dewey (No. 29) the bed is 2 feet thick. Three-fourths of a mile northeast of Dewey (No. 30) the bed has the section shown below.

Section of coal three-fourths of a mile north of Dewey, No. 30.

Shale.	Ft.	in.
Coal (dirty)	4	
Coal (clean)	1	3
Coal (bony)	7	
Clay.	<hr style="width: 100px; margin-left: 0;"/>	<hr style="width: 100px; margin-left: 0;"/>
	2	2

At Glady School, at the mouth of Glady Creek (No. 31), the following section was measured.

Section of coal at Glady School, No. 31.

	Ft.	in.
Coal	10	
Shale	2	
Coal	1	8
Coal (bony)	6	
	<hr style="width: 100px; margin-left: 0;"/>	<hr style="width: 100px; margin-left: 0;"/>
	3	2

Along South Fork of Pound River between Glady School and Donkey at least four coal beds appear at about the horizon of the bed here described and render identification doubtful. This condition is illustrated in the section following.

Section showing coal beds on South Fork of Pound River about midway between Glady School and Donkey, No. 32.

	Ft.	in.
Coal	2	
Interval	10	
Coal		6
Interval	10	
Coal		6
Interval	8	
Coal	1	1+
	32	1

Possibly the upper coal in this section is the Blair bed, next to be described. The two 6-inch beds may be splits from either the Blair bed or the bed next above the Glamorgan, described under this head, while the bottom bed represents the main bench of that bed.

At the Widow Short place (No. 33) the following section was obtained.

Section of coal beds at the Widow Short place on the South Fork of Pound River midway between Glady School and Donkey, No. 33.

Sandstone.	Ft.	in.
Coal	2	4
Shale	11	
Coal (impure)		4
Shale		3
Coal	1	6
	15	5

Here again there is doubt as to the interpretations of the section. It is possible that the bed here described and the Blair bed next above have approached within 11 feet of each other.

On Mullins Fork $2\frac{1}{2}$ miles above the mouth, at location No. 34, the bed under discussion seems best developed as shown by the section below.

Section of coal on Mullins Fork two and one-half miles above its mouth, No. 34.

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

At this point this coal is 70 feet above the Gladeville sandstone and 30 feet below the Blair coal.

Near the head of Dotson Fork of Bowlecamp Creek (No. 35) the bed is 38 inches thick and consists of clean coal. On the new Wise-Clintwood road, at locations 36 and 37, the bed has an upper bench of coal 1 foot 6 inches thick and a lower bench 1 to 2 feet thick made up of thin coal streaks and clay partings. On Lick Fork and Georges Fork this bed was not recognized.

Near the head of Dotson Fork of Birchfield Creek (No. 38) a bed that is doubtfully referred to this horizon has been opened. Its section is as follows.

Section of coal bed near the head of Dotson Fork, No. 38.

	Ft. in.
Shale.	
Coal	2 3
Clay	8
Coal	5
Shale.	<hr style="width: 100px; margin-left: auto; margin-right: 0;"/> 3 4

On Guests River between Lipps and a point 1 mile northwest along the road there are five coal beds dipping northward and passing in succession below road level. By projecting the beds into a plane as nearly as may be according to the dip the following section is obtained.

Section showing coal beds along Guests River road for 1 mile north of Lipps.

	Ft. in.
Coal (reported thickness)	2
Sandstone, hard siliceous	20
Interval not exposed	20
Coal (Clintwood?)	2
Sandstone	10
Shale	10
Coal (Clintwood split?)	2 3
Sandstone	15
Interval not exposed	10
Sandstone	5
Interval not exposed	20
Coal (Blair coal?)	2+
Sandstone (partly hard, siliceous)	40
Coal (reported thickness 3½ feet, next above Glamorgan bed), seen	2
	<hr style="width: 100px; margin-left: auto; margin-right: 0;"/> 160 3

This section includes the group of coal beds between the Gladeville sandstone and the Clintwood bed (described on page 10), except that it does not go down to the Glamorgan coal. That bed, however, shows in the road at the quadrangle boundary half a mile south of Lipps.

The coal next above the Glamorgan bed is opened at Lipps (No. 39), but the opening is partly closed. Two feet of solid coal was seen and the bed is reported to be $3\frac{1}{2}$ feet thick.

Blair coal.—On Lick Branch of Indian Creek 3 miles above its mouth a coal bed of good thickness has been opened on the Blair property and is therefore named the Blair bed. In the southeastern part of the quadrangle this bed is 2 to 5 feet thick, including partings. Below is a section of the bed at the Blair opening (No. 40).

Section of Blair coal at Blair opening near Indian Creek 3 miles above its mouth, No. 40.

Shale.	Ft.	in.
Coal	2	
Shale	10	
Coal	1	2
Coal (shaly)		3
Coal	1	3
Coal (shaly)	1	8
Coal	1	
Total lower bench	5	4

There are really two beds here, separated by 10 feet of shale, and it is possible that the lower represents the bed described under the last head, the situation being similar to that on South Fork of Pound River between Glady School and Donkey, as described on page 27.

On the east side of Indian Creek about half a mile due east of the Blair opening, at location No. 41, the bed is 30 inches thick and consists of solid coal. On McFall Fork, at location No. 42, the bed is much parted, as shown below.

Section of Blair coal on McFall Fork, No. 42.

Shale (black at bottom).	Ft.	in.
Coal	6	
Parting		$\frac{1}{2}$
Coal	2	$\frac{1}{2}$
Clay	5	$\frac{1}{2}$
Coal	11	
Bone	2	
Coal	3	
Clay (2 feet)	2	$7\frac{1}{4}$

On Mullins Fork $2\frac{1}{2}$ miles above its mouth, at No. 43, the bed has been opened and consists of 2 feet 2 inches of clean coal. On the head of Dotson Fork of Bowlecamp Creek (No. 44) the bed is about 2 feet thick. On the new Wise-Clintwood road (No. 45) the following section was measured:

Section of Blair coal on the Wise-Clintwood road, No. 45.

Shale.	Ft.	in.
Coal	1	2
Clay	1	6
Coal		7
	<hr/>	
	3	3

On the head of Dotson Fork of Birchfield Creek, at Nos. 46 and 47, the Blair bed is much the same as at the Blair opening described on page 29.

Section of Blair coal on the head of Dotson Fork, No. 46.

Shale.	Ft.	in.
Coal (soft)	2	
Clay		7
Coal (hard)	1	11
Bone		2
Coal (hard)		8
Shale.	<hr/>	
	5	4

On Guests River just north of Lipps, at location No. 48, the bed is 2 feet or more thick and made up of clean coal. (See section, p. 28.)

Clintwood coal.—The Clintwood is a thick bed throughout the region bounded roughly by Pound River and Birchfield and Indian creeks. It extends eastward to Clintwood, 2 miles east of this quadrangle, from which it takes its name. It persists as a thinner and parted bed throughout the rest of the quadrangle where the rocks at its stratigraphic horizon have not been eroded. It is thickest on Georges and Lick forks, where it is made up of two or more benches of coal separated by clay partings, some of which in places are 1 foot or more thick. In other parts of the quadrangle it seems split into two distinct beds separated by a considerable thickness of shale and sandstone. Everywhere it holds a nearly uniform distance of 200 feet above the Gladeville sandstone, and over a large part of its area it is overlain by a hard siliceous sandstone by which its outcrops may be recognized.

The bed has been extensively prospected by the Clinchfield Coal Corporation throughout the area of its best development. A few sections, out of many, are given below to show its thickness and make-up. On the head of Lick Fork, at No. 49, the bed is 15 feet thick, as shown below.

Section of Clintwood coal bed on head of Lick Fork, No. 49.

Shale.	Ft. in.
Coal and bone.....	3
Coal	1 2
Clay (average)	1 3½
Coal	3 1½
Clay	1½
Coal	3½
Bone	2½
Coal	6 10¾
Shale	9½
Coal	1 3½
	15 5¼

This appears to be about the maximum thickness of the bed. In the region about the head of Georges Fork, on the south side, (No. 50), and on the north side, (No. 51), the bed is very thick, as shown by the sections below.

Section of the Clintwood coal on the head of Georges Fork, south side, No. 50.

Shale.	Ft. in.
Clay	8
Coal (dirty)	3
Clay	3
Coal	3
Bone	½
Coal	3 5
Clay.	
Total coal bed.....	6 11½

Section of Clintwood coal on head of Georges Fork, north side, No. 51.

Shale.	Ft. in.
Coal	1 9
Clay	3 6
Coal	2 3
Clay	1 7
Coal	3 4
	12 5

The clay partings at this point are a serious detriment to the value of the bed.

On the head of Camp Creek three-fourths of a mile west of the quadrangle (No. 52), the section is similar to that at No. 51, but the bottom bench is thicker.

Section of Clintwood coal at the head of Camp Creek, No. 52.

Shale.	Ft.	in.
Coal	10	
Clay	1	
Coal	2	1
Clay	2	
Coal	5	
	<hr/>	
	10	11

On a small stream just east of Camp Creek, at location No. 53, the bed is made up as follows:

Section of Clintwood coal east of Camp Creek, No. 53.

Sandstone.	Ft.	in.
Coal	10	
Clay	10	
Coal	1	8
Clay		½
Coal	4	
Clay		½
Coal	1	5
Clay.	<hr/>	
	5	2

On Pound River 1¼ miles south of Phipps (No. 54) the bed is much deteriorated, as shown in the following section:

Section of Clintwood bed one and one-quarter miles south of Phipps, No. 54.

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

On McFall Fork 3 miles east of Pound (No. 55) the bed is in excellent condition.

Section on McFall Fork 3 miles east of Pound, No. 55.

Sandstone (50 feet).		Ft.	in.
Coal	4	3	½
Bone		3	
Clay		3	
Coal	2	2	
Clay.			
		<hr/>	
		6	11½

At this point the overlying hard siliceous sandstone is immediately in contact with the coal bed.

North of Birchfield Creek, 1½ to 2 miles west of the quadrangle, at Nos. 56 and 57, the bed is also in good condition and immediately overlain by sandstone.

Section of Clintwood coal north of Birchfield Creek, one and one-half miles west of quadrangle, No. 56.

Sandstone (40 feet).		Ft.	in.	Ft.	in.
Coal		8	½	3	11½
Clay		½			
Coal	3	2	½		
Clay			½		
Coal		2			
Bone		4			
Clay	1	6			
Coal	1				
Clay		5			
Coal		2			
Bone		1	½		
Coal		1	½		
Bone		1	½		
Coal		8			
Clay (5 feet).					
		<hr/>			
		8	7½		

The bed at this point carries 4 feet of workable coal at the top, the rest of it being practically worthless.

At location No. 57, 1½ miles southwest of No. 56, the bed is 3 feet 10 inches thick and has a clay roof and floor.

The Clintwood bed shows its presence at a number of points in the southeast corner of the quadrangle south of Birchfield Creek and on the headwaters of that stream, but no good exposures were found from which its thickness and make-up could be determined. It rises to the top of the ridges and knobs in the southeast corner.

On the head of Indian Creek it is mined at the Roberts bank (No. 58). On the west side of Indian Creek 3 miles above its mouth (No. 59) the bed lies close beneath its heavy sandstone and is much parted and about worthless.

Section of Clintwood coal on Indian Creek 3 miles above its mouth, No. 59.

Sandstone.	Ft.	in.
Coal	2±	
Clay	1	9
Coal		6
Clay		1
Coal		3
Clay		5
Coal		3
Clay		6½
Coal		6
Clay (?).		
	6	3½

About 30 feet below the bed shown in the above section, is another bed 1 foot or more thick that may be a split from the Clintwood.

In all the region west of Indian Creek and along Pound River southwest of Pound the bed is generally a little over 3 feet thick, including partings, and commonly has a 2-foot bench of solid coal. Just west of Donkey, at No. 60, the Clintwood shows the following section:

Section of Clintwood coal just west of Donkey, No. 60.

Sandstone.	Ft.	in.
Coal	1	11
Clay		10
Coal		10
	3	7

At this point the bed is in the bottom of the Pound syncline, here a narrow trough, whose southeast limb dips 30° NW.

At Dewey (No. 61) the bed is 29 inches thick, as follows:

Section of Clintwood coal at Dewey, No. 61.

Sandstone.	Ft.	in.
Coal		2
Bone		3
Coal		9
Shale		2
Coal		11
	2	3

On the North Fork of Pound River three-fourths of a mile northeast of Flat Gap post office, at No. 62, the Clintwood bed has been opened and is reported 18 inches to 2 feet thick, but it could not be seen. Near the west margin of the quadrangle half a mile south of Cumberland River, in Kentucky, at No. 63, the Clintwood bed has been opened and shows the following section:

Section of Clintwood coal near the west margin of the quadrangle half a mile south of Cumberland River, No. 63.

Shale.	Ft. in.
Coal	2
Clay	2
Coal	3
Clay	1
Coal	7
Clay (amount seen, 1 foot).	3 1

At No. 64, half a mile east of No. 63, another opening revealed the following section:

Section of Clintwood coal half a mile south of Cumberland River, near the west boundary of the quadrangle, No. 64.

Sandstone.	Ft. in.
Shale (6 inches).	
Coal	2
Clay	2
Coal	2½
Clay	5
Coal	1 7
	8 11½

On Guests River three-fourths of a mile north of Lipps post office, at No. 65, the Clintwood bed seems to be represented by two beds 20 feet apart and under heavy siliceous sandstone, as shown in the following section:

Section showing the Clintwood coals on Guest River near Lipps, No. 65.

Sandstone	Ft. in.
Coal, upper bench (?)	30
Coal, upper bench (?)	2
Shale and sandstone	20
Coal } lower bench (?) {	1
Clay } lower bench (?) {	1 1
Coal } lower bench (?) {	1 2
Clay (3 feet).	54 3

The Clintwood bed has been opened at several points on the East Branch of Guests River but is apparently thin and of little value.

The general chemical composition of the Clintwood coal was not well determined because there was no opportunity to collect unweathered samples for analysis within the quadrangle. Samples were collected from working banks at Clintwood and farther south and the analyses are published in the table (p. 54), Nos. 14766 and 14767. These show a very clean and pure coal.

Coal bed at top of sandstone above Clintwood coal.—Locally a workable coal bed occurs at the top of the sandstone above the Clintwood coal. Probably it is a persistent but generally thin bed, for ordinarily only shale is seen for 200 feet above the sandstone. The best development of this bed observed is on Mullins Fork at No. 66.

Section of coal bed on the west side of Mullins Fork, No. 66.

	Ft.	in.
Coal	6+	
Clay	1	
Coal	2	
	3	6

This bed shows on the hill tops near Hurricane post office on the new Wise-Clintwood road, but no good section of it was obtained. It is also exposed on the road west of Flat Gap post office near the west side of the quadrangle (No. 67), where it is 2 feet thick.

Thin coal.—On the head of the North Fork of Pound River about a mile southwest of Flat Gap post office (No. 68) a coal about 150 feet above the Clintwood and 1 foot thick has been dug on a small scale.

Bolling ("Five-foot") coals.—The names Upper and Lower Bolling are here applied to a pair of beds 20 to 40 feet apart, the upper one of which is known otherwise as the "Five-foot" coal. The Lower Bolling is 250 to 300 feet above the Clintwood bed. The name is adopted because one or both beds are worked by members of the Bolling family at several points in the southwestern part of the quadrangle. The beds underlie an unbroken area of about 25 square miles in the quadrangle west of Guests River and south of North Fork of Pound River. They also underlie an extensive area in the Buck Knob region and a number of smaller areas on the high knobs east of Indian Creek and south of Georges Creek. In these areas east and northeast of Indian Creek the beds are in their best condition.

On the summit at the head of Mill Creek northeast of Pound (No. 69) the Lower Bolling coal has the following section:

*Section of Lower Bolling coal on the summit at the head of Mill Creek
northeast of Pound, No. 69.*

Shale.	Ft.	in.
Coal	3	
Clay		3
Coal	1	
	<hr/>	
	4	3

About 3 miles northeast of Pound (No. 70) the Upper Bolling bed is as follows:

Section of Upper Bolling coal 3 miles northeast of Pound, No. 70.

Sandstone.	Ft.	in.
Shale (4 feet).		
Coal	2	
Bone		3
Coal	2	1
Clay		1
Coal		1
	<hr/>	
	4	6

The two coal beds are 20 feet apart at this point.

Near the summit at the head of Georges Fork (No. 71) prospects on both beds were open to inspection. The interval is 40 feet.

Section of Bolling coals at summit at head of Georges Fork, No. 71.

Upper bed.		Ft.	in.
Shale.			
Coal, clean		3	10
Clay.			
Interval, 40 feet.			
Lower bed.			
Shale.			
Coal, clean		2	2

North of the head of McFall Fork (No. 72) the following sections were obtained.

Section of Bolling coals north of the head of McFall Fork, No. 72.

Upper bed.		Ft. in.
Shale (5 feet).		
Coal, clean		4
Clay.		
Interval, 40 feet.		
Lower bed.		
Shale (4 feet).		
Coal		3 4
Bone		3
Clay.		
		3 7

The Bolling coals are present and one and perhaps both are of good thickness on the high hill between Bowlecamp and Birchfield creeks. One of the two was measured at prospect pits on the south side, but the field notes do not designate which bed.

Section of one of the Bolling coals on south side of hill between Bowlecamp and Birchfield creeks, Nos. 73 and 74.

No. 73.		Ft. in.
Coal		2 9
Clay.		
No. 74.		
Coal		5 4

These coals are present on the high hills between the heads of Indian and Birchfield creeks, probably on other knobs in the southeast corner of the quadrangle, and on the high knob between the two branches of Guests River southeast of Pinnacle Gap.

Between Indian Creek and Guests River in the Buck Knob region one or both of the coals is of good thickness except on the long spur north of Buck Knob. Between Indian and Glady creeks (No. 75) the beds are as shown below.

Section of Bolling coals between Indian and Glady Creeks, No. 75.

Upper bed.		Ft. in.
Shale.		
Coal		3½
Shale		1 6½
Coal		½
Shale		5
Coal		3 4½
Interval, 18 feet.		
		5 8

Lower bed.

	Ft. in.
Shale.	
Coal	3
Clay (5 inches).	

The upper bed shows shale and coal in the upper part, a feature that is common in the bed farther west.

On the spur north of Buck Knob, at location No. 76, a number of pits on both beds show only 1 to 2 feet of coal. This condition is shown in the following sections, which may be regarded as typical for the locality.

Sections of Bolling coals on spur north of Buck Knob, No. 76.

	Ft. in.
Coal (upper bed)	1±
Interval, 18 feet.	
Coal (lower bed)	1 5
Clay.	

A slight improvement is shown 1 mile northwest of the last locality and 1 mile southeast of Dewey:

Section of Bolling coals on point of spur 1 mile southeast of Dewey, No. 77.

	Ft. in.
Sandstone.	
Coal, upper bed	1 9
Interval, 23 feet.	
Coal, lower bed	1 6±

South of Buck Knob the Upper Bolling bed takes on a somewhat rashy and laminated character in its upper part, as shown by the following sections:

Section of Upper Bolling coal one and one-half miles southeast of Buck Knob, No. 78.

	Ft. in.
Coal, laminated thin partings of rash or mother of coal.....	1 6
Coal, laminated	1
Clay	2
Coal	3½
Clay and bone.....	1
Coal	1¼
Clay and bone.....	1½
Coal	2
Clay (2 feet).	
	3 5¼

Section of Upper Bolling coal 2 miles southeast of Buck Knob, No. 79.

Shale.	Ft.	in.
Coal, laminated	1	3
Coal, soft shaly.....		3
Coal, hard; bright.....	2	
Clay.		
	3	6

At 70 feet below the Upper Bolling at this point is a bed, reported to be 18 inches thick, which is probably the Lower Bolling with an enlarged interval between it and the Upper Bolling.

On Guests River 2 miles north of Lipps (No. 80) the following section was obtained:

Section of Upper Bolling bed on Guests River 2 miles north of Lipps, No. 80.

Shale coal, bone (2 feet).	Ft.	in.
Coal	4	
Clay		$\frac{1}{2}$
Coal		$1\frac{1}{2}$
Clay		$1\frac{1}{2}$
Bone		$1\frac{1}{2}$
Coal	2	$2\frac{3}{4}$
Bone		1
Coal	2	11
Clay.		
	5	$11\frac{3}{4}$

At river level at the mouth of Critical Fork (No. 81) a bed, apparently the Lower Bolling, is opened under a heavy sandstone.

Section of the Lower (?) Bolling coal on Guests River at mouth of Critical Fork, No. 81.

Sandstone.	Ft.	in.
Bone, rash, and pyrite.....		8
Coal, many thin partings and lenses of pyrite.....	3	6
Clay.		

On Steve Horn Branch at the west base of Buck Knob the beds have the following section:

Section of Bolling coals at the west base of Buck Knob, No. 82.

Upper bed.		Ft.	in.
Shale.			
Coal	.....		3
Shale	.....	2	
Coal	.....	1	10½
Bone	.....		½
Coal	.....	1	5
Shale.			
		5	7
Interval (shale?), 20 feet.			
Lower bed.			
Coal	.....	1	2
Clay	.....		2½
Coal	.....		9
Clay	.....		1
Coal	.....		2
		2	4½

On the upper courses of both North and South forks of Pound River the Bolling coals are of fair thickness and quality, the upper being about 4 feet and the lower 2½ feet thick.

At the place of J. E. Bolling, 1½ miles west of Dewey (No. 83), both beds are opened and have the following section:

Upper bed.		Ft.	in.
Shale.			
Coal	.....	2	
Bony coal	.....		2
Coal	.....	1	9
		3	11
Interval, 20 feet.			
Lower bed.			
Coal	.....	2	6
Shale.			

At Reuben Bolling's place, over 2 miles southwest of Dewey (No. 84), the Upper Bolling bed is worked and is made up as follows:

Section of Upper Bolling coal at Reuben Bolling's, 2 miles southwest of Dewey, No. 84.

[Analysis of sample from this bank is given in the table on p. 54, No. 15174.]

Shale (8 feet).	Ft.	in.
Coal, thin shale parting.....		4
Clay		10
Coal ¹	1	5½
Clay		1
Coal ¹	1	5
	<hr/>	
		4 1½

¹Included in sample.

About a mile southwest of Flat Gap post office, on the land of W. A. Bolling (No. 85), both beds have been opened.

Section of Bolling coals at W. A. Bolling's, about 1 mile southwest of Flat Gap post office, No. 85.

Upper bed.

Shale.	Ft.	in.
Coal and bone.....		4
Clay		6
Coal	1	6
Clay		½
Coal	1	7½
	<hr/>	

Shale (15 feet).

4

Lower bed.

Coal, reported 3 feet, exposed..... 2

On the west side of the quadrangle 1 mile south of Cumberland River (No. 86) both beds have been opened, but only the lower bed was accessible.

Section of the Bolling coals on the J. H. Mullen estate on the west side of the quadrangle 1 mile south of Cumberland River, No. 86.

Upper bed.

Coal, reported 3 feet or more; exposed.....	Ft.	in.
Interval, 30 feet.		2

Lower bed.

Coal ¹	2	3
Clay		2
Coal ¹	1	6
Clay		4
Coal ¹		4
	<hr/>	

Total Lower Bolling..... 4 7

¹Included in sample for analysis No. 15173, p. 54.

On Powell River on the south margin of the quadrangle (No. 87), a bed believed to be one of the Bolling coals has been opened and shows the following section:

Section of one of the Bolling coals on Powell River near margin of the quadrangle, No. 87.

Shale.	Ft. in.
Coal	8
Clay	1
Coal	1 8
	2 5

On account of their extent and comparative uniformity as workable beds throughout the area, the Bolling coals must rank among the most valuable coal beds of the Virginia part of the Pound quadrangle.

Standiford coals.—The Bolling coals are overlain by 260 feet of barren shale and sandstone. On the South Fork of Pound River a thin coal bed 80 feet above the Bolling coal was seen at two points, but east of Indian Creek a fully exposed section extending 150 feet above the Bolling coals is without coal, and no bed of value is known anywhere in the interval.

At the top of this barren group of shales and sandstones are two coal beds which are named the Standiford coals from a man of that name, who has worked both beds on the South Fork of Pound River. They are 20 feet apart at the type locality and constitute a pair in all respects similar to the Bolling coals. The Standiford coals are present only in the Buck Knob and Black Mountain regions west of Guests River, and their areal extent is therefore much less than that of the Bolling coals.

On the David Sturgill place, at the head of the South Fork of Cumberland River (No. 88), the Lower Standiford bed is worked. At this bank the bed has a shale roof and clay floor and comprises 3 feet 2 inches of clean coal. Its composition is shown in analysis No. 15172 of the table (p. 54). A few rods east of the Sturgill bank is an opening into the Upper Standiford bed (No. 89), in which the coal is 2 feet 6 inches thick and has a sandstone roof and clay floor. The beds here are about 20 feet apart.

At the Standiford place on the South Fork of Pound River (No. 90), the upper bed is opened on the east side and the lower on the west side of the valley. The lower bed at this point is clean coal 31 inches thick and has the section shown below:

Section of Upper Standiford coal at the Standiford place on South Fork of Pound River, No. 90.

Shale (6 feet).	Ft. in.
Coal	2 2
Parting	½
Coal	11½
Clay.	<hr style="width: 100px; margin-left: 0;"/>
	3 2

A bed cut on the new road north of Fox Gap, at an elevation of 2,235 feet above the sea (No. 91), is regarded as the Upper Standiford. The section is given below.

Section of Upper Standiford coal on new road north of Fox Gap, No. 91.

Shale.	Ft. in.
Coal	1
Clay	1½
Coal	1
Clay	3
Shale, purple (3 feet).	<hr style="width: 100px; margin-left: 0;"/>
Total coal bed.....	2 1½

The lower bed is not exposed, though it may be present under cover. The purple shale is significant, for it occurs below a coal at about the same level on the south side of Fox Gap and serves to identify the bed with the Upper Standiford.

On the new road south of Fox Gap, at the foot of the hill (No. 92), the Upper Standiford is cut and is of good thickness.

Section of Upper Standiford coal in new road south of Fox Gap, No. 92.

Shale.	Ft. in.
Coal	2 4
Clay	2
Coal	1 4
	<hr style="width: 100px; margin-left: 0;"/>
	3 10

This bed is also opened on the old road less than a quarter of a mile northeast of No. 92 and at that point has the purple shale beneath it as it has at Station No. 91, just described.

The rocks rise southeastward down Guests River and carry the outcrop of the coal beds upward into the hillsides, a fact which makes it probable that the Standiford coals are among those prospected by the Clinchfield Coal Corporation between the Low Splint (Buck Knob) and Bolling coals on the north and south sides of Buck Knob.

On Critical Fork of Guests River, at No. 93, two beds are exposed that are regarded as the Standiford coals, although on account of a rather strong westward dip the distance between them seems greater than known elsewhere.

Section of Standiford coals on Critical Fork of Guests River, No. 93.

Upper bed.	
Shale.	Ft. in.
Bone	3
Coal	2
Parting, clay, bone, and dirty coal.....	2
Coal, clean.....	3 5
Clay	2
Coal	3
	4 5
Clay.	
Interval, 40± feet.	
Lower bed.	
Shale roof.	
Coal (seen)	2

Near the head of Powell River (No. 94) a bed regarded as one of the Standiford coals is exposed in the stream:

Section of one of Standiford coal beds on branch near head of Powell River, No. 94.

	Ft. in.
Coal	1
Clay	½
Coal	1 9½
	1 11

It appears from the foregoing account that the Standiford coals are of workable thickness throughout the Black Mountain and Buck Knob regions. They should also be present in Bowlecamp Knob near its summit.

Taggart coal.—About 80 feet above the Standiford coals is a bed known in the region as the Taggart bed, which appears to be the same as the Keokee bed of Kentucky reports. It has been extensively prospected by the Virginia Coal and Iron Company on the head of Roaring Fork of Powell River, where it is 4 feet or more thick and varies from a solid bed to a bed with a shale parting as much as 6 feet thick. A bed, supposedly the Taggart, at one point on the South Fork of Pound River (No. 95) has the following section:

Section of the Taggart coal bed on South Fork of Pound River, No. 95.

	Ft.	in.
Shale.		
Coal, clean	2	10
Shale		6
Coal, clean	2	6
Clay.		
	11	4

On the hill south of Critical Fork of Guests River (No. 96) the section is as follows:

Section of Taggart coal bed on the hill south of Critical Fork, No. 96.

	Ft.	in.
Shale.		
Bone		3
Coal		11
Clay		2
Coal		10½
Clay.		
	2	2½

On Powell River, at Nos. 97 and 98, the bed is in excellent condition, as shown by the following sections:

Section of Taggart coal on Powell River, No. 97.

	Ft.	in.
Earth.		
Coal	2	10
Bone		1½
Coal	1	5
	4	4½

At Station No. 98, about half a mile south of No. 97, the following section is exposed:

Section of Taggart coal on Powell River, No. 98.

	Ft.	in.
Coal	3	7
Shale		10
Sandstone		10
Coal		3
Sandstone		40
Coal		3
Shale and unexposed.....		10
Coal		1
		6

A few feet away the upper bed of the section at No. 98 is 4 feet 5 inches thick and all coal. Probably the upper bed would best be regarded as the Taggart and the lower ones as beds not present in other sections or present and not exposed.

On Roaring Fork of Powell River the following sections furnished by the Virginia Coal and Iron Company have been selected from many as being typical:

Section of Taggart coal on Roaring Fork of Powell River, Nos. 99 and 100.

No. 99.		Ft.	in.
Shale.			
Coal		2	11
Shale		3	10
Coal		2	
Shale			8
Coal			4
Clay.			
		9	9

No. 100.		Ft.	in.
Shale.			
Coal		4	2
Clay.			

The section at No. 99 is similar to the section of the same bed in South Fork of Pound River, No. 95.

On Whitley Fork in the southwest corner of the quadrangle (No. 101) the bed is 37 inches thick.

Low Splint coal.—The name Low Splint is applied by the Virginia Coal and Iron Company and in reports of the Kentucky Geological Survey to a coal bed 220 feet or so above the Taggart bed.

The Low Splint bed is opened at the George Phillips place on South Fork of Pound River (No. 102), where it shows the following section:

Section of Low Splint coal on George Phillips place on South Fork of Pound River, No. 102.

Shale.		Ft.	in.
Coal		2	1
Clay			1½
Coal			6½
Clay.			
		2	9

In a ravine a short distance east of the new road north of Fox Gap (No. 103) a bed is opened that is identified as the Low Splint.

Section of Low Splint bed east of new road north of Fox Gap, No. 103.

Shale.	Ft.	in.
Coal	8	
Bone		½
Coal	2	4½
Clay		2
Coal, slaty		3
Coal		9
Clay		3
Coal	1	2
Clay.	<hr/>	
	5	8

It is probable that a coal prospected on Buck Knob by the Clinchfield Coal Corporation and called by it the Buck Knob is the Low Splint.

On the head of Critical Fork (No. 104) a bed showing a top bench of 23 inches of coal with a reported thin parting and lower bench seems likely to be the Low Splint.

The Low Splint at an opening south of Powell River (No. 105) shows the following section:

Section of Low Splint coal south of Powell River, No. 105.

Shale.	Ft.	in.
Coal		1
Bone		1
Coal	3	4

This bed has been thoroughly prospected on Roaring Fork by the Virginia Coal and Iron Company and a few representative sections are given below, Nos. 106 to 109.

Sections of Low Splint bed on Roaring Fork.

West side, No. 106.		East side of river, No. 108.	
Shale.	Ft. in.	Shale.	Ft. in.
Coal	1 7	Coal	1 10
Shale	3	Shale	7
Coal	1 1	Coal	1
Shale	3	Shale	10
Coal	4	Coal	9
	<hr/>		<hr/>
	3 6		5
Head of river, No. 107.		East side of river, No. 109.	
Shale.		Shale.	
Coal	2 9	Coal	3 9
Shale.		Shale.	

Phillips coal.—At the head of South Fork of Pound River, near the house of Ambrose Phillips, a coal bed, 260 feet above the Low Splint bed and provisionally named the Phillips bed, has been opened. At the Phillips place (No. 110) it is reported to be a clean splint coal 2 feet 2 inches thick. On the head of Critical Fork of Guests River (No. 111) a bed that has been opened and is reported 4 feet thick and nearby is not fully exposed but at least 2 feet thick, appears to be at the horizon of the Phillips coal. It was not seen elsewhere. The Phillips coal may be the same as the Dean coal of the Kentucky Geological Survey reports.

Coal 80 feet above the Phillips coal.—At the Phillips place (No. 112) occurs an 18-inch bed, 80 feet above the Phillips coal, not observed elsewhere.

Coal 215 feet above the Phillips coal.—At the head of South Fork of Pound River (No. 113) a bed is exposed which is 215 feet above the Phillips bed and which is made up as follows:

Section of coal bed 215 feet above the Phillips bed on the head of South Fork of Pound River, No. 113.

Shale.	Ft.	in.
Coal	1	4
Shale		6
Coal		6
Clay		2
Coal	1	7
Clay.		
		4 1

A bed regarded as the same as that at No. 113 is exposed on the head of Critical Fork (No. 114) and shows the following section:

Section of coal bed at head of Critical Fork, No. 114.

Sandstone.	Ft.	in.
Coal	1	2
Clay		2
Coal, hard.....	2	
		3 4

Pardee (Limestone or Parsons) coal.—The Pardee coal bed takes its name from the Pardee mine, just off the southwest corner of the quadrangle. It is called the Limestone bed in reports of the Kentucky Geological Survey because of the occurrence of a persistent limestone 50 to 100 feet above it to the west of this quadrangle, in Kentucky. It is also called the Parsons bed by the Virginia Coal and Iron Company.

The Pardee bed is 385 feet above the Low Splint bed. It is 7 to 10 feet thick where unbroken by partings, but it varies greatly within short distances owing to the occurrence of partings of clay or shale which in places reach a thickness of several feet. It underlies only a small area near the top of Black Mountain. It is mined at the Pardee mine and has been very thoroughly prospected around the head of Roaring Fork by the Virginia Coal and Iron Company. A measurement of the bed obtained on South Fork of Pound River (No. 115) is as follows:

Section of Pardee coal on South Fork of Pound River, No. 115.

	Ft.	in.
Coal	1	6
Clay		3½
Coal	1	7
Clay		½
Coal		7
Clay		3
Coal		½
Clay		½
Coal		4
Clay		1
Coal	1	1½
Clay		2
Coal		11
	6	11½

The following sections around the head of Roaring Fork have been selected from those furnished by the Virginia Coal and Iron Company.

Sections of Pardee coal around the head of Roaring Fork.

No. 116, between Roaring Fork and Powell River.

	Ft.	in.
Shale.		
Coal	2	
Shale	12	
Coal	1	2
Shale	20	
Coal	1	2

No. 117, head of Osborne Fork.

	Ft.	in.
Shale.		
Coal	4	1
Shale	1	7
Coal	4	2
Shale.	9	10

No. 118, head of Straight Fork.		No. 119½, ridge between Whitley and Roaring forks.	
Shale.	Ft. in.	Shale.	Ft. in.
Coal	6 6	Coal	6
Shale.		Shale	5½
No. 119, west side of Straight Fork.		Coal	3 11½
Shale.	Ft. in.	Shale	2
Coal	4 6	Coal	1 6
Shale	7	Shale	3 7
Coal	2 7	Coal	3 6
Shale	½	Shale	1
Coal	1 6	Coal	2
Shale	5	Shale	5
Coal	1 9	Coal	1½
		Slate	1
		Coal	1 7
		Shale.	
			<hr/>
			16 1½

The Pardee coal is rather hard and of the composition common to the Virginia and eastern Kentucky coals, as shown by the analysis, No. 15099 of the table on p. 54.

High Splint coal.—Practically 400 feet above the Pardee bed is the High Splint bed, well known to the west of this region in Kentucky. It is a genuine splint coal 4 to 5 feet thick underlying a small area near the top of Black Mountain. On the north side of Black Mountain at the head of South Fork of Pound River (No. 120) the following section was obtained:

*Section of High Splint coal at the head of South Fork of Pound River,
No. 120.*

Sandstone.	Ft. in.
Coal	3 4
Bone	1
Coal	1
	<hr/>
	4 5

The following sections (Nos. 121 to 123) are taken from those furnished by the Virginia Coal and Iron Company, obtained by extensive prospecting around the head of Roaring Fork of Powell River. The three sections given under No. 122 were taken within a distance of 1,000 feet and show exceptional variation.

Sections of the High Splint coal around the head of Roaring Fork of Powell River.

No. 121, on point of ridge between Powell and Roaring forks.

Shale.					Ft. in.
Coal	.....				2 4
Shale	.....				2
Coal	.....				6
					<hr/>
					3

No. 122, head of Osborne Fork.

Shale.	Ft. in.	Shale.	Ft. in.	Shale.	Ft. in.
Coal	..... 1 2	Coal	..... 1 10	Coal	..... 4 5
Shale	..... 1 2	Shale	..... 4 9	Shale.	
Coal	..... 2	Coal	..... 1 2		
Shale	..... 9½	Shale.	<hr/>		
Coal	..... 1 10		7 9		
Shale.	<hr/>				
	5 1½				

No. 123, ridge between Straight Fork and Cumberland River.

Shale.			Ft. in.
Coal	.....		4 5
Shale.			

This bed appears to be of excellent quality and is said to burn very freely. No samples of unweathered coal could be had for analysis. Except for the local irregularity shown by the three sections of No. 122 the bed is very uniform in thickness and make-up, maintaining a general thickness of 4 to 4½ feet all around the head of Roaring Fork. At only one point does it fall as low as 3 feet 4 inches except at the extreme south-east, where it thins and is much parted, as shown by section 121.

Coals above the High Splint bed.—On Black Mountain at two points, at least, coal was seen above the High Splint bed, but the beds were not exposed and no information was obtained about their thickness or character.

CHEMICAL COMPOSITION OF THE COALS.

In the subjoined table of analyses is shown the chemical composition of some of the coal beds of the region. But a small number of samples was taken because, owing to the scarcity of deep mines, there are very few opportunities for obtaining fresh unweathered coal. Most of the samples from local mines are probably somewhat affected by weathering. However, the composition of such samples approximates that of fresh coal closely enough for rough comparisons.

The samples were collected as follows: From the fresh face of the bed, or a face as nearly fresh as could be had, a uniform cut was made from top to bottom of sufficient size to yield 5 pounds to the foot after rejecting all partings that would not be included in the coal as marketed. This coal was pulverized and quartered down in the mine until sufficient coal of a size that would pass through a $\frac{1}{2}$ -inch mesh remained to fill a 2-quart galvanized can. This was sealed with adhesive tape and mailed to the laboratory for analysis.

The coals of this quadrangle are all bituminous and in composition are comparable to the coals of the east side of the Appalachian field from Russell County, Virginia, to Alabama, exclusive of Lookout Mountain. Samples from Russell, Dickenson, Wise, and Lee counties, Virginia, and those of eastern Kentucky run close together in average composition. All the samples from the Pound quadrangle are low in sulphur and moisture, and all but those from the Pardee and Bolling beds are notably low in ash. A large number of locality samples is, however, needed to give more satisfactory data. It should be added that the calorific determinations, based on samples from country banks or, in some cases, probably on weathered samples, are to be regarded as not showing the full heat value of the fuels.

The coals of this quadrangle all differ from the coals of the Pocahontas region in respect to content of volatile hydrocarbons and fixed carbon. The Pocahontas coals, generally having less than 20 per cent volatile and more than 70 per cent fixed carbon, are classed with the semibituminous coals like those of the Clearfield district of Pennsylvania. On the other hand, the coals described in the preceding pages contain over 30 per cent of volatile matter. The high volatile content of the coals of the Pound quadrangle invites consideration of by-product processes in coking.

The coals of this region are suitable for any of the uses to which the coals south of the Pocahontas region (except the semibituminous coal of Lookout Mountain in Georgia and Alabama) are put—for domestic use, including the grate, for the generation of steam, for coke and gas—and they will probably compare favorably with most of the coal mined for such uses in the southern Appalachian field.

Their coking qualities are mostly unknown. The Imboden bed at Stonega, southwest of the Pound quadrangle, is regarded as one of the best coking coals of the country. This bed is supposed to be the same as the Edwards bed in the Norton formation. The Glamorgan coal mined at Glamorgan makes good coke, into which the output of the mine is largely converted. It is quite probable that some of the other Norton coals also possess good coking qualities.

Analyses of coal samples from the Pound and Clintwood quadrangles.

[Collected in Virginia and in Kentucky just west of Virginia. Made by the U. S. Bureau of Mines. A. C. Fieldner, chemist in charge.]

Laboratory No.	Air-drying loss.	Form of analysis.	Proximate.				Ultimate.					Heating value.		Collector.	Name of mine and location.	Coal bed.		
			Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.					
14736	1.2	A.....	2.2	34.2	60.4	3.2	.85	8,110	14,590	W. A. Nelson.....	Mine of John A. Yeates, 1 mile southwest of Clintwood.	Clintwood.
		B.....	1.0	34.6	61.2	3.2	.86	.....	.....	.....	.....	.....	.....	8,205	14,770
		C.....	.....	34.9	61.8	3.3	.87	.....	.....	.....	.....	.....	.....	8,290	14,920
		D.....	.....	36.1	63.9	3.3	.96	.....	.....	.....	.....	.....	.....	8,570	15,420
14767	3.3	A.....	4.3	29.4	62.1	4.2	1.02do.....	Mine of Elbert Powers, 3 miles southeast of Clintwood.do.....
		B.....	1.0	30.4	64.2	4.4	1.05	.....	.....	.....	.....	.....	.....	.....	.....
		C.....	.....	30.7	64.9	4.4	1.07	.....	.....	.....	.....	.....	.....	.....	.....
		D.....	.....	32.1	67.9	.....	1.12	.....	.....	.....	.....	.....	.....	.....	.....
15099	1.0	A.....	2.3	33.8	54.7	9.21	1.56	4.99	74.46	1.57	8.21	7,420	13,360	Chas. Butts.....	Pardee No. 1 mine of Blackwood Coal & Coke Co., Pardee.	Pardee.		
		B.....	1.3	34.2	55.2	9.30	1.58	4.93	75.21	1.59	7.39	7,495	13,490					
		C.....	.....	34.6	56.0	9.45	1.60	4.85	76.20	1.61	6.31	7,595	13,670				
		D.....	.....	35.2	61.8	.....	1.77	5.35	84.13	1.73	6.97	8,335	15,100			
15100	1.6	A.....	2.6	33.1	59.3	5.0	1.37	7,895	14,220do.....	Glamorgan No. 3 mine of Stone Gap Colliery Co., Glamorgan.	Glamorgan.
		B.....	1.1	33.6	60.2	5.1	1.39	.....	.....	.....	.....	.....	.....	8,025	14,450
		C.....	.....	34.0	60.9	5.1	1.41	.....	.....	.....	.....	.....	.....	8,115	14,600
		D.....	.....	35.3	64.2	.....	1.49	.....	.....	.....	.....	.....	.....	8,550	15,390
15101	2.0	A.....	3.2	31.3	59.1	6.37	.87	5.27	73.02	1.65	7.32	7,730	13,910do.....	Do.....do.....		
		B.....	1.3	31.9	60.3	6.50	.89	5.15	73.61	1.63	6.17	7,885	14,200					
		C.....	.....	32.3	61.1	6.58	.90	5.03	80.65	1.71	5.08	7,930	14,330				
		D.....	.....	34.6	65.4	.....	.96	5.44	83.33	1.83	5.44	8,550	15,390		
15172	2.8	A.....	4.1	35.2	55.7	5.0	1.74	7,725	13,910do.....	Mine of David Sturgill, located in Ky., 1 1/2 miles south of Flat Gap, Va.	Lower Standford.
		B.....	1.3	36.2	57.3	5.2	1.79	.....	.....	.....	.....	.....	.....	7,950	14,310
		C.....	.....	36.7	58.1	5.2	1.81	.....	.....	.....	.....	.....	.....	8,055	14,500
		D.....	.....	38.7	61.3	.....	1.91	.....	.....	.....	.....	.....	.....	8,500	15,300
15173	2.6	A.....	4.0	31.3	53.0	11.2	.97	7,140	12,850do.....	Mine of J. H. Mullin, located in Ky., 3 miles southwest of Flat Gap, Va.	Lower Bolling.
		B.....	1.4	32.6	54.5	11.5	1.00	.....	.....	.....	.....	.....	.....	7,330	13,200
		C.....	.....	33.1	55.3	11.6	1.01	.....	.....	.....	.....	.....	.....	7,435	13,330
		D.....	.....	37.4	62.6	.....	1.14	.....	.....	.....	.....	.....	.....	8,415	15,150
15174	5.3	A.....	6.9	30.4	54.6	8.1	.95	7,910	13,930do.....	Mine of Reuben Bolling, 2 miles east of Flat Gap.	Upper Bolling.
		B.....	1.2	32.3	57.9	8.6	1.01	.....	.....	.....	.....	.....	.....	7,555	13,730
		C.....	.....	32.6	58.6	8.3	1.02	.....	.....	.....	.....	.....	.....	7,745	13,940
		D.....	.....	35.8	64.2	.....	1.12	.....	.....	.....	.....	.....	.....	8,455	15,250

A. Analysis of sample as received.
 B. Analysis of sample after drying at a temperature a little above the normal until its weight becomes constant.
 C. Represents the theoretical composition of the coal after the moisture is eliminated.
 D. Represents the coal after all moisture and ash have been theoretically removed.

. MINING CONDITIONS.

The coal beds of the region are nearly flat or gently inclined. Level haulways are possible throughout the field, permitting the use of electric haulage. It seems likely that all the beds of the Wise formation can be reached by drift mines, but it will be necessary to shaft for the coals of the Norton and Lee formations. In general the beds have a good roof. Such mines as have been opened appear to be free from gas or water in troublesome quantities.

The country has an abundant supply of mine timber, and the water supply for steam and other purposes will probably always be ample. The construction of railroads for transportation will be the most expensive factor in mining enterprises. That subject has been discussed on page 4.

AMOUNT OF ULTIMATELY AVAILABLE COAL.

The amount of ultimately available coal has been computed with the results shown in the following table:

Amount of available coal in the Pound Quadrangle, Virginia.

Bed	Thickness	Area in square miles	Tonnage [1,152,000 tons per sq. mile for each foot in thickness of coal.]
High Splint	3' — 10"	1.60	7,060,000
Pardee	7' — 6"	4.80	41,470,000
1st coal below Pardee.....	2' — 0"	6.57	15,130,000
2nd coal below Pardee.....	1' — 0"	8.17	9,520,000
Phillips	2' — 0"	9.62	22,160,000
Low Splint.....	3' — 2"	13.92	50,830,000
Taggart	4' — 0"	17.19	79,210,000
Upper Standiford.....	3' — 0"	20.15	69,640,000
Lower Standiford.....	2' — 6"	20.15	58,000,000
Upper Bolling.....	3' — 4"	39.19	150,300,000
Lower Bolling.....	2' — 4"	39.19	105,200,000
1st coal above Clintwood....	2' — 0"	75.92	174,900,000
Clintwood (thick)	7' — 3"	17.91	149,580,000
Clintwood (thin)	3' — 8"	58.00	245,200,000
Blair	2' — 8"	91.29	279,750,000
Coal 70 ft. above Glamorgan..	2' — 6"	99.61	285,700,000
Glamorgan (thick).....	2' — 7"	59.80	179,100,000
Glamorgan (thin)	2' — 0"	49.20	113,350,000
Total Wise.....			2,136,080,000
Norton	7' — 2"	137.72	1,137,550,000
Lee	7' — 4"	137.72	1,162,920,000
Grand total			4,436,550,000

In the above table the results are given to the nearest 10,000 tons.

The minimum thickness of a coal bed considered as ultimately minable in a commercial sense is 14 inches and the maximum depth for that thickness is taken at 1,700 feet. On this basis the comparatively meager data for the Norton and Lee formations in Virginia indicate a total thickness of 7 feet 2 inches in the former and 7 feet 4 inches in the latter. That is the amount of coal fulfilling the conditions of depth and thickness stated above equals a single bed 7 feet 2 inches thick in the Norton and 7 feet 4 inches in the Lee and having an areal extent equal to the mean area underlain by those formations.

The average thickness of the High Splint, Pardee, Low Splint, Taggart, Bolling, Clintwood (where 7 feet 3 inches thick), and Glamorgan (where 2 feet 7 inches) is based on an adequate number of detailed measurements and can be accepted as reliable. The thickness in the case of the other beds is less reliable.

Beds other than those estimated were seen at one or a very few points of which so little is known that they were left out in this computation and this fact together with the fact that the beds estimated are as likely to average somewhat thicker as they are to be thinner supports confidence in the belief that the total estimated tonnage, enormous though it be, does not exceed the actual amount of ultimately minable coal in the Pound Quadrangle.

DEVELOPMENTS.

The region is almost entirely undeveloped, only the Glamorgan mine being operated on a commercial scale. Here and there a local mine supplies the surrounding neighborhood. However, most of the best coal land is in the possession of large coal companies, the coal resources have been ascertained by thorough prospecting, and developments on a large scale may be expected in the near future.

SUMMARY.

It was ascertained by this survey that the maximum thickness of the coal-bearing rocks of the area is 4,800 feet. This thickness is attained in Black Mountain and is probably the maximum thickness for the coal measures of the Appalachian coal field outside of the Coosa and Cahaba coal fields of Alabama.

The coal resources of the lower 2,000 feet of these rocks could not be thoroughly investigated, but it is known from borings and scattered

exposures of coal beds on the outcrops of these rocks that there are a dozen beds or so, 14 inches to 4 feet thick, at depths of less than 2,000 feet, the coal in all of which is to be considered ultimately available. In the upper 2,800 feet of the coal rocks there are 16 coal beds from 18 inches to 10 feet thick, all but one of which is known to be $2\frac{1}{2}$ feet or more thick over large areas. The areal extent of the individual beds varies from 2 or 3 square miles to 100 square miles or so, the extent depending on variation in thickness of the beds and their position in the hills. The total amount of ultimately available coal is computed to be 4,295,272,312 short tons. The coal of the region is all bituminous, has the same range of composition, and is suitable for the same uses as the coal of the Appalachian field south of the Pocahontas region, except that of Lookout Mountain in Georgia and Alabama. The region is as yet without adequate railroad facilities.

The rocks are in general nearly flat, and all coal beds that outcrop can be exploited by drift mines. The beds generally have a strong roof and stable floor. There is no reason to expect trouble from gas or water. Timber and water for mining purposes are abundant. Mining conditions therefore seem highly favorable and the region should, with development, become one of the principal coal-producing centers of the central Appalachian coal field.

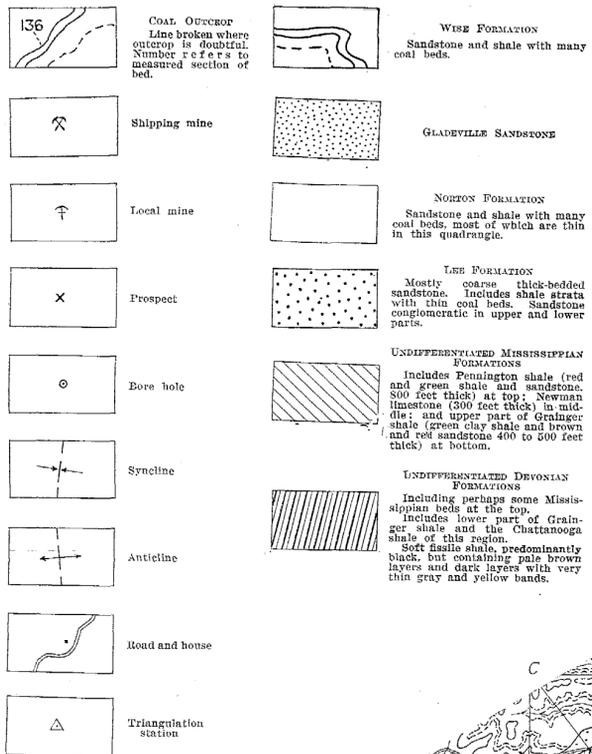
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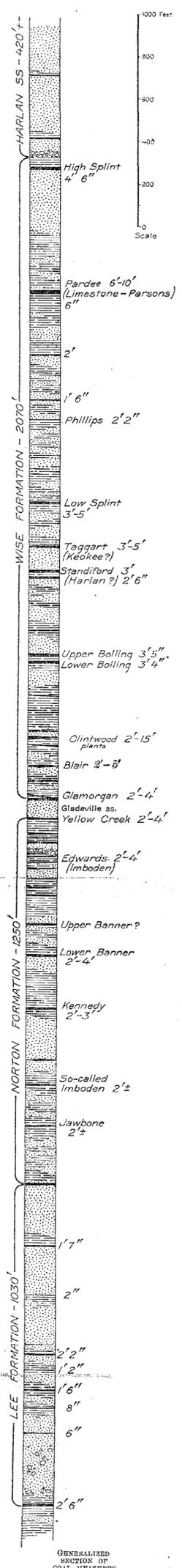
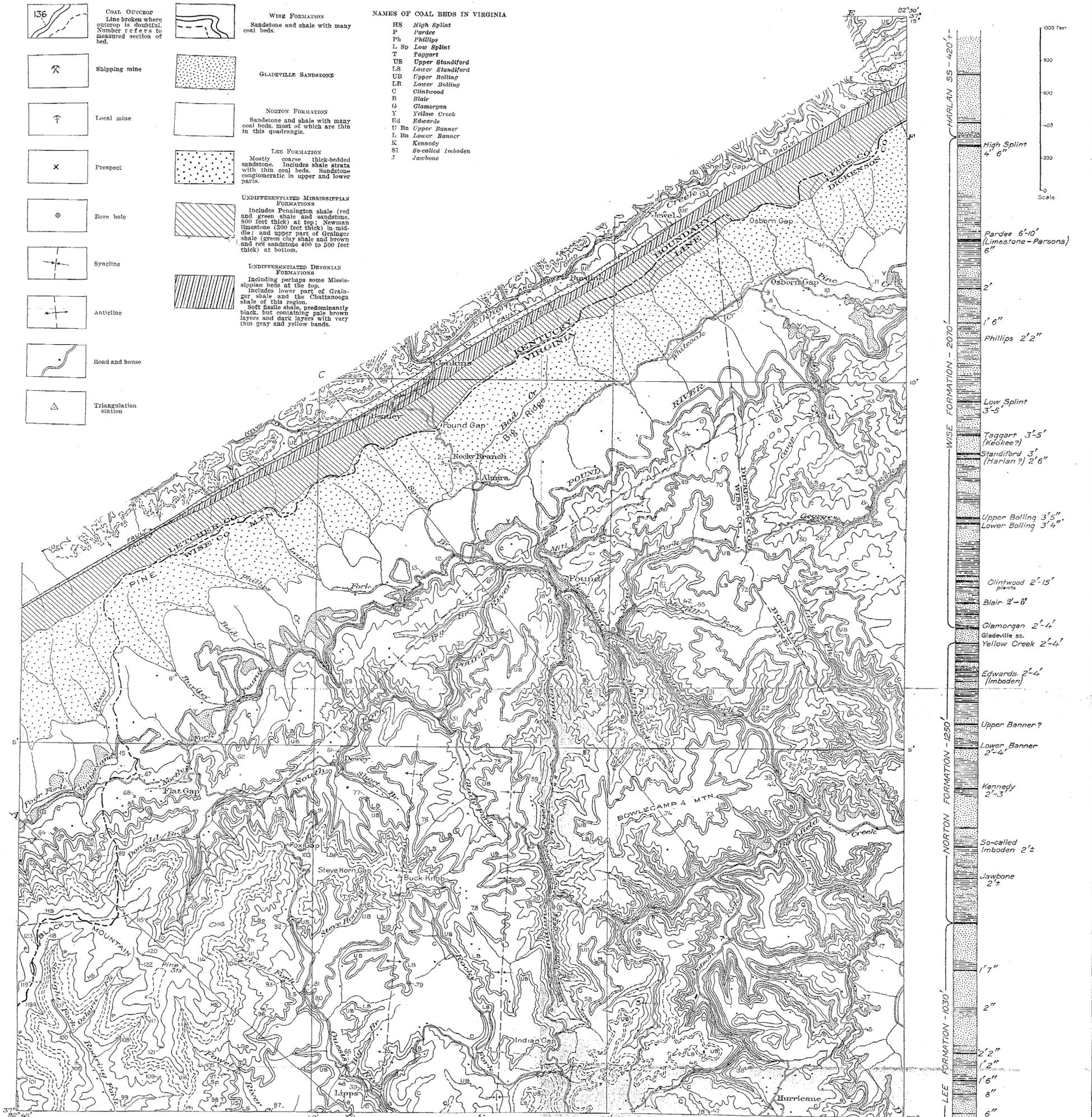
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NAMES OF COAL BEDS IN VIRGINIA

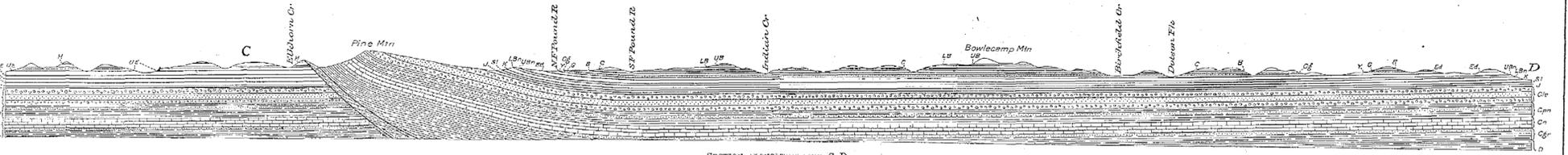
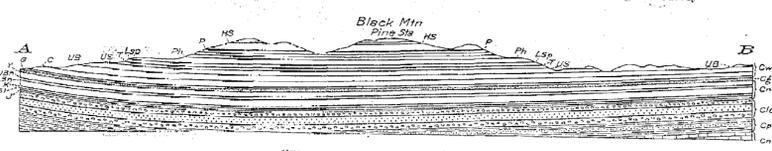
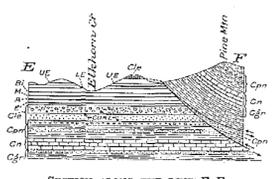
HS	High Splint
P	Pardee
Ph	Phillips
L Sp	Low Splint
T	Taggart
US	Upper Standford
LS	Lower Standford
UB	Upper Bolling
LB	Lower Bolling
C	Clintwood
B	Blair
G	Glamorgan
Y	Yellow Creek
Ed	Edwards
U Ba	Upper Banner
L Ba	Lower Banner
K	Kennedy
SI	So-called Imboden
J	Jawbone



NAMES OF FORMATIONS

- Cw Wise formation
- Cs Gladeville sandstone
- Cno Norton formation
- Clc Lee formation
- Cpn Pennington shale
- Cn Newman limestone
- Cgr Upper part of Grainger shale
- D Undifferentiated Devonian formations, including lower part of Grainger shale and the bluish Chattanooga shale of this region.

GEOLOGY BY CHARLES BUTTS
ASSISTED BY D. D. CONDIT AND W. A. NELSON
Surveyed in 1912 in co-operation with the U. S. Geological Survey



GEOLOGICAL MAP AND SECTIONS OF THE POUND QUADRANGLE, VIRGINIA

By CHARLES BUTTS, Assisted by D. D. CONDIT and W. A. NELSON
Surveyed in 1912 in co-operation with the United States Geological Survey