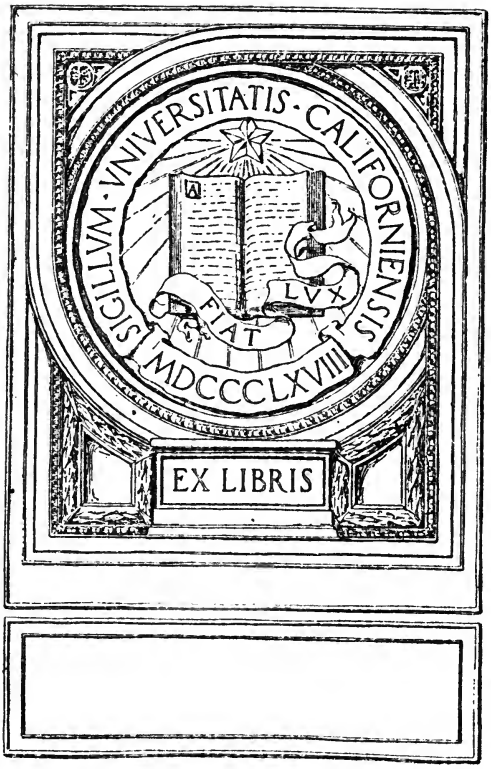
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COALS AND COKES

IN

WEST VIRGINIA

A HAND-BOOK ON THE COALS AND COKES

OF THE

GREAT KANAWHA, NEW RIVER, FLAT TOP, AND
ADJACENT COAL DISTRICTS IN
WEST VIRGINIA

BY

WILLIAM SEYMOUR EDWARDS

CINCINNATI
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PREFACE.

This pamphlet is, by necessity, largely a compilation—a compilation of facts gathered together with considerable pains, either by my own personal examination and observation, or the investigation of others who have given especial attention to such matters. The intention and aim in bringing together the information here collected is to put in compact and handy form what precise knowledge we now have of the coal beds and their coals and the coal trade of that great section of country drained by the waters of the Great Kanawha River, and outlying regions contiguous to it, in West Virginia.

I wish here, also, to express my obligation to the many gentlemen who have kindly aided me in gathering this information, and especially would I mention among them Mr. Addison M. Scott, U. S. Resident Engineer, Great Kanawha River Improvements; Prof. I. C. White, of Morgantown; Mr. J. H. Bramwell, M. & C. E.; Mr. Stuart M. Buck, M. & C. E.; Mr. Jed. Hotchkiss, M. E.; Mr. M. A. Miller, M. & C. E.; Mr. A. M. Campbell, E. M.; Mr. Jo. L. Beury, Mr. John Cooper, Mr. W. L. Nuttall, Mr. H. J. Tucker, M. & C. E.; Mr. O. A. Veasy, M. & C. E.; Mr. R. O. Baillie, M. & C. E.; Mr. I. A. Welch, C. E.; Mr. C. E. F. Burnley, M. & C. E.; as well as to Messrs. A. S. McCreath and E. V. D'Invilliers for data heretofore published by them regarding analyses of Virginia and Southern coals and cokes.

If any one who may need and desire such information as is here collected shall find this pamphlet of service my end will have been gained.

WILLIAM SEYMOUR EDWARDS.

Charleston-Kanawha, W. Va., May 1, 1892.

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COALS AND COKES IN WEST VIRGINIA.

PART I.

GEOLOGICAL, STRATIGRAPHICAL, CHEMICAL, AND PHYSICAL VIEWS.

CHAPTER I.

A Brief Review of the Coal Measures of Southern West Virginia.

SECTION I.

The State of West Virginia, occupying the middle and widest portion of the Appalachian coal field, is the greatest coal bearing state of the Union, possessing an estimated coal area of sixteen thousand square miles, as against twelve thousand square miles in Pennsylvania and nine thousand square miles in Kentucky. Of the fifty-four counties in the state, probably not more than three, and possibly four of them, the counties of Jefferson, Berkeley, and Morgan, in the north-eastern panhandle, and Monroe, in the southern tier, are wholly without coal.

Within the borders of the commonwealth may be viewed in distinct geological series every formation of the carboniferous epoch, with the divers rocks and coal beds that mark each formative period.

The rocks and interlying coal beds throughout this commonwealth, and especially the southern portion of it, of which this pamphlet more particularly treats, have almost universally remained in the horizontal planes of their original formation, the great uplift

of the Alleghany mountains, upon the south-eastern border, having done little more than slightly tilt them toward the depression or trough of the Ohio Valley, without in any way faulting, squeezing, crushing, or changing the physical and chemical structure of the coals; while the many gorges, cañons, and valleys that now break and segregate the former plateau into a thousand hills and ridges and mountains have been scarped and cut out by the erosion of the elements during subsequent ages, leaving the coal beds and their rocks, in the containing hills, or deeper levels below the surface of the waters, in undisturbed repose.

As yet, the great abundance of coal in hill-side and mountain, above the water level of adjacent streams, has prevented practical consideration of what coal beds may lie at the deeper levels, and it is only from the information gained through the many oil wells drilled and now drilling in West Virginia, that we have accurate information of the extensive deposits of coal that lie deep under the surface, and are now, and for many years to come, safely locked up in trust for the peoples of this republic yet unborn.

It is the purpose of this pamphlet to treat chiefly of the coals and coal measures exposed in that portion of the commonwealth drained by the great Kanawha river and tributary waters, and of the regions south of it. And in reviewing the coal measures and coals of this portion of the state, (perhaps the larger portion) it will be observed that there are here exposed above the levels of the creeks and rivers, in due geological sequence, very nearly all the coal bearing rocks and coal beds of the carboniferous time.

SECTION II.

THE NO. XII MEASURES, COKING AND STEAM COALS.

Throughout that south-eastern tier of counties bordering the great limestone belt which parallels the upheaval of the Alleghany mountains, may be observed for a distance of some one hundred miles and more, the coarse sandstone rocks and interstratified seams of rich, soft, bituminous coal, marking the uplift of the Pottsville

Conglomerate or Lower* Coal Measures (the No. XII of Messrs. Rogers Brothers). We find these rich coke yielding coals just edging into the south-western border of the county of Randolph, thence extending south-westward—above the water horizon—in a more or less regular belt from sixteen to thirty miles in width, through portions of the counties of Webster, Pocahontas, Greenbrier, Nicholas, Fayette, Raleigh, Summers, Wyoming, Mercer, and McDowell, and into the counties of Tazewell and Buchanan in Virginia.

The rocks of these measures at their north-eastern exposure show a thickness of little more than seven hundred feet in the counties of Randolph and Webster, but thicken as they trend south-westward until along the cañon of New river, in the county of Fayette, they develop a thickness of some 1,300 feet, and continue in about the same thickness through the counties of Raleigh, Mercer, Wyoming, and McDowell, to their southern limit in the state. These lowest of the coal bearing measures apparently preserve a generally uniform dip north-westward from their eastern exposure. They are caught high up along the spine of the Black mountains in Randolph and Pocahontas counties, where the coal seams show along the upper benches of the mountain range on the head waters of the Gauley, Williams, Cranberry, Cherry, and Meadow rivers; then onward through the Big Sewell mountains of Greenbrier and Fayette counties, and still on south-westward to their culmination in the great Flat Top mountain range of Mercer and McDowell counties, and its outlying spurs, even to their western border, where the coal dips beneath the water levels, a short distance above the junction of Tug Fork and Elk Horn rivers, in McDowell county, of Rock Castle creek of Guyandotte river, in Wyoming county, of

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*The term "Lower" Coal Measures is used throughout this pamphlet to denote what has been called "Pottsville Conglomerate," Series No. XII, by the Pennsylvania and Ohio geologists. To use the term "Lower" for what are in fact the "Middle" Measures, is but to prolong the life of a now recognized error in nomenclature.

Meadow river and Gauley river, in Fayette county, and the mouth of Laurel creek or Bear run, in Webster county.

The seams of coal contained in these Lower Measures apparently increase in number and thickness toward the south-western portion of the field, and undoubtedly reach their culmination in Mercer and Tazewell counties, where now worked along the line of the Norfolk and Western railroad.

The seams of coal in this, the south-western, section of the coal field are generally reckoned to be some ten in number, of varying thickness, the chief of these, and in which most of the mining in that field is now done, being the great "Pocahontas" or "Number 3" seam, showing from ten to twelve feet in thickness at Pocahontas mines, and six to eight feet along the valley of Elkhorn river.

Further north-eastward, where the measures are cleft by the New river cañon, the coal strata have lessened to three workable seams running from four to six feet in thickness, and all are worked at various collieries along the line of the Chesapeake and Ohio Railway. The coal beds here are locally known as the Sewell or Nuttallburg, the Fire Creek and Quinnimont (which, though generally regarded as distinct beds, are yet thought to probably be the upper and lower benches of a single bed), and the Meadow Creek seams, in descending series, and, according to the better opinion, although there is yet some question as to perfect identification, correspond with the seams as worked in the Flat Top Field, as follows:

NEW RIVER.	FLAT TOP.
No. 3, Sewell	No. 10 seam, on Crane Creek.
No. 2, Fire Creek.. } No. 2, Quinnemont }	Nos. 6 and 7 seams, on Crane Creek.
No. 1, Meadow Creek	No. 3, Pocahontas. Nos. 3 and 4, on Crane Creek.

Trending still further north-eastward, and into the yet undeveloped counties of Nicholas, Greenbrier, Webster, Pocahontas, and Randolph, our information of the exact extent of these coal measures and their coals is as yet somewhat imperfect, but, so far as the

seams have been opened and examined, the number of workable seams appears to lessen as they proceed north-eastward, there being generally prevalent along the basins of the Upper Elk and Gauley rivers what is probably the lowest bed of New river, showing, in the county of Webster, a thickness of four to five and a half feet of clean coal, without partings, and of a quality as excellent as the coals of New river and Flat Top.

Throughout this entire coal field the seams of coal run with quite uniform thickness, the thickening or thinning of the seams, their appearance or disappearance, being very gradual.

Whether in the south-western section, the Flat Top field, or the middle section of the New river field, or the great basin of the Gauley and Upper Elk rivers, the quality of the coals, as taken from the workable seams and tested by careful analyses and actual work, is remarkably uniform, there being practically no difference in the excellence of these coals, wherever mined.

As will be hereafter observed from the tables of analyses of both coals and cokes produced from these measures, the coals are distinguishable for their high per cent of fixed carbon, their low per cent of ash and almost perfect freedom from sulphur and traces of phosphorus, yielding, consequently, a coal unsurpassed for its steam producing power, and giving a coke whose analysis and physical structure and market rating show it to be unexcelled even by the product of the ovens of Connellsville, and which, as shown by the following tables, is practically closing out from competition the product of the coals of Tennessee, Georgia, and Alabama mines wherever given opportunity, while in the north and west it is steadily crowding upon the firmly established cokes of Pennsylvania.

Although this great area of coal is so uniform a deposit wherever appearing above water level, it is yet a notable fact that there is apparently a complete thinning out of the coals as their beds descend toward the bottom of the great Ohio Valley depression, where the beds, as shown by the records of the many oil wells drilled through the rocks, have dwindled to mere traces of coally matter.

SECTION III.

THE NO. XIII MEASURES, SPLINT AND BITUMINOUS COALS.

Immediately north-west of and bordering the conglomerate rocks and their soft coals of the Lower or No. XII measures, stretches the great exposure of the Middle or No. XIII measures, being the same group of coal measures to which belong the famous coal beds now extensively mined and worked in Clearfield, Cambria, and Jefferson counties, Pennsylvania. This is the most extensive coal formation of West Virginia. In the more north-eastern sections of central West Virginia these middle measures are comparatively limited in extent, rarely exceeding 200 or 300 feet in thickness and rarely containing more than two workable coal seams, the Lower Kittanning, known as the "Austin coking coal," and the Upper Freeport, known as the "Newburg shaft coal," along the Baltimore and Ohio Railway; and known as the "Davis" and "Thomas" seams, where worked along the line of the West Virginia Central, in Tucker county, etc. As these measures pass south-westward, they develop enormously and finally reach the great thickness of 1,000 to 1,200 feet in the Great Kanawha Valley, where they contain some six beds in workable thickness, being nearly all the characteristic coal seams of these measures.

The exposure of these measures above the water level may be observed as a great belt lying generally parallel and superimposed upon the "No. XII" measures, that geologically lie beneath and physically to the south-eastward of them, widening from the counties of Braxton and Clay and Nicholas, and extending across the counties of Kanawha, parts of Fayette, of Boone, parts of Wyoming, of Logan, parts of Lincoln, of Wayne and of Cabell, and passing beyond the Big Sandy river and stretching on into the State of Kentucky, affording to that commonwealth its greatest coal bearing area. The belt may be some forty to sixty miles

in its greatest width, and attains a thickness of 1,000 to 1,200 feet.

The coals of these No. XIII measures are the more extensively mined along the basin of the Great Kanawha river, in the counties of Kanawha and Fayette, and afford a variety of coal suitable for diverse uses not elsewhere yielded in any one field. The chief coal seams of these measures, as noted locally, and as named in the older fields of Pennsylvania, are now determined to be as follows:

PENNSYLVANIA NAME.	LOCAL KANAWHA NAME.
Upper Freeport.....	Crown Hill or Belmont.
Lower Freeport.....	Coalburgh.
Upper Kittanning.....	Winifrede and Kanawha Mining.
Middle Kittanning.....	Cedar Grove.
Lower Kittanning.....	Peerless and Coal Valley, and Campbell's Creek.
Clarion.....	Eagle Seam.

The coals of these measures, like those of the lower conglomerate measures before described, lie in horizontal beds dipping slightly to the north-west (having a general inclination of about forty feet to the mile), and pass under water level in the neighborhood of Charleston, the lowest of them being caught high in air in the summits of the mountains of Fayette and Nicholas, and other counties, some fifty miles to the south-east.

Although of greater extent, the beds of these coals are not of as uniform a thickness as those of the No. XII measures, seeming to be rather in greater or lesser pockets, or basins, thickening toward the centers and thinning out or running to slates toward the outer edges. And a somewhat elaborate prospecting of a newly-to-be-developed area is, therefore, desirable in these seams, in order to mine the coal at its thickest and purest part.

As the coals of the different beds of these measures have quite a uniform character wherever opened and mined, although varying in quality much more than do the coals of the No. XII measures, and as they have been more extensively explored and worked at the

many collieries along the Great Kanawha Valley than elsewhere, an examination of them in the Great Kanawha field will give, perhaps, the more perfect understanding of them.

The lowest coal bed of the series found in workable thickness is thought, by Prof. I. C. White, to correspond with the "Clarion" seam of the Pennsylvania geologists, and is worked at the mines of Wm. Wyant, the St. Clair Coal and Coke Company, and the Diamond Mines, all in Fayette county. The coals here taken out are shipped for steam purposes, and are also made into a superior coke whose excellence will be observed by a comparison of its analysis with others in the appended tables. This seam passes beneath the water level at Cannelton and is not elsewhere developed.

The next higher seam in the series is the Lower Kittanning (of the Pennsylvania geologists), and is very extensively mined throughout the valley. It affords a fine gas producing coal, while, where coked at the Great Kanawha Colliery Company's works, at Mount Carbon Mines, at Mount Carbon Company's works, at Powellton Mines, at Crescent and East Bank Mines, it makes a remarkably clean coke, little, if any, softer than the coke produced from New river or Flat Top fields. From this seam, also, where mined at Mt. Carbon, Powellton, Diamond, St. Clair, Edgewater, Crescent, Coal Valley, Peerless, and Acme mines, is taken a coal extrordinarily rich in gas, the upper bench of the seam being the great gas coal producing bed of the Great Kanawha field; while, where mined upon Campbell's creek, the seam, from its lower bed, yields superior domestic grate coal of somewhat harder quality.

The next workable seam in the ascending series, known as the Middle Kittanning seam of Pennsylvania, and locally known as the "Cedar Grove" seam, is extensively distributed throughout the basin, but as yet is only worked, to any great extent, at Cedar Grove and Peabody mines in the neighborhood of the mouth of Kelley's creek. This coal is good as a gas producer, ranking next to the coals from the Lower Kittanning seam, and is also used ex-

tensively as a steam coal, while its coking qualities have as yet never been conclusively tested.

Leaving the softer coals of these three lower beds, the three succeeding coal beds of the middle measures may be generally characterized as yielding chiefly fine splint coals of great hardness and which slake but little upon exposure to the weather. The lower of these is the seam taken to be the Upper Kittanning, of Pennsylvania, and locally known as the "Winifrede" and "Kanawha Mining" seam, named from the two most extensive mines in it. It is a coal of great richness and purity, and is sold chiefly as a domestic and as a steam coal.

The seams next higher in the series, the Lower and Upper Freeport seams of Pennsylvania, and locally known as the "Coalburgh," and "Crown Hill" or "Belmont" seams, are the great splint coal beds of this field, the coals being characterized by hardness and closeness of texture, small per cent of ash, remarkable purity from sulphur, and low per cent of water. The coals slake very little in the weather, and bringing the highest price in the markets, are yet the most expensive to mine on account of their hardness.

In the Freeport seams, also, is found, in widely separated pockets, occasional deposits of cannel coal of superior quality. A deposit of this cannel coal was mined and shipped for many years from the Upper Freeport seam at Cannelton. Another is in the Lower Freeport seam, on Paint creek; and it is the view of Prof. I. C. White that the beds of cannel coal lying in Boone county, and at one time mined at the works of the Peytona Cannel Coal Company, are also in the Freeport seam.

SECTION IV.

THE NO. XIV MEASURES—SPLINT COALS.

Above the beds of the Middle Coal Measures, lie the coals and rocks of the Upper Barren Measures (No. XIV of Messrs. Rogers Brothers).

Although, in Pennsylvania, these rocks are characterized by containing a few feeble traces of coal, if any at all, yet, as in Ohio, so in this section of West Virginia, the great Mahoning sand stones of these measures lie in immediate neighborhood to coal beds of considerable magnitude. And, although in the Kanawha region, they are as yet only worked in one or two localities, it is probable that they will eventually rank among the most prolific and valuable coal beds of the district. As here found they are thought to coincide with the "Brush Creek" seams of Ohio, but have been given the locally distinguishing name of the "Mahoning Beds," for better identification.

The most extensive exposure of these Mahoning coal beds, as yet opened, lies upon the great divide between the waters of the Great Kanawha and Elk rivers, where the seam is apparently severed into four distinct layers of a clean splint coal, and with a considerable underlying layer of cannel coal in the upper division.

These beds, also, as reported to be opened upon Little Coal river (see profile of W. C. Reynolds) and in Logan county (by Logan M. Bullitt), display there also great thickness while lying at high altitude above the level of the streams below.

The same beds are also caught high up on the summits of the mountains immediately south of the Great Kanawha river, but are chiefly valuable, commercially, where outcropping at lower and more accessible levels toward the waters of Elk river.

SECTION V.

THE NO. XV MEASURES.

Still above the coals of the No. XIV Measures, in the geological horizon, and westward of the lower beds of coal, lie the Upper Coal Measures (No. XV of Messrs. Rogers Brothers). These, forming as they do, the great coal producing beds of the Monongahela Basin, lessen, in area of exposure above water level and in exposure and extent of workable coal seam, as they extend south westward. The coal beds, having been largely eroded with the rocks they lie among, appear as intermittent and separate patches.

One of these probably is caught among the hills along the northern bend of Elk river, in Clay county, is found in scattered fragments along the northern portion of Kanawha county, and attains workable thickness in Putman county, where worked at the Raymond City, Plymouth and Energetic mines; thence, caught in the upper hill tops of Cabell and Wayne counties, is found in occasional limited areas, as a few miles back of Huntington, and among the lower reaches of the Guyandotte river, while, rising in altitude somewhat, as it trends south-westward, it disappears, passing into Kentucky high above the tops of the river hills.

The coals of southern West Virginia, whether those exposed at the various mines along the length of the Great Kanawha river, which for a distance of almost one hundred miles, traverses the coal measures and almost at right angles with their strike, or of the New river or Flat Top Coal fields, are especially noteworthy for their purity, their comparative freedom from sulphur and very low per cent of ash. Whether we consider the gas coals of the lower seams of the Middle Measures, or the splint coals of the upper seams of these or the still overlying Barren Measures and Upper Measures, or whether we take the steam and coking coals of

the Lower (Conglomerate) Measures, we find these conditions of excellence generally prevailing.

It is largely the purity of the coals of this section of the Commonwealth that has attracted to them the world-wide attention they are now receiving, and that enables them to be worked with profit, and to gain and maintain a position of continually greater and greater command in the trade of the markets into which they penetrate.

These facts are strikingly illustrated by a study of the comparative tables of analyses and tests and market price quotations hereinafter appended.

The seams lie in horizontal beds with a more or less dip northwestward, and are worked with horizontal drifts, and inclined planes or slopes of greater or less length, depending upon the altitude of the seam above the level of the water or rail transportation. The general direction of dip of the field being between N. 22° and 37° W., and at an average inclination of about forty feet to the mile.

CHAPTER II.

TABLES OF VERTICAL CROSS-SECTIONS,

SHOWING

The interlying Coal and Rocks of the Upper (No. XV), Barren (No. XIV), Middle (No. XIII), and Lower (No. XII) (or Pottsville Conglomerate of Pennsylvania) Measures, and the several Coal Seams in their vertical order and relative position to one another.

SECTION I.

Table showing generalized section Kanawha and New River Coal Fields.—I. C. WHITE.

1. Waynesburg coal....	Coal, rather shaly	0 ft. 10 in.	3 ft.	No. XV. Upper Coal Measures. 274 ft.
	Coal, soft sulphurous,	0 ft. 8 in.		
	Shale	0 ft. 5 in.		
	Coal, good	0 ft. 8 in.		
	Coal, slaty	0 ft. 5 in.		
2. Shales and sandstone			75 ft.	
3. Raymond City limestone			5 ft.	
4. Shales and sandstone			130 ft.	
5. Massive sandstones			35 ft.	
6. Shales			15 ft.	
7. Coal, Pittsburgh, (Raymond City.)	Coal, slaty	1 ft. 0 in.	Roof coal. 4 ft. 10 in.	
	Coal	0 ft. 6 in.		
	Slate	0 ft. 1 in.		
	Coal	0 ft. 8 in.		
	Shale	0 ft. 1 in.		
	Coal, slaty	1 ft. 6 in.		
	Fire clay	1 ft. 0 in.		
	Coal, Main Bench	6 ft. 0 in.		
8. Concealed red shales and sandstone			140 ft.	
9. Massive sandstone			30 ft.	
10. Red shales, sandstone, and concealed			150 ft.	
11. Coal, impure (Elk Lick)			1 ft.	
12. Shales			10 ft.	
13. Sandstone, pebbly at base			30 ft.	
14. Marly shales, with limestone nodules			30 ft.	
15. Two mile limestone			5 ft.	
16. Dark red shale, with iron-ore			30 ft.	
17. Shales			25 ft.	
18. Coal and coaly shade (Bakerstown)			5 ft.	
19. Fire-clay and shales			5 ft.	
20. Massive pebbly sandstone			30 ft.	No. XIV. Barren Measures. 806 ft.
21. Shales and massive sandstone....	Upper Mahoning.		100 ft.	
22. Shales, coal, and iron-ore			20 ft.	
23. Very hard, yellowish-whitestone			25 ft.	
24. Coal, Mahonning (Big Bed)	Lower Mahoning.	1— 15 ft.	Mahonning group. 231 ft.	
25. Massive sandstone		75 ft.		
26. Shale		10 ft.		
27. Coal, Upper Cannelton		0— 6 ft.		
28. Massive sandstone		50 ft.		
29. Shales, sandy		10— 20 ft.		
30. Coal (Middle Cannelton)			0— 2 ft.	
31. Black Flint			0— 10 ft.	
32. Shales			1— 5 ft.	

33. Upper Freeport coal (Crown Hill, Cannelton)	0— 10 ft.		
34. Shales and sandstones	75 ft.		
35. Lower Freeport coal (Coalburgh)	0— 8 ft.		
36. Shales and massive sandstone (Upper Freeport)	75 ft.		
37. Upper Kittanning coal (Winifrede, Kanawha Mining Co.)	0— 6 ft.		
38. Shales and massive sandstones (Lower Freeport), with several thin streaks of coal	250 ft.		
39. Middle Kittanning coal (Cedar Grove)	0— 4 ft.		
40. Shales	50 ft.		
41. Campbell's Creek limestone (Johnstown cement bed)	1 ft.		
42. Shales	20— 40 ft.		
43. Lower Kittanning coal (Campbell's Creek, Coal Valley, Peerless)	2— 10 ft.		
44. Fireclay and shales	5 ft.		
45. Massive sandstone (Kittanning)	40 ft.		
46. Coal	0— 2 ft.		
47. Shales	30 ft.		
48. Ferriferous limestone (Cannelton Cement bed)	2 ft.		
49. Shales	35 ft.		
50. Clarion coal (Eagle)	2— 4 ft.	976 ft.	No. XIII. Middle ("Lower") Coal Measures.
51. Shales	20 ft.		
52. Coal	1½—2½ ft.		
53. Sandstone and sandy shales	55 ft.		
54. Putnam Hill limestone (black marble)	1 ft.		
55. Black fossiliferous shales	0— 6 ft.		
56. Shales and sandstones with two or three unimportant coal streaks	275 ft.		
57. Homewood sandstone (Kanawha Falls rock)	150 ft.		
58. Coal	0— 2 ft.		
59. Massive sandstones and shales	275 ft.		
60. Nuttall or Sewell coal	2— 6 ft.		
61. Shales	75 ft.		
62. Massive sandstone	150 ft.		
63. Shales	75 ft.		
64. Coal, Quinnimont (?) probably Fire Creek	0— 5 ft.		
65. Shales and sandstone	100 ft.		
66. Coal, Fire Creek (?) probably Quinnimont	0— 5 ft.		
67. Shales and massive sandstone, with a few streaks of coal	580 ft.		
68. Limestone of No. XI Measures			

SUMMARY OF SECTION.

Upper coal measures	No. XV.	274 ft.
Barren coal measures	No. XIV.	806 ft
Middle (or "lower") coal measures	No. XIII.	976 ft.
Lower "Pottsville conglomerate" coal measures	No. XII.	1,310 ft.
Total		3,366 ft.

"This summation gives a thickness of nearly 3,400 feet for the carboniferous beds proper, along the Great Kanawha river, as measured between Point Pleasant and Quinnimont.

SECTION II.

Nos. XV, XIV, and XIII Measures, Great Kanawha Coal Field.

On Paint Creek, Kanawha County, by C. H. Frazer.

Coal.	Penn. Name.	Local Name.	Height. Feet.	Height. Inches.	Material.	Remarks. No. XIV Measures.	Altitude above Paint Creek Bed in Feet.
.....	.....	....	134	.....	Sandstone.	Top of mountain unexplored.	974
Coal.	Mahoning.	.....	7	6	.....	Upper and Middle Cannelton seams.	840
.....	.....	.....	.....	.....	Sandstone.	Unexplored.	
.....	.....	... .	....	.....	Black flint ledge.	....	725
.....	.....	.....	.....	.....	Sandstone.	No. XIII Measures.	
Coal.	Upper Freeport.	Crown Hill, or Bellmont.	4	6	.....	Opening on Jones branch of Paint Creek.	640
.....	....	.....	90	.....	Sandstone.	.....	.....
Coal.	Lower Freeport.	Coal-burgh.	12	8	.....	Opening on Jones branch of Paint Creek.	550
.....	.....	.....	50	.....	Sandstone.	....	.....
Coal.	Upper Kittanning.	Winifrede, Kanawha Mining Co.	8	7	.....	Opening on Jones branch of Paint Creek.	500
.....	.....	.....	150	.....	Sandstone.	....	.....
Coal.	Middle Kittanning.	Cedar Grove.	4	9	.....	Opening at Peach Orchard one-half mile above Ash Branch.	250
.....	.....	.....	100	.....	Sandstone.	.....	.....
Coal.		Powelton, Coal Valley, Peerless.	3 3	3 1	.....	Opening R. H. F. of Ash Branch.	150
.....	.....	.....	.....	.....	.....	Water level of creek.	
Coal.	Clarion seam.	Eagle.	.....	.....	....	Below water level on P. C.	.....

Altitude above sea level, mouth of Paint Creek, 577.87 feet.

2. On Cabin Creek, Kanawha County, by Prof. Sharpless.

Coal.	Penn. Name.	Local Name.	Height in Feet.	Material.	Remarks. No. XIV Measures.	Altitude above Cabin Creek Bed in Feet.
.....	.....	.....	.....	.....	Mountain Summit.	1000
Coal.	Mahoning beds.	.....	6	.....	.....	876
.....	.....	.....	25	Sand rocks.	.....	.....
.....	.....	.....	6	Slate.	.	
Coal.	Mahoning beds.	.....	2	.....	.....	845
.....	.....	.....	169	Sand rocks.	.....	.....
Coal.	.....	Middle Cannelton.	3	.....	.....	686
.....	.....	.....	70	Flint ledge and rocks.	.....	.....
Coal.	Upper Freeport.	Crown Hill.	2	.....	No. XIII Measures.	544
.....	.....	.....	60	Sand rocks.	.....	.....
Coal.	Lower Freeport.	Coalburg.	10	.....	.....	484
.....	.....	.....	50	Sand rocks.	.....	434
Coal.	.....	.....	.....	Coal outcrop.	.....	.....
.....	.....	.....	135	Sand rocks.	.....	299
Coal.	Upper Kittanning.	Winifrede.	2	.....	.....	.....
Coal.	Middle Kittanning.	Cedar Grove.	25 6	Sand rocks.	.....	268
.....	.....	.....	235	Sand rocks.	.....	.....
Coal.	Lower Kittanning.	Keystone, Peerless, Campbells.	8	.....	.....	25
.....	.....	.....	25	Concealed.	Creek level.	.....

Altitude above sea level, mouth of Cabin Creek, 569.47 feet.

3. On Cabin Creek, Kanawha County, by I. C. White.

Coal.	Penn. Name.	Local Name.	Height. Feet.	Height. Inches.	Material.	Remarks. No. XIV Measures.	Altitude above Cabin Cr. Bed in Feet.
.....	....	.....	50	0	Mahoning sandstone.	Mountain top very pebbly at top.	1,292-7
.....	.....	.....	200	0	Concealed and sandstone.	....	.....
Coal.	Mahoning beds.	Mahoning.	5	5	....	Splint coal with two partings.	1,037 1-6
.....	.....	.....	25	0	Concealed and shales.	....	.....
Coal.	Mahoning beds.	.....	2	6	....	Splint coal.	1,012 1-6
.....	.....	.....	10	0	Concealed shales and sandstone.	.....	.....
Coal.	Mahoning beds.	....	2	2	.....	1 ft. 2 in. coal. 0 ft. 6 in. shale. 0 ft. 6 in. coal.	1,000 1-2
Coal.	.....	Blossom of Upper Cannelton.	14	0	.....	Concealed, but showing blossom of coal.	860 1-2
.....	.....	.....	3	0	Dark shales.	.....	.....
Coal.	....	Middle Cannelton.	3	4	.....	1 ft. coal. 0 ft. 6 in. shale. 1 ft. 10 in. coal.	854 1-6
.....	.....	.....	75	0	Concealed shales and sandstone.	..... No. xiii Measures.	.....
Coal.	.....	....	1	0	.....	Soft coal.	778 1-6
.....	.....	.....	55	0	Shaley sandstone and shales.	.....	.....
Coal.	Lower Freeport.	Coalburgh.	14	0	....	Splint coal, with four partings.	723 1-6
.....	.....	.....	40	0	Concealed and shales.	.....	.....
Coal.	Upper Kittanning.	Winifrede, upper bench.	1	2	....	Slaty coal.	682
.....	.....	.....	30	0	Concealed and sandstone.	.....	.....
Coal.	Upper Kittanning.	Winifrede, lower bench.	.....	6	.....	Splint coal.	652
.....	.....	.....	210	0	Concealed and sandstone.	....	.....
.....	.....	.....	3	0	Calcareo, silicious, stratum.	.....	.....

ON CABIN CREEK, KANAWHA COUNTY, BY I. C. WHITE.—*Continued.*

COAL.	PENN. NAME.	LOCAL NAME.	HEIGHT. FEET.	HEIGHT. INCHES.	MATERIAL.	REMARKS. No. XIII MEASURES.	ALTITUDE ABOVE CABIN CR. BED IN FEET.
.....	.....	.....	7	0	Shales.	.....	.....
Coal.	Middle Kittanning.	Cedar Grove, upper bench.	2	2	.....	Gas and steam coal.	432
.....	.....	.....	40	0	Sandstone and shales.	.....	.....
Coal.	Middle Kittanning.	Cedar Grove, lower bench.	2	0	.....	Gas and steam coal.	392 3-4
.....	.....	.....	135	0	Concealed.	.....	.....
Coal.	Lower Kittanning.	Peerless and Acme, gas coal and hard coal.	5	9	.....	.....	252
.....	.....	.....	250	0	Concealed.	.....	.....
Coal.	.....	.....	2	0	.....	Near bed of Cabin Creek.	.....

Altitude above sea level, mouth of Cabin Creek, 569.47 feet.

4. At North Coalburgh, Kanawha County, by C. C. Lewis.

Coal.	Penn. Name.	Local Name.	Height. Feet.	Height. Inches.	Material.	Remarks. No. XIII Measures.	Altitude above River in Feet.
.....	.....	....	.....	.....	.....	Mountain top.	830
.....	.....	.....	33	6	Sandrock.	.....	.....
....	.....	.....	2	.....	Slate.	....	.....
.....	.....	. ...	11	.....	Conglomerate rock.	.....	.....
Coal.	Mahoning beds.	North Coalburgh, Upper Seam.	17	.....	.....	Coals and slates.	662¼
.....	.....	.....	1	6	Limestone nodules.	.....	.....
.....	.....	.....	39	.....	Hard sandrock.	.....	.....
.....	.....	.....	17	6	Rotten sandstone.	.....	.....
.....	.....	.....	37	6	Coarse white sandrock.	.....	.....
.....	.....	.....	3	.....	Red sandstone.	....	.....
Coal.	.....	Upper Cannelton.	3	.....	.....	Eleven inches. Fire clay 2 ft. Coal.	563¼
.....	.....	....	64	9	Coarse sandstone.	....	.....
.....	.....	.....	1	6	Iron nodules	.....	... .
.....	....	.....	7	.....	Black flint ledge.	.....	491
.....	....	.....	13	6	Hard sandstone.	.....	.....
Coal.	Upper Band, Upper Freeport.	Crown Hill.	2	6	.....	No XIII Measures.	475
.....	.....	.....	4	5	White sandstone.	.....	.....
Coal.	Upper Freeport.	Crown Hill.	4	6	.....	.....	470
.....	.....	.....	2	6	Slate.	.....	.....
....	.....	.....	32	3	Sandstone.	.....	.....
Coal.	Lower Freeport.	Coalburgh.	4	.. .	.....	.....	445
.....	.....	.....	8	.....	Slate.	.....	.....
Coal.	Lower Freeport, Lower Band.	.....	2	.....	....	Outcrop showing.	435

AT NORTH COALBURGH, KANAWHA COUNTY, BY C. C. LEWIS.—*Continued.*

COAL.	PENN. NAME	LOCAL NAME.	HEIGHT. FEET.	HEIGHT. INCHES.	MATERIAL.	REMARKS. No. XIII MEASURES.	ALTITUDE ABOVE RIVER IN FEET.
.....	.....	.....	76	6	Sandstone.	....	.....
Coal.	Upper Kittanning.	Winifrede.	5	..	Slate and iron ore mixed.	.....	358 1-2
.....	.....	.....	2	...	Slate.	.....	.....
.....	.....	....	44	5	Sandstone.	.....	.....
.....	.....	.....	23	9	Slate with some iron nodules.	.....	.....
Coal.	.....	Coal, stray seam.	2	.....	.....	Outcrop, stray, imperfect coal seam.	286¼
.....	.....	.....	59	9	Sandstone.	.....	.....
.....	.....	.....	3	6	Slate.	.....	.....
.....	.....	.....	1	.....	Iron ore.	.....	.....
Coal.	.....	Stray seam.	1	....	.....	Outcrop of stray imperfect coal seam.	221¼
.....	.....	.....	71	4	Sandstone.	.....	.....
.....	.....	.....	11	4	Dark slate.	.....	.....
Coal.	Middle Kittanning.	Cedar Grove.	2	9	.....	.....	138¾
.....	.....	....	5	.....	Fire clay.	.....	.....
.....	.....	.....	42	9	Loose sandstone.	.....	.....
Coal.	Lower Kittanning.	Peerless.	1	....	....	.....	90
.....	.....	.....	25	6	Sandstone.		.....
Coal.	Lower Kittanning.	.....	2	6	.....		64 1-2
.....	.....	.....	15	6	Sandstone.	Split beds of Lower Kittanning.	
Coal.	Lower Kittanning.	Campbell's Creek.	2	6	.....		34 1-2
.....	.....	.....	15	....	Sandstone.		
.....	.....	.....	19½	.....	Concealed measures.		
.....	.....	.....	....	.. ..	.....	River Level.	.....

Altitude above sea level, Kanawha river, at Coalburgh, 569.67 feet.

5. On Kelly's Creek, Kanawha County.

	Coal.	Penn. Name.	Local Name.	Height. Feet.	Height. Inches.	Material.	Remarks.	Altitude above level Kanawha River in Feet.
Upper No. XV. Measures.	....	.....	.....	.....	...	. . ..	Mountain Summit.	1,115
	.....	....	.....	290	....	Sandstone, slate, etc.	....	.....
	Coal.	Pittsburgh.	Raymond City.	5	....	....	.....	845
Upper Barren, No. XIV Measures.	.....	.....	.....	180	....	Slate and sandstone.	.....	.....
	Coal.	Mahoning bed No. 4.	.....	5	3	.....	.....	665
	.....	....	....	30	....	Slates.	.....	.....
	Coal.	Mahoning bed No. 3.	.....	3	6	.....	.....	635
	.....	.....	.....	10	....	Slates.	.....	.....
	Coal.	Mahoning bed No. 2.	.....	7	3¾	.....	.....	625
	.....	.....	.....	2	...	Slates.	.....	.....
	Coal.	Mahoning bed No. 1.	.....	3	6	.....	.....	619
	.....	.....	Upper Cannelton.	... .	...	.....	.....	.....
	.....	.....	....	96	...	Sandstone and slates.	... .	....
	Coal.	.....	Middle Cannelton.	3	....	.....	Coals and slates, valueless.	523
	.....	..... .	Black flint ledge.	8		. .....	.....	515
	.....	.....	.....	26	....	Sandstone and shales.	.....	.....

5. On Kelly's Creek, Kanawha County.—*Continued.*

	Coal.	Penn. Name.	Local Name.	Height. Feet.	Height. Inches.	Material.	Remarks.	Altitude above Level Kanawha River in Feet.
Middle No. XIII Measures.	Coal.	Upper Freeport.	Crown Hill, Belmont.	8	9	.....	.....	480
	.....	.....	.....	60	....	Sandstone.	.....	.....
	Coal.	Lower Freeport.	Coalburgh.	6–7	....	.....	.....	420
	.....	.....	.....	30	....	Sandstone.	.....	.....
	Coal.	Upper Kittanning.	Kanawha mining seam, Winifrede.	2	11	.....	.....	390
	.....	.....	.....	260	....	Sands, slaty clay.	.....	260
	Coal.	Middle Kittanning.	Cedar Grove.	3	2	.....	....	130
	Coal.	Lower Kittanning.	Tunnel seam Lower Blacksburgh.	.....	....	.....	.....	.....
	.....	.....	.....	30	....	Clays, slates, rocks.	....	.....

(6.) Mountain Between Pond and Spruce Forks, Little Coal River, Boone County, by W. C. Reynolds, C. & M. E.

Coal.	Penn. Name.	Local Name.	Height. Feet.	Height. Inches.	Material.	Remarks.
.....	.....	.....	.....	.....	.....	Mountain between Pond and West Forks of Little Coal River. No. XIV Measures.
.....	.....	.....	.....	.....	.....	Top of mountain above level Coal River, 1,350 feet.
.....	.....	.....	300	.....	Sand stone and concealed.	.....
Coal.	Mahoning seam.	Bed No. 2.	13	6	.....	.....
.....	.....	.....	2	.....	Fire clay.	.....
Coal.	Mahoning seam.	Bed No. 1.	7	.....	.....	Streak of boney coal near the top.
.....	.....	.....	190	.....	Sand stone and concealed.	.....
Coal.	.....	Upper Cannelton.	7	.....	.....	With one slate parting.
.....	.....	.....	150	.....	Sand stone and concealed.	.....
Coal.	.....	Middle Cannelton.	.....	.....	.....	Containing 10 to 12 inches cannel coal and without partings.
.....	.....	.....	8	.....	Clays and slates.	.....
Coal.	Upper Freeport.	Belmont or Crown Hill.	5	.....	.....	No. XIII Measures.
.....	.....	.....	30	.....	Clays, slates and concealed.	.....
Coal.	Lower Freeport.	Coalburgh.	9	9	.....	24 inch coal. 18 inch fire clay. 60 inch coal. 5 inch fire clay. 10 inch coal. 4 inch fire clay. 5 inch coal.
.....	.....	.....	110	.....	Sand stone and concealed.	.....
Coal.	Upper Kittanning.	Winifrede and Kan'a Mining.	2	7	.....	.....
.....	.....	.....	50	.....	Sand stone and concealed.	Lower Freeport series, holding 4 small coal seams from 10 to 18 inches thick.

(6.) MOUNTAIN BETWEEN POND AND SPRUCE FORKS, LITTLE COAL RIVER, BOONE COUNTY—*Continued.*

COAL.	PENN. NAME.	LOCAL NAME.	HEIGHT. FEET.	HEIGHT. INCHES.	MATERIAL.	REMARKS.
Coal.	Probably lower band of Upper Kittanning.	.....	3	10	.....	Splint coal
.....	.....	.....	250	.....	Sand stones, shales, slates, concealed, etc.	.....
Coal.	Middle Kittanning.	Cedar Grove.	22	4	Clays and slates.	2 ft. coal. 5 ft. clay slates. 40 in. coal. 8 ft. clay slates. 2 ft. coal. } gas coal
.....	.....	.....	160	.....	Sand stones and concealed.	.....
Coal.	Brownstown.	Powelton Coal Valley Peerless.	3	8	.....	A coking coal.
.....	.....	.....	30	.....	Sand stones.	.....
Coal.	Lower bed of L. Kittanning or the Clarion seam.	.....	2	7	.....	A coking coal.
.....	.....	.....	30	.....	Sand stones and concealed.	.....
.....	.....	.....	....	.....	.....	Water Level, Pond Fork, Little Coal River.

(7) Approximate Average Section at West Fork of Twelve Pole River, Wayne County, by Andrew Roy, M. E.

Coal.	Probable Penn. Name.	Probable Kanawha Name.	Local Name.	Ht. Feet.	Ht. Inches.	Material.	Altitude.	Remarks
.....	.....	.....	.....	...	..	Concealed.	.. ..	Top of monntain.
Coal.	... .	.....	Top coal.	2	6	.....	514	....
.....	.....	.....	.....	60	00	Concealed.	....	No. XIV Measures.
.....	.....	.....	.....	44	00	Kidney iron and bastard limestone.	.....	.....
Coal.	.....	.....	Jackson's branch.	2	6	Concealed.	410	..... .
.....	.....	.....	....	146	00	Concealed.	.....	.....
Coal.	Upper Freeport.	Crown Hill.	Upper Ferguson or Kirk.	6	00	Hard splint coal, (sometimes cannel	258	No. XIII Measures.
.....	....	.....	.....	30 to 40	00 00	Concealed.	.....	.....
Coal.	Lower Freeport.	Coalburgh.	Lower Ferguson	2	6	.....	218	.....
.....	.....	.....	.....	50	00	Concealed.	....	.....
Coal.	Upper Kittanning.	Winifrede Kanawha mining.	Dawson.	3	6	.....	168	.....
.....	....	.....	.....	40	00	.....	.....	.....
Coal.	Middle Kittanning.	Cedar Grove.	Upper Dunlow.	5	6	.....	123½	.....
.....	.....	.....	.....	30	00	Concealed.	...	.....
Coal.	Lower Kittanning.	Coal Valley.	Lower Dunlow.	3	6	.....	90	.....
.....	.....	... .	.....	60	00	Concealed.	.....	.....
Coal.	....	.....	.....	..	....	Probably lower bed of L. Kittann'g or Clarion.	...	.....
.....	.....	.....	.....	30	00	Concealed.	.....	.....
.....	.....	... .	.....	...	...	.....	.....	Level of W. Fork of Twelve Pole River.

SECTION III.

NO. XII MEASURES—THE NEW RIVER COAL FIELD.

The "New River" Coal District, lying immediately south-east of the Great Kanawha District, is characterized by the presence of probably three workable seams.

These are distinguished, as already referred to, as the Meadow Creek, "Quinnimont" or "Fire Creek," and "Nuttallburgh" or Sewell Seams, named from the chief workings in each during the early development of the field.

The following tables of vertical cross-sections are by Prof. I. C. White and S. Fisher Morris, C. & M. E., and give with approximate accuracy the average stratification of the field.

MOUNTAIN NEAR NUTTALLBURGH, FAYETTE COUNTY, BY I. C. WHITE.

COAL.	LOCAL NAME.	HEIGHT.		MATERIAL.	REMARKS.
		FEET.	INCHES.		
.....	.....	.....	.....	....	Top of mountain, 1,400 above bed of New River.
.....	....	110	....	Sandstone.	Massive, pebbly, Homewood.
.....	.....	60	.....	Shales.	....
Coal.	.....	....	....	.....	Coal of "Mercer," Pa., group.
.....	....	75	....	Sandy shales and sandstone.	.....
.....	.....	25	.....	Sandstone.	.....
.....	.....	2	.....	Black slate.	....
Coal.	....	1	.....	.....	Coal of "Mercer," Pa., group.
.....	....	75	.....	Shales and sandstone.	.....
Coal.	....	0	10	.....	Coal of "Mercer," Pa., group.
.....	.....	50	.....	Shales, sandstone, and shales.	.....
Coal.	Nuttall or sewell.	3	6	.....	.....
.....	.....	75	.....	Shales and slates.	.....
.....	.....	155	. . .	Sandstone massive.	... .
... .	.....	10	.....	Slates, dark.	....
.....	.....	120	....	Concealed and shales.	.....
Coal.	Fire Creek.	3	6	....	....
....	.....	130	.....	Shales and sandstone.	....
.....	.....	.....	.....	Slate.	....
Coal.	Quinnimont.	4	5	.....	.....

MOUNTAIN NEAR NUTTALLBURGH, FAYETTE COUNTY, BY I. C. WHITE.—*Continued.*

COAL.	LOCAL NAME.	HEIGHT.		MATERIAL.	REMARKS.
		FEET.	INCHES.		
.....	.....	.....	.....	Shales and sandstone.	....
Coal.	....	2	4	....	Coal of slaty quantity.
.....	.....	40	.....	Shales.	.....
Coal.	.....	1	5	.....	.....
.....	.....	10	.....	Shales.	....
.....	.....	30	.....	Concealed.	.....
.....	.....	125	.....	Sandstone massive.	.....
.....	.....	60	.....	Consealed and sandstone.	....
.....	.....	140	.....	Sandstone massive.	....
.....	.....	.....	.....	Concealed and sandstone.	To top of No. XI shales.

2. Mountain at Fire Creek, Fayette County, by S. Fisher Morris, C. & M. E.

Coal.	Local Name.	Height. Feet.	Height. Inches.	Material.	Remarks.
.....	.....	.....	....	Concealed.	Top of mountain, 1,560 feet above level of New river.
Coal.	.....	3	6	.....	1,465 feet above New river, not worked.
.....	.....	....	....	Soft.	.....
Coal.	.....	4	6	Concealed.	1,260 feet above New river, not worked.
.....	.....	....	....	Concealed.	.....
Coal.	Sewell.	3	0	.....	1,050 feet above New river.
.....	.....	.....	....	Hard white sandstone and conglomerate.	.....
.....	.....	.....	.....	Sandstone and shale.	.....
.....	.....	.....	....	Hard sandstone.	.....
Coal.	Fire Creek.	3	0	.....	760 feet above New river.
.....	.....	.....	....	Soft shales and slate.	.....
Coal.	Quinnimont.	2	0	.....	660 feet above New river.
.....	.....	....	....	Sandstone and shale.	.....
.....	.....	....	....	Sandstone.	.....
.....	.....	...	.....	Sandstone and shale.	.....
.....	.....	.....	.....	Sandstone.	.....
.....	.....	.....	.....	Sandstone and shale.	The "Meadow Creek" bed as operated on Meadow Creek by John Beury, seems to lie about 180 feet below the true Quinnimont seam.
.....	.....	....	.....	Hard conglomerate sandstone.	.....
.....	.....	....	.....	Shale.	C. & O. Ry. level.
.....	.....	.....	.....	.....	Water level, New river.

3. Mountain of Quinnimont, Fayette County, S. Fisher Morris, C. & M. E.

Coal	Local name.	Height.		Material.	Remarks.
		Feet.	Inches.		
.....	.....	.....	.....	Hard sandstone and conglomerate.	Top of mountain 1,400 feet above New river.
.....	.....	.....	.....	Sandstone and shales.	.....
Coal.	.....	2	5	Hard sandstone.	1,200 feet above New river, not worked.
.....	.....	.....	.....	Slate and shales.	.....
Coal.	Quinnimont.	4	0	.....	1,100 feet above level of New river.
.....	.....	.....	.....	Sandstone and shale.	.....
Coal.	.....	2	0	.....	Outcrop.
.....	.....	.....	.....	Hard sandstone.	.....
Coal.	.....	.....	.....	Shales.	Thin seam.
.....	.....	.....	.....	Sandstone and shales.	.....
.....	.....	.....	.....	Sandstone.	.....
.....	.....	.....	.....	Olive shales, red shales.	.....
.....	.....	.....	.....	Sandstone and conglomerate.	.....
.....	.....	.....	.....	Sandstone and shale.	.....
.....	.....	.....	.....	Shale.	C. & O. Ry. level.
.....	.....	.....	.....	Red shale.	.....
.....	.....	.....	.....	.....	Level of New river.

SECTION IV.

NO. XII MEASURES—THE FLAT TOP MOUNTAIN COAL FIELD.

The most complete examination of the Great Flat Top mountain coal field of Mercer, McDowell, and Tazewell counties appears to determine the presence of some thirteen distinct beds of the soft, rich coking coals, characteristic of the No. XII measures, wherever appearing in West Virginia. Of the beds of coal, three—possibly four—may be viewed as workable, the others being generally too thin to warrant development. The exploitation of the coal field was due very largely to Mr. Jed. Hotchkiss, and his comprehensive examination of the geological stratigraphy of that region has left but little for subsequent research to do. The coal seams, as examined by him, ranged from about $1\frac{1}{2}$ feet to 12 feet in thickness, and the aggregate average thickness of all the beds was determined at about 47 feet. Six of the beds were measured to be over 3 feet in thickness at the outcrop, and five of them ranged from 5 feet 2 inches to 9 feet in thickness. Coal seams No. 1 to No. 5 were determined to be in all the field south-west of Simmons creek, and all the seams, except Nos. 11, 12, and 13, in eroded localities, are found throughout the field north-east of Simmons creek. The great No. 3 seam has proved to be the working seam of the field, whether at Pocahontas mines, or upon other Bluestone waters, or on Elk Horn, over the dividing watershed. And it is from this seam that has come the great coal output of the Flat Top field. But little development has been made in any other of the coal beds.

The following tables are given from Hotchkiss, showing—I, the average thickness of coal beds, with numbering of seam; and, II, the vertical section of the mountain at the mouth of Crane creek, on Bluestone river, showing coal beds appearing and their thickness and altitudes above the water level.

Table No. I.

No.		Average Thickness.	
		Feet.	Inches.
13	One bed	2	6
12	One bed	2	6
11	One bed	1	6
10	One bed	5	2
9	One bed	2	3
8	Outcrop of bed		
7	One bed	5	6
6	Bed 5 ft. 2 in.; and 6 ft. average	5	7
5	Bed 1 ft. 6 in.; 4 ft. 2 in.; and 4 ft. 6 in. average	2	4
4	Bed 4 ft. 6 in.; 5 ft.; and 6 ft. 6 in. average	5	4
3	Bed 4 ft. 9 in.; 9 ft. 7 in.; 9 ft. 9 in.; and 12 ft. average.	9	9
2	Bed 2 ft. 6 in., and 3 ft. 2 in. average	2	10
1	One bed	1	6

Table No. II.

No.	Feet.	Inches.	Summit. 1,090 feet.	Altitude above Level of Blue Stone River in Feet.
13	2	6		900
12	2	6		800
11	1	6		620
10	5	2		520
9	2	3		400
8				365
7	5	6	Coal	305
6	6	0	Coal	275
			Level of Blue Stone river at mouth of Crane creek.	

Vertical Cross-sections.

1. On Crane Creek, Mercer County, by I. C. White.

Coal.	Local Name.	Height. Feet.	Height. Inches.	Material.	Remarks.	Altitude.
.....	.....	400 (Estimated)	.....	Sandstone and shales.	Here eroded from top of No. XII.	1402
.....	.....	100	.....	Shales and sandstone.	.....	.....
.....	.....	35	.....	Sandstone and shales.	.....	.....
.....	.....	20	.....	Gray sandstone.	.....	.....
.....	.....	60	.....	Shales and concealed.	.....	.....
.....	.....	95	.....	Massive sandstone and shales.	.....	.....
Coal.	.....	7	2	.....	Stone broken with slate bands.	.....
.....	.....	110	.....	Shales, sandstone, and concealed.	.....	.....
.....	.....	5	.....	Shales.	.....	.....
Coal.	.....	1	8	.....	Good quality of coal.	.....
.....	.....	100	.....	Shales and concealed.	.....	.....
.....	.....	10	.....	Sandstone.	.....	.....
.....	.....	3	.....	Shale.	.....	.....
Coal.	.....	6	.....	.....	Coal 3 ft. Slate 2 ft. Coal and slate 1 ft.	.....
.....	.....	150	.....	Concealed.	With shales, sandstone, and 2 thin coals.	.....
Coal.	Pocahontas, or "No. III" bed.	13	6	.....	Coal 2 ft. 6 in. Shale 5 ft. 0 in. Coal 6 ft. 0 in.	.....
.....	.....	80	.....	Shales, sandstone, and concealed.	.....	.....
Coal.	"No. II" bed.	2	6	.....	.....	.....
.....	.....	20	.....	Sandstone and shales.	.....	.....

ON CRANE CREEK, MERCER COUNTY, BY I. C. WHITE.—*Continued.*

COAL.	LOCAL NAME.	HEIGHT.		MATERIAL.	REMARKS.	ALTITUDE.
		FEET.	INCHES.			
Coal.	"No. I" bed.	0	2	.....	.....	.....
.....	.....	28	.....	Shales.	.....	.....
.....	.....	85	.....	Gray sandstone.	.....	.....
.....	.....	20	.....	Dark shales.	.....	.....
.....	.....	50	.....	Concealed.	.....	.....
.....	.....	40	.....	Sandstone and concealed.	.....	.....
.....	.....	10	.....	Gray massive sandstone.	.....	.....
.....	.....	.....	.....	Shales.	.....	Green, limy, fossiliferous, top of lower carboniferous.

2. On Laurel Creek, Pocahontas Mines, Tazewell County, Va., by A. S. McCreath (Lathrop).

Coal.	Local Name.	Height. Feet.	Height. Inches.	Material.	Remarks.
.....	.....	.....	.....	....	Top of ridge 431 feet 9 inches above water level.
.....	....	40	0	Concealed measures.	.....
Coal.	Seam No. 7.	2	0	.....	.....
.....	.....	20	0	Concealed measures.	.....
Coal.	Seam No. 6.	1	6	....	....
.....	.....	80	0	Concealed measures.	.....
Coal.	Seam No. 5.	4	6	....	Bone and dirt 2 ft. 0 in. Coal and dirt 2 ft. 6 in.
.....	....	91	0	Concealed measures.	.....
Coal.	Seam No. 4.	2	0	....	.....
.....	....	90	0	Concealed measures.	.....
.....	....	6	0	Sandy fire clay.	.....
Coal.	Seam No. 3 or Pocahontas.	11	3	.....	Coal 10 ft. 0 in. Slate 0 ft. 3 in. Coal 1 ft. 0 in.
.....	.....	6	0	Fire clay.	....
.....	.....	61	0	Shales and sand stone.	.....
Coal.	Seam No. 2.	4	0	....	Coal 1 ft. 0 in. Shale 2 ft. 0 in. Coal 1 ft. 0 in.
.....	.....	12	6	Concealed to water level.	.....
.....	....	....	....	.....	Water level. Below this level all measurements taken from bore hole record.
.....	.....	15	4	Gray sand rock.	.....
Coal.	Seam No. 1.	1	0	.....	.....
.....	.....	2	0	Shales.	.....
.....	.....	27	0	Sand stone.	.....
.....	.....	3	0	Slate.	.....
.....	.....	35	4	Gray sand rock.	.....
.....	.....	8	8	Sand stone with coal streaks.	.....
.....	.....	27	2	Sand stone and shale.	.....
.....	.....	4	0	Gray sand stone.	.....
.....	.....	8	5	Gray sand stone and shale.	.....
.....	.....	8	10	Fire clay and shale.	.....
.....	.....	7	10	Blue slate.	.....
.....	.....	15	1	Sand stone and shale.	.....

2. On Laurel Creek, Pocahontas Mines, Tazewell County, Va.—*Continued.*

Coal.	Local Name.	Height.		Material.	Remarks.
		Feet.	Inches.		
.....	.....	17	0	Gray sand stone.	.....
.....	.....	27	1	Dark slate.	.....
.....	.....	26	3	Blue sand stone.	.....
.....	.....	26	4	Blue sand stone, very hard.	.....
.....	.....	1	0	Slate.	.....
.....	.....	23	10	Gray sand stone.	.....
.....	.....	102	7	Dark shale, lighter colored below.	.....
.....	.....	3	0	Gray sand stone.	.....
.....	.....	3	7	Red shale and gray sand stone.	.....
.....	.....	2	0	Gray sand stone.	.....
.....	.....	2	4	Gray shale.	.....
.....	.....	1	6	Gray sand stone.	.....
.....	.....	2	0	Gray shale.	.....
.....	.....	7	6	Red shale.	.....
.....	.....	.....	.....	.....	Bottom of bore hole, total section 841 feet 11 inches.

3. North Side Guayandotte River, 4 Miles above Pineville, Wyoming County, by M. A. Miller, C. & M. E.

Flat Top. No. of seam.	New River name.	Flat Top name.	Height of seam.	Material.	Remarks.	Altitude above tide water.
.....	.....	.....	.....	.....	Top of mountain.	2055
.....	.....	.....	105	Sandstone.	.....	.....
6 Coal.	Fire Creek seam.	.....	.....	8 " top coal. 2 " slate. 28 " coal. 21 " slate. 8 " coal. Fire clay bottom.	Bottom of bed.	950
.....	.....	.....	40	Sandstones.	.....	.....
.....	.....	.....	140	Slates.	.....	.....
5 Coal.	Fire Creek seam.	.....	.....	16 " top coal. 48 " slate. 28 " coal.	.....	1630
.....	.....	.....	65	Sandstone.	.....	.....
.....	.....	.....	55	Slates.	.....	.....
4 Coal.	Quinnimont seam.	Pocahontas seam, upper bench.	.....	24 " coal.	.....	1510
.....	.....	.....	140	Sandstone.	.....	.....
3 Coal.	Quinnimont seam.	Pocahontas seam, lower bench.	.....	54 " coal.	Lying above the water.	1370
.....	.....	.....	.....	.....	Water level.	.....

As will be observed from an examination of the foregoing tables showing the stratigraphical relation of the rocks and coal seams of the Coal Measures to one another, the seams of coal lie imbedded between layers of sandstones and slates, and extend in more or less level-lying deposits throughout the formations of which they form a part.

The different beds of coal appear to be generally characterized by a certain similarity in physical structure, while the thickness of coal in any one seam or bed, and the thickening and thinning of over and inter-lying sands and slates, or other impurities, if any, are subject to more or less local variation.

CHAPTER III.

TABLES OF VERTICAL CROSS-SECTIONS OF COAL SEAMS

Of Great Kanawha, New river, Elk and Gauley, and Flat Top Districts, Nos. XV, XIV, XIII and XII Measures.

The following tables of the vertical cross sections of the seams of the Nos. XV, XIV, XIII and XII Measures, as now worked in the Great Kanawha, New River, and Flat Top Mountain Districts, give a fair record of the condition of the coal beds. The sections have been taken with great care by myself, or by well-known authority, and show the general character of the seams and the local variations.

The sections of the three seams of the New River District show the quite general uniformity of the coal beds in that field.

The sections of the coal bed characteristic of the No. XII Measures, as appearing on the upper Elk and Gauley river basins, have also been taken with care, and appear to indicate the presence of a valuable coking coal district quite equal to the New River field. The examinations, of which these sections are a fair average, have been quite extensive and establish the general character and presence of the bed over a large territory.

The sections of the principal seams of the Flat Top Mountain district give, probably, a fair view of the main "No. III" bed of that field, with its separation into two separate seams as it passes out of the somewhat limited basin where it attains its maximum.

SECTION 1.

Section of Pittsburgh Seam, No. XV Measures.

RAYMOND CITY MINES, PUTMAN COUNTY.

	Height.	
	Feet.	Inches.
Roof, soft slate		
Top coal, worthless (full of small bands of slate)	2	0
Bottom coal, clean	5	8
Total height of seam	7	3

A. M. Campbell, C. & M. E.

PLYMOUTH MINES AND ENERGETIC MINES, PUTMAN COUNTY.

	Height, Feet.
Roof, slate	
Bottom, coal	6 ft. to 7 ft.
Floor, clay	

	Plymouth.	Energetic.
Altitude above river	90 ft.	120 ft.
Altitude above sea	520 ft.	

O. A. Veazey, C. & M. E.

SECTION 2.

Sections of Mahoning and Upper Cannelton Seams, No. XIV Measures.

1. MAHONING SEAM AT NORTH COALBURG MINES, KANAWHA COUNTY.

	Height.	
	Feet.	Inches.
Roof, slate		
Fire clay	3	0
Coal	2 to 2¼	0
Slate	0	2 to 4
Coal	4½ to 5	0
Slate	2 to 3	0
Coal	4½ to 5	0
Total height of seam	16 2 to 18	6
Total height of workable coal, average, 5 to 6 feet.		

Geo. Connell, Esq.

2. MAHONING SEAMS ON KELLEY'S CREEK, J. D. LEWIS' HEIRS' LANDS, KANAWHA COUNTY.

		HEIGHT.	
		FEET.	INCHES.
	Roof, slate	..	..
	Coal, bituminous, soft	0	5
	Coal, bony	0	½
Bed 4.	Coal, bituminous, soft	1	11
	Slate	0	1
	Coal, bituminous, soft	1	0
	Coal, cannel	2	10
	Slates	30	0
	Coal	1	1
Bed 3.	Slate	0	10
	Coal	1	1½
	Slates	10	0
	Coal, splint	1	1½
	Slate	0	½
	Coal, splint	1	5½
Bed 2.	Coal, bony	0	½
	Coal, block splint	4	3
	Coal, bony	0	1
	Coal, block splint	1	4
	Slates	2	0
	Coal	1	0
Bed 1.	Slate	0	10
	Coal	1	½
	Sandstones	..	..

3. UPPER CANNELTON SEAM AT CANNELTON MINES, "NO. 5" SEAM, KANAWHA COUNTY.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate	..	..
Block coal	0	8
Niggerhead above coal	0	3
Block coal	2	0
Impure coal	0	0 to 8
Block coal	1	6 to 24
Slate or fire clay floor	.	..
Total height of seam	4	5 to 5 ft. 7 in.

O. A. Veazey, C. & M. E.

4. UPPER CANNELTON SEAM AT M. T. DAVIS & CO.'S MINES, ON MORRIS CREEK, KANAWHA COUNTY.

	HEIGHT.	
	FEET.	INCHES.
Roof, sandstone	..	.
Draw slate	0	4
Coal, hard splint	1	0
Niggerhead slate	0	½
Coal, hard splint	3	11½
Total height of seam	5	4

R. O. Baillie, C. & M. E.

5. Upper Cannelton Seam, with Cannel Bed at Cannelton Mines, (New Mine) on Land of C. P. Huntington.

	Height.	
	Feet.	Inches.
Roof, hard slate	..	..
Coal, bituminous	0	5
Coal, cannel	3	4
Floor, hard slate	..	..
Total height of seam	3	9

Henry Davis, Esq.

SECTION III.

1. *Vertical Cross-sections of Upper Freeport (Crown Hill) Seam, No. XIII Measures, Kanawha County.*

At Crown Hill Mines.

	Height.	
	Feet.	Inches.
Roof, sandstone	..	..
Draw slate	0	0 to 12
Coal, hard splint	0	8
Coal, hard splint	3	2½
Total height of seam	3	10½ to 4 ft. 10½ in.

R. O. Baillie, C. & M. E.

On Paint Creek, Paint Creek Colliery Lands.

	Height.	
	Feet.	Inches.
Roof, slate	..	..
Coal, hard splint	4	6
Floor, slate	..	..
Total height of seam	4	6

C. H. Frazer, Esq.

At Belmont Mines.

	Height.	
	Feet.	Inches.
Roof, friable slate	..	..
Coal, hard splint	0	1
Slate	0	½ to 1
Coal, hard splint	3	3
Total height of seam	4	3½
Seam varies in height from 3 ft. 3 in. to 4 ft. 10 in.		

R. O. Baillie, C. & M. E.

On Kelley's Creek, J. D. Lewis' Heirs Lands.

	Height.	
	Feet.	Inches.
Roof, slate	..	..
Coal, block splint, hard	0	11½
Coal (bony)	0	2½
Coal, block splint	2	1
Coal (bony)	0	½
Coal, block splint	1	0
Coal, softer bituminous	2	11½
Slate	0	3
Coal, block splint	1	0
Coal, shelly splint	0	5
Floor, slate	..	..
Total height of seam	8	11

At Cannelton Mines, Cannel Bed.

	Height.	
	Feet.	Inches.
Roof, sandstone	.....	.....
Black flint	0	10
Slate, hard	0	10
Coal, bituminous	2	10
Coal, cannel	3	0
Floor, hard slate	.....	.....
Total height of (coal in) seam	5	10

Henry Davis, Esq.

2. Of Lower Freeport (Coalburgh) Seam, at Coalburgh Mines.

	Height.			
	Ft.	In.	Ft.	In.
Roof, slate	....	.....	to.....	
Coal, hard splint	0	6	to 0	10
Slate ("niggerhead")	0	4	to 0	6
Coal, hard splint	2	6	to 3	6
Shale	1	0	to 8	0
Coal, soft bituminous	1	0	to 1	6
Total height of seam	5	4	to.....	
Showing variations in structure in its typical locality.				

I. C. White, Esq.

On Paint Creek, Paint Creek Colliery Lands.

	Height.	
	Feet.	Inches.
First opening on Jones' Branch—		
Roof, slate	.....	.....
Coal, hard splint	6	0
Slate (niggerhead)	0	2
Coal, hard splint	2	2
Slate	1	4
Coal, soft bituminous	1	5
Floor, slate	.....	.....
Total height of seam	11	1

ON PAINT CREEK, PAINT CREEK COLLIERY LANDS.—*Continued.*

	HEIGHT.	
	FEET.	INCHES.
Second opening on Left Hand Branch.—		
Roof, slate		
Coal, hard splint	3	4
Slate (niggerhead)	0	2
Coal, hard splint	5	3
Slate	0	6
Coal, soft bituminous	1	3
Floor, slate		
Total height of seam	10	6

C. H. Frazer, Esq.

ON CABIN CREEK, SEYMOUR LAND CO.'S LANDS.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate		
Coal, hard splint	1	10
Slate (niggerhead)	0	8½
Coal, hard splint	5	11¾
Slate	0	6
Coal, soft bituminous	1	6
Floor, slate		
Total height of seam	10	6¼

ON DAVIS CREEK, BLACK BAND AND IRON AND COAL CO.'S LAND.

	HEIGHT.			
	FT.	IN.	FT.	IN.
Roof, sandstone			to	
Coal, hard block splint	2	6	to 3	6
Slate, white	0	0	to 1	7
Bone coal and slate	0	6	to 0	10
Floor, slate			to	

J. W. Kirby, Esq.

ON KELLEY'S CREEK, ON J. D. LEWIS' HEIRS LAND.

	HEIGHT.	
	FEET.	INCHES.
Roof, sandstone		
Coal, bony	0	9½
Coal, block splint	2	3
Slate (niggerhead)	0	2
Coal, block splint	4	9¼
Floor, slate		
Total height of seam	8	

ON PAINT CREEK, WACOMAH MINE, CANNEL BED.

	HEIGHT IN FEET.
Roof, sandstone.	
Coal (soft splint, rather bituminous)	2 to 6 feet.
Coal, cannel	3 to 4 feet.
Floor, fire clay	
Total height of seam	5 to 10 feet.

3. OF UPPER KITTANNING (WINIFREDE OR KANAWHA MINING) SEAM, AT WINIFREDE MINES.

	HEIGHT.	
	FEET.	INCHES.
Coal, gray splint.	0	5
Coal, soft	0	5
Coal, gray splint	0	3
Coal, soft	0	3
Coal, gray splint.	1	2
Coal, soft	1	3
Slate	0	5
Coal, soft	1	8
Total height of seam	5	10

I. C. White, U. S. Geolog. Rep.

AT KANAWHA MINES (CONSOLIDATED M. CO.)

	HEIGHT.			
	FT.	IN.	FT.	IN.
Roof.			to	
Coal, block splint	3	0	to 3	6
Slate or black rock	0	3	to 0	6
Coal, soft gas	1	0	to 1	6
Floor, slate			to	
Total height of seam	4	3	to 5	6

(Showing variations in height.)
Altitude of sea above level Kanawha river, 440 feet.
O. A. Veazey, C. & M. E.

AT CHESAPEAKE MINING CO.'S MINE.

	HEIGHT.			
	FT.	IN.	FT.	IN.
Roof, slate			to	
Coal, block splint	4	0	to 5	0
Slate or black rock	0	3	to 0	5
Coal, soft gas	1	0	to 2	0
Total height of seam	5	3	to 7	5

(Showing variations.)
O. A. Veazey, C. & M. E.

ON PAINT CREEK, PAINT CREEK COLLIERY'S LAND.

	Height.			
	Ft.	In.	Ft.	In.
Roof, slate	..	..	..	..
Coal, soft bituminous	3	6	to 4	0
Slate, or black sand rock	0	2	..	..
Coal	0	5	..	..
Slate	1	3	..	..
Coal, bituminous	1	1	..	..
Slate	0	2½	..	..
Coal	0	2	..	..
Slate	0	3	..	..
Coal	1	6	..	..
Floor, slate	..	..	..	..
Total height of seam	8	6	to 9	..
Total height workable coal, 3 feet 6 inches to 4 feet.				

C. H. Frazer, Esq.

ON KELLEY'S CREEK—J. D. LEWIS' HEIRS LAND.

	Height.	
	Feet.	Inches.
Roof, slate	..	..
Coal, soft bituminous	0	9
Coal, bony	0	2
Coal, soft bituminous	0	6
Slate	0	1
Coal, soft bituminous	0	3½
Slate	0	3½
Coal	8	½
Floor, slate	..	..
Total height of seam	10	1½

4. *Of Middle Kittanning (Cedar Grove) Seam.*

AT CEDAR GROVE MINES.

	Height.	
	Feet.	Inches.
Roof, slate	..	..
Coal	3	6
Fire clay	1	6
Floor, slate	..	..
Total height of coal in seam	3	5

J. G. W. Tompkins, Esq.

AT PEABODY MINES.

	Height.	
	Feet.	Inches.
Roof, sandstone	..	..
Slate	4 to 6	0
Coal	3	0
Total height of coal in seam	3	0

George Connell, Esq.

ON PAINT CREEK, ON WACOMAH MINING CO.'S LANDS—AT PEACH ORCHARD OPENING.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate	..	..
Coal, soft bituminous	3	8
Slate	0	1
Coal, splint	0	5
Coal, cannel	0	7
Total height of seam	4	9

C. H. Frazer, Esq.

CEDAR GROVE SEAM, ON HANSFORD'S LANDS.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate	..	..
Coal, clean	2	6
Coal and fine slate	0	7
Total height of seam	3	1

R. O. Baillie, C. & M. E.

5. *Of Lower Kittanning (Coal Valley) Seam.*

COAL VALLEY SEAM AT ANSTED, GAULEY MOUNTAIN COAL CO.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate	..	..
Coal	0	20
Slate	0	9
Coal	0	22
Slate	0	6
Coal	3	6
Slate	0	5
Coal	2	4
Floor	..	..
Total height of seam	11	10

R. O. Baillie, C. & M. E.

AT POWELLTON MINES (MT. CARBON CO., LIMITED), IN BROWNSTOWN BED.

	HEIGHT.				
	FT.	IN.		FT.	IN.
Roof	..	..		..	..
Top coal	0	3	to	0	6
Coal, gas, and coking	2	6			
Middle slate	0	1	to	2	3
Coal, coking (very fine)	2	0	to	2	3
Total height of seam	4	4	to	7	6

A. M. Campbell, C. & E. M.

At Great Kanawha Colliery Co. Mines.

	Height.					
	Ft.	In.		Ft.	In.	
Roof, slate	..	..		..	..	
Coal	3	0		..	..	
Slate	0	6	to	1	4	
Coal, gas	1	4		..	..	
Slate	0	3	to	0	6	
Slate, niggerhead	0	1	to	0	2	
Coal, gas	3	0		..	..	
Total height of seam	8	2	to	9	4	

Symington MacDonald, Esq.

At Eureka Mines.

	Height.	
	Feet.	Inches.
Roof, slate	..	..
Coal	1	10
Slate	0	1½
Coal, gas	0	5
Slate	0	3
Coal, gas	3	0
Total height of seam	5	7½

M. T. Davis, Esq.

At St. Clair Mines.

	Height.	
	Feet.	Inches.
Roof, slate	..	..
Coal	1	5
Slate	0	1
Coal, gas	2	11
Total height of seam	4	5

M. T. Davis, Esq.

Upper or "Peerless" Bed. At Peerless Mines.

	Height.	
	Feet.	Inches.
Roof, slate	..	..
Draw slate	0	5
Coal, soft bituminous	2	3
Total height of seam	2	3

At Keystone Mines, on Cabin Creek.

	Height.	
	Feet.	Inches.
Roof, slate		
Coal, gas	4	4
Slate	0	1
Coal, gas	0	9
Total height of seam	5	2

R. O. Baillie, C. & M. E.

On Paint Creek Colliery's Land, at Ash Branch.

	Height.	
	Feet.	Inches.
Roof, slate		
Draw slate	0	4
Coal, gas	3	1
Slate floor		
Total height of seam	3	5

C. H. Frazer, Esq.

At Cedar Grove Tunnel Mines.

	Height.	
	Feet.	Inches.
Roof		
Coal	2	4
Slate, niggerhead	0	2
Coal	1	4
Slate, floor		
Total height of seam	3	10

J. G. W. Tompkins, Esq.

Lower, or "Campbell's Creek Bed." At Campbell's Creek C. Co.'s Mines.

	Height.			
	Ft	In.	Ft.	In.
Roof				
Top coal (in some places divided with thin bands of slate)	3	10 to	5	0
Slate	0	3 to	2	6
Bottom coal, gas	1	6 to	2	2
Total height of seam	5	7	9	8

A. M. Campbell, E. M.

Note.—When the coal is large the slate is small; so 9′–8″ is never gotten. The old working averaged 6′–0″; new working 4′–6″.

6. *Of Clarion (Eagle) Seam.*

EAGLE MINES.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate		
Coal	1	2
Shale	0	3
Coal	0	3
Shale	0	3
Coal	2	10
Total height of seam	4	9

I. C. White, Esq.

ST. CLAIR MINES.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate		
Coal	1	2
Slate	0	1
Coal	0	1
Slate	0	4½
Coal	2	10
Total height of seam	4	7

M. T. Davis, Esq.

SECTION IV.

Vertical Cross-Sections of New River District Coal Seams, No. XII Measures.

NUTTALL OR SEWELL (NO. 3 SEAM), AT NUTTALLBURGH MINES.

	HEIGHT.	
	FEET.	INCHES.
Roof		
Draw slate	0	8
Blue slate and sand rock	2	0
Coal	2	10 to 5 ft.
Floor, slate		
Total height of coal in seam	2 ft.	10 in. to 5 ft.

W. L. Nuttall, Esq.

AT ECHO MINES.

	HEIGHT.			
	FT.	IN.	FT.	IN.
Roof, slate			to	
Fire clay	2	0	to 0	6
Floor, hard bluestone	4	4	to 4	6
Total height of coal in seam, showing variations	4	2	to 4	6

1¾ of coal from bottom up hard, ¼ of coal at top hard.
Altitude above New River, 850 feet.
Altitude above sea level, 1,850 feet.

Jo. L. Beury, Esq.

Fire Creek (No. 2) Seam, at Fire Creek Mines.

(1)	Height.	
	Feet.	Inches.
Roof, slate		
Coal	3	0 to 5 ft.
Total height of coal in seam	3	.. to 5 ft.

Stuart M. Buck, C. & M. E.

(2)	Height.			
	Ft.	In.	Ft.	In.
Roof, sandstone	..	..	to ..	..
Slate	5	0	to 6	0
Coal	3	0	to 5	0
Floor, hard bluestone	2	0	to 2	6
Total height of coal in seam, showing variations	3	0	to 5	0

Top of bed hard coal, bottom softest.
Altitude above New river, 630 feet.
Altitude above sea level, 1,630.

Jo. L. Beury, Esq.

Quinnimont (No. 1) Seam, at Quinnimont Mines.

	Height.	
	Feet.	Inches.
Roof		
Coal	1	0
Slate	0	3
Coal	2	0
Slate	0	2
Coal	1	0
Total height of seam	4	5

I. C. White, U. S. Geo. Rep.

At Echo Mines.

	Height.			
	Ft.	In.	Ft.	In.
Roof, sandstone	..	..	to ..	..
Slate	6	0	to 0	0
Coal	3	0	to 10	0
Floor, fire clay	2	6		
Total height of coal in seam, showing variations	3	0	to 10	0

⅔ of coal bed from bottom up hard, ⅓ on top soft.
Altitude above New river, 550 feet, and 1,550 above the sea level.

Jo. L. Beury, Esq.

SECTION V.

Vertical Cross-Sections of Upper Elk River and Gauley River District (Webster Co.) Coal Seams, No. XII Measures.

1. *On Elk River.*

Fire Creek (probably) Seam.

AT ELK RIVER AND BERGOO, ON CHAS. PRATT'S LAND.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate		
Coal, coking bituminous Coal	4	8
Coal, bony	0	4
Total height of seam	5	0
Slate	2	0
Coal, coking, bituminous	1	11
Floor, slate		

Altitude above Elk river, 800 feet.

C. H. Frazer, Esq.

AT ELK RIVER AND DEEP RUN, ON ADAM COGER'S LAND.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate		
Coal, coking, bituminous	5	4
Floor, slate		
Total height of seam	5	4

Altitude above Elk river, 825 feet.

C. H. Frazer, Esq.

2. *On Gauley River.*

GAULEY RIVER AND HUGHES RUN, ON CHAS. PRATT'S LAND.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate		
Coal, coking, bituminous Coal, soft	4	2
Total height of seam	4	2

Altitude above Gauley river, 310 feet.

C. H. Frazer, Esq.

AT GAULEY RIVER AND MILL RUN, ON CHAS. PRATT'S LAND.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate		
Coal, coking, bituminous Coal Coal	4	0
Total height of seam	4	0

Altitude above Gauley river, 300 feet.

C. H. Frazer, Esq.

AT SOUTH SIDE GAULEY RIVER, ON J. N. CAMDEN'S LANDS.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate		
Coal, coking, bituminous	4	3
Floor, slate		
Total height of seam	4	3

Altitude above Gauley river, 300 feet.

C. H. Frazer, Esq.

AT SOUTH SIDE GAULEY RIVER, ON J. N. CAMDEN'S LANDS.

	HEIGHT.	
	FEET.	INCHES.
Roof, slate		
Coal, coking, bituminous. Coal Coal	4	5
Total height of seam	4	5

Altitude above Gauley river, 280 feet.

C. H. Frazer, Esq.

SECTION VI.

Vertical Cross-Sections of Flat Top Mountain District Coal Seams, No. XII Measures.

NO. V SEAM, OPENING ON CRANE CREEK.

	HEIGHT.	
	FEET.	INCHES.
Roof		
Coal	0	2
Shales	2	6
Coal	2	4
Shales	0	6
Coal	1	8
Total height of seam	7	2

I. C. White, U. S. Geo. Rep.

No. IV Seam, Opening on Crane Creek.

	Height.	
	Feet.	Inches.
Roof	..	..
Coal	3	0
Shale	2	0
Coal and slate	1	0
Total height of seam	6	0

I. C. White, U. S. Geo. Rep.

No. III Seam, "Pocahontas" Bed. At Pocahontas Mines.

	Height.	
	Feet.	Inches.
Roof, sandstone	..	..
Roof of mines. Slate	0	6
Roof of mines. Coal	1	0
Roof of mines. Sulphur band	0	1
Coal (portion of seam worked)	9	0
Floor of mines. Slate	0	3
Floor of mines. Coal	1	0
Floor, fire clay	..	..
Total height of seam	11	10

C. E. F. Burnley, C. & M. E.

At Pocahontas Mines, Coal Branch Opening.

	Height.	
	Feet.	Inches.
Roof, slate, and sandstone	..	..
Coal, bony	0	8
Coal, with irregular thin slate streaks	4	8
Slate	0	½
Coal	6	0
Slate	0	3
Coal	1	8
Floor, slate	..	..
Total thickness bed	12	7
Total thickness to be mined	11	8

A. S. McCreath, C. & M. E. (after Lathrop).

At Maybeury Mines, on Elk Horn River.

	Height.	
	Feet.	Inches.
Roof, slate	..	..
Coal	1	0
Sulphur band	0	2
Coal	2	0
Bone coal	0	2
Coal	2	6
Bone coal	0	2
Coal	2	6
Floor, slate	..	..
Total height of seam	8	6

Stuart M. Buck, C. & M. E.

On Crane Creek.

	Height.	
	Feet.	Inches.
Roof	..	..
Coal	2	6
Shale	5	0
Coal	6	0
Total height of seam	13	6

I. C. White, U. S. Geo. Rep.

On North Side Guyandotte River, Four Miles Above Pineville, Wyoming County.

	Height.	
	Feet.	Inches.
Roof, sandstone	..	..
Coal	4	4
Total height of seam	4	4

M. A. Miller, C. & M. E.

CHAPTER IV.

TABLES EXHIBITING CHEMICAL ANALYSES

Of Great Kanawha, New River, Upper Elk and Gauley, and Flat Top Coals, Nos. XV, XIV, XIII, and XII Measures, and in comparison with other Bituminous Coals.

The following tables demonstrate the general chemical excellence of the coals of West Virginia as mined in the Great Kanawha, New river, and Flat Top districts.

In percentage of fixed carbon, low percentage of ash, and almost total freedom from sulphur, the splint coals of the Freeport and Upper Kittanning seams, as worked in the Great Kanawha field, are unexcelled either by the famous coals of the Briar Hill or Erie mines, which they much resemble in physical hardness, or by the coals of the Pittsburgh and Youghiogheny districts in Pennsylvania.

In percentage of volatile matter and gas-producing power, the coals of the Paint creek gas bed in the Lower Freeport seam and the gas coals of the Upper or Peerless Bed of the Lower Kittanning are of the highest order.

In high percentage of fixed carbon and minimum of ash and freedom from sulphur, the coals of the New river and Flat Top fields yield superiority to neither the coals of the Connellsville nor Cumberland districts.

TABLE I.

Beds of Coal worked and Analyses of Coals.

NOS. XV AND XIV MEASURES, KANAWHA FIELD.

		NAME OF MINES.	WATER.	FIXED CARBON.	VOLATILE MATTER.	SULPHUR.	ASH.	AUTHORITY.	REMARKS.
Upper or No. XV Measures.	Pittsburgh Seam.	Raymond City mines.	.....	.....	.....	.....	.....	.....	Splint, hard.
		Energetic.	.....	.....	.....	.....	.....	.....	Splint, hard.
		Queen City.	.....	.....	.....	.....	.....	.....	Splint, hard.
		Plymouth.	.....	.....	.....	.....	.....	.....	Splint, hard.
	Mahoning Bed.	North Coalburgh.	.....	.....	.....	.....	.....	.....	Splint, hard.
Upper Barren or No. XIV Measures.	"Upper Cannelton."	Cannelton No. 5 seam.	.....	.....	.....	.....	.....	.....	Splint, rather hard.
		Eureka.	.....	.....	.....	.....	.....	.....	Splint, rather hard.

TABLE II.

Beds of Coal worked, and Analyses of Coal.

No. XIII Measures, Great Kanawha Field, and Comparison with Analyses of other Standard Coals.

Penn. Name of Seam.	Local Name of Seam.	Name of Mine Worked.	Chemical Analysis. Water.	Fixed Carbon.	Volatile Matter.	Sulphur.	Ash.	Authority.	Remarks. Average Height of Seam.	Class of Coal.
Upper Freeport.	Crown Hill or Belmont.	Crown Hill mines.	2 14	62 61	33 26	0 18	1 81	Dewey, Vance & Co.	4 feet.	Splint hard.
		Belmont mines.	.....	...	.. ..	.....	.....	.....	.....	.....
		Coalburgh mines, upper seam.	.....	.....	...	.....	.....	.....	.....	.....
Lower Freeport.	Coalburgh.	Coalburgh mines, lower seam.	3 65	62 00	33 50	0 35	1 50	D. G. M. Levette.	4 to 5 ft.	Splint hard.
		Paint Creek Colliery.	... ..	63 74	30 13	.....	6 13	R. O. Doremus.	10 to 13 ft.	"
		Paint Creek colliery, lease No. 7.	1 54 1 84	57 07 60 77	39 36 36 26	....	2 03 1 13	P. B. Wilson.	9 feet.	Gas.
		Acme mines, C. Creek.	1 930 1 665	57 900 53 225	37 09 41 36	0 62 0 80	3 08 3 75	E. L. Howard, U. S. Geo. Sur. Shaler.	Top. Basin. Bottom. Basin. 5 feet.	"
		Black Band mines.	2 24	57 48	38 58	... .	1 70	R. M. Byrnes.	3 to 3½ ft.	Splint hard.
Upper Kittanning.	Winifrede or Kanawha Mining.	Winifrede mines.	1 36	58 73	36 33	0 36	2 72	Winifrede Coal Co.	4 to 5 ft.	Splint.
		Kanawha Mining Co.'s mine.	....	.....	.....	.....	.....	.....	.....	.....
		Consolidated Mining Co.'s mine.	.....	.....	... ..	.....	.....	.....	4 to 5 ft.	Bituminous, hard.
		Union mines.	.....	.....	.....	.....	....	.....	4 to 5 ft.	"
		Chesapeake Coal Co.'s mines.	.... .	.....	.....	.....	.....	.....	6 to 7 ft.	"
		Peele Coal Co's mines.	1 75	57 78	35 34	.....	5 13	Arthur R. Otter.	4 to 5 ft.	"
Middle Kittanning.	Cedar Grove.	Cedar Grove mine.	.....	59 144 60 67	38 35 36 83	.. ..	2 506 2 50	Hy. Froeling.	... .	.....
		Cedar Grove Pure Coal Co.	.....	61 27	36 83	....	1 80	Kelleys Creek Coal Co.	.....	.....
		Peabody mines.	.....	.....	.....	.....	....	.....	.....	.....
		Lower Blacksburgh.	.....	.....	.....	.. ..	.....	.....	.....	.....
		East Bank lower seam.	.....	.....	.. ..	.. ..	.....	.....	.... ..	.....
		Carkin mines.	.....	.....	.....	.....	.....	.....	.....	.....

TABLE II.—*Continued.*

Penn. Name of Seam.	Local Name of Seam.	Name of Mine Worked.	Chemical Analysis. Water.	Fixed Carbon.	Volatile Matter.	Sulphur.	Ash.	Authority.	Remarks. Average Height of Seam.	Class of Coal.
Lower Kittanning.	Powellton, Coal Valley, Peerless, Campbell's Creek.	Average Kanawha gas coals.	1 25	56 26	37 36	1 28	3 85	C. & O. Coal Agency.	.....	.....
		Gauley Mt. C. Co.'s mines.	1 40	64 00	32 60	0 232	2 00	W. N. Page.	7 feet.	.....
		Powellton mines.	0 94	61 75	34 91	0 164	2 40	Hy. Froeling.	5 feet.	Steam coking coals.
		Great Kanawha Colliery Co.	0 62	58 43	38 48	0 56	1 91	Hy. Froeling.	.....	.....
			1 14	59 89	34 61	0 81	4 36	A. S. McCreath.	5 feet.	"
			1 20	61 967	33 91	0 648	2 355	Hy. Froeling.	.....	"
		Faulkner's mines.	.....	.....	.....	.....	.....	.....	.....	"
		Crescent mines.	.....	59 10	36 72	1 27	2 91	J. W. Mallett.	5 feet.	"
		Eureka mines.	.....	.....	.....	.....	.....	.....	.....	"
		Carver Bros. mines.	.....	.....	.....	.....	.....	.....	.....	"
		Keystone mine, Cabin Cr'k.	1 34	56 42	38 09	1 68	4 15	S. P. Sharpless.	4 feet.	Bituminous, soft fine gas coals.
		Peerless mines.	1 442	55 416	39 822	0 784	2 536	A. S. McCreath.	30 in.	"
		Black Peerless mines.	0 90	58 62	38 05	0 775	2 43	F. P. Dewey, U. S. Gov't.	30 in.	"
		Campbell Creek.	1 51	61 07	35 64	0 37	1 21	River Side Iron Co.	6 feet.	Bituminous, hard.
		Pioneer mines.	.....	.....	.....	.....	.....	.....	.....	"
Clarion.	Eagle.	Eagle mines.	2 35	70 47	22 90	1 78	2 50	Wm. Wyant.	5 feet.	Bituminous, coking.
		St. Clair mines.	.....	.....	.....	.....	.....	.....	.....	Coking.
		Black Diamond mines.	.....	.....	.....	.....	.....	.....	.....	Coking.
Penn., Ohio, Indiana.		Average Pittsburgh, Pa.	1 30	61 45	31 45	0 86	5 80	Penn. Ry. Co.	.....	Splint.
		West Moreland.	1 430	55 891	36 145	0 439	5 595	A. S. McCreath.	.....	Block, splint, hard.
		Briar Hill, Ohio.	3 60	62 66	32 58	0 85	1 16	Wormly	.....	.....
		Indiana, (Staabs).	1 86	58 23	37 11	.....	2 80	Dela Fontaine.	.....	"
		Average Hocking Valley, Ohio.	6 95	51 30	36 15	0 668	5 56	C. & H. V. C. & I. Co.	.....	.....
		Av. 10 mines.	5 93	52 41	36 48	1 09	5 13	Edw. Orton.	.....	.....
English.		Clyde, Splint, England.	.....	59 00	36 80	.....	4 20	Mushet.	.....	.....
		Worsboro, Yorkshire, England.	.....	60 32	38 18	.....	1 50	Mushet.	.....	.....

ANALYSIS OF COAL OF "UPPER FERGUSON SEAM," TWELVE POLE DISTRICT.

WATER.	FIXED CARBON.	VOLATILE MATTER.	SULPHUR.	ASH.	AUTHORITY.
3 45	51 35	38 70	1 92	6 50	Hy. Froeling.

TABLE III.

Beds of Coal Worked and Analyses of Coals.

No. XII Measures, New River and Flat Top Fields, and Comparison with Analyses of other Standard Coals.

District.	Name of Seam.	Name of Mine Worked.	Chemical Analysis. Water.	Fixed Carbon.	Volatile Matter.	Sulphur.	Ash.	Authority.	Remarks.
New River Field.	Nuttall or Sewell Seam No. 3.	Nuttallburgh mines.	1 35	70 67	25 35	0 57	2 10	Prof. Eggleston.	All steam and coking coals.
			0 34	69 00	29 59	0 78	1 07	C. E. Wright.	.....
		McKell's lands, New river.	0 52	75 80	21 83	0 37	1 85	Hy. Froeling.	....
	Fire Creek Seam No. 2.	Fire creek mines.	0 61	75 02	22 34	0 56	1 47	Prof. Rickette.	.....
			0 735	75 499	22 425	0 536	0 805	A. S. McCreath.	.....
			0 40	72 25	22 40	0 508	4 95	Hy. Froeling.	.....
	Quinnimont Seam No. 2.	Quinnimont mines.	0 76	79 29	18 65	0 23	1 11	Prof. Eggleston.	....
		New River C. & Coke Co.	0 668	70 657	26 642	0 498	1 535	A. S. McCreath.	.....
		McKell's lands.	0 97	74 45	21 48	0 316	3 10	Hy. Froeling.	.....
		Pratt's lands, Elk Basin, Webster Co. (outcrop).	0 95	68 20	29 40	0 556	1 45	Hy. Froeling.	....
Flat Top Field.	No. 5, 6, and 7 seams.	East Fork, Flipping creek, No. 6 seam.	0 568	77 335	19 337	0 800	1 960	A. S. McCreath.	....
		West Fork, Flipping creek, No. 5 seam, outcrop.	7 360	76 077	18 936	0 793	3 405	A. S. McCreath.	.....

TABLE III.—*Continued.*

District.	Name of Seam.	Name of Mine Worked.	Chemical Analysis.					Authority.	Remarks.
			Water.	Fixed Carbon.	Volatile Matter.	Sulphur.	Ash.		
Flat Top Field.	Pocahontas or No. 3 seam.	Average 10 samples, Flat Top coal.	0 694	74 066	18 832	0 761	5 647	A. S. McCreath.	.....
		Average 8 samples, No. 3 bed.	0 698	73 406	18 756	0 752	6 388	A. S. McCreath.	.....
		Nelson opening.	7 50	75 833	19 584	0 531	3 302	A. S. McCreath.	.....
		East mine.	0 684	73 021	19 964	0 656	5 675	A. S. McCreath.	.....
		West Fork, Flipping creek.	0 516	74 272	17 639	0 998	6 575	A. S. McCreath.	.....
		Crane creek.	0 600	76 833	18 020	0 662	3 925	A. S. McCreath.	.....
		Pinnacle creek outcrop, average.	1 366	74 625	17 434	0 575	5 950	A. S. McCreath.	.....
Pennsylvania.		Connellsville.	1 26	59 61	30 10	0 78	8 23	Vol. G, II Pa. Geol. Reps.	.....
			1 338	70 073	22 122	0 652	5 815		
		Clearfield.	1 666	67 538	22 299	1 422	7 575	A. S. McCreath.	.....
			1 054	70 199	22 081	0 726	5 940		
Maryland.		Cumberland.	0 942	73 154	18 403	0 806	6 695	A. S. McCreath.	.....
			0 974	72 261	19 876	0 769	6 120		
		Broad Top.	0 594	71 334	17 551	0 976	9 545	A. S. McCreath.	.....

CHAPTER V.

EXHIBITING TABLE SHOWING COMPARATIVE GAS YIELDING POWER

Of Great Kanawha Coals, No. XIII Measures, and in comparison with other Coals.

It will be observed that the coal of the Lower Freeport (Coalburgh) seam, as developed at the Acme mines, on Cabin creek, there changes its character from a hard splint, with low gas yielding power, and becomes a coal softer in quality and more highly charged with bitumen and of high gas yielding capacity, giving 6.35 cubic feet of gas to one pound of coal. This same change in the general character of the coal in this seam is also observed upon Paint creek, where, upon the Nos. 5 and 7 Leases of the Paint creek Colliery, a bed of cannel coal appears underlying the thinned bed of splint coal, and then itself thins out and is replaced by a coal very rich in bitumen, the whole seam apparently being affected by this change, and becoming a coal high in percentage of volatile matter—39.36 per cent—and gas yield. And it is not improbable that in this seam, under further development, will yet be opened up one of the chief gas coal beds of the Great Kanawha field.

The Middle Kittanning (Cedar Grove) seam is also credited with value as a gas producer, yielding by analysis 38.35 per cent volatile matter.

It is from the Lower Kittanning (Coal Valley and Peerless) seam, however, that the chief gas coal product of the Great Kanawha field has long been taken. And the coals, as mined at Great Kanawha colliery, Powellton, Crescent, Coal Valley, etc., have long ranked in market with the first grades of the Pennsyl-

vania and Maryland mines, one pound of coal from the seam at Powellton yielding 5.18 cubic feet of gas of 19.00 candle power. The portion of this seam known as the Upper or "Peerless" bench, where now mined at Peerless and Black Peerless, Beane, and Keystone mines, has won especial attention for its remarkable record as a gas producer; the coals showing by analysis 38.00, 38.09, and 39.82 per cent volatile matter, and by test 5.79, 5.14, and 4.91 cubic feet of gas of 18.36 and 17.00 candle power per pound of coal.

This Upper or "Peerless" bed of the Lower Kittanning seam, separated from the lower bed of the seam by widely dividing sandstones and shales, has been extensively opened and traced along both Cabin and Paint creek valleys, and, lying at low altitude in the mountains, there constitutes a very great area of coal accessible to profitable working.

In comparison with either the coals of English New Castle, or Nova Scotia, the yield of gas per pound of coal is favorable to the West Virginia coal, while the yield of 6.35 cubic feet of gas per pound of coal of the Acme mines is only exceeded by the cannels or the product of Boghead, Scotland.

TABLE

Exhibiting Comparative Candle Power and Gas yielding Power Kanawha Coals.

	Penn. Name of Seam.	Name of Mine.	Yield of Cubic Feet of Gas per lb. of Coal.	Candle Power of Gas per lb. of Coal.	Candle Feet per lb. of Coal.	Authority Reported by.
West Virginia.	Upper Freeport.	Cannelton.	5 00	64 54	.....	Manhattan G. L. Co., N. Y.
	Freeport.	Peytona, Boone county.	6 60 6 01	42 79 45 60	.....	" " "
	Lower Freeport.	Acme mines on Cabin creek, Kanawha.	6 35	17 09	419 10	Cincinnati, O., Gas Works.
	Lower Freeport.	Acme mines on Cabin creek, Kanawha.	6 25	19 00	.....	Consolidated Gas Works, New York, City.
	Upper Kittanning.	Winifrede mines.	4 62	14 10	65 14	Winifrede Coal Co., tests (a domestic, not a "gas coal.")
	Middle Kittanning.	Cedar Grove mines, Kanawha county.	.....	.....	....	.....
	Lower Kittanning.	Keystone mines, Cabin creek, Kanawha.	4 91	18 36	.....	Laclede Gas Co., St. Louis, Mo.
	Lower Kittanning.	Peerless mines.	5 79 5 14	14 75 17 00	61 00	Cincinnati Gas Works. Richmond, Va., Gas Works.
		Powellton mines, Armstrong creek, Fayette county.	5 18	19 00	.....	One ton coal yields light equivalent to 7557 lbs. spermaceti. A. S. McCreath.
	Lower Kittanning.	Gauley Mt. C. Co. mines, Fayette county.	5 00	17 00	.....	Manhattan Gas Co., New York City.
	Lower Kittanning and Clarion seams.	Kanawha gas coals.	4 75 4 80	18 00	.....	Average yield Kanawha gas coals, Chesapeake & Ohio coal agency.

TABLE.—*Continued.*

	Name of Mine.	Yield of Cubic Feet of Gas per Lb. of Coal.	Candle Power of Gas per Lb. of Coal.	Candle Feet per Lb. of Coal.	Authority Reported by.
Pennsylvania.	Westmoreland.	5 32	16 62	.....	Prof. Chandler.
Pennsylvania.	Penn. Gas Co.	4 92	....	.....	Prof. Cresson.
Ohio.	Sterling.	5 26	18 81	.....	Prof. Chandler.
England.	Newcastle.	5 02	10 11	.....	Fyfe.
Scotland.	Boghead.	7 71	.....	.....	Fyfe.
Nova Scotia.	Lingan.	4 76	12 92	....	Prof. Chandler.
Nova Scotia.	Block House, Cape Breton.	5 10	17 32	.. ..	

CHAPTER VI.

EXHIBITING TABLES SHOWING STEAM PRODUCING POWER

Of coals of Nos. XIII and XII Measures, as demonstrated by United States Government tests.

The following tables of individual and comparative tests of the steam producing power of the coals of the Upper Freeport (Crown Hill) seams of the XIII Measures, from the Great Kanawha District, and of the coals of the No. XII Measures, as taken from the New River District, are of especial interest, since the trials made of these coals, and coals from many different fields, were under like conditions, and by presumably impartial judges.

Observation of Table I shows that under like conditions both the Kanawha and the New river coals yielded the maximum results.

Observation of Table II shows the coals of the No. XII Measures, as taken from the New river field, to have yielded a superior result to any other in capacity of water evaporation.

TABLE I.

The following table is an accurate statement of tests of average New river coal, No. XII Measures, and of coal from the Great Kanawha field, No. XIII Measures, taken from the Upper Freeport, or Crown Hill seam, at Crown Hill mines, compared with the Frostburgh and average anthracite coals from North-east Pennsylvania.

The tests were made by the United States Navy Department, Bureau of Steam Engineering, under supervision of B. F. Isherwood, Theo. Zeller, Henry L. Snyder, chief engineers, as reported by William H. Shack, Chief of Bureau of Steam Engineering, 1878, page 27.

TABLE SHOWING COMPARATIVE STEAM PRODUCING POWER OF NEW RIVER, KANAWHA, (UPPER FREEPORT SEAM), AND FROSTBURG ANTHRACITE AND COALS, AS BY REPORT OF BUREAU STEAM ENGINEERING U. S. NAVY.

K M N O P L	R S T	G H I	C D E	DESIGNATION OF THE EXPERIMENT.					
Anthracite coal (Penn).	Frostburg semi-bituminous coal.	Kanawha splint coal, (Upper Freeport, Crown Hill seam).	New River bituminous coal.	KIND OF COAL.					
Slow. Medium. Maximum.	Slow. Medium. Maximum.	Slow. Medium. Maximum.	Slow. Medium. Maximum.	RATE OF COMBUSTION.					
7 7905 10 5798 12 9531	7 8199 11 6340 13 9875	7 8715 12 9767 21 2153	7 9896 13 0334 14 3664	POUNDS OF THE CRUDE COAL.	RATE OF COMBUSTION PER HOUR PER SQUARE FOOT OF GRATE SURFACE.				
6 611 8 978 10 992	6 858 10 203 12 267	7 4025 12 2042 19 9524	7 4809 12 2036 13 4517	POUNDS OF THE GASIFIABLE PORTION OF THE COAL.					
9 9923 9 9923 9 9923	10 3361 9 9357 9 6912	9 9800 9 4806 7 5824	10 9595 10 2023 10 1386	PER POUND OF CRUDE COAL.	POUNDS OF WATER VAPORIZED FROM THE TEMPERATURE OF 212 DEGREES FAHRENHEIT AND UNDER THE STANDARD ATMOSPHERIC PRESSURE.				
11 7751 11 7751 11 7751	11 7858 11 8292 11 0506	10 6117 10 0807 8 0623	11 7047 10 8960 10 8280	PER POUND OF THE GASIFIABLE PORTION OF THE COAL.					
559 5688 559 5688 559 5688	558 1494 536 5278 523 3248	474 0500 450 3285 360 1640	594 2756 497 3621 494 2567	PER CUBIC FOOT OF THE CRUDE COAL.					
3335 36 3171 50 2882 96	2424 93 3467 69 4066 80	2356 60 3690 79 4825 90	2626 86 3889 14 4369 67	POUNDS OF STEAM PRODUCED PER HOUR.					
15 1402 15 1402 15 1402	12 3005 12 3005 12 3005	5 9528 5 9528 5 9528	6 3670 6 3670 6 3670	PERCENTUM OF THE COAL IN REFUSE OF ASH, CLINKER, AND SOOT.	WEIGHTS OF THE COALS.				
56 00 56 00 56 00	54 00 54 00 54 00	47 50 47 50 47 50	48 75 48 75 48 75	WEIGHT OF THE COAL IN POUNDS PER CUBIC FOOT.					
40 000 40 000 40 000	41 4815 41 4815 41 4815	47 1579 47 1579 47 1579	45 9487 45 9487 45 9484	CUBIC FEET OF SPACE REQUIRED TO STORE ONE TON OF COAL.					

TABLE II.

SHOWING THE COMPARATIVE EXCELLENCE OF BITUMINOUS COALS AS STEAM PRODUCERS.

Taken from Report of Board of Officers appointed by United States Navy Department, June 19, 1884, "to investigate and report comparative merits of anthracite and bituminous coals for ordinary naval uses," the board being composed of the following gentlemen: S. B. Luce, Commodore, U. S. N.; D. B. Harmony, Captain, U. S. N.; Chas. H. Baker, Chief Engineer, U. S. N.; Fred. G. McKeon, Chief Engineer, U. S. N.; C. F. Goodrich, Lieutenant Commander, U. S. N. Reported January 5, 1885.

MARKET DESIGNATION OF COAL.	KIND OF COAL.	PERCENTAGE OF COMBUSTIBLE IN COAL.	PERCENTAGE WATER EVAPORATED PER POUND OF COAL.
New river	Bituminous	93 6000	10 2023
Frostburg	Semi-bituminous	87 7000	9 9357
Cumberland	Semi-bituminous	86 6700	10 0200
Broad Top	Semi-bituminous	86 1200	9 9940
Pittsburgh	Bituminous	91 7470	8 2044
Lacawanna	Anthracite	91 0723	
Newcastle, England	Bituminous	94 3205	8 6558
Average 37 samples, Welsh coals	Bituminous and semi-bituminous		9 0500
Average 17 samples, English coals, Newcastle	Bituminous		9 1683

CHAPTER VII.

TABLES SHOWING CHEMICAL ANALYSES AND PHYSICAL TESTS OF COKES

Of Great Kanawha, No. XIII Measures, New river and Flat Top, No. XII Measures, and in comparison with cokes of Pennsylvania, etc., Alabama, Tennessee, and Europe.

Observation of Table I, showing comparative chemical analyses of cokes, is striking in the uniformly higher percentages of fixed carbon contained by the cokes of the West Virginia fields, as compared with the celebrated cokes of the Connellsville region and average Pennsylvania product, also in their uniformly lower percentages of ash and sulphur.

These cokes show in strong contrast with the leading cokes of Tennessee, Georgia, and Alabama, excelling them in higher percentage of fixed carbon, freedom from water, and greatly lower average percentages of ash and sulphur and freedom from phosphorus.

Compared with the cokes of English Bromney and Belgian Mons Basin, the best cokes of Europe, they average higher in percentages of fixed carbon, and run about with them in percentages of ash.

Observation of Table II shows these cokes to rank with the Connellsville and other superior cokes in percentages of coke cells and hardness.

TABLE I.

Showing Chemical Analyses of Cokes.

GREAT KANAWHA AND NEW RIVER AND FLAT TOP MOUNTAIN FIELDS, NOS. XIII AND XII MEASURES, AND COMPARED WITH ANALYSES OF OTHER STANDARD COKES.

LOCALITIES.		MINE OR SEAM.	MOISTURE.	FIXED CARBON.	VOLATILE MATTER.	ASH.	SULPHUR.	PHOSPHORUS IN ASH.	AUTHORITY.
Great Kanawha No. XIII Measures.		Cedar Grove seam.	.....	95 02	.....	4 40	0 58	....	M. A. Scoville.
		Powellton mines,	1 10	93 25	1 50	5 15	.....	.....	Hy. Froeling.
		(L. Kittanning seam.)	0 446	93 015	1 130	5 409	.....	....	A. S. McCreath.
		Great Ka. Colliery Co. (Lower Kittanning.)	. ..	95 862	... .	3 623	0 515	.....	A. S. McCreath.
		Crescent mines Lower Kittanning.	.....	90 31	1 77	7 92	0 594	.....	J. W. Mallett.
		Eagle and St. Clair mines (Clarion seam).	.....	90 48	....	9 00	0 500	....	Porter and Going.
		East Bank mines (Lower Kittanning).	.....	89 95	.....	9 13	0 378	.....	H. V. C. & I. Co.
New River, No. XII Measures.	Sewell, Nuttallburgh or No. 3 Seam.	Nuttallburgh	.....	92 220	...	7 530	0 910	.....	C. E. Dwight.
		mines and seam	0 82	91 96	2 20	5 02	0 453	0 015	Henger & Wickham.
		or Sewell mines and seam.	.....	93 000	.....	6 760	0 270	.....	C. E. Dwight.
		Echo mines.	0 290	97 710	0 14	1 860	0 569	.....	J. B. Britton.
		Caperton mines.	0 230	94 620	0 240	4 910	0 549	.....	J. B. Britton.
	Fire Creek or No. 2 Seam.	Fire creek	.....	92 180	.....	6 680	0 618	.....	J. B. Britton.
		mines and seam.	0 105	91 940	0 492	6 925	0 538	.....	A. S. McCreath.
	Quinnimont or No. 2 Seam.	....	0 128	88 940	2 800	6 980	0 520	0 028	Heager & Wickham.
		Stone Cliff mine.	0 060	89 660	2 680	6 600	0 662	0 017	Heager & Wickham.
		Quinnimont mines and seam.	.....	93 850	.....	5 850	0 300	.....	J. B. Britton.
		Echo mines.	1 410	92 730	0 710	5 150	0 581	0 020	Heager & Wickham.
Meadow Creek No. 1 Seam.		Meadow creek mines.	... .	.....	.. ..	.. ...	....	.....	.....

TABLE I.—*Continued.*

Localities.	Mine or Seam.	Moisture.	Fixed Carbon.	Volatile Matter.	Ash.	Sulphur.	Phosphorus in Ash.	Authority.
Flat Top Mt. No. XII Measures.	Pocahontas or No. 3 seam.	0 182	92 248	0 719	6 286	0 565	.....	McCreath and d'Invilliers.
	Pocahontas mines.	0 196	92 585	0 494	6 048	0 677	...	"
	Stephenson and Mohler No. 3 seam.	0 663	92 816	1 059	4 913	0 548	.....	"
Pennsylvania Districts, Connellsville.	Bradford.	.....	89 576	....	9 113	0 821	....	A. S. McCreath.
	Caperton.	....	89 150	....	9 650	1 200	....	B. Crowther.
Irwins.	Penn. Gas Co.	....	88 240	....	9 414	0 962	...	Carnegie B. & Co.
Alleghany Mountain.	Bennington B.	....	87 580	.....	11 360	1 060	....	A. S. McCreath.
Blossburgh.	Arrot Seymour seam.	....	84 760	.....	13 345	0 998	....	"
Alleghany river.	Lower Freeport seam.	.....	85 777	.....	11 463	2 107	.....	"
Beaver county.	Holmes and Bro.	.....	84 727	....	12 630	1 994	.....	"
Alabama. Pratt Coal Bed.	P. R. & R. Co. mines.	0 192	88 875	0 758	8 993	1 182	....	McCreath and d'Invilliers.
Warrior Coal Field.	Sloss Furnace.	0 130	86 478	1 130	11 203	1 049	.. .	"
.....	Woodward mines.	0 180	89 164	0 640	9 346	0 670	.....	"
.....	Coalburgh mines.	0 128	84 678	0 685	12 630	1 899	.....	"
Georgia.	Dade mines.	0 542	75 911	1 091	21 756	0 670	....	"
Tennessee.	Soddy mines.	0 172	86 823	1 098	15 780	2 127	....	"
	Etna mines.	0 856	85 450	1 100	11 083	1 451	....	"
	Daisy mines.	0 218	70 830	1 055	16 756	2 132	.....	"
European. England, Durham.	Bromney.	.....	91 580	.....	6 86	....	...	L. L. Bell.
Belgium.	Mons basin.	.....	91 300	.....	6 20	.....	...	M. De Maisilly.
Germany.	Westphalia.	.....	85 060	.....	0 400	...	....	Dr. F. Mueck.

TABLE II.

Showing Physical and Chemical Properties of Cokes.

GREAT KANAWHA, No. XIII MEASURES, NEW RIVER AND FLAT TOP, No. XII MEASURES, IN COMPARISON WITH PENNSYLVANIA, MARYLAND, ILLINOIS AND ALABAMA COKES (ARRANGED AFTER HOTCHKISS).

LOCALITY.		West Va. Coke.	Kanawha L. Kit'ng Powellton mines.	New River.	Connellsville, Pa.	Broad Top Md.	Clearfield Pa.	Cumberland, Md.	Ala.	Illinois.
GRAMMES IN ONE CUBIC INCH.	DRY.	13 76	14 16	15 30	12 46	11 76	14 70	12 76	13 30	11 06
	WET.	21 19	22 93	23 39	20 25	20 18	19 86	21 63	18 29	17 00
POUNDS IN CUBIC FOOT.	DRY.	52 41	58 88	58 31	47 47	44 81	56 35	48 61	50 70	42 02
	WET.	81 56	87 33	89 12	77 15	76 88	76 69	82 41	69 01	65 09
PERCENTAGE.	C'KE.	61 32	46 48	65 42	61 53	58 27	74 45	58 99	73 17	63 79
	C'LS	35 67	53 52	34 58	38 47	41 73	25 57	41 01	26 28	36 21
COMPRESSIVE STRENGTH PER CUBIC INCH, ¼ ULTIMATE STR.		258	381	335	284	240	319	215	225	180
H'T OF FUR'CE, CH. SUP'D WITHOUT CRUSHING.		103	152	134	114	96	128	86	87	70
ORDER IN CELLULAR SPACE.		1	1 25	1 25	1	1	1	1½	1	1
HARDNESS.		3 15	3 00	2 80	3 50	3 35	3 60	3 00	3 50	3 20
SPECIFIC QUANTITY.		....	1 86	1 73	1 500	1 342	1 560	1 750	1 493	215
FIXED CARBON.		92 18	91 48	91 11	89 57	89 28	89 86	.....	.....	89 77
MOISTURE.		0 11	0 1177	0 51	0 30	.....	0 54	.....	.....	0 12
ASH.		6 68	7 548	7 02	9 11	8 66	9 41	.....	.....	9 58
SULPHUR.		0 618	0 626	0 84	0 82	1 06	.....	.....	.....	0 93
PHOSPHORUS.		0 270	0 007	0 006	0 140	.....	.....	.....	.....	0 33
VOLATILE MATTER.		0 350	0 661	0 488	0 460	.....	0 667	.....	.....	.....
AUTHORITY.		Chemical analysis, Prof. J. B. Britton.	A. S. McCreath, average 4 tests.	Chemical analysis. Prof. John Fulton.	Chem. an'y's, Prof. A. S. McCreath.	T. T. Morrell.	Booth, Garrett & Blair.	Soft coke.	Good coke.	T. T. Morrell.

APPENDIX TO PART I.

NOTE 1.—The "LOWER KITTANNING SEAM."—In the treatment of this coal bed or seam, we have discussed the bed as being composed of two divisions or benches, distinguishing the one as the Lower or Campbell's creek, and the other as the Upper or Peerless. There appears to be, however, some doubt as to this distinction, and it may be the more accurate position that the bed, as appearing in the Great Kanawha valley is subdivided into three divisions, all uniting at Campbell's creek, but separating as they extend southward. We here quote from Prof. I. C. White, U. S. Geological Report:

"On the Great Kanawha river, above Charleston, this is one of the principal coal beds, and has long been known there as the 'Campbell's creek' seam. At this locality, on Campbell's creek, the coal is four to six feet thick with only two parting slates, but in passing southward up the Kanawha, new partings come in, and the old ones thicken up until the bed, with its included rock partings, swells out to a thickness of nearly fifty feet, and two of the members are mined independently, the upper one being known as the Peerless bed, and the lower one as the Blacksburgh. The upper member never exceeds three feet, and is usually about 20 feet above the Blacksburgh member, which is often four to five feet thick, and is the 'Coal Valley' gas seam. On the 'Mount Carbon (L't'd)' property, 25 miles south from Campbell's creek, the 20 feet of shales, which usually separate the Peerless and Blacksburgh members of the Lower Kittanning, thin away to a few inches, locally, and both are taken out of the same drift. This is also the condition of affairs at the famous Ansted mines on top of Gauley mountain. At the head of Cabin creek, the Peerless and upper half of the Blacksburgh member come completely together, forming a bed of excellent gas coal 5½ feet thick." (Mined at "Keystone" mine, Stevens Coal Co.)

NOTE 2.—THE BROWNSTOWN SEAM.—Between the Clarion and Lower Kittanning seams, occurs, occasionally, in the Great Kanawha district, a stray seam which has been locally named the "Brownstown" bed. This seam shows a thin dirty layer of coal, 2 feet thick at or near Brownstown, 10 miles south of Charleston, and is nowhere found of workable

thickness or value, except it be that the working in the "Powell" seam, on the property of the Mount Carbon Company (L't'd), should prove to be that seam, where a fine bed of clean coking coal, 5 feet thick, apparently lying above the Clarion or Eagle bed, is now worked.

NOTE 3.—The vertical cross section of the Campbell's creek seam, given on page 55, is correct for average of bed and variations in whole district, but at Campbell's creek mine the slate portion has almost or entirely disappeared.

PART II.

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PART II.

HISTORICAL AND INDUSTRIAL VIEW.

CHAPTER I.

The Great Kanawha Coal District.

1. Historical Sketch.
2. Tables showing increase in output and in comparison with Pittsburgh and other Districts.
3. Table showing Mines and Seams worked, etc.

SECTION I.—Historical Sketch.

Although coal was dug and taken from the lower beds of the Lower Kittanning (Campbell's creek) along its outcrop in the river hills near the Kanawha Salines, for many years previous to 1840, yet its use was largely experimental and intermittent, the fuel being applied to the running of salt furnaces and boiling of brine whenever the supply of wood ran short.

Here and there an occasional opening into the lowest seams had been made to supply the local blacksmiths with coal, but generally wood was used in the cabins.

It was not until about the year 1849, and thereafter, that the systematic exploration of the mountains and hills of the Great Kanawha valley was undertaken with a view of determining its value as a coal producing field.

Cannel coal had then recently been found along the hills of Coal river by William M. Peyton, of Roanoke, and below Smither's creek, on the Kanawha, by Col. Aaron Stockton, and it was with a view of determining whether or not this valuable fuel might not be found in the mountains south of the Great Kanawha river that

Mr. William H. Edwards, owner of the Wilson survey of 85,600 acres, embracing most of the coal lands immediately south of the river, instituted, in the years following 1849, elaborate investigations in search of coal.

In 1850, the big bed of the Lower Freeport seam was discovered on Paint creek. This seam was subsequently traced down the creek and along the river hills to where the village of Coalburgh and the famous mines in that seam are now located. In the year 1854, the beds of cannel coal upon Paint creek were discovered by the late Mr. Alvah Hansford. About the year 1857, mines were opened upon Paint creek, and refineries established for roasting the cannel coal and extracting oil and paraffine. A few years earlier similar works were erected at Cannelton, and a good deal of cannel coal was taken from the Stockton cannel bed in the Upper Freeport seam, and an abortive attempt was made at Forest Hill to manufacture oil from a bituminous shale. The discovery of petroleum and the out-break of the civil war brought these operations to a final close. About the year 1853, also, mines were established upon Field's creek, in the Upper Kittanning seam, where are now the Winifrede collieries, and coal was taken by rail to the Kanawha river and shipped thence to Cincinnati and the lower Ohio in flat boats, when the waters were sufficiently high to permit it. The wild condition of the river, however, and frequent losses of entire boat loads of coal brought this enterprise to an early termination.

With the close of the civil war, coal mining operations were again begun, and mines were established at Campbell's creek, at Coalburgh, and some short-lived attempts were made to take coal from the Freeport seams along Lower Elk river. Mines were also opened in the Pittsburgh seam in Putman county, near the mouth of the Pocatalico river at Raymond City.

SECTION II.—Tables showing increase in output and in comparison with Pittsburgh and other Districts.

The development of the Great Kanawha field since the inauguration of the deep water improvement of the river by the United States government, and the completion of the Chesapeake and Ohio Railway, has been notable. At the time of commencement of these locks and dams, and, also, of the completion of this railroad, there were but two collieries working and shipping coal above Charleston, each shipping by water—the Kanawha and Ohio Coal Company, at Coalburgh mines, and the Campbell's Creek Coal Co., at Campbell's creek mines, and one mine below Charleston—the Raymond City Coal Company, at Raymond City, in Putman county. With the inauguration of the great system of free locks and dams, and the completion of the railroad, the coals of this field began to go forth into markets both east and west in increasing tonnage, and have, at the present time, close of 1891, reached the output as stated in the following tables. These tables demonstrate the vigorous growth of the district; the increasingly important position its coals are assuming in markets; and, especially, the gradual and steady ouster of the Pittsburgh coals from markets they once held in complete control, by the coals from the Great Kanawha district.

TABLE I.

SHOWING ANNUAL RECEIPTS OF COAL, AT CINCINNATI, FOR YEARS ENDING AUGUST 31, ACCORDING TO REPORTS OF GAUGERS, PRIVATE RETURNS, AND RECORDS OF THE CHAMBER OF COMMERCE.

YEARS.	PITTSBURGH. (Youghiogheny.)	KANAWHA.	OHIO RIVER.	CANNEL.	ANTHRACITE.	OTHER KINDS.	TOTAL.	EQUAL TONS.
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	
1874-75	24,225,002	4,476,619	4,277,327	565,352	248,750	1,597,260	35,390,300	1,311,488
1875-76	27,017,592	6,004,675	4,400,792	409,358	282,578	2,068,322	40,183,317	1,489,108
1876-77	28,237,572	3,631,813	5,141,150	322,171	376,125	1,913,793	39,622,634	1,468,619
1877-78	26,743,055	6,386,623	3,288,008	380,768	439,350	1,654,425	38,892,229	1,441,754
1878-79	20,769,027	6,134,039	4,068,452	333,549	768,750	2,136,850	34,210,667	1,269,339
1879-80	31,750,968	8,912,801	4,268,214	202,489	712,075	2,351,699	48,198,246	1,787,230
1880-81	23,202,084	10,715,459	3,151,934	67,684	770,525	2,336,752	40,244,438	1,492,817
1881-82	37,807,961	13,950,802	3,560,881	77,336	779,925	3,090,715	59,267,620	2,197,407
1882-83	33,895,064	13,260,347	3,309,534	180,621	977,250	2,997,216	54,620,032	2,025,859
1883-84	32,239,473	15,926,743	2,956,688	293,010	1,085,350	3,910,795	56,412,059	2,092,551
1884-85	32,286,133	14,588,573	3,007,078	314,774	1,257,900	2,683,864	54,138,322	2,008,850
1885-86	34,933,542	17,327,349	939,746	205,717	1,287,925	2,720,250	57,416,529	2,130,354
1886-87	37,701,094	20,167,875	338,435	129,503	1,314,775	3,693,850	63,345,532	2,350,026
1887-88	41,180,713	20,926,596	1,533,358	26,098	1,328,225	5,710,649	70,705,639	2,551,415
1888-89	36,677,974	23,761,853	544,940	12,129	1,020,525	3,075,000	65,092,421	2,348,055
1889-90	42,601,615	19,221,196	454,385		1,001,175	4,709,775	67,988,146	2,452,253
1890-91	43,254,460	19,115,172	1,479,670	15,111	1,118,671	7,362,698	72,345,782	2,608,923

NOTE.—Shipments of Coal for 1890-91, 13,814,020 bushels. Receipt of Coke, 5,921,144 bushels. Quantity of Coke manufactured, 5,032,660 bushels.

TABLE II.

Showing total Comparisons of total Bituminous Coal Receipts in Cincinnati Market, Seventeen Years, in Percentage.

	Kanawha Coal received in Cincinnati.	Of Pittsburgh Coal received	Of all Bituminous Coal, other than Pittsburgh received.	Of entire Coal received.
1874–75	Equaled.	18 per cent.	76 per cent.	12 per cent.
1890–91	Equaled.	44 per cent.	216 per cent.	26 per cent.
17 years.	Gain.	26 per cent.	140 per cent.	14 per cent.

1. Showing that in 1874-75, Kanawha coal receipts in Cincinnati were about one-fifth of Pittsburgh coal receipts, and that in 1890–91, Kanawha coal receipts had increased to be almost one-half of Pittsburgh coal receipts.

2. Showing that in 1874–75, Kanawha coal receipts were about one-fourth less than all bituminous coal receipts other than Pittsburgh, and in 1890–91, Kanawha coal receipts were over two times as much.

3. Showing that while in 1874–75, Kanawha coal receipts equaled about one-eighth of all bituminous coal received in Cincinnati markets, in 1890–91, seventeen years, Kanawha coal receipts had grown to be over one-fourth of all, and this in an increasing market.

4. Showing that in 17 years, Kanawha coals had gained on Pittsburgh coals 26 per cent.; gained on all other bituminous coals 140 per cent, and on an increasing market 14 per cent.

5. Showing a greater and greater dependence of Cincinnati markets upon Kanawha coals, and a correspondingly steady ouster of Pittsburgh and all other coals.

TABLE III.

SHOWING THE DECREASED RATIO OF PITTSBURGH COAL RECEIPTS IN COMPARISON WITH INCREASING RATIO OF MARKET IN COURSE IN SEVENTEEN YEARS.

	PITTSBURGH COAL RECEIVED IN CINCINNATI.	PERCENTAGE PITTSBURGH COAL RECEIPTS ARE OF ENTIRE MARKET RECEIPTS	PITTSBURGH LOSS.
1874-75	Equaled	68	.....
1890-91	Equaled	59	9 per cent.
Gain, Kanawha Coal, 17 years			330 per cent.
Market increase, 17 years			104 per cent.

Showing for Pittsburgh coals a decreasing ratio of 9 per cent. in a market that increased 104 per cent., as against an increase of 330 per cent. for Kanawha coals in the same market, and a consequent displacement of Pittsburgh by Kanawha coals.

TABLE IV.

SHOWING COMPARATIVE RATIOS OF INCREASE OR DECREASE IN SEVENTEEN YEARS OF COAL RECEIPTS EROM KANAWHA, PITTSBURGH AND OTHER COAL DISTRICTS.

DISTRICTS.		PERCENTAGE.
Kanawha Coal Receipts	Gain.	330
Pittsburgh Coal Receipts	Gain.	74
All other kind of Coal Receipts	Gain.	50
Entire Cincinnati Market Coal Receipts	Gain.	104

1. Showing Kanawha coal receipts have more than quadrupled, while Pittsburgh receipts have gained but three-fourths; other bituminous coals have gained but one-half, while the market itself has doubled.

2. Showing Kanawha coals to be the only coals holding their own and increasing in their receipts, and in a ratio twice as rapid as general increase of the market.

TABLE V.

SHOWING THE SHIPMENTS OF COAL FROM THE GREAT KANAWHA VALLEY, BELOW KANAWHA FALLS, BOTH BY RIVER AND RAILROAD, FOR THE SEVERAL YEARS NAMED, TAKEN FROM THE LAST ANNUAL REPORT ON THE GREAT KANAWHA RIVER IMPROVEMENT, MADE TO COL. WM. P. CRAIGHILL, THE OFFICER IN CHARGE OF THE U. S. GOVERNMENT IMPROVEMENT, GREAT KANAWHA RIVER, AND PUBLISHED IN THE REPORT OF THE CHIEF OF ENGINEERS FOR 1890.

YEAR OF TWELVE MONTHS ENDING	SHIPMENTS BY RIVER.	SHIPMENTS BY RAILROAD.	TOTAL BUSHELS.
June 30, 1881	9,628,696	6,631,660	16,260,356
June 1, 1883	15,370,458	13,290,255	28,660,713
" 1884	18,421,084	12,059,172	30,480,256
" 1885	17,812,323	12,972,217	30,784,540
" 1886	17,861,613	13,953,745	31,815,358
" 1887	23,233,374	19,160,896	42,394,270
" 1888	20,100,625	20,962,686	41,063,311
" 1889	26,921,788	22,031,121	48,952,909
" 1890	24,161,554	27,433,425	51,594,979
" 1891	25,761,346	28,668,025	54,429,371
" 1892	26,787,788	30,844,100	57,631,888

The comparatively slight falling off in the river shipment between 1889 and 1890 was mainly, if not altogether, due to a difference in the market at Cincinnati, Louisville, etc., in the two years.

TABLE VI.

SHOWING ANNUAL TONNAGE COAL AND COKE TAKEN BY RAIL FROM KANAWHA (AND NEW RIVER) DISTRICT OVER PERIOD OF NINE YEARS BY CHESAPEAKE AND OHIO RAILWAY.

YEAR.	TONNAGE.
1883	1,004,099 tons (2,000 pounds).
1884	966,910 " "
1885	1,296,793 " "
1886	1,420,108 " "
1887	1,663,381 " "
1888	1,823,514 " "
1889	1,886,256 " "
1890	2,341,002 " "
1891 (to July 31st, 7 months)	1,637,336 " "

Showing a total increase in output in nine years of 2,282,763 tons, or 227 per cent.

SECTION III.—TABLE SHOWING MINES, COAL SEAMS WORKED, ETC.

The collieries now working, and the coal seams worked, in the Great Kanawha district are set forth in the following table, together with the estimated present monthly or daily capacity of output and kind of coal mined, or coke ovens in blast or building:

TABLE SHOWING MINES WORKING IN GREAT KANAWHA DISTRICT, SEAMS WORKED, CAPACITY OF OUTPUT, ETC.

NAME OF MINE.	POST-OFFICE DESIGNATION	N. XV.	No. XIV.		No. XIII.										THICKNESS OF SEAM IN FEET.	KIND OF COAL.	COKE OVENS.		AVERAGE DAILY CAPACITY FOR OUTPUT IN TONS (2,240 lbs.)
		PITTSBURGH OR RAYMOND.	MAHONING.	UPPER CANNELTON.	UPPER FREEPORT OR CROWN HILL.	LOWER FREEPORT OR COALBURGH.	UPPER KITTANNING OR WINIFREDE.	MIDDLE KITTANNING OR CEDAR GROVE.	LOWER KITTANNING OR CAMPBELL'S CREEK. FULL SEAM.	UPPER OR MIDDLE BENCH OR PEERLESS.	MIDDLE AND LOWER BENCH OR COAL VAL'Y.	"BROWNSTOWN" OR POWELLTON.	CLARION OR WYANT.				IN BLAST.	BUILDING.	
Acme.	Stevens C. Co.	.....	.....	..	.....	work'g	.....	.....	.....	.....	.....	..	.....	5–6	Hard splint.		...	200
Ansted.	Gauley Mt. Coal Co.	.....	.....	..	.....	.....	.....	.....	work'g	.....	.....	..	.....	7	Soft gas and coking.	.	100	500
Bancroft.	Kanawha Lake Erie C. Co.	work'g	.....	..	..	.....	.....	. .	.....	.....	.....	..	.....	6	Hard splint.	..	..	200
Belmont.	.....	.....	.....	..	work'g	work'g	.....	.....	.....	. .	.. ...	..	.....	4–5	Hard splint.	.	..	200
Black Diamond.	Peel Splint Coal Co.	.....	.....	..	.....	...	work'g	.....	.....	.....	.....	..	.....	4–5	Hard splint.	...	....	200
Black Peerless.	.....	.....	.....	...	.....	.....	.....	.....	.....	work'g	.....	..	.....	2½3	Soft gas.	..	..	idle.
Campbell's creek.	Campbell's Creek C. Co.	.....	.....	....	.....	.....	.....	.....	work'g	.....	.....	..	.....	5–6	Splint.	....	...	400
Cannelton.	Cannelton Coal Co.	.....	work'g	..	work'd	.....	.....	.....	.....	.....	.....	....	.....	4–5 3–4	Splint. Splint, can'l.	..	..	200
Carkin.	W. S. Carkin.	.....	.....	..	.....	.....	.....	.....	.....	.....	work'd	..	.....	3–4	Splint.	..	..	idle.
Carver	Carver Bros.	.....	.....	..	.....	.....	.....	.....	.....	.....	work'g	..	.....	4–5	Soft gas.	....	...	200
Cedar Grove.	Cedar Grove Coal Co.	.....	.....	..	.....	...	.....	work'g	.....	.....	.....	....	.....	3–5	Soft gas and steam.	..	...	50
Cedar Grove P. C.	Cedar Grove P. C. Co.	.....	.....	.	.....	.....	.....	work'g	.....	.....	...	..	.....	3–5	Soft gas and steam.	..	.	25
Champion.	Champion C. Co.	.....	.....	..	work'g	work'g	.....	.....	.....	.....	.....		.....	3–5 4–6	Hard splint.	..	...	idle.
Chesapeake.	Chesapeake M. Co.	.....	.....	.	.....	.....	work'g	.....	.....	.....	.....	..	.	5–6	Splint.	....	...	200
Coalburgh.	Robinson C. Co.	.....	.....	.	work'g	work'g	.....	.....	.....	.....	.....	..	.....	3–4 4–6	Hard splint.	.	....	200

Coalburgh, north.	Peabody Coal Co.		work'g											4-6	Hard splint.			200
Coal Valley.	Straughan C. Co.										work'g			4-6	Soft gas.			200
Crescent.	W.R. Johnson.		work'g								work'g			5-6 4-6	Hard splint. Soft gas and coking.	35		300
Crown Hill.	Crown Hill Coal Co.				work'g	work'g								3-5 5-6	Hard splint.			idle.
Diamond.	Wm. Wyant.										work'g			4-5	Soft gas.			100
Dickinson.	J. Q. Dickinson & Co.									work'g				4-5	Splint.			25
Eagle.	Wyant Coal & Coke Co.												work'g	4-5	Soft coking.	54		300
East Bank.	East Bank C. & C. Co.					work'd					work'g			4-6	Hard splint.			50
Eureka.	Carver Bros.										work'g			3-3½	S. G. & cok'g.	12		100
EdgeWater.	Carver Bros.										work'g			4-5	Soft gas.			100
Excelsior.	M. T. Davis & Co.		work'g								work'g			4-5 6-8	Soft gas. Hard splint.			200
George's creek.	Straughan C. Co.										work'g			5-6 4-5	Soft gas. Splint.			idle.
Great Kanawha Col.	G. Kanawha Collery Co.										work'g			4-6	Soft gas and coking.	65		300
Handley.	Stand. C. Co.						work'g							4-5	Splint.			idle.
Keystone.	Stevens C. Co.									work'g	work'g up.half			4-5	Soft gas.			200
Lewiston Coal Works.	Lewiston Coal Works.									work'g				3	Soft gas.			50
Mt. Morris.	Mt. Morris Coal Co.										work'g			4-6	Soft gas.			200
Peabody.	Monarch C.Co.							work'g						3-4	Soft gas.			100
Peerless.	Peerless C. Co.									work'g				3	Soft gas.			50
Pioneer.	Pioneer C. Co.								work'g					4-6	Splint.			200
Plymouth.	Carver Bros.	work'g												6	Hard splint.			200
Powellton.	Powellton.										work'g	w'g		4-5	Gas & coking	202		500
Raymond.	Marmet C. Co.	work'g												6	Hard splint.			400
Queen City.	Queen C.C. Co.	work'g												6	Hard splint.			100
St. Clair.	St. Clair Coal & Coke Co.										work'g			4-5	Soft gas. Coking.	70		200
Wacomah.	Kanawha C. C. Co.					work'd								5-8	Splint and cannel.			idle.
Winifrede.	Winifrede M. Co.						work'g							4-6	Splint.			500
Union.	Consolidated M. Co.						work'g				work'g			5-6 4-6	Soft splint. and steam.			500 300

CHAPTER II.

Past and Present Development of the Coal River Coal District.

This coal district may be said to embrace and include all that region included within the water shed of the Big and Little Coal rivers, and occupies, probably, not far from 800 to 1,000 square miles of territory situated in the counties of Kanawha, Boone, Raleigh, Logan and Lincoln.

The region lies entirely upon the Upper Barren or No. XIV and Middle or No. XIII Coal Measures, and the coals characteristic of the various beds are substantially the same as the coals of the same measures in the Great Kanawha field, of which this Coal river district is practically an outlying part, Coal river itself being a southerly affluent of the Great Kanawha, and joining it some 48 miles from its junction with the Ohio.

The vertical cross sections of this field, where examined (see section by W. C. Reynolds, C. and M. E., pp. 29, 30), agree very closely with the sections from the Great Kanawha valley, while the cross sections of the coal seams themselves are but little variant from those of the Great Kanawha field.

The more striking feature of the Coal river basin is the seemingly quite extensively distributed deposit of cannel coal appearing, it is believed, in the Freeport beds, the abundance and richness of which early attracted great attention to the region.

As early as 1840, this great natural wealth in cannel coal was brought to the attention of investors by the late William M. Peyton, Esq., of Roanoke, Virginia, to whose enterprise and energy was due the effort made to open and develop these valuable deposits.

Within a few years following these discoveries, four coal mining companies were established in the Coal river basin for the purpose of mining and shipping the cannel coals, and, incident-

ally, the splint and bituminous coals, and a navigation company was also formed, in which the several operating companies were jointly interested, for the purpose of building locks and dams in that river, and shipping to market the coal boats and barges loaded at the mines.

The companies were all organized under special charters granted by the legislature of the State of Virginia, and were entitled:

The Virginia Cannel Coal Company, with mines at Peytona, in Boone county;

The Western Mining and Manufacturing Company, with mines at Droddy's creek, near Peytona;

The Cannel Coal Company of Coal River, with mines at Manningville, on Little Coal river;

The Coal River and Kanawha Mining and Manufacturing Company, with mines at Briar creek in Boone county;

And the Coal River Navigation Company.

This latter company being jointly owned by the several mining companies. Eight locks and dams were built on Big Coal river and one on Little Coal river, having an average lift of 10 feet, and providing 4 feet of navigable water at all seasons.

These mining companies all shipped considerable coal, and finally reached a total output of probably about 200,000 tons per annum—a large amount in those early days. The coal was floated out of the river at considerable risk and cost, and taken to the lower Ohio markets, where it was sold at great profit.

The outbreak of the war, however, destroyed both collieries and markets; the neglected river washed out the locks and dams; and this early attempt at coal mining in Virginia came to a profitless end.

Subsequent to the war, an attempt was made to revive this coal development. The Virginia Cannel Coal Company was reorganized under the name of the Peytona Cannel Coal Company, extensive mines were re-opened at Peytona; the river was locked

and dammed anew, and the struggle was continued ten years or more, when the enterprise was abandoned until a cheaper and more certain mode of transportation should expose the miner and shipper to fewer risks and losses.

This region now lies dormant awaiting the modern railway.

CHAPTER III.

Past and Present Development of the Twelve Pole or Kenova and the Guyandotte or Logan Court-house Coal Districts.

The development of this coal district is scarcely begun, and is entirely due to the construction of the Ohio division of the Norfolk and Western Railroad, traversing that portion of the state between the No. XII Measures of the Flat Top Mountain district crossing the No. XIV and No. XIII Measures of the basins of the Guyandotte and Twelve Pole rivers, through the counties of Logan and Wayne to the Ohio river at the town site of Kenova.

The exploration of this region has necessarily been very incomplete, and only sufficient opening of coal seams has been done to establish the existence of the characteristic coal beds of the Middle Measures and their probable similarity to those of the Great Kanawha district.

The vertical cross-section of the field, as given by Mr. Andrew Roy, M. E., local agent of the land company (the Guyandotte Coal Land Association), controlling the greater part of this coal-field, would seem to correspond fairly with the seams as opened and worked at the collieries along the Great Kanawha river, and it is thought by Prof. I. C. White, who has made personal examination of the coals and region, that the seams may be correlated with the Kanawha seams as given in the Table of Vertical Cross Sections, Part I, page 31.

The coal beds lie in horizontal planes with a quite uniform dip of about 70 feet to the mile, N. W. Here, too, as in the Coal river district, appear to have been formed extensive beds of cannel coal in the Freeport (locally known as the "Ferguson") seams, the cannel coming in as a layer or bed between bituminous coals and roof or floor.

The top and bottom coal beds, as shown in vertical section

(page 31), are not deemed to be of much value; the chief beds that are likely to be worked with profit, along the present line of the railway, being the "Ferguson" and perhaps "Damron" (Freeport and Upper Kittanning), the coals of which are very similar in quality to those of the corresponding beds in the Great Kanawha region.

SECTION I.

TWELVE POLE OR KENOVA DISTRICT.

From reports by Prof. I. C. White and observations made by Mr. Andrew Roy, M. E., are submitted the following brief statements concerning the coal beds and seams of this district:

Referring first to what is known, locally, as the "Upper Ferguson" seam (probably the Upper Freeport or Crown Hill), Prof. White observes: This bed varies from five to twelve feet in thickness, and, as a rule, from four to six feet of merchantable coal can be mined from it by the removal of one or two thin intervening slates.

The quality of the coal is generally of a splinty nature, like the famous steam and domestic coals of Coalburgh and Winifrede, but over a considerable area through the region the middle portion of the bed changes to an excellent quality of cannel coal from twenty-five to thirty-eight inches thick. This belt of cannel begins near the head of Cove creek and trends thence westward across the field, the Brush creek and Moses Fork cannel being the western extension of the same belt. It is not regular in its distribution and thickness, but there is a very large area of merchantable cannel in this belt.

The next seam in importance is the Upper Dunlow, which is five feet six inches. This is very uniform in thickness, and has a parting of fire clay. The Lower Dunlow and the Damron seams are from three and a half to four and a quarter feet in thickness, and are good merchantable coals. The latter corresponds, it is thought, with the Winifrede seam in the Kanawha, it having many

of the characteristics of that coal. The four seams enumerated above, together with the Lower Ferguson and Jackson branch, contain about twenty-four feet of coal, including partings to the extent of, say five feet, which leaves about nineteen feet of coal for mining.

The following analysis of coal from this region was made by Dr. Henry Froehling, of Richmond, Va., and is reliable: Moisture, 3.45; volatile matter, 38.70; fixed carbon, 51.35; ash, 6.50; sulphur, 1.92.

Four companies have begun active operations in the Twelve Pole region. The companies now shipping are the Coaldale Mining and Manufacturing Company, the Hope Splint Coal Company, and the Dunlow Coal Company.

The first operation in the Kenova coal-field after leaving the Ohio river is at Fleming, and from there to Pondmouth the numerous outcrops on the main and side streams give every indication of a superior field.

The Fleming seam outcrops about one mile north of Fleming and at the mines of the Coaldale Coal Company, at Fleming.

This seam is seventy-five or eighty feet above the creek. At the mines of the Hope Splint Coal Company the Upper Ferguson seam is 150 feet above the creek, and shows on each side of the Twelve Pole river, measuring six feet three inches. The next place where this seam is visible is on Moses Fork, about five miles south of Dunlow. This is the last development south of Dunlow that has yet been made.

The Damron seam is first seen a mile south of Fleming, where it is about forty feet above the level of Twelve Pole, and will measure thirty-nine inches, three of slate and thirty-six of coal. The best developments yet made in this seam have been on Big branch, on the property of the Guyandotte Coal Land Association, where it is four feet five inches, less four inches parting.

The Dunlow seam is first met about six miles north of Dunlow and two miles south of Fleming, and is about one hundred feet above the level of the track at Dunlow, and is being developed by

the Dunlow Coal Company. South of Dunlow the three seams which have been sighted are found on nearly all the property in the region, and are especially in good condition on Moses Fork. Here there is one opening in the Damron seam which carries seventeen inches of splint coal and three feet of cannel.

Three miles south of Fleming is the town of Ferguson, at which point are located the plants of the Ferguson Coal Company and the Hope Splint Coal Company.

The Hope Splint Coal Company has erected a tipple and is now making shipments.

Below is given in tabulated form the collieries and coal beds, etc., worked and working in the Twelve Pole or Kenova district:

TABLE SHOWING MINES WORKING AND COAL SEAMS WORKED, TWELVE POLE COAL DISTRICT.

	SEAM WORKED.			PRESENT DAILY CAPACITY IN TONS (2240 LBS).	KIND OF COAL.
	PROBABLE PENN. NAME.	PROBABLE KANAWHA NAME.	LOCAL NAME.		
Coal Dale M. & M. Co.	Upper Freeport.	Crown Hill.	Upper Ferguson.	200	Splint coal.
Hope Splint Coal Co.	Upper Freeport.	Crown Hill.	Upper Ferguson.	.....	Splint coal.
Ferguson Coal Co.	....	.....	.....	.....	Splint coal.
Dunlow Coal Co.	Middle Kittanning.	Cedar Grove.	Middle Kittanning.	....	Cannel coal.

SECTION II.

GUYANDOTTE OR LOGAN COURT-HOUSE COAL DISTRICT.

"In Logan county, west of the Guyandotte river and south of the Twelve Pole divide, there are beds of excellent coal, attaining in some places, it is said, a thickness of twelve feet. Within this region there are two series of productive coal measures, both lying within the rocks of No. XIII, and separated at Logan Court-house by about 700 feet of strata. The characteristic seam of the upper series has been called the Floyd seam, and of the lower series the Island creek seam.

There is an opening near the mouth of Pigeon creek, 365 feet above the bed of Tug river, which shows the following section:

Roof yellow sandstone—

4″ coal and slate.
6″ streaky coal.
18″ gas coal.
1″ slate.
6″ coal.
3″ clay.
12″ coal.
2″ niggerhead.
22″ splint coal.
18″ slate.
24″ gas coal.

The floor of this seam has not been exposed. A general sample of the coal at this opening gives the following analysis (Booth, Garrett, and Blair): Water, 2.757; volatile matter, 35.850; fixed carbon, 20.432; ash, 10.961; sulphur, 0.524.

Following the Floyd seam up Pigeon creek, the next observable outcrop is at the Road Gap, opposite the mouth of Trace creek. The coal here is stated to be ten feet, the roof being of compact gray sandstone.

The Floyd seam outcrops all through the district, notably on Little Laurel at Walnut Gap; on Main Laurel not far from the former opening; near head of Main Laurel five miles from Walnut Gap, and again on Marrowbone creek. The Floyd seam will probably be found in all the high ranges as far east as Oceana, in Wyoming county.

About 110 feet below the Floyd seam on Little Laurel is the "Meachem" seam, which is reported variously as from twelve, fourteen, and sixteen feet thick.

It has not been developed sufficiently to determine its purity, but enough is exposed to show that it is of considerable size, and at the outcrop on Marrowbone creek, below Walnut Gap, it shows seven feet of coal. This seam has not as yet been observed elsewhere in that region.

At Sang branch, at an elevation of 110 feet above the bed at Island creek, the Island creek seam outcrops; again it is seen one mile north and the next time about two miles further down Island creek, and at this point it gives the following section:

Roof shales–

24″ coal.

24″ cannel.

12″ coal.

15″ slate.

30″ coal.

Floor sandstone.

It will be observed that the Island creek seam here contains twenty-four inches of cannel, not seen in the seam at any other point, excepting at the opening one-half mile below.

It is not likely, however, that the cannel in the Island creek seam is contained throughout sufficient area to modify the character or value of its coal in general.

Although the Island creek seam rises rapidly toward the north, between Mill creek and Coal branch, it dips at the same time toward the north-west, and is carried under water level at the mouth of Copperas mine fork. East of the Guyandotte river, near

Oceana, it is called the Campbell's creek bed, and is described as equivalent to the Lower Kittanning. It is said to attain there a thickness of ten feet.

At and west of Pigeon creek the Island creek seam attains workable dimensions again, and again it outcrops on Mate creek.

On Lick creek it outcrops, showing a thickness of about seven feet of coal. On Sycamore creek, one mile above its mouth, this seam has been opened and shows a total thickness of eight feet, including twenty inches of slate."

CHAPTER IV.

Past and Present Development of the New River Coal District.

The development of the New river coal district began with the completion of the Chesapeake and Ohio Railroad in 1873, and was inaugurated by Mr. Jo. L. Beury, who, in September of that year, shipped the first car loads of coal from mines in the "Quinnimont" bed, at Quinnimont.

Following Mr. Beury's energetic efforts were the operations of Mr. John Nuttall, at Nuttallburgh, and then were opened the mines of the Long Dale Iron Co., at Sewell, both of these latter operations being in the upper (No. 3) or "Sewell" bed.

The opening of these mines was followed by the steady and constant development of the entire district. The immediate demand for these coals of the No. XII Measures continually exceeding the capacity of the developing mines to supply.

The high percentage of fixed carbon in these coals and their purity (freedom from ash and sulphur and phosphorus), also early attracted the attention of the coke producers, and the erection of ovens speedily followed the inauguration of mining.

The New river field has heretofore been considered to contain some three main working seams of coal. These seams have generally been designated as the Sewell or Nuttall or No. 3 seam, being the highest bed, and then what were supposed to be two distinct beds, the Fire creek and Quinnimont, respectively, lying below the Sewell. But the more recent and careful examination of the field would appear to lead to the view that the so-called "Fire creek" bed is probably only a thickened portion of the Quinnimont bed, where that bed locally thickens and, possibly, parts into two benches in the immediate vicinity of Fire creek, for above that single point the apparent doubling of the seam disappears, and a single workable bed traverses the remainder of the field, continu-

ing with a very uniform height of coal. From an altitude above New river of about 550 feet at Echo mines, two miles above Fire creek, the seam rises to the altitude of 2,200 feet in the mountain tops slightly beyond the most southward workings at Quinnimont, and, like the Sewell seam above it in geological horizon, finally outcrops and disappears above the highest levels of the mountain summits.

The dip of the rocks and coals of the New river district is approximately that of the Kanawha Middle Measures, about 40 to 50 feet to the mile, the direction varying from N. 22° W. to N. 37° W., and the course of the New river, cutting directly through them, exposes the coal beds, generally, at right angles to their strike.

In the northern section of the field the operated mines are all in the upper or Sewell seam; as the river is ascended southward, the Fire creek or Quinnimont bed appears and is the working seam of the field, while, upon Meadow creek, at the extreme southern margin of the district, are now being opened extensive mines in the third or lowest workable bed of the field, a bed that apparently lies 180 to 200 feet below the Quinnimont bed. These very recent developments in the more southern portion of the field (by Mr. Jo. L. Beury and associates on Meadow creek), would now apparently demonstrate that the true third bed of the New river field lies considerably below the Quinnimont or Fire creek bed.

If these conclusions as to the oneness of the Quinnimont and Fire creek beds and the existence of a third and distinct seam 200 feet or more below this bed be correct, the correlation of the seams of the New river and Flat Top fields would present fewer difficulties than heretofore, and Meadow creek bed would apparently quite properly correspond with the main or No. 3 bed of the Flat Top field.

A distance of some 20 to 25 miles practically exhausts the working coal district upon New river, which is opened by the Chesapeake and Ohio Railway main line, and further expansion of the field can only be had by means of lateral workings and branch

railway lines diverging into and along the great axis of the coal field in its north-easterly and south-westerly extensions: (a general direction, probably, of N. 45° to 50° E., and S. 45° to 50° W.)

The future development of the New river district may then be looked for by the opening of the counties of Fayette and Raleigh to the south-west, and the counties of Fayette and Greenbrier to the north-east, upon the headwaters of Piney, Little Wolf and Paint creeks, in Raleigh county, and the streams flowing from the divide to New and Meadow rivers in Fayette and Greenbrier counties.

We give a tabulated statement, showing the number of mines and coke ovens now worked and in fire in the New river district, with the seams of coal each colliery is working, on the following page.

TABLE SHOWING COLLIERIES AND COKE OVENS WORKING IN THE NEW RIVER DISTRICT AND THE COAL SEAM MINED.

LOCAL NAME OF MINE OR COLLIERY.	NUMBER OF COKE OVENS IN BLAST.	NAME OF COAL BED OR SEAM IN WHICH MINING OPERATION IS CONDUCTED.		
		MEADOW CREEK, LOWER OR NO. 1 BED.	QUINNIMONT OR FIRE CREEK, MIDDLE OR NO. 2 BED.	SEWELL OR NUTTALL, UPPER OR NO. 3 BED.
Alaska Coal and Coke Co	Welsh 20		Working.	
Beechwood Coal and Coke Co.	26		Working.	
1. Beechwood mine				
2. Keystone mine				
Beury Coal and Coke Co.				
Stone Cliff mine	60		Working.	Working.
Beury, Wm. Cooper & Co				
1. Beury mine	50		Working.	
2. Caperton mine				Working.
Wm. A. Burke & Co., Elmo				Working.
Central Coal and Coke Co.			Working.	
Dimmock Coal and Coke Co.			Working.	
Fayette Coal and Coke Co.	12			Working.
Fire Creek Coal and Coke Co.	98		Working.	
Gaymont Coal and Coke Co	36			Working.
Longdale Coal and Coke Co.	250			Working.
Meadow Creek mine		Working.		
New River Coal and Coke Co	150			Working.
Nuttall Coal and Coke Co.				
1. Keeney's creek mine				Working.
2. Nuttallburgh mine	90			Working.
Penna Coal and Iron Co				
Quinnimont mine			Working.	
Royal Coal and Coke Co			Working.	
Rush Run Coal and Coke Co			Working.	
Sterling Coal and Coke Co.			Working.	
Sunnyside Coal and Coke Co.	16			Working.
Taylor, Stephen, of Hawksnest	10			Working.
Thurmond Coal and Coke Co.				Working.
Total	818	1	11	12

CHAPTER V.

Present and Prospective Development of the Upper Elk River and Gauley River Districts.

That portion of the Upper Elk river basin lying east and above the mouth of Laurel creek, may be roughly designated as being generally underlaid with one or more seams of the coking coals of the No. XII Measures.

The column of rocks of this geological horizon has here thinned out to a total height of scarcely more than 700 feet, and the two or three regular seams of the New river district are apparently, so far as the yet limited explorations and developments show, represented by not more than two seams of the soft coking coals, one of which will average from 4 to 5 feet in thickness, generally running at about 52 inches, and one, at a lower altitude of probably not more than 2 feet in average thickness. These seams, however, cover a very extensive area of country, and finally disappear in the southwestern borders of Randolph county. The greater part of southern Webster county, probably, contains these coals, and they have been extensively opened upon the dividing mountains between the Elk and Gauley rivers, from 3 to 10 miles above Addison, the county seat. The coals as here exposed present a clean solid bed without partings, rarely falling below 4 feet in thickness and rising to $5\frac{1}{2}$ feet.

The upper two-thirds of the coal bed consists of an extremely hard coal, underlaid by a band of coal much softer and more friable. This will render the seam an economical one to work, and enable the hard portion of the seam to be taken out in large blocks. In analysis, the coal is almost identical with the coals of the New river beds, and equally free from impurity and high in percentage of fixed carbon. The seam, where opened, lies at about 800 feet above Elk river, but not more than 300 feet above that of

the Gauley river, which here flows at an altitude some 500 feet higher than the Elk stream at one point but four or five miles distant.

This Upper Elk basin is the most easterly of any of the coking coal districts of the No. XII Measures, and must eventually become a formidable rival to the now developed districts further to the south-west, having an actual advantage over them of being some 100 to 150 miles nearer the seaboard.

The region of the Gauley river basin, like that of the Upper Elk, is as yet quite undeveloped. The greater portion of the basin, which is broad and bowl like, is underlaid with the coals of the No. XII Measures, and here and there the lower seams of the No. XIII Measures are caught in the higher levels of its mountains. These coking coals of the No. XII Measures have been but little investigated as yet, but the examinations, so far as made, show that throughout the now inaccessible valleys of Meadow river, Cherry, Cranberry, Williams, and Upper Gauley river, the New river beds appear to extend with a rather uniform thickness of four to five feet, sometimes rising to six feet and perhaps to pocket beds of yet greater thickness.

This great and probably most important coal district of the No. XII Measures, is as yet unpenetrated by any line of transportation, although already the thoughts of railroad projectors have been turned toward it.

The Pittsburgh and West Virginia Railroad (under the wing of the Baltimore and Ohio R. R. Co.), is already just crossing the Elk and entering the Gauley valley, and will be running to Gauley river by June 1892.

The Toledo and Ohio Central (Kanawha and Michigan), the Chesapeake and Ohio and Pennsylvania systems will be forced to also enter the field at no distant date, unless they are to permit the richest coal fields of the state to pass to the control of interests alien to their own.

CHAPTER VI.

Past and Present Development of the Flat Top Mountain Coal District.

The development of this district has been and is very rapid. The first shipments of coal were made in 1883 upon the completion of the East river branch of the Norfolk and Western Railroad, and the opening of the first mines in the field at Pocahontas, Tazewell county, Virginia, where the great No. 3 seam probably reaches its maximum thickness.

The opening and successful development of these mines was quickly followed by that of other mines working the same coal bed, and with the extension of the railroad to the upper Blue Stone river, and then through the divide to the waters of the Elk Horn river, still further development of the field has occurred.

The district is worked upon one general system, a uniform rate prevailing to digger and carrier, and a common agent taking away all coal delivered into cars at the several collieries at agreed district prices.

The wonderful development of this important coal district has been very largely due to the efficiency of the management of the Norfolk and Western R. R. Co., and the unity of action by all coal operators in dealing through one common agent not connected with but independent of the railroad management in the sale of their coals and the opening of new markets for increasing output.

At the present time there are 19 collieries mining and shipping coal from the district, with an average daily capacity of 11,745 tons of coal and 1,564 tons of coke (2,240 pounds to ton).

The following Table I shows the yearly shipment of coal and coke from the Flat Top field from the commencement of operations in 1883 to the end of the year 1891, a series of nine consecutive years:

TABLE I.

Year.	Tons of Coal of 2,240 Pounds.	Tons of Coke of 2,240 Pounds.
1883.	60,828.0	19,805.0
1884.	175,252.2	52,530.0
1885.	519,357.7	44,945.0
1886.	766,035.7	54,440.8
1887.	1,026,142.6	136,450.5
1888.	1,376,568.6	180,214.4
1889.	1,611,223.7	280,007.0
1890.	1,808,942.6	387,076.8
1891.	2,268,541.0	353,383.5

Showing an increase in coal output in nine years of 2,207,713 tons or 3,646.20 per cent; and in coke output of 333,578.5 tons or 1,684.31 per cent.

The following Table II. gives the number of collieries now working in the field, their names, and daily capacity, and number of coke ovens in blast and building at each:

TABLE II.

Name of Colliery.	Locality.	Daily Capacity Coal Output in Tons 2,240 Pounds.	Daily Capacity Coke Output in Tons 2,240 Pounds.	Number Coke Ovens in Blast.	Number Coke Ovens Building.	Remarks.
S. W. Va. Improvement Co.	Pocahontas.	2,750	430	444	206	
Mill Creek C. & C. Co.	Cooper.	780	145	150	None.	
Ceswell Creek C. & C. Co.	Freemans.	1,000	75	146	None.	
Boothe Bown C. & C. Co.	Freemans.	780	54	91	None.	
Buckey C. & C. Co	Freemans.	700	50	100	None.	Collieries of
Goodwill C. & C. Co.	Goodwill.	380	30	50	None.	Flat Top Coal
Louisville C. & C. Co.	Goodwill.	400	40	75	None.	Land Asso-
Elkhorn C. & C. Co.	Maybeury.	400	65	100	None.	ciation.
Shamokin C. & C. Co.	Maybeury.	400	65	100	None.	
Norfolk C. & C. Co.	Maybeury.	430	85	172	None.	
Lick Branch Colliery.	Maybeury.	380	80	120	None.	
Coal Dale C. & C. Co	Coal Dale.	460	45	53	50	
Algoma C. & C. Co.	Algoma.	60	00	00	100	Just started.
Lessees of Crozer Land Co.						
Turkey Gap C. & C. Co.	Ennis.	450	85	150	50	
Crozer C. & C. Co	Elkhorn.	1,000	130	250	None.	
Huston C. & C. Co	Elkhorn.	400	65	100	None.	
Powhatan C. & C. Co.	Powhatan.	425	70	125	None.	
Lynchburg C. & C. Co	Kyle.	350	50	100	None.	
Uplands C. & C. Co.	Elkhorn.	200	....	18	74	Just starting.
New Collieries Just Starting and will be in Operation During This Year (1892).						
Delta Colliery.	Maybeury.	....	....	.....	100	Flat Top Coal
Angle Colliery	Maybeury.	....	....	....	100	Land Asso-
Gilliam Colliery	Algoma.	....	....	.....	100	ciation.
Keystone Colliery	Belcher.	....	....	....	100	
Greenbrier Colliery	Bramwell.	....	....	....	100	To build.
McDowell Colliery	McDowell.	....	....	....	200	To build.
Rolf Colliery	Bramwell.	....	....	....	100	To build.
Tide Water Colliery	Helena	....	....	....	100	Building.
C. A. Andrews Land Co.						
Empire C. & C. Co	Land Graff.	....	....	.....	100	Building.
Bottom Creek Coal Co	Helena.	....	.....	....	100	Building.

CHAPTER VII.

Treating of the General Cost of Production of Coals mined and Cokes manufactured in the several Districts over a series of years, together with comparative Tables showing Price paid for mining Coal in the several Districts, and compared with similar prices paid in Pennsylvania and Ohio.

SECTION I.—Showing Prevailing Prices paid Miners for Coal dug, and compared with prevailing prices paid in Pennsylvania and Ohio Bituminous and Splint (or Semi-bituminous) Coal Districts.

Observation of Table I (pages 114, 115) shows in striking contrast the superior economy with which similar coals are mined in the Great Kanawha over the Pennsylvania coal districts. During the past ten years, the price paid the miner in the Kanawha district has uniformly averaged from 7 to 14 cents per ton less ($\frac{1}{4}$ to $\frac{1}{2}$ a cent per bushel less) than in Pittsburgh and Pennsylvania districts. For the years 1890 and 1891, the prevailing rate in the Kanawha district has been 77 cents per ton ($2\frac{3}{4}$ cent per bushel) as against 84 and 98 cents per ton (3 and $3\frac{1}{2}$ cents per bushel) paid in the First Pennsylvania district (Youghiogheny and Monongahela) for both railroad and river coals (or 70 and 84 cents per ton in the Fourth Monongahela pool collieries, averaging $\frac{1}{2}$ cent per bushel less).

TABLE I.

SHOWING PRICES PAID IN CENTS TO COAL MINERS FOR COAL MINED OVER TOP COAL DISTRICTS, AND IN PENNSYLVANIA AND OHIO SEMI-BITU-

STATE.	NAME OF SEAM WORKED.	NAME OF MINE.	1882.	1883.	1884.	1885.	1886.	1887.
West Virginia, Great Kanawha District.	Pittsburgh, (Putnam Co.)	Raymond City Mines,	84	70	70	70	56	56
		Marmet Co.	84	70	70	strike.	56	56
	Upper Freeport.	Crown Hill.	91	91	77	70	70	70
			91	91	77	70	70	70
	Lower Freeport.	Coalburgh.	84	84	84	84	70	70
			84	84	84	70	70	70
	Upper Kittanning.	Kanawha Mines.	84	84	84	70	70	70
			56	56	56	56	56	56
	Middle Kittanning.	Cedar Grove.	.....	91	91	70	70	70
			.....	91	91	70	70	70
	Lower Kittanning. Full Seam.	Ansted, Gauley Mt. C. Co.	....	.....	...	.....	.....	.. ..
			....	.....	.....	.....	.....	.....
		Great Kanawha Colliery Co.	.. .	.....	....	.....	... ..	40
			....	.....	....	.. .. ..	.....	40
		Powellton, Mt. Carbon Co., L'd.	....	.....	.....	40	40	40
			.....	....	.....	40	40	40
		Campbell's Creek.	84	70	70	70	56	56
			84	70	70	70	56	56
	Lower Kittanning. Upper or Middle Bench.	Keystone, Stevens Coal Co.	...	.. ...	.....	.. ....	.....	.....
			.....	.....	.....	....	.....	... ..
	Clarion.	Eagle, Wyant C. & C. Co.	49	49	49	49	49	49
Penna.	Pittsburgh.	R. R. Mines, average.	....	.... .	.....	67	68	76½
		River Mines, average.	105,91	91	77, 70	70	70	70, 77
		Fourth Pool, Monon.	.....	.....	.. ...	77	70	77
			.....	....	.....	63	56	63
Ohio.	Upper Freeport.	Hocking county.	.....	....	.....	.....	.....	.... .
			.....	....	.....	.....	.....	.....
	Middle Kittanning.	Perry and Starke counties.	.. ..	.....	.....	.....	.....	.....
			.....	.....	.....	.. ....	.....	.....
	No. XII Measures.	Mahoning county, "Briar Hill Block,"	.. ..	....	.....	.....	.....	.....
			.....	.....	.....	.....	.....	.. ..
	Pittsburgh.	Athens and Belmont counties.	.....	....	.....	.....	.....	.. ...
						.....		.....

TABLE I.—*Continued.*

A Series of Years in Great Kanawha, New River and Flat minous Coal Districts. (Per Long Ton, 2,240 lbs.)

1888.	1889.	1890.	1891.	Season or Month.	Screen or Run of Mine.	Kind of Coal.
56 56	56 56	56 56	56 56	June. November.	..... 1¼ inch.	Hard splint.
70 70	70 70	70 77	77 .	June. November.	1½ inch.	Hard splint.
70 70	70 70	70 77	77 77	June. November.	1½ inch.	Hard splint.
70 56	70 56	70 56	77 56	Year. Year.	1¼ to 1885, then 1½ in.	Hard, semi-bituminous. Soft bituminous.
70 70	70 77	77 77	77 77	June. November.	1 inch.	Steam coal, not hard.
... .	....	25 25	25 25	June. November.	Run of mine.	Bituminous gas coal, soft.
40 40	40 40	40 40	40 40	Summer. Winter.	Run of mine.	Bituminous gas and coking.
50 50	50 50	50 50	40 40	June. November.	Run of mine.	Bituminous gas and coking, soft.
....	....	....	 35	.... .. November.	Run of mine.	Bituminous gas, soft.
56, 63 56, 63	56, 63 56, 63	56, 63 70	70 70	June. November.	1½ inch.	Semi-bituminous, hard.
49	49	49	49	Average.	Run of mine.	Bituminous steam and coking, soft.
76½	73	79	79	Average.	... .	Semi-Bituminous.
84	63, 70	84, 98	98	Average.	.. ..	Semi-bituminous.
84 70	84 70	84 70	98 84	.... Average.	....	Semi-bituminous. Semi-bituminous.
average. 65, 70	average. 62½	75 75	....	Summer. Winter.	1¼ inch.	Semi-bituminous.
average. 70 to 80.	average. 62½, 67½ to 80	80 80	.... .	Summer. Winter.	1¼ inch.	Semi-bituminous.
average. 92	average. 85	72 72	... .	Summer. Winter.	1½ inch.	Black splint or semi-bituminous.
....	67½	62 67	....	Summer. Winter.	1¼ inch.	Semi-bituminous.

In comparison with the similar coals of Ohio, the average price paid to miner does not show so great variance.

The average price per ton paid in the Mahoning county collieries, where the celebrated "Briar Hill" block splint coals are mined in shaft workings, has been 72 cents per ton for 1890, while the average price paid during that year in Kanawha was 73½ cents per ton. The prices paid in the Hocking Valley district, for the year 1890, averaged about 75 cents per ton during the whole year for a coal greatly inferior to the Kanawha splints in purity and market rating. While the coals mined from the Pittsburgh seam, in Athens county, averaged about 65 cents per ton throughout the year 1890, having a slight advantage over the harder splint coals of the upper Kanawha district, and being about 11 cents per ton higher than the similar coals mined in the Pittsburgh seam where worked on lower Kanawha in Putnam county.

Taking the general average of price paid the miner, which is the first and largest item in cost of production, it is observed that the producer in the Pittsburgh district, shipping either by rail or by water, is at the distinct disadvantage of 7 cents to 14 cents per ton (¼ to ½ cent per bushel) in comparison with the producer in the Kanawha district. While taken in comparison with the producer in the several Ohio districts, the price there paid the miner runs about with, or slightly in favor of, the Kanawha producer.

In brief, so far as the first factor, cost of production, goes, the producer of hard splint, semi-bituminous, coal in the Great Kanawha district mines his coals cheaper than do his competitors in either Pennsylvania or Ohio, while the mine laborer is fully compensated by the lower rents and cost of living in West Virginia as compared with the Pennsylvania and Ohio coal regions.

Observation of Table II of prices paid per ton for the mining of the softer gas and steam coals of either the Kanawha, New river, or Flat Top Mountain districts reveals a yet greater reduction of first cost in favor of the West Virginia producer.

The price paid the miner in the Meigs and Belmont county districts, Ohio, average 40 and 50 cents per ton during the year 1890, and during year 1891–2, 25¾ to 31½ cents per long ton in the Connellsville district of Pennsylvania, while the price paid the miner in the Kanawha district was 49 cents per ton at Eagle mines, 50 cents at Powellton mines (40 cents for 1891), and 25 cents at Ansted mines, with 50 cents in the New river district for both years, and 35, 31 and 25 cents in the Flat Top districts. The coal bought in the West Virginia mines was "run of mine," and it is presumed that such was also the coal in Connellsville and in Ohio.

None of these West Virginia coals exceed the Ohio coals in miners' price; and the average price paid for their mining is distinctly less, while the price paid the miner in the Flat Top district is just about the same as the price paid in the Connellsville district, Pennsylvania.

TABLE II.

SHOWING PREVAILING PRICES PAID IN CENTS TO COAL MINERS OVER A SERIES OF TEN YEARS IN NEW RIVER, FLAT TOP, OHIO, AND PENNSYLVANIA CONNELLSVILLE DISTRICTS (BITUMINOUS OR SOFT COAL).

	DISTRICT.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	SEASON OR MONTH.	SCREEN OR RUN OF MINE.
West Virginia.	New River	50	50	50	40	45	50	50	50	50	50	50	June.	Run of mine.
		50	50	50	40	45	50	50	50	50	50	50	November.	
	Flat Top Mountain.	.....	.....	40	40	40	35	35	35	35	35	30* to 25	Average for a year.	Run of mine.
Ohio.	Meigs county.	.....	.....	.....	.....	.....	.....	.....	.....	.....	40	.....	Average for year.	.....
	Belmont county.	.....	.....	.....	.....	.....	.....	.....	.....	.....	40	.....	Average for year.	.....
Pennsylvania.	Connellsville.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25¾† to 31½	Average variations.	Run of mine.

* Nominally, 75c. per mine car, of the "standard capacity" of 92 cubic feet. This is estimated to give a price varying from 25 to 31 cents per long ton.

† $1.32 to $1.03 per 100 bushels. From 1882 to 1892, the price has varied between 22½ to 31¼ cents per long ton.

SECTION II.—Cost of Handling from Miners to Delivery in Cars and Barges.

In the examination of this second factor in the cost of the production of coal, it is impossible to lay down any exact rule or make any definite estimate. The sum will vary both with locality and still more with ability for close management.

It is the estimate in the lower Kanawha field, where very short inclined planes or none at all are required to convey the coal from mines to car or barge, that the cost does not exceed 20 cents per ton (2,240 pounds), while with the mines at greater altitude, requiring inclined planes of greater length, the cost may considerably increase, until, where mines have been long worked and considerable underground or exterior haul is required, the cost will be yet greater, rising to even 40, 50, or 60 cents per ton. And where cost of handling thus rises to much exceed say $\frac{1}{2}$ to $\frac{2}{3}$ the price paid the miner, the profit in producing coal is likely to be so close that mines can not be profitably operated.

Therefore in ascertaining the general cost of operation of any mine and works, no fixed standard can be laid down.

The first two factors, price paid to miner or digger and, perhaps, the cost of handling from miner to car or barge, may be reduced to almost a known sum, but the general cost of operation, outside these items, is a variable quantity, and will depend upon the location of the mines, magnitude of the operation, and closeness of management.

But taking into consideration the prices paid to miner, as exhibited in Section I, and cost of handling this coal from him to delivery in car or barge, it would appear that in the first factor the operator in the Great Kanawha, New river, and Flat Top Mountain districts in West Virginia has a decided advantage over the operator in either Pennsylvania or Ohio; in respect to the second factor, cost of handling, the West Virginia operator is probably at no advantage over his competitor in other districts; although in regard to the general cost of operation, the West Virginia producer,

owing to cheapness of living, abundance of timber for use in and about mines, etc., is at an advantage over his competitors in either Pennsylvania or Ohio.

SECTION III.—Manufacture of Coke.

The three districts now manufacturing coke in southern West Virginia are (1) the Upper Kanawha, (2) the New river, and (3) the Flat Top.

(1) In the Upper Kanawha district the coke is manufactured from the coals of the Clarion (Wyant), and possibly, the "Brownstown" seam, and the Lower Kittanning (Coal) valley seam. Some 450 ovens are there now in blast. The oven universally used being the bee-hive oven of about five tons coal capacity.

The coals here only run to about 60 and 62 per cent fixed carbon, and are harder than the coals of New river or Flat Top, and very free from sulphur and ash. At the collieries of this district making the most successful coke, pulverizing machines have been established, with the result that a dense, hard coke is produced, especially fitted for foundry purposes where strong cellular structure and fierce heat are required.

(2) In the New river district the coke is manufactured somewhat cheaper than in the Upper Kanawha, and the charge to the oven yields a slightly larger return in manufactured coke, the New river coal averaging from 68 to 72 per cent of fixed carbon.

This coal is also very pure and quite free from slate partings and sulphur. Hence a homogeneous coke of great purity and cellular strength is produced. In the New river district no crushing machinery is used, but the coal is put into the ovens as screened slack or as run of the mine. In this district are now some 820 ovens in blast.

The superiority of these New river cokes, as compared with the coke of the Upper Kanawha, is as yet a controverted question; a cheaper coke is produced on New river, but it weighs somewhat less to the cubic foot.

(3) In the Flat Top district the coke product would seem, as yet, to be inferior to the product of either the Upper Kanawha or New river ovens. This inferiority has sometimes been ascribed to there being a greater or less proportion of slate leaves and particles among the Flat Top coals, and to a troublesome sulphur band that traverses the upper portion of the seams generally worked, and which may sometimes become intermixed with the coals going into the ovens. This latter obstacle to first-class coke making is not so serious, however, but that it may be obviated. Whether, or not, the alleged presence of more or less slate is the actual cause of a coke being here produced that is not of so high a standard as that produced in the other districts, it is yet unquestionably true that a very much superior product will be drawn from the Flat Top ovens so soon as like care shall be taken in preparing the coals for the charges, either by washing or pulverizing. The low price of coal mining of this district. and extensive scale on which coke is manufactured, enables it to produce its coke at a very low cost, probably less than in either Upper Kanawha or New river.

From a series of carefully made tests of the comparative weight of coke manufactured in the three districts, the following interesting results have been obtained: Upon a maximum basis of 100 for Flat Top coke, the coke taken having been carefully selected from every battery of ovens in each district, Upper Kanawha coke weighs ten per cent more to the cubic foot, and New river coke six per cent more to the cubic foot; the closeness of cellular structure being proportioned to the weight.

The present superior coke make of many of the ovens of the Upper Kanawha district, is largely due to the now general use of pulverizing machinery to prepare the coal for charging, and to the great care used in filling, leveling and drawing the ovens. And similar care in the other districts should result in like satisfactory results.

The cost of mining coal has already been discussed in the foregoing sections of this chapter. The following estimates of the cost

of making coke (exclusive of the cost of royalties, if any, and of mining and handling the coal) have been prepared by Mr. A. M. Campbell, M. E., from a series of working tests extending over a period of several years, and are believed to be approximately correct as representing outside maximum cost of manufacturing. Cost of manufacturing coke, Kanawha district, per ton (2,240 lbs) (coal not crushed before charging) :

Coke foreman	$0.0145
Charging ovens	0.0200
Drawing ovens	0.1800
Loading coke on railroad cars	0.1300
Management and office expenses	0.0500
Cleaning yards	0.0100
Leveling charges and daubing ovens	0.0248
Watchman	0.0070
Machinist labor	0.0100
Lumber	0.0150
All other expenses, tools, deterioration of plant, taxes, etc	0.0600
Total	0.5213
To this may be added cost of crushing coal, per ton	0.0250
Giving a total of	0.5463
Cost of coal, taxed on payment to miner of 40 cents per ton, run of mine	1.0833
Cost of manufacturing, as above	0.5463
Total cost of coal and manufacturing into coke, per ton	1.6296
Or for uncrushed coal	1.6046

For the New river district, it is estimated that burning to higher percentage of fixed carbon will cost from 5 to 7 cents less than in the Kanawha region.

Some companies charge their ovens with slack coal, after selling the lump from various sized screens, and charge this slack to the ovens at a very much less price than given above, but when run of mine coal is used, or when miners are paid by run of mine, the above figures are a close approximation. If the rate paid for

mining be less than 40 cents per ton, the above table must be corrected accordingly.

Some companies, in both Kanawha and New river, are making coke for very much less than the above figures, which will represent the outside limit of cost.

The percentage of coke yielded per ton of coal used, will vary considerably, but the general practical rule seems to obtain that a charge of five tons of coal should yield not less than three tons coke (72 hours fires). While it may be also generally estimated that about four per cent of the fixed carbon of the coal analysis will be consumed in firing; or a ton of coal whose analysis shows 70 per cent of fixed carbon will yield 66 per cent of coke. However, there must be considerable variation from the above rule, according to management and other variable factors at each coke plant.

CHAPTER VIII.

Treating of General Facilities and Cost of Transportation of Coals from Mines to Markets.

1. Historical Sketch of Projects leading to Present Improvement of Great Kanawha River.
2. Facilities for, and Cost of Transportation by Water.
3. Facilities for, and Cost of Transportation by Rail.

SECTION I.—Historical Sketch of Projects leading to Present Improvement of the Great Kanawha River.

In the early history of Virginia, the advantages of a continuous water line connecting the deep harbors of tide-water and the inland waters of the Ohio and Mississippi rivers, attracted the attention of her greatest statesmen. But a few years after the cessation of hostilities with Great Britian, August 21, 1785, the James River Company was formed for the purpose of promoting the construction of such a water-way, with George Washington, as president, which position he continued to hold until October 5, 1795. In one of his letters, written during his incumbency, he says: "It can, I think, be demonstrated that the products of the western territory, as low down the Ohio as the Great Kanawha, and I believe to the falls (*e. g.*, now Louisville), and between the parts above to the lakes, may be brought to the highest shipping port on the James river at a less expense and with more ease, including the return, and in a much shorter time, than it can be carried to New Orleans."

The three routes then under consideration from the west to the seaboard, were the way across Ohio and New York by the Erie Canal, from Cincinnati 1,123 miles; by way of the Pennsylvania

State Canal, from Cincinnati 992 miles; and by way of the proposed Kanawha and James River Canal through Virginia, from Cincinnati, 784 miles.

For many years the agitation of this project became an important factor in Virginia state politics, and southern statesmen at Washington lent it their countenance as a national undertaking. However, the superior business alertness of the people of the State of New York in constructing the Erie Canal, entirely without national aid, and the subsequent similar achievement in Pennsylvania, connecting the Ohio with the sea, brought the more southern enterprise to a seeming permanent standstill, although the final completion of the great enterprise was never wholly abandoned by the people of Virginia.

In 1860–61, the project was again mooted. A company of French capitalist came forward and proposed to build the great work. In March of that year, the legislature of Virginia, with the consent of the stockholders, transferred all the rights and franchises of the James River and Kanawha Canal Company, successors of the old James River Company, to the French syndicate, who termed themselves "Bellot Minieres, Freres et Cie," on condition "that they should complete the water line improvement from tide-water at Richmond to the Ohio river, so as to give at all seasons of the year not less than six feet of navigable water for the entire length of the line." The civil war prevented the French from beginning the construction of the work, but in 1864–5, they again sought to take up the enterprise. The Emperor, Napoleon III, became interested in the project, and he directed the French ambassador at Washington, the Marquis de Monthalon, to give it all the support he could compatible with his official position. Negotiations with the now two States of Virginia and at Washington, were thus carried along several years. Meanwhile, General Grant entered the White House, and gave the project of this water-way the earnest support of his name. He knew the country to be traversed, and desired the construction of the canal as a national

enterprise. He brought the matter to the attention of congress in a special message, and at his instance a committee of senators and representatives was appointed, with Senator Roscoe Conkling, of New York, as chairman, who visited the proposed route, and advised the immediate improvement of the Great Kanawha river as an initial step. And thus it is, that this river is now almost completely locked and dammed for its entire length, thereby opening to the markets of the Ohio and Mississippi valleys, a limitless and continuous supply of cheap coal for at least ten months of the year, and securing these great centers of population, for all time, against coal famines and consequent industrial distress.

In the following pages is given a more succinct discussion of the transportation facilities now afforded the coal shipper by the improved water-way.

SECTION 2.—Facilities for and Cost of Transportation by Water.

The Great Kanawha river, flowing into the Ohio at Point Pleasant, 263 miles below Pittsburgh, opens to the shippers of coal by water, the entire inland water-way of the continent for all Ohio and Mississippi ports, affording over 16,000 miles of inland water navigation.

With the completion of the system of locks and dams, now being constructed in the Great Kanawha river by the United States government, deep water navigation will be assured adequate to enable the loaded coal boats and barges to be taken away from the mines throughout every month in the year. The coal barges as soon as loaded may be dropped down to Point Pleasant harbor, on the Ohio, and the fleets there lie ready to take advantage of every tide in that stream.

According to the records of the United States engineering department, this will enable coal to be shipped thence about 330 days out of the 365; and gives the Kanawha shippers a great advantage over the shippers of the Pittsburgh and Monongahela districts,

who have the greater distance of 263 miles to travel, and rarely have coal boat tides more than 190 to 200 days per annum. (According to the observations of the U. S. engineers.)

This elaborate system of well constructed locks and dams was begun in 1873, the actual construction of the first dam in 1875, and it is now well toward completion. Seven locks and dams are either finished or under construction, but three more are required to secure the final accomplishment of this great enterprise, and recent action by Congress provides some $2,000,000, for the immediate completion of the system.

The greater nearness of the Great Kanawha district to the markets of the west, will not only enable it to ship its coals more directly and speedily than coals can be shipped from the upper Ohio, but gives it the almost equally great advantage of the more speedy return of the empty barge when its burden of coal is discharged. Thus, a loaded barge can make from four and one-half to five round trips per year from the Great Kanawha district, while a similar barge can rarely make more than one to one and one-half round trips per year from the Pittsburgh and Monongahela districts to the same markets (Cincinnati). And the same money invested in the barge from the Great Kanawha district will thus earn more than three fold what it will earn from investment in the Pittsburgh barge; consequently the same tonnage of coal can be carried from the Great Kanawha region at a less charge per ton than from the pools of the Pittsburgh regions.

The locks of the Great Kanawha improvement are free and no tolls are levied, while the Monongahela districts are hampered with the exactions of onerous toll charges from a private corporation, which levies tribute of $2\frac{1}{4}$ to $7\frac{6}{10}$ cents per ton on every ton of coal issuing forth from the pools behind their dams.

The wise forethought of the congress of the United States in securing to the people of the lower Ohio and Mississippi valleys, a near and comparatively constantly open source of coal supply, has already shown its effects upon western industry in the prevention

of coal famines, and with the final completion of the improvements in the Great Kanawha river, now speedily assured, uniform and moderate prices for coal will be secured throughout the year to the consumers of Cincinnati, Louisville, Cairo, St. Louis, Memphis, and even New Orleans, as well as to the vast sections of outlying territory dependent upon these markets as centers of distribution.

The following table shows the number and location of the locks and dams in the Great Kanawha river as built and as located by the United States Government.

No. of Lock and Dam.	Location.	Kind of Dam.	
No. 2.	1 mile below Cannelton and 84¼ miles from mouth of river.	Fixed.	Finished in 1887.
No. 3.	1 mile below Paint Creek and 79¼ miles from mouth of river.	"	" 1882.
No. 4.	1½ miles below Coalburgh and 73 miles from mouth of river.	Movable.	" 1880.
No. 5.	9 miles above Charleston and 67¼ miles from mouth of river.	"	" 1880.
No. 6.	4½ miles below Charleston and 54 miles from mouth of river.	"	" 1886.
No. 7.	1¼ mile below St. Albans and 44 miles from mouth of river.	"	Now building.
No. 8.	2½ miles below Raymond City and 35¾ miles from mouth of river.	"	" "
No. 9.	3¾ miles above Buffalo and 25¼ miles from mouth of river.	"	Not begun yet.
No. 10.	2¾ miles below Buffalo and 18½ miles from mouth of river.	"	" " "
No. 11.	Foot Three Mile Bar and 1¾ miles from mouth of river.	"	" " "

Upon this subject of the slack water improvement of the Great Kanawha river, we quote from a valuable report by Mr. Addison M. Scott, U. S. engineer in charge:

"The works are planned to make an available depth of $6\frac{1}{2}$ feet, or full shipping water for coal, at all seasons. The chambers of the locks below Charleston are 342 feet long between quoins and 55 feet wide (those above Charleston are 300 feet by 50), sufficient to admit four large sized coal barges.

MOVABLE DAMS.

The first 'movable' dams in America in connection with slack water improvement were built on the Great Kanawha, Nos. 4 and 5, as stated above, being completed and put in operation in 1880. The usefulness and adaptability of movable dams are thoroughly established, and all on the river below No. 3, as shown by the table, are to be of this type.

Movable dams are kept up during low stages and down in high water. Their advantages over the ordinary fixed dams for a commerce and river like the Great Kanawha are decided, furnishing the benefits of the usual slack water without its most serious inconveniences and drawbacks. With fixed dams, every thing must pass through the locks. With them, navigation is entirely suspended, too, when the river is near or above the top of the lock walls. The difference between the fixed and movable dams in the scour and wash of the banks about the works, is also greatly in favor of the modern type.

With movable dams, the locks are used only when the water in the river is so low as to make them necessary. At all other times the dams are down flat, practically on the river bottom, out of the way, affording unobstructed, open navigation. This is a great advantage to all classes of commerce, and is particularly so with coal, transported as it is (and empty barges returned) in 'fleets' of large barges. More barges can, of course, be taken by a tow boat and much better time made in 'open river,' where there is

water enough for such navigation, than when the stage or discharge of the river compels the use of the locks.

The gauge record of the Great Kanawha, kept at the U. S. engineer office at Charleston, for the last 16 years, shows there is on an average 196 days in the year when there is 5 feet or more of water for 'open navigation' from Charleston down; the average for 16 years shows 142 days of 6 feet or more.* From this it appears that coal can be shipped by open river on about six months of the year, during which time the movable dams will be down. The rest of the time, or, in other words, when the river falls below a coal boat stage, the dams will be kept up, and make an available slack water depth of 6 feet.

CHEAP TRANSPORTATION.

The manner pursued in shipping coal on the Great Kanawha and Ohio rivers is generally understood and need not be particularly described. It makes remarkably cheap transportation, probably without exception, particularly when length of routes are compared, the lowest inland freight rates in the world.

The coal barges themselves, considering their capacity and service are cheap carriers; they cost from $800 to $1,200 and last about ten years. The barges are generally 130 feet long, 25 feet wide, and 7½ deep. A barge carries from 10,000 to 14,000 bushels, or from 400 to 560 tons; 480 tons, or 12,000 bushels per barge, is a fair average, equal, it will be remembered, to a train of 24 cars of 20 tons each.

A small tow of 4 barges, easily handled by a small tug or tow boat, and passed through the locks when the dams are up at one lockage, will have nearly or quite 50,000 bushels, or 2,000 tons, enough to fill 100 freight cars of 20 tons each.

In open navigation, a tow boat handles from 4 to 14 loaded barges in the Kanawha, depending on the stage of the river and the size of the tow boat. In the Ohio river, or from Point Pleasant

* See table and foot note on pages 135 and 136.

down, the Great Kanawha tow boats take from 14 to 34 barges. A fleet of 30 barges has about 375,000 bushels, or 15,000 tons; this amount of coal loaded into 20 ton cars *would make* 30 *trains of* 25 *cars each, or a continuous line of cars nearly* $5\frac{1}{2}$ *miles long.*

RATES OF TOWING COAL.

The general rate at present from the Charleston pool to Cincinnati is one cent per bushel or 25 cents per ton. Operators who hire barges pay half a cent a bushel barge rent, making the cost to Cincinnati, to operators who hire both barges and towing, $1\frac{1}{2}$ cents per bushel, or $37\frac{1}{2}$ cents per ton. This includes the return of the empty barge to the mine. This rate to Cincinnati (distance from Charleston 263 miles) is $1\frac{42}{100}$ mills (or about one-seventh of a cent) per ton per mile. For longer distances, or to points on the Ohio and Mississippi below Cincinnatii, the rates per mile are much less.

The usual rates from Cincinnati to the mouth of the Kentucky river, Louisville, and points between, amount to about $10\frac{1}{2}$ cents per ton, making the cost from the Charleston pool to Louisville, including towing and rent and return of barges, 48 cents per ton. The distance from Charleston to Louisville being 394 miles, makes the rate $1\frac{21}{100}$ mills per ton per mile.

The above rates, it will be noticed, are both for comparatively short distances.

A considerable quantity of the Great Kanawha coal is towed to different points on the lower Mississippi, as far down as New Orleans.

[The greater part of the coal for the Mississippi market is carried in larger and cheaper built craft than the ordinary barge, designated 'boats.' They are usually about 170 by 27 feet and from $7\frac{1}{2}$ to $8\frac{1}{2}$ feet draught, and carry from 20,000 to 25,000 bushels, or from 800 to 1,000 tons. These 'boats' are generally owned by the party that does the towing, and they are usually sold in these lower markets with the coal in them. Many of them are never brought back.]

The rate for these long distances is exceedingly low. Take it to New Orleans, for instance; the cost to the Kanawha operator

anywhere below Lock 3, who hires both barge and towing, is 5 cents per bushel, or $1.25 per ton. The distance from Charleston to New Orleans, 1,776 miles, makes the rate $\frac{7}{10}$ mill, *or about one-fourteenth of a cent per ton per mile.** ·

The rates to the three principal cities, Cincinnati, Louisville, and New Orleans given above, are the regular rates that have prevailed on the river now for at least three years; they may, in fact, fairly be called the highest rates, as they are never exceeded and there is really a good deal of towing done at considerably lower figures. As the river is improved and the business increases, the tendency is all the time to lower the rates. One of the largest companies on the river has been getting its coal towed to Cincinnati and Louisville by regular contract for the past two years at rates at least 20 per cent below those named above.

The rates given apply as stated to operators who hire both barges and towing. To operators who own their own barges or tow boats, or both, as some of the large concerns on the river do, the cost of transportation is, of course, materially less than the rates.

All of the rates given, it will be remembered, too, include 54 miles of the present unreliable and expensive navigation (as com-

* The next lowest inland rates are undoubtedly those of the great lakes of the North-west, where enormous quantities of heavy freight, such as iron ore, lumber, grain, and, coal, are carried, mainly by a system of towing in large barges. The average rate on the lakes in 1888, determined from records kept at the St. Mary's Falls Lock, under direction of Gen. O. M. Poe, Corps of Engineers, was $1\frac{1}{2}$ mills per ton per mile. The average length of route was 806.9 miles. In 1887, the rate was $2\frac{3}{10}$ mills per ton per mile for an average route of 811.4 miles. (See Report of Chief of Engineers for 1889, page 2220, etc.)

The average railroad rate last year on freight from Chicago to New York (distance 913 miles) was close to $4.50 per ton, or 5 mills per ton per mile; the lowest rate on grain was about $4.00 per ton, or $4\frac{38}{100}$ mills per ton per mile.

The rate on all the freight carried by the railroads in the United States in 1889, according to the Inter-State Commerce Commission, averaged $9\frac{22}{100}$ mills per ton per mile.

pared with the slack water improvement now under construction) on the Great Kanawha.

BENEFITS TO RESULT FROM THE COMPLETED IMPROVEMENT.

Under this head and in connection with the general subject, the following from an official report by the resident engineer to Col. Craighill, published in the Report of the Chief of Engineers for 1887, page 1921 *et seq.*, is of interest.

The benefits to result from the completion of the locks and dams to the mouth of the river, not alone to the Kanawha valley, but to the entire region of the lower Ohio and Mississippi, in the interests of cheap coal, are obvious and important. A brief presentation of two leading facts will make this plain.

1. It *will increase materially—nearly doubling—the time when coal can be shipped.*

The following is compiled from daily gauge records kept at Charleston and Point Pleasant (the mouth of the Great Kanawha) under your direction. It shows the number of days in each year there were 6 feet or more of water for navigation from Charleston down, and the same from Point Pleasant down; the Charleston gauge reading the available water for navigation in the Kanawha below; that at Point Pleasant the available water in the Ohio below:

Year.	No. of Days Charleston Gauge read 6 Feet or More.	No. of Days Point Pleasant Gauge read 6 Feet or More.
1879	164	235
1880	94	207
1881	126	215
1882	184	271
1883	138	294
1885	164	231
1886	82	287
Averages for 7 years	136 days.	248½ days.

This shows that there are on the average considerably over 100 more days during the year when coal can be shipped down the Ohio from Point Pleasant, by open navigation, than from the Great Kanawha. It also shows the shipping season to be much more uniform on this part of the Ohio than on the Kanawha.*

After the slack-water improvement is completed, the great part of the coal mined for river shipment during low stages (*i. e.*, when the movable dams are up) will be locked down to the mouth about as fast as the barges are loaded (with smaller tow-boats too, and less expense than now), and held there ready to go down the Ohio as the water in that stream admits.

The slack water will be of great advantage, too, in affording reliable navigation for the return of empty barges. There is much trouble about this in low stages of the Kanawha, and it is a frequent cause of suspension at the mines.

In short, the continuation of the locks and dams to the mouth of the river will not only nearly or quite double the time for shipping coal, but will, in effect, put the Great Kanawha coal fields about 300 *miles nearer to the markets of the Lower Ohio and Mississippi valleys.*"

* The records since 1886 shows as follows:

YEAR.	NO. OF DAYS CHARLESTON GAUGE READ 6 FEET OR MORE.	NO. OF DAYS POINT PLEASANT GAUGE READ 6 FEET OR MORE.
1887	140	207
1888	96	199
1889	170	309
1890	189	307
Averages for 11 years	140 days.	251 days.

SECTION 3.—Transportation by Rail.

(*a*) *From the Great Kanawha District.*

(*b*) *From the New River District.*

(*c*) *From the Upper Elk and Gauley Districts.*

(*d*) *From the Flat Top, and Guayandotte, and Twelve Pole Districts.*

(*a*) *From the Great Kanawha District.*

The Great Kanawha district is opened and traversed by two railway lines—the Chesapeake and Ohio Railway system, and the Kanawha and Michigan Railroad in connection with the Toledo and Ohio Central Railway system, of which it forms a part.

The Chesapeake and Ohio Railway gives the collieries of the district rail connection with eastern markets and tide-water transportation, with rates, however, varying from 5 to 3 mills per ton per mile, which practically compels all eastward moving coals to be sold through the co-ordinate organization—the Chesapeake and Ohio Coal Agency.

For westward moving coals, the competition of the free navigation of the improved Great Kanawha river secures greater freedom of action to all shippers of coal to western markets, and rates which permit all rail shipments of coals and cokes direct from mines to individual consumers.

The prevailing west bound coal rates over the railroad have been nominally about 4½ mills per ton per mile, but, in fact, the district has frequently enjoyed a rate much within these limits.

The distances by rail to Cincinnati and Chicago are, respectively, 211 and 516 miles, and the nominal standard rates of $1.00, to the former, and $2.25 per ton, to the latter market, have frequently been reduced to .75 and $2.00 to meet the necessities of the trade. While the railroad company has guaranteed to the district, at all times, as low a rate to the Chicago market as shall prevail from the Pittsburgh district to the same.

The Kanawha and Michigan Railroad Company, now operated as part of the Toledo and Ohio Central system from Malden, six miles above Charleston, to its connection with that road at Corning, Ohio, a distance of about 130 miles, gives another outlet from the Kanawha valley to the great lakes, and another connection by rail to Cincinnati and Chicago. This road carries considerable coal from the mines in the Pittsburgh seam of the No. XV Measures, in Putnam county, and when the extension to Gauley river, now under construction, is completed, will open a valuable and promising field in the Nos. XIV and XIII Measures of the Upper Kanawha, which now lies undeveloped or wholly depends upon water transportation.

The local and through rates upon this road are usually the same as those offered by the Chesapeake and Ohio for similar coals.

(*b*) *From the New River District.*

The New river district is altogether dependent upon the transportation facilities of the Chesapeake and Ohio Railroad Company for the carriage of its coals and cokes to markets.

The rates given the individual shippers for eastward moving tonnage have generally not exceeded 3 mills per ton per mile, while a large proportion of the product is sold at the mines to the Chesapeake and Ohio Agency.

For westward moving tonnage a rate has generally been offered permitting these coals, and especially the cokes, to meet, successfully, the competition of the Pennsylvania and other fields.

Taking into consideration the rapid expansion of the coal and coke production along the line of the Chesapeake and Ohio Railway, and the continually greater demand in both eastern and western markets for the coals and cokes mined and made along its route, it is but fair to say that the railroad management have exercised great enterprise in the effort to furnish trackage and equipment adequate to give every facility for the increasing tonnage offered. But, at the same time, their efforts have fallen considerably short

of the needs of the districts, and the failure to keep pace with this expansion, has largely crippled a development that would have otherwise occurred.

We here insert a

TABLE SHOWING COST TRANSPORTATION PER TON PER MILE.

	DISTRICT.	BY WATER.	BY RAIL.
Eastward.	Kanawha.	....	3 to 5 mills.
	New River.	....	3 to 4 mills.
Westward.	Kanawha.	1⅔ mills.	3½ mills.
	New River.	... .	3 to 5 mills.

which illustrates the great advantage to shipper of the now improved water transportation. The water carriage being about 2½ times as cheap as rail transportation, and this low rate, also, serving to hold railroad charges to a minimum.

(c) *From the Upper Elk and Gauley Districts.*

The West Virginia and Pittsburgh Railroad, a branch of the Baltimore and Ohio Railroad, is now building to the Gauley river in Webster county, and traverses the valley of Elk river, in Braxton county, thus opening to commerce and future development the mineral wealth of coking coals in these districts.

The Charleston, Clendenin and Sutton Railroad is also ascending Elk river from Charleston, and if it be extended to the coking coal beds of the Upper Elk valley, will afford another outlet westward for these coals.

The Gauley river branch of the Chesapeake and Ohio Railway is now under construction from the main line up the Gauley river, and should this road be pushed to the coking coal district of the Upper Gauley, a second outlet toward the west will be given this region.

The West Virginia Central and Pittsburgh Railroad now reaches Beverly, in Tygart's river valley, in Randolph county, and has approached from the east to within 30 miles of the coking coal beds of Webster and Randolph counties, and it is possible that this system, connecting as it does with the Pennsylvania lines, may yet afford an open way for the transportation of these coals eastward to the seaboard.

As yet, however, the West Virginia and Pittsburgh Railroad (branch of the B. & O. R. R.) is the only railway actually entering these coal districts.

(*d*) *From the Flat Top, and Guayandotte, and Twelve Pole Districts.*

Transportation in the Flat Top mountain district is wholly by rail, and the dependence of that region wholly upon the Norfolk and Western Railroad Company.

The first railroad track into this then unbroken wilderness was laid in 1882, and the marvelous expansion and development of the coal mining and coke producing trade of the district, within the short period of nine years, is the best evidence of the liberal and vigorous policy exercised by the management of that road. The better to enable the shippers of the region to meet the opposing competition of longer established trade, a common agency has been established for the selling of the coals, and this agency has taken the product of the mines, arranging with the railroad company for the furnishing of the necessary cars and daily distribution, *pro rata*, of empties among the mines upon a strictly impartial basis. Hence, the question of rates to the seaboard has not been one of general concern to the producer, but of private contract between the railroad company and the selling agency, and has always been so adjusted that the entire output of coal and coke from the rapidly expanding collieries has been promptly and efficiently handled.

For the western trade, the Flat Top coals have had, as yet, no direct outlet, but with the completion of the Norfolk and Western Railroad to the Ohio, at Kenova, probably during the year 1892, it

is likely that the strong and liberal system which has been inaugurated and conducted so successfully with regard to the eastern trade, will also be employed in meeting competition and opening markets in the west.

CHAPTER IX.

Treating of Market Prices, with comparative Tables showing Market Ratings over a series of years, and in comparison with other competing Coals of Ohio, Pennsylvania, etc., showing at the same time the Current Ruling Prices of Great Kanawha, New River, and other Bituminous Coals in the Cincinnati and Chicago markets over a series of consecutive years.

These tables are interesting, inasmuch as they demonstrate the high prices obtained for these West Virginia coals in competition, in open market, with the well known and longer established coals of the Pennsylvania and Ohio coal districts.

TABLE I.

AVERAGE PRICE GREAT KANAWHA COAL, AFLOAT, CINCINNATI, O.

DATE OF YEAR.	PRICE PER BUSHEL.		PRICE PER LONG TON, 2240 LBS.		AVERAGE PRICE FOR 13 YEARS. PER BUSHEL.		PER LONG TON, 2,240 LBS.	
	Cents.	Mills.	$	Cents.	Cents.	Mills.	$	Cents.
1890-91	.....	.....	.....	.....	7	8.1	2	19
1889-90	7	0 4	1	97	.....	.....	.....	.....
1888-89	6	7.7	1	90	.....	.....	.....	.....
1887-88	9	7 5	2	73	.....	.....	.....	.....
1886-87	7	2 6	2	03	.....	.....	.....	.....
1885-86	6	2 4	1	75	.....	.....	.....	.....
1884-85	7	4.3	2	08	.....	.....	.....	.....
1883-84	7	5 4	2	11	.....	.....	.....	.....
1882-83	7	9 6	2	21	.....	.....	.....	.....
1881-82	9	0 8	2	54	.....	.....	.....	.....
1880-81	9	6.7	2	70	.....	.....	.....	.....
1879-80	8	6 6	2	42	.....	.....	.....	.....
1878-79	7	1.0	2	00	.....	.....	.....	.....
1877-78	7	1.0	1	99	.....	.....	.....	.....

TABLE II.

AVERAGE PRICE GREAT KANAWHA COAL, DELIVERED, CINCINNATI, O.

DATE OF YEAR.	PRICE PER BUSHEL.		PEICE PER LONG TON.		AVERAGE PRICE FOR 13 YEARS.			
					PER BUSHEL.		PER LONG TON, 2,240 LBS.	
	Cents.	Mills.	$	Cents.	Cents.	Mills.	$	Cents.
1890-91	.....	.....	.....	.....	11	7.6	3	29
1889-90	10	7.6	3	01	.....	.....	.....	.....
1888-89	10	7.0	2	99	.....	.....	.....	.....
1887-88	13	2.7	3	72	.....	.....	.....	.....
1886-87	10	8.6	3	04	.....	.....	.....	.....
1885-86	9	6.5	2	70	.....	.....	.....	.....
1884-85	10	7.3	3	00	.....	.....	.....	.....
1883-84	11	6.5	3	26	.....	.....	.....	.....
1882-83	12	2.5	3	43	.....	.....	.....	.....
1881-82	14	4.7	4	05	.....	.....	.....	.....
1880-81	14	8.7	4	16	.....	.....	.....	.....
1879-80	12	5.5	3	51	.....	.....	.....	.....
1878-79	10	7.0	3	00	.....	.....	.....	.....
1877-78	10	4.5	2	93	.....	.....	.....	.....

Showing a steady average rise in prices of Kanawha coal (excepting last two years), thus indicating their stronger and stronger position in the market year by year.

TABLE III.

AVERAGE PRICES PER TON GREAT KANAWHA AND OTHER COALS IN CHICAGO MARKET OVER A SERIES OF YEARS FROM N. Y. COAL TRADE JOURNAL REPORTS.

LOCALITY OF PRODUCTION.	1887, Nov. 2.		1888, Nov. 7.		1889, Nov. 5.		1890, Nov. 5.		1891, Nov. 4.		AVERAGE.		REMARKS.
	$	cts	$	cts	$	cts	$	cts	$	cts	$	cts	
Kanawha District.													
Black Band Mine	4	50	4	25	4	00	..	..	..	..	4	25	
Winifrede	3	50	3	50	3	50	3	60	3	75	3	57	Splint coals.
Raymond	4	00	3	75	3	50	3	60	..	..	3	71	
Plymouth	..	..	3	65	3	50	3	60	..	.	3	58	
Belmont	..	..	..	..	3	50	..	..	..	..	3	50	
Pittsburgh	3	60	3	35	3	20	3	40	3	40	3	38	
Youghiogheny	3	60	3	45	3	30	3	40	3	45	3	45	Splint and bituminous coals.
Hocking Valley	3	40	3	25	3	10	3	30	3	10	3	23	
Shawnee	3	30	3	25	3	10	3	30	3	10	3	21	
Baltimore and Ohio	3	30	3	25	3	10	..	..	..	..	3	21	
Sandy creek	3	30	3	25	3	10	3	30	3	10	3	21	
Jackson Hill, Ohio	3	45	3	30	3	35	3	45	3	35	3	38	
Erie	4	50	4	25	4	25	4	25	4	25	4	30	
Briar Hill	4	50	4	15	4	25	4	25	4	25	4	25	
Kanawha cannel	4	75	4	50	4	50	4	50	..	..	4	56	
Buckeye cannel	..	..	6	00	5	00	5	00	5	25	5	31	Cannel coal.
Brush creek cannel	4	75	4	00	4	25	4	25	..	..	4	44	

TABLE IV.

AVERAGE PRICE PER TON KANAWHA, NEW RIVER, FLAT TOP COKES, CHICAGO, N. Y. COAL TRADE JOURNAL REPORTS.

LOCALITY OF PRODUCTION.	1887, Nov. 2.		1888, Nov. 7.		1889. Nov. 5.		1890, Nov. 5.		1891, Nov. 4.		AVERAGE.		
	$	cts	$	cts	$	cts	$	cts	$	cts	$	cts	
New River	4	25	5	75	..	..	..	..	..	..	5	00	W. Va.
Flat Top, Pocahontas mine	5	75	..	..	..	..	..	.	.	..	..	..	
Connellsville	5	60	5	25	5	55	3	90	5	0	4	95	Penna.
Wolston	4	40	4	25	4	55	5	20	5	0	4	68	
Blossburgh	..	..	..	..	5	80	..	..	..	..	..	..	

CHAPTER X.

General Summary, etc.

[*Summary of facts portrayed in the foregoing pages concerning the chemical and physical qualities of the coals of West Virginia their cost of production, transportation and market ratings. As shown by the foregoing tables of analyses of coals and cokes (Part I)*].

1. The coals of West Virginia, herein reviewed, average higher in percentage of fixed carbon, and lower in ash and sulphur and trace of phosphorus, than any of the coals of Pennsylvania, Ohio, Indiana, Maryland, Tennessee, Georgia, Alabama, or other known coal fields in the United States. They are, in fact, remarkable for their general purity.

2. The cokes produced by these coals are equally pure, being unexcelled in their high percentage of fixed carbon, and low percentage of ash, sulphur and trace of phosphorus. They consequently make the hottest fires and leave the least residuum of ash. In physical structure they rate with the highest product of Connellsville, but are, because of their very purity, a trifle softer and more inclined to breeze.

3. The seams of coals lying in horizontal beds are worked by drifts and with economy in ventilation and drainage.

4. The coals are dug cheaper on an average than are similar coals in Pennsylvania and Ohio.

5. The coals, with equal care and management, can be handled as cheaply as those of other districts.

6. In matter of water transportation, the coals of the Great Kanawha district have an advantage over the coals of the Pittsburgh and Monongahela districts of free lockage and a saving of $2\frac{1}{2}$ to $7\frac{6}{10}$ cents per ton lockage dues, and of 209 miles in distance, and have about 300 days floatable water against 130 to 140 days in the Pittsburgh district.

In matter of rail transportation, whether the coal fields of West Virginia are to be opened and developed as have been those of Pennsylvania and Ohio, must depend upon the facilities offered, and liberal management, on the part of the great trunk lines now traversing and opening up the state.

7. In market rating where coals go in unhampered and upon their merits, as of late into the Chicago market and north-west, West Virginia coals are ranking highest and bringing higher prices per ton than any others.

And wherever free competition prevails, whether in the markets of Cincinnati and Chicago, or in New Orleans and even Birmingham, in Alabama, there may be found these West Virginia coals or cokes steadily winning the markets against those already and longer established.

CHAPTER XI.

Appended Tables and Statistics.

Table Showing Location of Collieries in the Kanawha, New River and Flat Top Coal Districts.

(1.) GREAT KANAWHA DISTRICT, FAYETTE, KANAWHA AND PUTMAN COUNTIES.

NAME OF COLLIERY.	NAME OF OPERATOR.	NAME OF SUPERINTENDENT.	POST-OFFICE ADDRESS.
Ansted Mines	The Gauley Mountain Coal Co	William N. Paige	Ansted
Belmont, Nos. 1 and 2	Belmont Coal Co.	J. C. Morrison	Crown Hill
Black Band Mining and M'f'g Co.	Blackband Mining and M'f'g Co.	A. M. Wooldridge	Spring Hill
Black Diamond	Peel Splint Coal Co	Z. W. Krieger	Lewiston
Black Peerless	Black Peerless Coal Co.	C. B. Smith	Lewiston
Campbell's Creek Coal Co.	Campbell's Creek Coal Co	J. L. Dana	Malden
Cannelton, Nos. 1, 2, 3	Cannelton Coal Co.	Henry Davis	Cannelton
Cedar Grove. Nos. 1 and 2	Cedar Grove Mining Co	J G. W. Tompkins	Cedar Grove
Champion	Champion C. C. Co	Champ	Crown Hill
Chesapeake	Chesapeake Mining Co	J. B. Lewis	Handley
Chestnut Point	Eastbank Coal and Coke Co.	J. W. Wilson	Eastbank
Coalburg	Robinson Coal Co.	Arthur Robinson	Coalburg
Dickinson's	J. Q. Dickinson & Co	J. Q. Dickinson	Malden
Eagle	Wyant Coal and Coke Co.	Wm. Wyant	Eagle
Eastbank	Eastbank Coal and Coke Co.	J. W. Wilson	Eastbank
Edgewater	Carver Bros	John Carver.	Edgewater
Eureka	M. T. Davis & Co.	M. T. Davis	Montgomery
Excelsior	M. T. Davis & Co.	M. T. Davis	Montgomery
Great Kanawha Colliery	Great Kanawha Colliery Co.	Symington Macdonald	Mt. Carbon
Kanawha, Nos. 1, 2, and 3	Consolidated Mining Co	Chas. Trudgeon	Union Mines
Lewiston Coal Works	Lewiston Coal Co	M. Beane	Lewiston
Monarch	Monarch Coal Co	J. D. Harris	Peabody
Mt. Morris	Mt. Morris Coal Co.	Samuel Chirgwin	Union Mines
Peabody	Peabody Coal Co.	J. A. Carter	Shrewsburg
Peerless	Peerless Coal Co.	S. W. Bard	Peerless
Pioneer	Pioneer Coal Co.	J. J. Lovell	Malden
Powellton Mines	Mt. Carbon Co. (limited)	Evan Powell	Powellton
Standard	Standard Coal Co		Handley
Stevens Acme and Keystone	Stevens Coal Co.	F. L. Garrison	Coalburg
Straughan Mining Co.	Straughan Mining Co	W. H. Straughan	Malden
Union, Nos. 1 and 2.	Union Coal Co	J. P. Chapman.	Union Mines
Upper Creek			Handley
Winifrede, Nos. 1, 2, 3, 4, 5, 6.	Winifrede Coal Co.	R. B. Cassady	Winifrede
PUTNAM COUNTY.			
Bancroft Mine	Kanawha and Lake Erie Coal Co.	Thos. Bancroft.	Lock Eight
Florence Mine	Marmet Co.	R. Woodward	Raymond City
Queen City Mine	Queen City Mining Co.	Wm. Grauer.	Queen City.
Plymouth Mine.	Carver Coal Co	John Carver.	Plymouth

(2.) Kenova or Twelve Pole Coal District, Wayne County.

Name of Colliery.	Name of Operator.	Name of Superintendent.	Post-office Address.
Coal Dale	Coal Dale M. & M. Co.	J. H. Toudy	Fleming
Dunlow	Dunlow Coal Co	E. J. Collins	Dunlow
Ferguson	Ferguson Coal Co.	E. W. Oviatt	Ferguson
Hope	Hope Splint Coal Co	John Weysemiller	Ferguson

(3.) New River Coal District.—Fayette and Raleigh Counties.

Alaska	Alaska Coal and Coke Co.	Geo. Lawson	Claremont
Beechwood and Keystone	Beechwood Coal and Coke Co	C. C. Beury	Claremont
Caperton	William Beury, Cooper & Co	Edward Crickmer	Caperton
Central	Central Coal Co.	J. R. Seal	Fire Creek
Dimmock	Dimmock Coal & Coke Co.	W. T. Thayer	Beury
Echo	William Beury, Cooper & Co.	Jo. L. Beury	Beury
Elmo	W. A. Burke Coal Co	J. D. Thomas	Elmo
Fayette	Fayette Coal and Coke Co	John A. Boone	Fayette Station
Fire Creek	Fire Creek Coal and Coke Co	M. Erskine Miller	Fire Creek
Gaymont	Gaymont Coal and Coke Co.	F. Howald	Hawk's Nest
Keeney's Creek	Nuttalburg Coal and Coke Co	W. H. Holland	Nuttalburg
New River	New River Coal and Coke Co.	J. H. Ferguson	Caperton
Nuttalburg	Nuttalburg Coal and Coke Co	W. H. Holland	Nuttalburg
Quinnimont	Quinnimont Coal and Iron Co	D. C. Boyce	Quinnimont
Royal	Royal Coal and Coke Co.	James Ray	Prince, F'y'te Co ,W.Va.
Rush Run	Rush Run Coal and Coke Co	F. Howald	Rush Run
Sewell	Longdale Coal and Iron Co.	J. A. McGuffin	Sewell Depot
Sterling Mine	Edwards & Young	W. E. Edwards	Clifton
Stone Cliff	Beury Coal and Coke Co.	O. C. Kuback	Stone Cliff
Sunny Side	Thomas Coal and Coke Co	Edward Thomas	Hawk's Nest
Thurmond	Thurmond Coal and Coke Co		Thurmond

(4) Flat Top Mountain Coal District, Mercer County.

Name of Colliery.	Name of Operator.	Name of Superintendent.	Post-office Address.
Caswell	Freeman & Jones	John Freeman	Freeman's
Coal Dale	Coal Dale Coal and Coke Co	J. A. Williams	Coal Dale
Buckeye	Buckeye Coal and Coke Co.	J. D. Hewitt	Freeman's
Elkhorn	Freeman & Jones	John Freeman	Freeman's
Goodwill	Robt. Goodwill & Co.	Philip Goodwill	Flipping
Hemlock	Freeman & Jones	John Freeman	Freeman's
Louisville	Louisville Coal and Coke Co	Justus Collins	Flipping
Millcreek	John Cooper & Co.	John Cooper	Cooper's
Reliance	Booth Bowen Coal & Coke Co.	Jas. Booth	Freeman's

McDowell County.

Algoma	Algoma C. & C. Co.		
Barlow's	Elkhorn Coal and Coke Co	A. Barlow	Maybeury
Bottom	Bottom Creek Coal and Coke Co	Wm. Spencer	
Crozer	Crozer Coal and Coke Co.	J. J. Tierney	Elkhorn
Empire	Empire C. & C. Co.	Wm. D. Orr	
Eureka	Eureka Coal and Coke Co.		
Gilliam	Gilliam C. & C. Co.	W. C. Brooke	Algoma
Greenbrier	Greenbrier Coal and Coke Co	W. D. Tyler	
Houston	Houston Coal and Coke Co.	T. E. Houston	Elkhorn
Lick Branch	Norfolk Coal & Coke Co	E. J. Hutchinson	Maybeury
Lynchburg	Lynchburg Coal and Coke Co.	L. E. Tierney	Kyle
Keystone	Keystone Coal and Coke Co	Jno. D. Hewett	
McDowell	McDowell Coal and Coke Co	Jno. Cooper	
Norfolk	Norfolk Coal and Coke Co.	Stuart M. Buck	Maybeury
Peerless	Peerless Coal and Coke Co	J. J. Tierney	
Pocahontas, W. Va., Mine	South-western Virginia Improvement Co.		Pocahontas, Va
Powhatan	Powhatan Coal and Coke Co	J. J. Tierney	Elkhorn
Pulaski	Pulaski Coal and Coke Co.	James E. Ellwood	
Rolf	Rolf Coal and Coke Co		
Shamokin	Shamokin Coal and Coke Co.	T. L. Henritze	Maybeury
Shawnee	Shawnee Coal and Coke Co.		
Turkey Gap	Turkey Gap Coal and Coke Co.	T. B. Dennen	Ennis
Upland	Upland Coal and Coke Co		

COMPARATIVE STATISTICS

Concerning the Coal and Coke Production of the Entire State from 1880 *to* 1891 *inclusive.*

STATISTICS OF WEST VIRGINIA COAL PRODUCTION, 1880–1891.

YEARS.	Inside Miners.	Outside Laborers.	Total production. Ton 2,240 lbs.	Percentage of Increase.	Average Annual Increase.
1880	2,553	1,173	1,253,579	.....	
1881	3,063	1,407	1,610,700	28.48	
1882	3,573	1,641	2,158,000	33.90	
1883	4,438	1,956	2,805,556	30.00	
1884	4,627	1,724	2,901,642	3.40	
1885	5,486	1,806	3,008,091	3.60	
1886	6,081	1,181	3,213,093	6.80	
1887	7,023	1,582	4,407,875	37.18	
1888	7,269	1,705	4,799,611	8.89	
1889	7,764	1,882	4,826,047	0.55	
1890	9,173	2,324	5,359,000	11.04	
1891	10,434	2,589	7,281,430	35.87	
					Average annual percentage of increase from 1881 to 1891, 18.16.

STATISTICS OF THE MANUFACTURE OF COKE, 1880–1891.

YEARS.	No of Ovens.	Ovens Building.	Coal Used.	Coke Produced.	Total Value of Coke at Ovens.	Value of Coke at Ovens per ton.	Per cent of Yield of Coal in Coke.
1880	631	40	306,034	121,715	$318,797	$2.30	60.0
1881	689	189	272,163	164,058	429,571	2.30	61.0
1882	878	84	321,625	202,103	520,437	2.26	63.0
1883	962	43	360,664	225,993	563,490	2.19	63.0
1884	1,005	127	385,588	288,472	425,952	1 91	62.0
1885	1,078	63	415,533	260,571	485,188	1.86	63.0
1886	1,154	317	425,002	264,168	513,843	1.94	62.0
1887	2,080	442	698,327	442,031	976,732	2.21	63.3
1888	2,137	68	786,139	499,985	.....	.....	63.6
1889	2,453	142	562,739	360,715	.....	.....	64.1
1890	3,442	184	1,377,299	892,490	.....	.....	64.8
1891	4,117	777	1,899,122	1,238,418	.....	.....	65.21

THE WORLD'S PRODUCTION OF COAL.

DETAILED STATEMENT OF THE WORLD'S OUTPUT OF COAL, IN TONS, FOR YEARS INDICATED.

COUNTRIES.	1890.	1889.	1888.	1887.
Great Britain	181,614,000	176,917,000	169,935,000	162,120,000
United States	140.032,000	132,419,000	132,549,000	120.147,000
Germany	87,591,000	84,341,000	76,864,000	76,115,000
Other Countries	88,893,000	72,899,000	76,181,000	72,919,000
Total tons	498,130,000	468,576,000	455,529,000	431,301,000

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ERRATA.

Page 14, ninth line from bottom, omit "*from its lower bed.*"

Page 15, bottom line, last word, read "*Seams.*"

Page 45, tenth line from bottom, omit fifth word, "*three.*"

Page 71, the word *Cannel* should follow designation, "Cannelton" and "Boone County," at top of table.

Page 78, Table, read "Stephenson and *Mullins*"; read *Arnot* Seymour.

Page 118, thirteenth line from top, read *9* for *11.*

Page 127, fifteenth line from top, second word, read *Capitalists.*

Page 138, twelfth line from bottom, read Chesapeake & Ohio *Coal* Agency.

Page 148, Table, sixth name of superintendent, read *J. E. Dana.*

Page 159, Index, under head "Rivers," insert Great Kanawha River, 8–16, 17, 45, 81–85, 96, 126–136.