VIRGINIA DIVISION OF MINERAL RESOURCES
PUBLICATION 85

MINING HISTORY OF THE RICHMOND COALFIELD OF VIRGINIA

Gerald P. Wilkes

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF MINES, MINERALS AND ENERGY
DIVISION OF MINERAL RESOURCES
Robert C. Milici, Commissioner of Mineral Resources and State Geologist

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FRONT COVER: Boy and haulage mule (Humphrey, 1959).

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DEPARTMENT OF MINES, MINERALS AND ENERGY
RICHMOND
O. Gene Dishner, Director

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF PURCHASES AND SUPPLY
RICHMOND

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MINING HISTORY OF THE RICHMOND COALFIELD OF VIRGINIA

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ABSTRACT

The first commercial production of coal in the United States was in 1748 from the Richmond coalfield located in the Richmond Triassic basin of Virginia. Over the next 200 years, hundreds of drill holes, shafts, slopes, and open pit mines were developed, of which 71 mines and 38 drill holes have been located in the field. Coal quality information is represented by 112 coal and coke analyses from mining operations. Directly related to the development of the coalfield were transportation improvements, such as the Midlothian Turnpike, two canals, and four railroad companies with several miles of main and spur lines. Mining engineering practices were also improved by the Richmond coal industry. Initially, mining was haphazard and accidents and lost coal were common; explosions of methane or coal dust alone claimed at least 311 lives. Modern mining methods such as ventilation and dust control, roof support, and mechanized mining machinery were in use when the last major operation closed in 1927 due to competition from other coalfields. Attempts to mine coal continued sporadically through the 1950s but recent interest in the coalfield is related to the potential for in-situ degasification of the coal beds.

INTRODUCTION

Coal is a basic ingredient of an industrial society. The United States is blessed with an ample supply of this fossil fuel, which has helped our country to become the world's industrial leader. The story of coal in the United States began with discoveries along the Illinois River in what is now western Illinois in 1673 and 1679 and along the James River west of Richmond in 1701. With easy access to a tidewater port, the Richmond coalfield developed rapidly. The first documented coal production in the United States was from the Richmond field in 1748. In the years to follow, this field produced an estimated 8-million tons of coal.

Transportation facilities were a major influence on the Richmond coal industry. Ocean-going vessels could dock and load on the James River as far inland as Richmond. The Richmond coal mines were only ten to fifteen miles from the docks, and road improvements, such as the Midlothian Turnpike (now U.S. Highway 60), were built to handle coal wagon traffic. The James River and Kanawha Canal, one of George Washington's dreams, moved large amounts of coal to tidewater docks. Later, the canals were replaced by the more efficient rail lines. The Chesterfield Railroad, one of Virginia's first rail lines, was built solely to move coal.

While Richmond coal production was increasing, other coalfields were also being developed. The bituminous coal and anthracite regions of Pennsylvania, Maryland, and the Valley fields of western Virginia began shipments to tidewater ports by the middle 1800s. Soon to follow were coals from the Flat Top and Pocahontas fields in southwestern Virginia and West Virginia. Competition from these fields, an economically and socially devastating Civil War, and mismanagement of mining operations took their toll on Richmond coal production. The larger mines continued operations in the late 1800s but the coal was becoming increasingly difficult to mine and production steadily declined. In 1927 the last major mines closed, 226 years after the initial discovery. A few attempts were made to reopen old mines or start new ones up to the 1950s, but none have proved to be a profitable venture. Recently, exploration efforts in the basin have been aimed toward coal-bed methane or oil. To date, these efforts have not resulted in commercial development.

Even with such an extended mining history, relatively few documents of a geologic or engineering nature exist. There are hundreds of drill holes and exploration pits throughout the Richmond coalfield, but because most of them are undocumented or incompletely documented, they are of little use in understanding the history of the basin. This paper presents historical information obtained by the writer in an effort to compile reliable data on the coal resources as well as to describe their historical significance. Some mine maps and cross sections were modified primarily for legibility but the accuracy of the information was maintained as much as possible. Readers are encouraged to notify the Virginia Division of Mineral Resources of any discrepancies or additional information so that a more accurate record of this interesting region may be compiled.

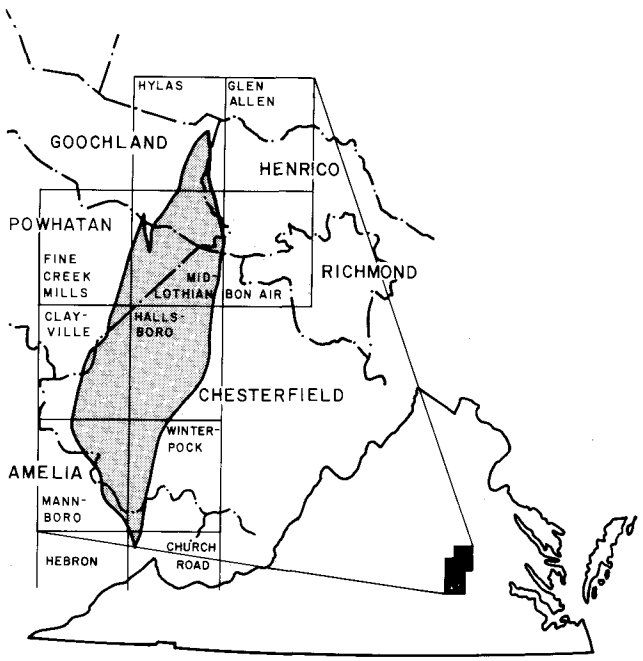


Figure 1. Location map of the Richmond basin.

PHYSIOGRAPHIC SETTING

The Richmond coalfield, located in a structural basin filled with Triassic-age sediments, is in parts of Amelia, Chesterfield, Goochland, Henrico, and Powhatan counties, Virginia (Figure 1). The basin occupies parts of the Glen Allen, Hylas, Fine Creek Mills, Midlothian, Bon Air, Clayville, Hallsboro, Mannboro, Winterpock, Hebron, and Church Road 7.5-minute quadrangles (Figure 1).

The Appomattox and James rivers and their tributaries constitute the major drainages in the area. The location of these rivers in relation to the coal was an important factor in the early development of coal mining.

Current land use in the basin is primarily forest and agricultural. The area is predominantly rural with small communities scattered throughout. Several large antebellum estates are located within the basin, especially near the James River. Suburban expansion has developed in the Gayton and Midlothian areas on and near the old coal mining properties.

Five major east-west highways (U.S. Highways 250, 60, 360, State Highway 6, and Interstate Highway 64) and several secondary roads provide excellent access to the basin. Also traversing the basin in an east-west direction are the Southern Railway System and CSX Transportation, Inc.

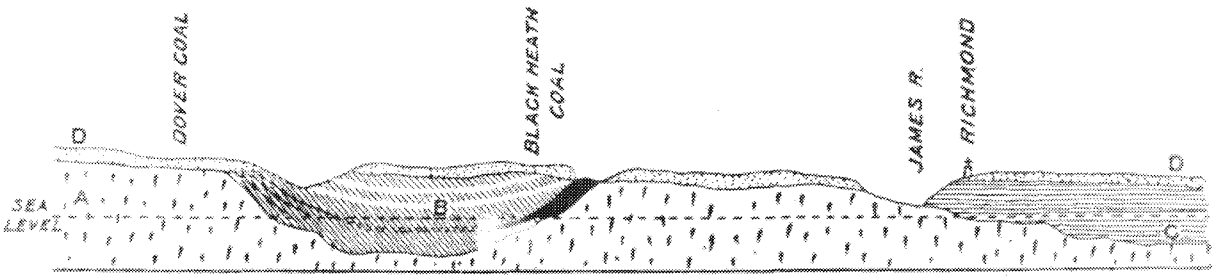


Figure 2. Geologic cross section of the Richmond basin by Lyell (1847).

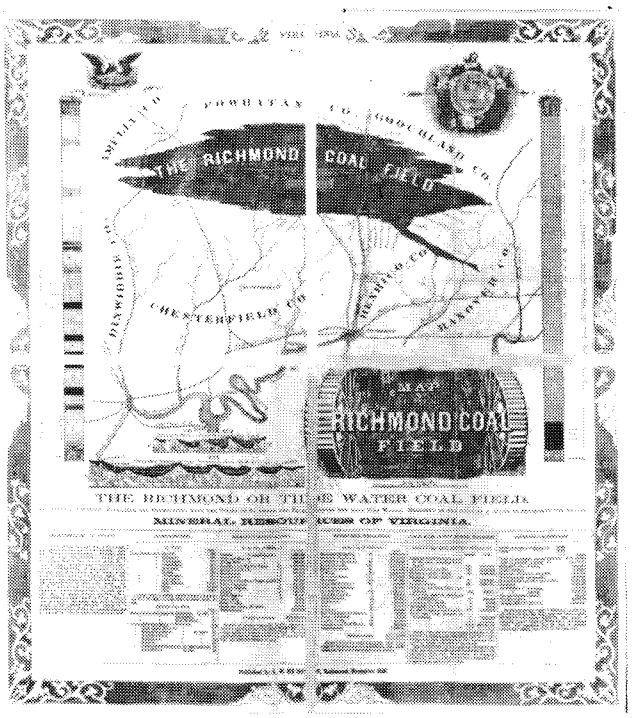
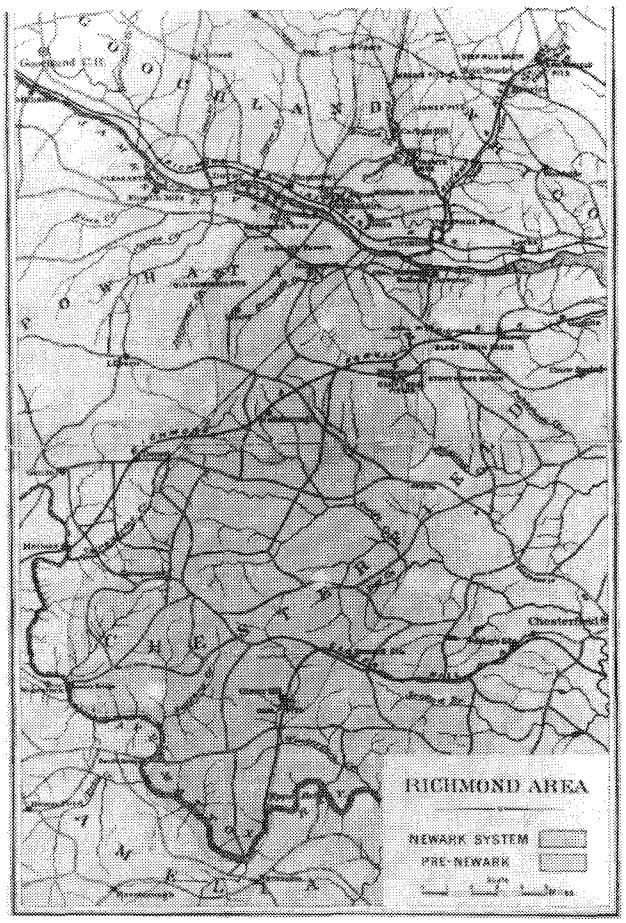


Figure 3. Geologic map of the Richmond basin by DeBow (1860).



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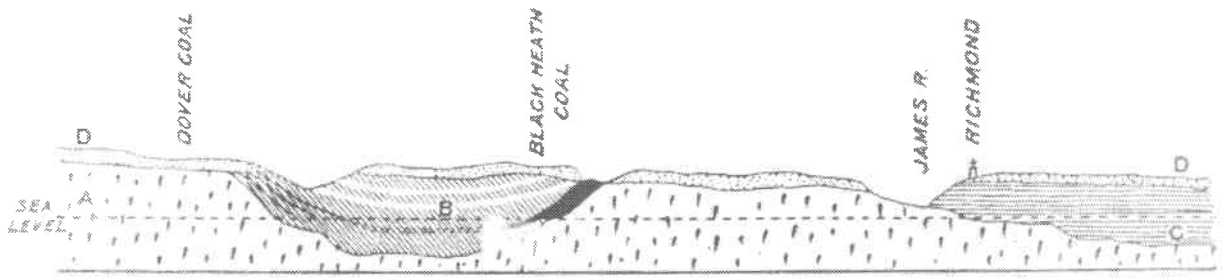

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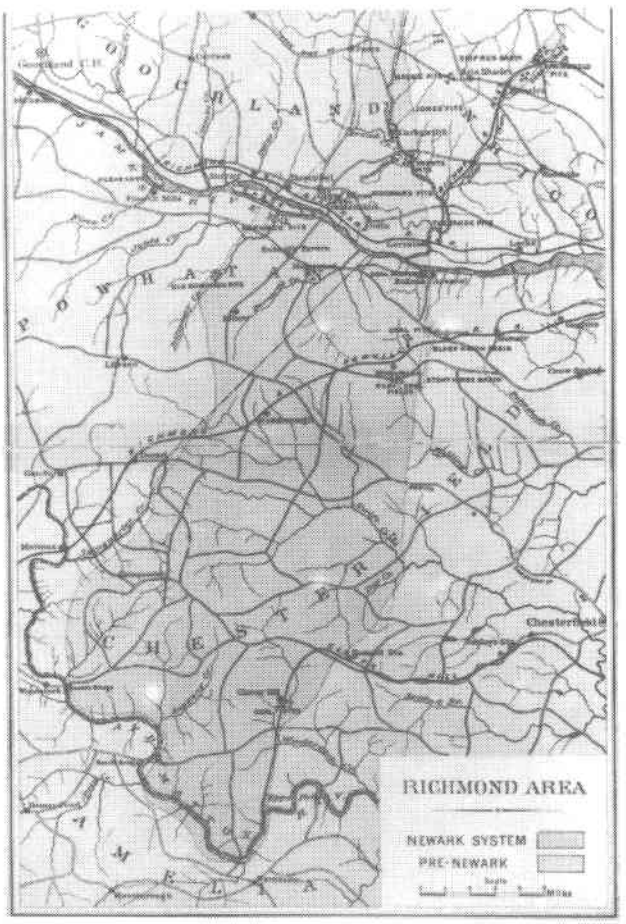

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GEOLOGY

Early geologic interpretations of the Triassic-age rocks located west of Richmond were sometimes more fantasies than practical evaluations of the geology. A glacial theory proposed by Fontaine in 1878 supposed that alpine glaciers flowing off the Blue Ridge Mountains scoured out basins, which were subsequently filled with glacial outwash. Even so, it was realized very early that a basinal structure was responsible for entrapment of the sediments. In 1836, W.B. Rogers published a cross section of the basin showing a synclinal structure broken by graben-type faulting. Sir Charles Lyell (1847) also considered a synclinal basin but without faulting (Figure 2). In 1860, S. Herries DeBow produced a map of the basin which included cross sections showing extreme distortion of the basement contact (Figure 3). I.C. Russell's 1892 map of the basin (Figure 4) defined geologic boundaries and coal mine locations, but the stratigraphic nomenclature was limited to Newark and Pre-Newark strata.

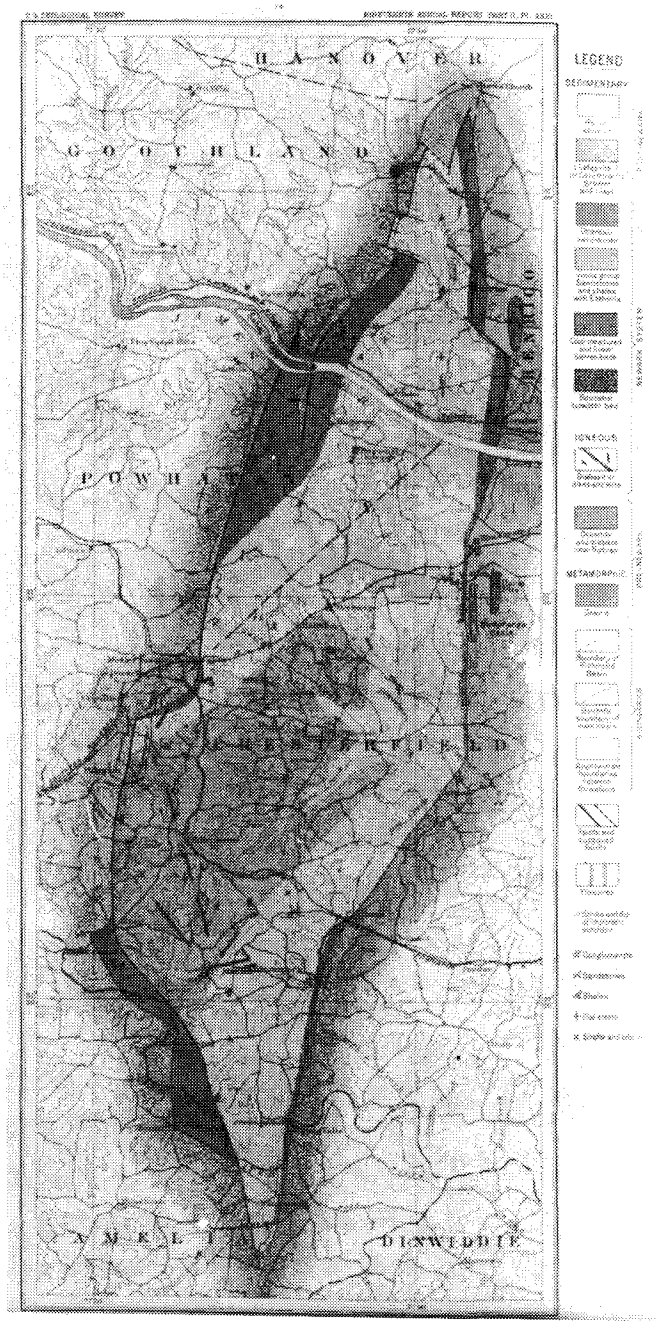

Figure 5. Geologic map of the Richmond basin by Shaler and Woodworth (1899).

The most detailed and substantial work to date on the geology of the Richmond basin was that of Shaler and Woodworth (1899). This report is still used because it contains many notes as well as observations that cannot be made today. The geologic map produced for the report was the most detailed of its time and is still helpful for modern interpretations (Figure 5). The stratigraphy of the basin they defined is still used today.

Geologic mapping at the 1:24,000 scale includes the Hylas and Midlothian quadrangles (Goodwin, 1970), Bon Air quadrangle (Goodwin, 1980b), Glen Allen quadrangle (Goodwin, 1981), and Fine Creek Mills quadrangle (Reilly, 1980). The geology of the entire basin has been described most recently by Goodwin and others (1986, Figure 6) who suggest that the basin is bounded on the west by high-angle normal faults and that the eastern boundary is predominantly an unconformable contact with Piedmont crystalline rocks, but is faulted in places. Gravity profiles traversing the basin, constructed from a 1979 survey (Wilkes and Lasch, 1980), infer a graben or tilted fault-block structure with contacts faulted against the Piedmont crystalline rocks (Figure 7).

Sediment deposition and lithification in the Richmond basin occurred in a tectonically unstable area. As the early Triassic land surface subsided, sediments poured in to fill the lowlands. Favorable climate, topography, geography, and abundant flora contributed to formation of peat swamps. Occasional lowering of the land surface or runoff from storms introduced silt and sand to the swamp.

Eventually, the swamps were covered by sand, silt, and clay and the conversion of peat to coal began. Contemporaneous tectonic activity affected the lithification process by distorting the less competent beds. The coals found in the trough of a flexure are blocky, bright, and attain a maximum thickness, whereas near or at the crest of a flexure, the coals become part of a distorted structural framework.

Three episodes of coal deposition are indicated by palynological studies (E.I. Robbins, U.S. Geological Survey, personal communication, 1985). Two episodes are associated with deltaic complexes, and the third may have been a fringing lake deposit.

Several coal beds, the thickest is locally 40 feet thick, occur within a stratigraphically bounded interval. Throughout the basin the coal interval averages 100 feet thick but may be up to 400 feet thick. Heinrich (1878) described this interval as the Coal Measures, 90 feet thick at the Midlothian Main Colliery. The section is composed of approximately 38 percent sandstone, 36

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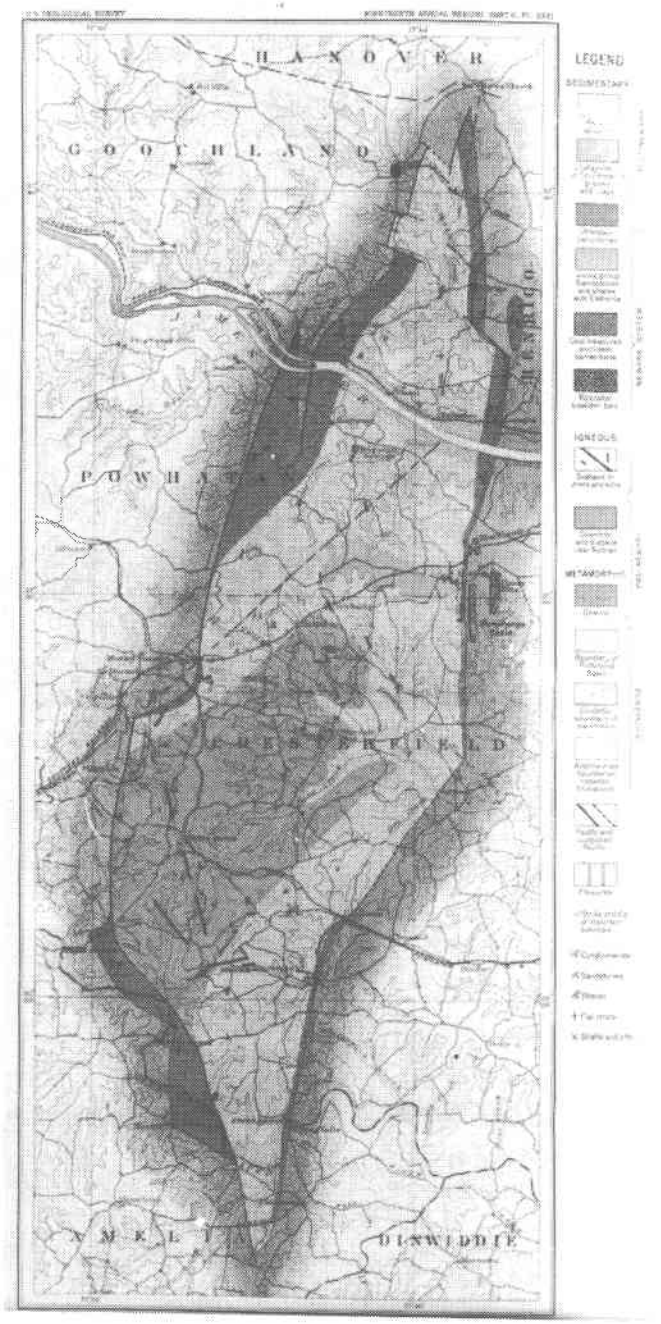

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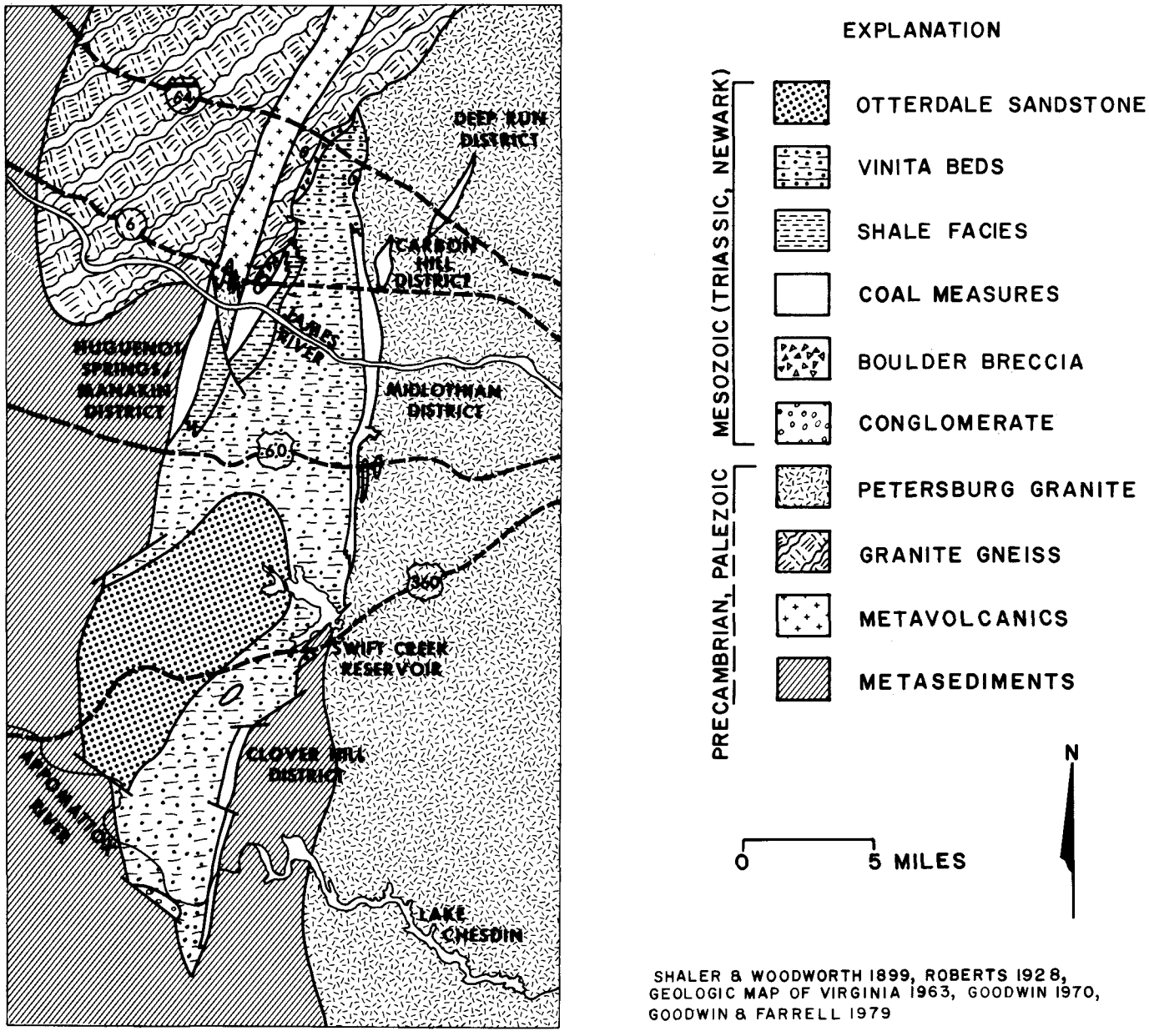

Figure 6. Geologic map of the Richmond basin (compiled in 1979).

percent coal, and 26 percent shale. Drilling by the Richmond Syndicate in 1930 indicates many of Heinrich's shales to be siltstones.

Sandstone is an abundant lithologic constituent of the Coal Measures. It is gray, arkosic in places, and cross-bedded. The grains are generally poorly sorted, rounded, and cemented by silica or calcite. Coal bands, rafted coal, and plant debris have been noted at several locations (Heinrich, 1878; Shaler and Woodworth, 1899). The sandstone occurs either as massive bodies or interbedded with shale, siltstone, or coal.

Another component of the Coal Measures is siltstone. It is dark-to light-gray and in places it is interbedded with sandstone, shale, or coal. Well preserved fossil plant debris is locally abundant. The siltstone may be massive and display soft-sediment deformation as in the Phillips core hole number VACH-2 in Chesterfield County (stored at the Virginia Division of Mineral Resources, Charlottesville).

Light-gray to black shale occupies a small part of the Coal Measures section. Shale is interbedded with sandstone, siltstone, or coal. Fossiliferous, carbonaceous shale occurs just above, or below, some coal beds but grades into the enclosing lithology within a few feet. Rooted underclay occurs under some coal beds.

The coals are generally steeply dipping (20° to vertical) and subject to abrupt changes in attitude. Detailed sections and results of analyses are included elsewhere in this report. In general, the coal is high volatile B bituminous with less than 10 percent ash and less than 2 percent sulfur (see Appendix I). The number of coal beds varies throughout the basin and basin-wide stratigraphic correlation is not yet possible. In places the coal rests on, or within, a few feet of the granitic basement rock.

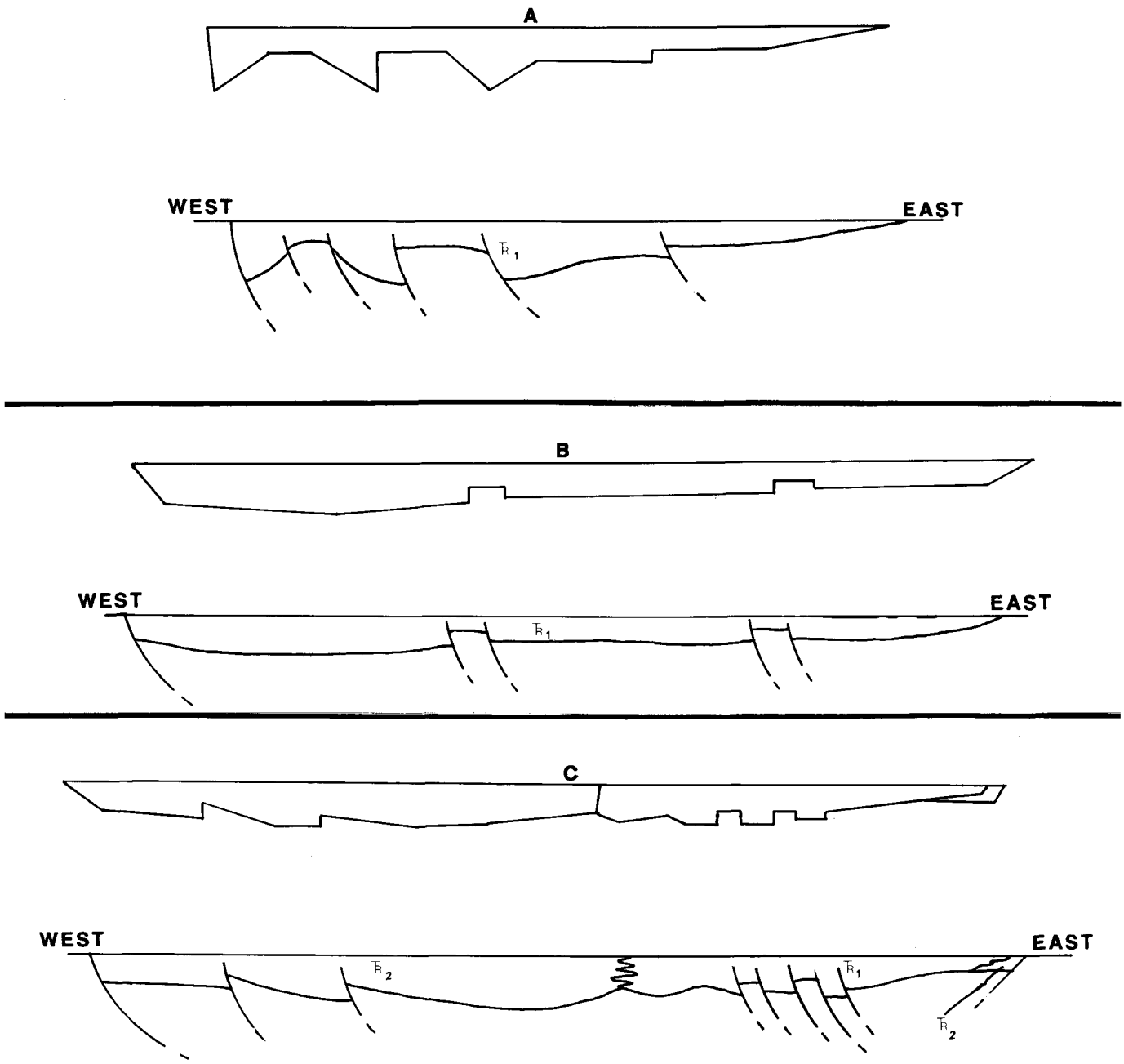

Figure 7. Gravity profiles with geologic interpretations by Wilkins and Lasch (1980). See figure 6 for locations of highways: (A) State Highway 6; (B) U.S. Highway 60; (C) U.S. Highway 360. $\bar{R}_1$ indicates Triassic sediments relatively less dense than Triassic sediments $\bar{R}_2$.

MacFarlane (1875) observed that, "After this coal has been excavated and its base is laid bare, the floor of the mine exhibits the original undulating surface of the granite, and in some few instances the eminences which protrude from this ancient surface rise entirely through the lower carboniferous beds, as, on a larger scale, an island rises above the waters of the ocean." Abundant thin and medium banding, and thin partings of siltstone and sandstone are common throughout the coal bed. Because of the regional tectonic imprint imposed upon the coal, slickensides are abundant throughout the coal, much like the coals of the Valley coalfields. Where the cleat is preserved, it is well developed and may be greater than two inches wide. Coal-bed methane is apparently found in most coals and has caused problems in mining efforts. The recoverable methane resource may be as much as 750 billion cubic feet (Virginia Polytechnic Institute and State University, 1980).

Above the uppermost mineable coal of the Coal Measures are the Vinita beds. The Vinita beds are characterized by gray to black fossiliferous shale and siltstone that grades upward into dominantly gray sandstone. The Vinita beds may be as much as 6000 feet thick and crops out in the central portion of the

Richmond basin.

Below the Coal Measures are the lower barren beds. These strata range from 0 to 160 feet thick and crop out along the margins of the basin (Davis and Evans, 1938). The base of the lower barren beds is conglomeratic and unconformable with the granitic basement. The lithology grades from a basal conglomerate into interbedded shales and sandstones. The base of the first mineable coal marks the top of the lower barren beds.

The Otterdale sandstone is a large lobate body which crops out in the southwest and central portion of the basin. It is predominantly a coarse-grained arkosic sandstone which is cross-bedded and contains well-rounded clasts of quartz, gneiss, granite, and cataclastic rock (Goodwin and others, 1986). The Otterdale sandstone thins to the northeast where it overlies the Vinita beds. Elsewhere, the Otterdale and the Vinita may share an interfingering facies relationship. In the Gray Lumber Company drillhole, 1500 feet of Otterdale sandstone was recorded, and in all likelihood, the section is thicker.

Natural coke occurs in parts of the coalfield and is directly related to intrusions of diabase dikes and sills. Large quantities of natural coke were mined in the Clover Hill, Midlothian, and Carbon Hill districts in the middle to late 1800s. W.B. Rogers (1854) describes the natural coke at Carbon Hill as "...a nearly homogeneous mass, of a bluish-black color, uniformly vesicular and light enough to float on water.... It is wholly wanting in lustre. It has lost, if it ever possessed, all continuous slines or cleat, and even the surface of deposition appears to be in a great degree obliterated." It was also not unusual to find columnar jointed coke, which reflects the metamorphic process imposed on the original coal bed.

COALFIELD DEVELOPMENT

A brief look at the discovery of coal in the United States yields a perspective on the importance of coal in colonial America. Whereas mining was active in Europe at the time of the Richmond coal discovery, it was an entirely new and often crudely practiced technology in the colonial settlements.

The discovery of coal in the United States occurred during the 1673 traverse of Louis Joliet and Father Jacques Marquette in their search for the Mississippi River. They noted on their map "charbon de terre" near the present site of Ottawa, Illinois along the Illinois River. Previous to this time the only other discovery of coal on the North American continent was on Cape Breton Island, Nova Scotia, perhaps as early as 1654.

In Illinois, Father Louis Hennepin and the Sieur de la Salle found coal along the Illinois River near present-day Peoria in 1679. "Cole" mine was noted on their map near Fort Creve Coeur. At this time the term coal mine referred to land where coal occurs. The "coal pit" was what now is considered a mine.

Coal was first discovered in Colonial Virginia on the banks of the James River near Manakin. Colonel William Byrd, in a letter to the Colonial Council of Virginia dated May 10th and 11th, 1701, refers to French Huguenot settlers using coal for domestic needs. Colonel Byrd took out a patent on 344 acres of coal land in 1701 and by 1709 he reported "...that the coaler found the coal mine very good and sufficient to furnish several generations" (Brock, 1886). It is probable that the Huguenot settlers knew of the coal prior to 1701.

The previous references document the occurrence and use of coal but not its actual commercial production. The first commercial production of coal in the United States was from the Richmond mines. In 1758, nine tons of Richmond's coal was transported by ship from Hampton to New York. Later in that same century street lamps in New York, Philadelphia, and Boston were fueled by coal gas derived from the flourishing Virignia coal industry near Richmond.

Due to a restricted local market (wood was plentiful) and competition from foreign coal, the Richmond mines produced less than 1000 tons of coal annually during most of the 1700s. In 1794 an import tariff was imposed on foreign coal and the Richmond mines took advantage of it by expanding and establishing a solid market on the east coast of the United States. Until about 1850, the coalfield experienced its greatest activity and was marked by many new shaft and slope mines. As is so often seen in a society of abundant natural resources, some of these mines were worked a year or two, with the operators taking only the coal most easily mineable, abandoning the site and putting in a new mine nearby. However, some larger mines became established and were worked regularly for several years.

Interstate transportation of coal from the Richmond coalfield was interrupted in 1861 by the Civil War. Production during the war years, 1861-1865, was primarily directed to the Confederate war effort. Cannon foundries in Richmond exclusively used the celebrated Black Heath coal in conjunction with iron ore mined in western Virginia. When Union troops marched on Richmond, molds and machinery from these foundries were dumped into the James River by the Confederates to avoid their use by the enemy. After the war, several new mines were dug and old ones re-opened. Although newer mining techniques were employed, the mines were still primitive by today's standards.

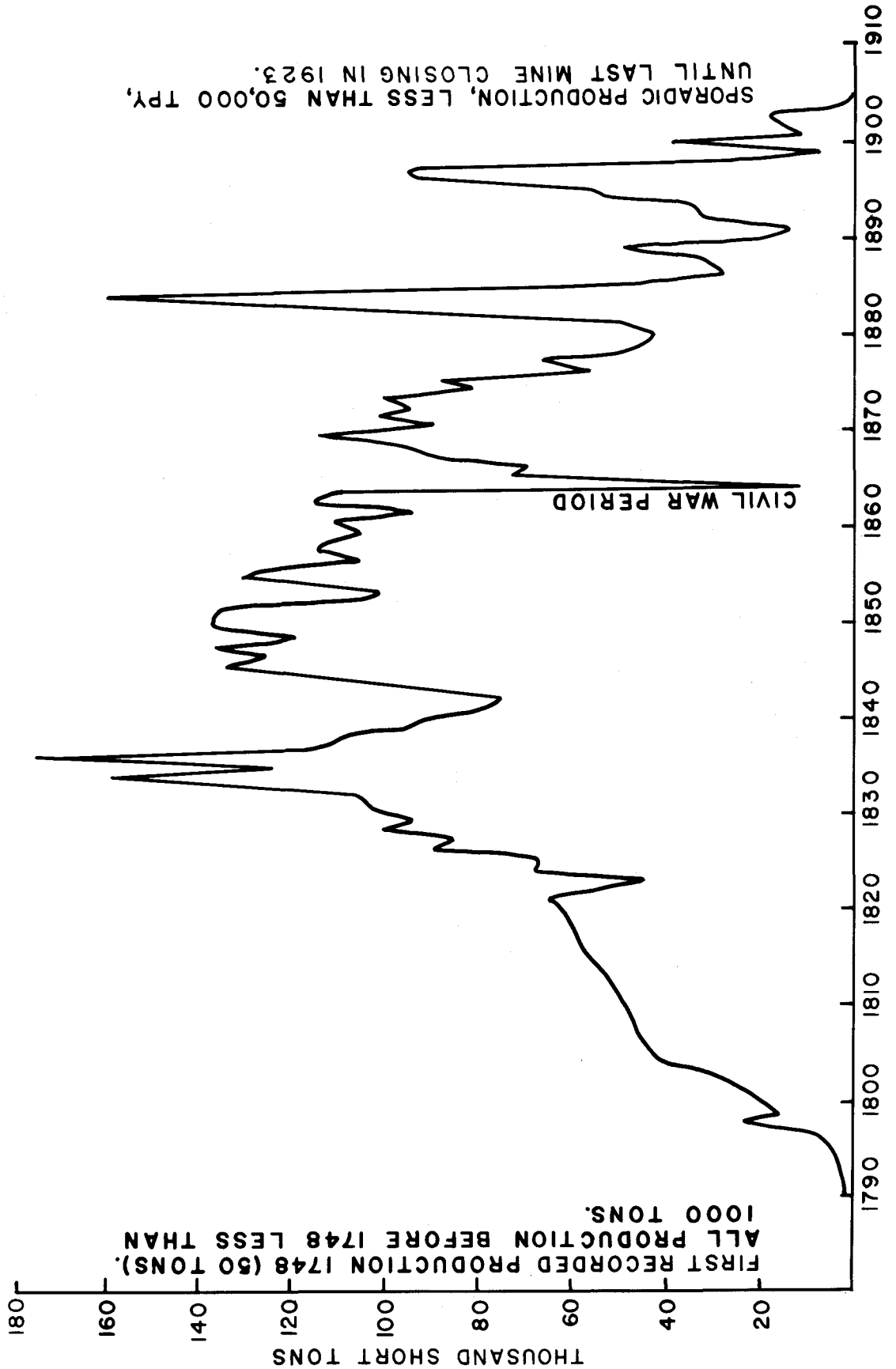

Figure 8. Coal production from the Richmond coalfield.

The market for Richmond coal declined in 1883 when the Norfolk and Western Railway opened the Pocahontas coalfield of the Virginias to Tidewater ports. By this time only a relatively few Richmond mines, scattered through the field, were in operation. These suffered through several changes of management, which contributed in part to their eventual abandonment. By the time the last large mine closed in the 1920s, production had been sporadic for years. Several attempts were made to re-open the mines after this date but all of these lasted at most for only a few years. Total production for the life of the coalfield was over 8 million tons (Figure 8).

TRANSPORTATION

For more than 200 years, the Richmond coalfield helped build Richmond into a major metropolitan trade center. Coal initially was used for household purposes, but more importantly, it was later used as a forge fuel. An iron industry soon developed in Richmond with a major part of this development based on transportation of raw materials to Richmond.

Early in the life of the field, coal was transported from the mines by wagon over dirt roads to Richmond. The Midlothian Turnpike was built near the pits of Midlothian and Black Heath in 1802 primarily to relieve coal wagon traffic on the Buckingham Road.

After 1795, when the James River and Kanawha Canal was completed, the mines north of the James River could transport their coal by barge to Rocketts (now the Fulton area), thereby reducing coal wagon traffic on roads. The Richmond and Alleghany Railroad (now CSX Transportation, Inc.) was built on the James River and Kanawha Canal towpath in 1880, ending 85 years of continuous use.

Small mines opened in the Carbon Hill district in the early 1800s and produced coal for the local market. By 1827, business was good and the supply of coal in the ground was proven to be substantial. To move larger quantities of coal, the Tuckahoe Creek Navigation Company was chartered and in 1828 the Tuckahoe Canal was completed from Broad Branch on Tuckahoe Creek to the James River and Kanawha Canal at Tuckahoe Aquaduct. From the canal's origin to the present site of State Highway 6, the low-lying swampy areas of Tuckahoe Creek were dredged for bateau navigation. Landings were constructed on the high ground east of the canal where the Carbon Hill mines were located. A dam was constructed on Tuckahoe Creek just north of present State Highway 6 and a canal dug parallel to the west bank of the creek. Another dam with locks was

Figure 9. Tuckahoe and James River Railroad wingwall and grade on Tuckahoe Creek (1982).

constructed along this stretch. The Tuckahoe Canal was in constant use until 1840 when the Tuckahoe and James River Railroad (a spur line of the Richmond, Fredericksburg and Potomac Railroad) was built. This rail line increased the amount of coal delivered to Richmond and Fredericksburg from the Carbon Hill mines.

Today, only parts of this system are still preserved (Figure 9). The rest reverted to swamp or have been destroyed by the encroachment of suburban Richmond. At least one landing is preserved just south of the Engine Shaft of the Coalbrook workings. South of the Coalbrook Slope the route of the rail line can be found on the east side of Tuckahoe Creek. Here, a "watering trough" is located. This structure is at ground level and was filled with water. Its function was to replace water in steam locomotive boilers without requiring the locomotive to stop. A pan dropped from the locomotive as it passed over, scooped up water and closed at the end of the trough.

In the Midlothian area, the Chesterfield and Manchester Railroad was completed in 1831 to move coal from the Midlothian mines to Manchester on the James River. Designed by

The market for Richmond coal declined in 1883 when the Norfolk and Western Railway opened the Pocahontas coalfield of the Virginias to Tidewater ports. By this time only a relatively few Richmond mines, scattered through the field, were in operation. These suffered through several changes of management, which contributed in part to their eventual abandonment. By the time the last large mine closed in the 1920s, production had been sporadic for years. Several attempts were made to re-open the mines after this date but all of these lasted at most for only a few years. Total production for the life of the coalfield was over 8 million tons (Figure 8).

TRANSPORTATION

For more than 200 years, the Richmond coalfield helped build Richmond into a major metropolitan trade center. Coal initially was used for household purposes, but more importantly, it was later used as a forge fuel. An iron industry soon developed in Richmond with a major part of this development based on transportation of raw materials to Richmond.

Early in the life of the field, coal was transported from the mines by wagon over dirt roads to Richmond. The Midlothian Turnpike was built near the pits of Midlothian and Black Heath in 1802 primarily to relieve coal wagon traffic on the Buckingham Road.

After 1795, when the James River and Kanawha Canal was completed, the mines north of the James River could transport their coal by barge to Rocketts (now the Fulton area), thereby reducing coal wagon traffic on roads. The Richmond and Alleghany Railroad (now CSX Transportation, Inc.) was built on the James River and Kanawha Canal towpath in 1880, ending 85 years of continuous use.

Small mines opened in the Carbon Hill district in the early 1800s and produced coal for the local market. By 1827, business was good and the supply of coal in the ground was proven to be substantial. To move larger quantities of coal, the Tuckahoe Creek Navigation Company was chartered and in 1828 the Tuckahoe Canal was completed from Broad Branch on Tuckahoe Creek to the James River and Kanawha Canal at Tuckahoe Aquaduct. From the canal's origin to the present site of State Highway 6, the low-lying swampy areas of Tuckahoe Creek were dredged for bateau navigation. Landings were constructed on the high ground east of the canal where the Carbon Hill mines were located. A dam was constructed on Tuckahoe Creek just north of present State Highway 6 and a canal dug parallel to the west bank of the creek. Another dam with locks was constructed along this stretch. The Tuckahoe Canal was in constant use until 1840 when the Tuckahoe and James River Railroad (a spur line of the Richmond, Fredericksburg and Potomac Railroad) was built. This rail line increased the amount of coal delivered to Richmond and Fredericksburg from the Carbon Hill mines.

Figure 9. Tuckahoe and James River Railroad wingwall and grade on Tuckahoe Creek (1982).

Today, only parts of this system are still preserved (Figure 9). The rest reverted to swamp or have been destroyed by the encroachment of suburban Richmond. At least one landing is preserved just south of the Engine Shaft of the Coalbrook workings. South of the Coalbrook Slope the route of the rail line can be found on the east side of Tuckahoe Creek. Here, a "watering trough" is located. This structure is at ground level and was filled with water. Its function was to replace water in steam locomotive boilers without requiring the locomotive to stop. A pan dropped from the locomotive as it passed over, scooped up water and closed at the end of the trough.

In the Midlothian area, the Chesterfield and Manchester Railroad was completed in 1831 to move coal from the Midlothian mines to Manchester on the James River. Designed by

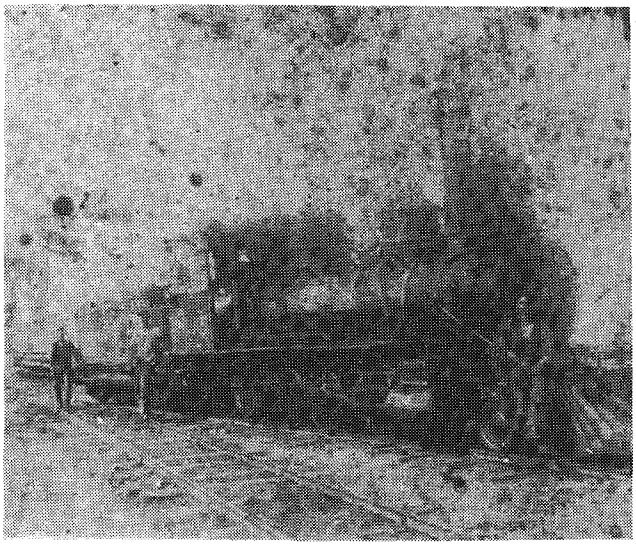

Figure 10. Clover Hill Railroad at Winterpock (mid-1800s, courtesy Rosemary Bagby).

Claudius Crozet, the line was 13 miles long and was constructed of wooden rails that were topped with a steel strip. Several cars were hooked together and were moved from the Midlothian mines to Manchester by using gravity as the motive power. Mules were carried in the last car to pull the empty train back to the head of the line. This line is discussed in more detail in the description of the Railey Pits in this report. In 1850, the Richmond and Danville Railroad (now Southern Railway System) was completed eliminating the need for the Chesterfield and Manchester Railroad.

A "new railroad" was completed in 1838 to serve mines in the northern Midlothian mining district. It terminated at the James River at Boshers Dam where the coal was off-loaded into barges and distributed. In constructing this railroad, iron mineralization was discovered near Salle's Pit. Efforts made to develop the ore were unsuccessful.

The Clover Hill Railroad (later the Brighthope Railroad) began operations in 1841 and transported coal from the Clover Hill Pits to Chester (Figure 10). This route was also shared by the Farmville and Powhatan Railroad (later Tidewater and Western Railroad). Another spur of the Clover Hill Railroad ran from the Clover Hill Pits to barge loading facilities at Epps Falls on the Appomattox River.

MINING METHODS

Domestic coal used by the early settlers was probably dug from small pits on the coal outcrop. This "outcrop coal" was undoubtedly very poor in quality because of its exposure to weather, but it was suitable for domestic fuel. These early miners followed the outcrop of the coal, digging trenches or shallow pits. Because of the coal's steep dip, overburden soon became too thick to remove (about 25 to 30 feet) and underground mines were advanced in the coal. As the demand for coal increased, large slopes or incline mines followed the coal one or two hundred feet down dip. Levels were constructed from the slope in the direction of the strike of the coal. When the mine became more established, the main levels were sometimes known as gangways. The pattern of mining and the placement of slopes and levels were influenced by local rolls or faulting of the coal. At a roll or fault, mining either ceased in that direction or a horizontal tunnel was driven through the structure seeking to relocate the coal.

By the mid-1700s, shaft mining was the dominant method used to extract coal. This type of mining was used primarily to keep away from the older slope workings. Breaking through to these old mines could flood the active mine with water or dangerous gases. The Richmond shaft mines were constructed by hand, by digging a vertical shaft until coal was encountered. The walls of the shafts were most commonly supported by timbers, but some of the established mines were brick-lined. Slopes originating at the surface were sometimes connected to the base of shaft mines and were used for ventilation, haulage, and escapeways.

Most of the mines in the Richmond coalfield accumulated water that had to be removed from the workings. This was accomplished in the early mines by a windlass-driven bucket hoisting water from a sump. Power for this was initially provided by mules but, later, steam engines were used. By the late 1800s water pumps were employed to more efficiently remove the water.

When mining commenced underground, the need to supply fresh air to the working face became apparent. In addition, some of the coals were gassy and mine explosions caused by the ignition of methane or coal dust were common and costly. An early method for ventilating underground workings was in use at the Black Heath Pit by 1818. Part of the workings had been on fire for several years and to separate the active and abandoned workings, a stopping with a mandoor was built. When the door was opened, fresh air was drawn from the outside, through the mine and into the damped fire. Care had to be exercised in using this method because flammable concentrations of methane, being emitted from the coal, could also be drawn into the fire. In 1839, this did happen and the violent explosion that resulted killed 53 men and outlined on the ground's surface the underground workings because of the collapse of the mine's sections.

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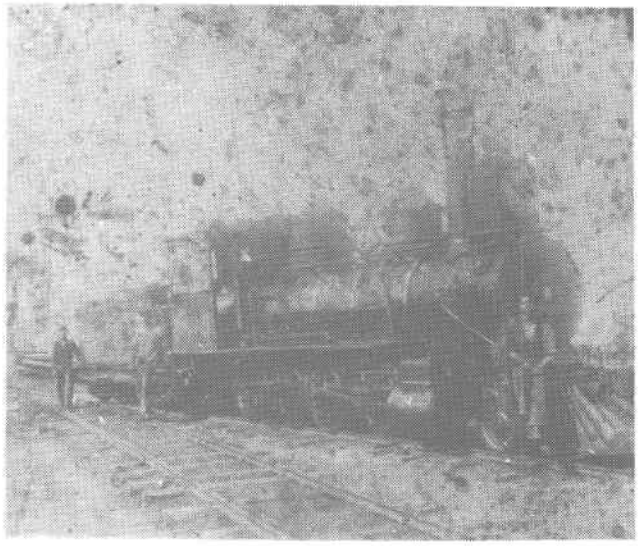

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"firing line", a candle was attached to a cord and drawn into the gaseous area by using a pulley fixed to the working face. The miners could stand back in relative safety while the gas was ignited by the candle flame. Another method was accomplished by the "cannoneer" of the mine. This man would wrap himself in a wet, heavy cloak and lie flat on the floor upon reaching the gassy area. He would then hold a torch over his head to ignite the gas.

In the mid 1800s two shafts were dug for each mine. The downcast shaft brought in fresh air from the outside and the upcast shaft removed the mine air. By controlling the direction of airflow in the underground workings, a circulation of fresh air could ventilate the mine. Wooden walls, called brattice, were constructed in the passageways to control direction of ventilation. In some shaft mines, boilers were placed at the base of the upcast shaft and the heat generated caused an updraft, thus freeing the workings of gas and dust. Care had to be taken in this method because high volumes of methane passing the boilers to the upcast shaft could ignite causing severe explosions. By the late 1800s, most major mines were using fans to draw air and employed both wooden and stone brattice for controlling ventilation. This is basically the method used by the coal industry today.

The actual mining of coal was by pick and shovel. Late in the field's mining history, steam-driven chainsaw-like machines were used to undercut the coal and holes were drilled in the coal face, filled with black powder and a clay "dummy". A fuse was placed in the powder, lit by open flame and the "shot was pulled". The loose coal could then be shoveled into carts and hauled by mules out of the slope or to the base of the shaft. At some mines, the mules worked and were stabled underground, never seeing daylight. They appeared very healthy due to the stable environment of the mine.

Later, the mules were replaced by wire cables attached to a steam-driven engine. In some shaft mines, a steam boiler at the base of the shaft was used to wind the cables. This boiler also made an excellent place to locate the smith's shop. A hoist was used to lift coal from the base of the shaft to the surface where various degrees of cleaning (removing rock and other debris) were done before loading the coal into wagons or railroad cars. Washing or other preparation was not normally used.

Man-made coke was produced from the coal at some mine sites. The Creek Company operated two ovens in 1842, an oven was in operation at Winterpock during 1865 to 1870, and the Richmond Coal Mining and Manufacturing Company had ovens at the Gayton Shaft in the late 1800s. Generally, the brick ovens were constructed about eight feet square with an exhaust hole in the top and a hinged steel door at the front. Coal was loaded in the oven, fired and allowed to bake slowly. This process, known as carbonization, drove off much of the volatile matter, thus forming a product high in carbon and hydrogen with minor amounts of nitrogen, oxygen, and sulfur. After a given amount of time the coke was raked out of the oven and quenched with water. Richmond iron foundries, such as the Tredegar Iron Works, used all the coke that was produced.

DRILLING

How is coal studied in the ground away from its outcrop where the initial discovery was made? Today, the science of geology and the technology of subsurface drilling are used to answer this question. Geophysical logs and oriented core samples from exact intervals can be obtained thousands of feet below the surface, and with this information a geologist can predict with some accuracy the size, quantity, and quality of a mineral deposit such as a coal bed.

In the Richmond coalfield during the 1700s and most of the 1800s, subsurface information was obtained by digging shallow exploratory pits. By necessity, these pits were placed along the coal outcrop. Samples ahead of mining, other than from such pits, were not available and mining was conducted blindly. Potential problems with the geologic structure, roof conditions, and coal thickness could not be anticipated which sometimes resulted in mining efforts ending in flooding, gas explosions, roof falls, rib heaving, or merely no coal.

Percussion drills were probably in use by 1860 to 1870 and obtained primarily fractured cuttings at moderate depths of about 500 feet. By 1874 a rotary diamond core hole was drilled on the Midlothian property by O.J. Heinrich, a mining engineer employed by the Midlothian Coal Mining Company from 1873 to 1876. He reported this hole as being 1142 feet deep and bottoming in granite. Good recovery of shale and harder rocks was obtained, but the friable rock was washed out. The hole cost $3,548.90 and took twenty-two 12-hour shifts (264 hours) to drill. Heinrich held great promise for this drilling method, referring to it as "the boring tool of the future."

Listed in Appendix II are available drill hole records. Information on these holes can be found in other publications or on file at the Division of Mineral Resources in Charlottesville. The holes are also noted on Plate 1.

MINING ACCIDENTS

The mining history of the Richmond coalfield is marred by numerous accidents such as roof falls, flooding, and explosions of methane gas or coal dust. Considering the age of the coalfield, this is not surprising. Coal mining in the United States was a new venture and many, if not all, of the early mine accidents were the result of primitive mining procedures. Mining engineers from Wales and England were brought in by coal companies during the 1800s and progress was made toward making the mines safer. Although the theory of prevention of accidents was introduced by the Europeans, the technology and materials available were still inferior to today's standards, devastating accidents continued to occur.

A complete recording of all mining accidents does not exist and the total number is probably much higher than records show. Appendix III is a compilation of documented accidents attributed to gas or coal dust ignited by an open flame.

DESCRIPTION OF MINES BY DISTRICT

Mining activity has taken place along the northwestern and eastern margins of the Richmond basin. The earliest mines were near Manakin and Huguenot Springs as documented by Colonel Byrd in 1701. The Deep Run Pits were in operation by the mid 1700s and were shortly followed by pits opening near Midlothian, Black Heath, and Carbondale (now Gayton). Pits in the Clover Hill vicinity began operations in the early 1800s.

In this report, mining activity has been catalogued by geographic location and geologic similarities. Five mining districts are recognizable: Carbon Hill, Deep Run, Midlothian (which includes the Black Heath, Union, and Stonehenge basins), Clover Hill, and Manakin/Huguenot Springs. Mining notes correspond to location numbers on Plate 1.

Carbon Hill District

The area included in this district is on the northeast margin of the main Richmond basin, and has a north-south trend between Big Swamp and the James River (Plate 1). Included in this district is the Flat Branch (Edge Hill) basin, which is an erosional remnant of the main basin.

Compared to the other mining districts, the Carbon Hill area appears to have the most favorable mining conditions. Minor rolls and small faults were indicated from past mining but were not severe enough to complicate early mining practices. Average dip of the strata in this district is 25° to the west and the strike is N 32°E.

Four major coals are present in this district. The uppermost is the "Coke seam" and is so-named because of the localized metamorphism of coal to natural coke. Intrusion of diabase sills drove off volatile matter in the coal and literally coked it in-situ. Results of analyses certainly indicate it is suitable for use in contemporary iron foundries. The natural coke was marketed by the James River Coal Company in 1888 as Carbonite. Average thickness of the "Coke seam" is 6 to 8 feet. A sandstone and shale interval, 60 feet or more in thickness, separates the "Coke seam" from the C coal below, which is from 2 to 5 feet thick. The 3 to 5 foot thick B coal is separated from the C coal by 12 or more feet of shale and sandstone. Forty feet below the B coal is the A coal, which averages 6 feet thick. Diabase dikes also occur in this area; one separates the south workings of the Deep Shaft and the north works of the Coalbrook Slope.

Coal was being mined in this district by 1835 and continued at various pits until 1923 when the Coalbrook mine closed, ending continuous mining efforts in the Richmond coalfield. Sporadic efforts were made until the 1950s in the district to reopen the mines.

Saunders Shaft

Location: 1

Historical notes: The Saunders Shaft has a long history of ownership and may date to the early 1800s. It was one of three mines to be operated in this district after 1873, but was closed in 1902. The shaft was 220 feet deep; the depth to the "Coke seam" was 200 feet and the last 20 feet of the shaft was used as a sump. At least four levels were developed on a slope that was driven downdip in the "Coke seam." The levels driven north were the easiest to mine and most productive. The "Coke seam" averaged 10 to 12 feet thick in this mine, but pinched to an unmineable thickness near rolls in the strata.

References: Newell (1888), Shaler and Woodworth (1899), Woolfolk (1901), Roberts (1928), Swartout (1930), Wadleigh (1934), Rilee and others (1977).

Eureka Shaft

Location: 2

Historical notes: In 1853, this shaft was dug 230 feet to the "Coke seam." Initial production was from a single level on this bed, which was later connected by tunnel to the C and B coals. The mine was dewatered by buckets hoisted by a 50-HP winding engine.

References: Kimball (1866), Newell (1888), Swartout (1930), Wadleigh (1934), Rilee and others (1977).

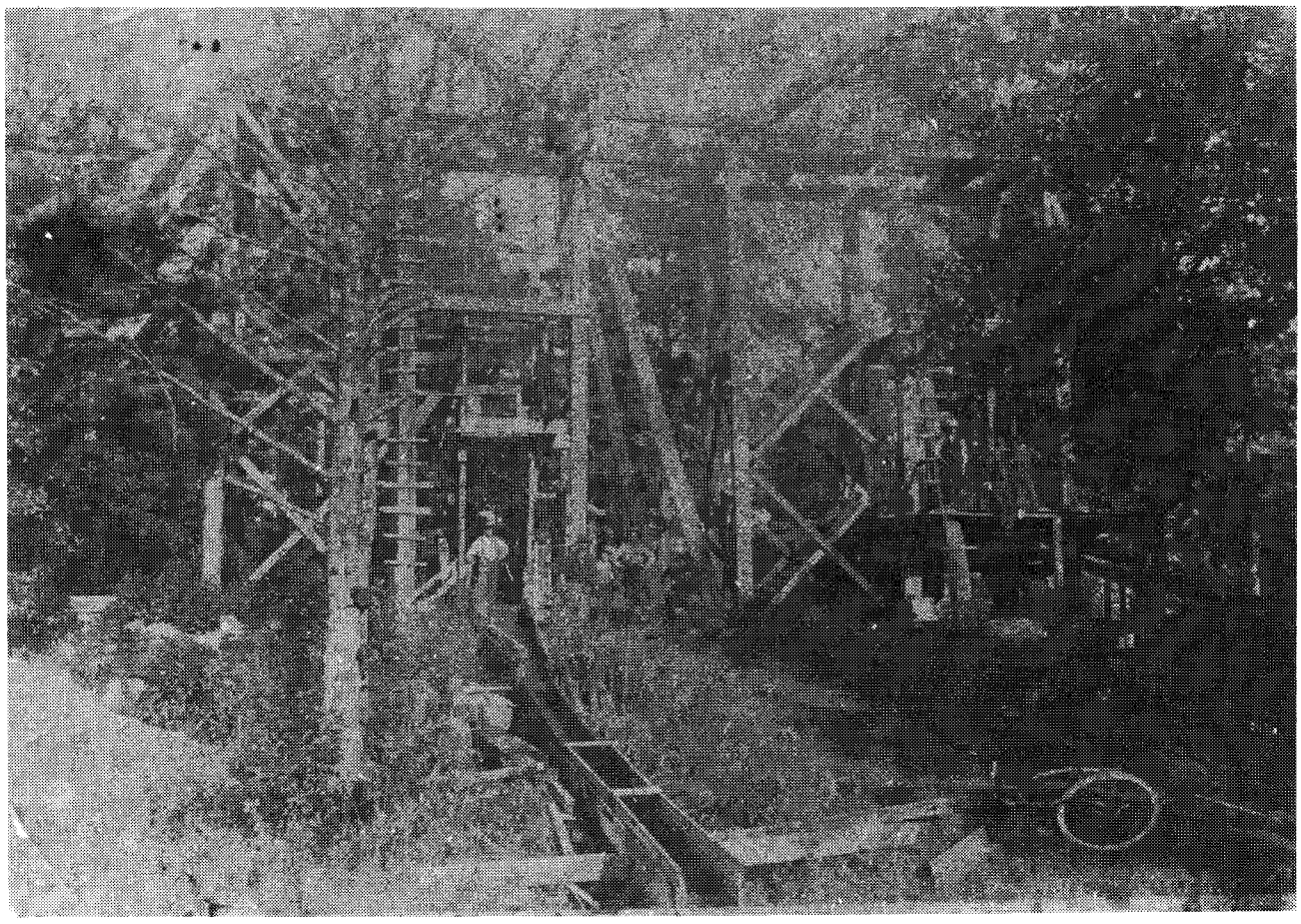


Figure 11. Gayton Shafts (1890, courtesy Rosemary Bagby).

Turpius Colliery, Magruder Pit, Maggi Pit

Location: 3

Historical notes: This mine was opened before the Civil War. The "Coke seam" is three feet thick with no partings and was mined by shallow shafts and some outcrop pits. All production from this pit was for home use. These pits were also known as the Maggi Pits in 1882.

References: Kimball (1866), Eavenson (1942).

Gayton Shaft, Coke Shaft, Orchard Shaft, Twin Shaft, Double Shaft, Breaker Shaft

Location: 4

Historical notes: The Gayton property represents a long history of ownership and development as reflected in the number of names given to the workings. The first pits were shallow and were probably worked before 1819. The Breaker or Orchard shaft was sunk 180 feet to diabase by Messrs. Crouch and Snead about 1850 and were collectively known as the Gayton Shafts (Figure 11). A slope was dug in the "Coke seam" near the base of the shaft. Here, the "Coke seam" was 8 to 10 feet thick with two shale partings.

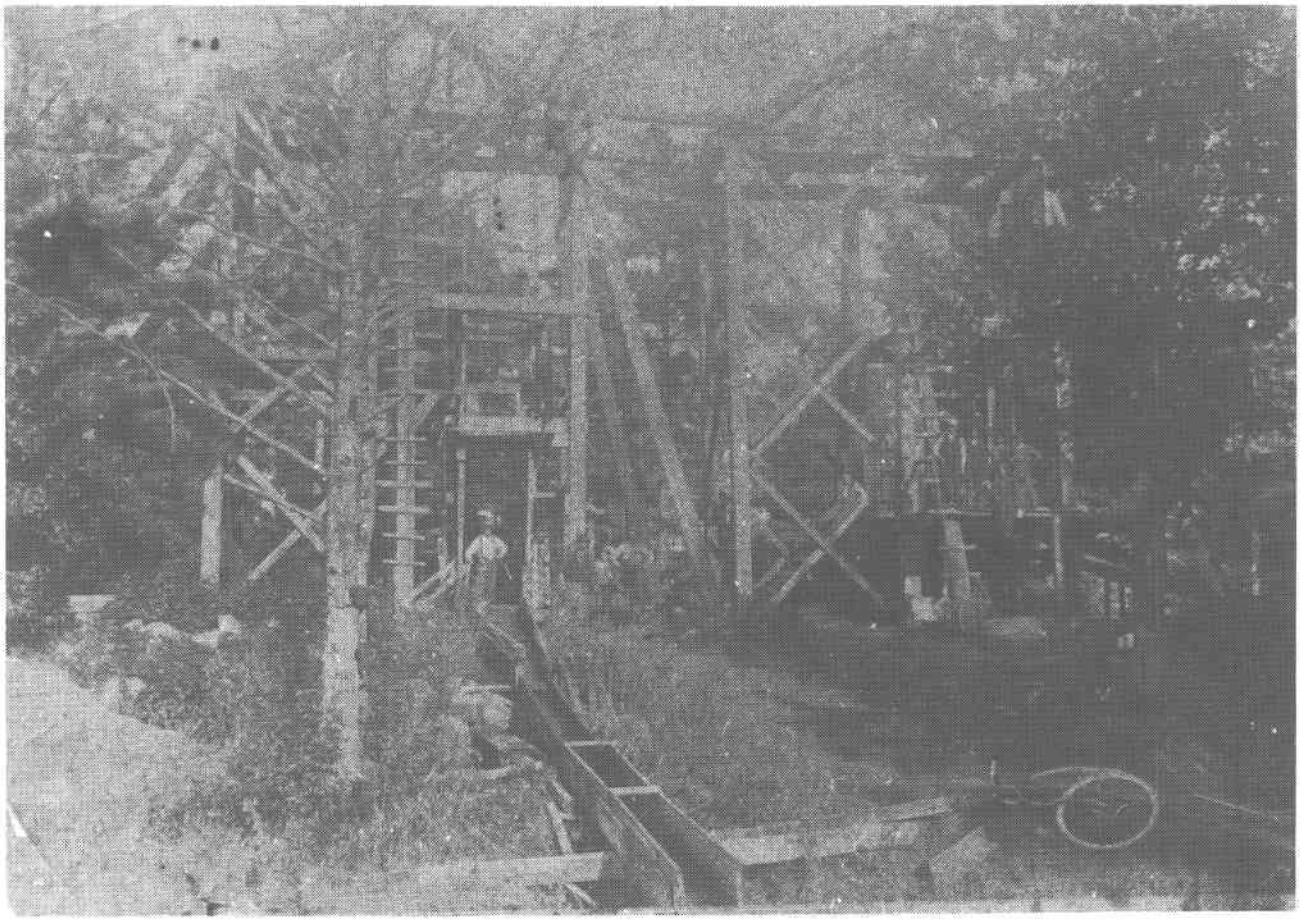
A 325-foot shaft through the "Coke seam" was dug 40 feet south of the original shaft by the Richmond Coal Mining and Manufacturing Co. about 1887. A slope was put in that followed the "Coke seam" 1000 feet at a 30° west dip. From the slope, levels were turned every 60 feet, the longest level being 3000 feet from north to south. Most production was from levels 6 and 8. Last production was in 1901 and the property was sold at auction in 1902. After abandonment, the upper workings caught fire by spontaneous combustion. Pumping ceased and the mine was allowed to fill with water.

References: Newell (1888), Woolfolk (1901), d'Invilliers (1903, 1904), Treadwell (1928), Roberts (1928), Wadleigh (1934), Jones (1916), Lawton (1942), Rilee and others (1977).

Edge Hill Shaft

Location: 5

Historical notes: The Edge Hill Shaft was worked by Grabs and Company who produced 3472 tons in 1842. Coal was transported to Richmond on the Richmond, Fredericksburg and Potomac Railroad. The mine site was located 165 yards west of the "Coke seam" outcrop. The shaft intersected the B coal at 264 feet and the "Coke seam" at 180 feet.



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Slopes were driven both down and updip on each bed. A 35-HP engine was used for pumping and hoisting.

References: Kimball (1866), Newell (1888), Swartout (1930), Wadleigh (1934).

Barbershop Shaft, Railroad Shaft

Location: 6

Historical notes: This shaft, of undetermined depth, worked the C coal. Workings from the Deep Shaft connected with this mine.

References: Newell (1888), Lemist and Taylor (1921), Rilee and others (1977).

Deep Shaft, Air or Shelter Air Shaft, Snead's Shaft, Crouch and Snead's Shaft, Crouche's Pits, Brooks Shaft

Location: 7

Historical notes: There were four interconnected shafts on this property: Deep, Brooks, Air (or Shelter Air) and an unnamed shaft. Work began about 1851 by Mr. Snead on the Crouch property. Mining ceased near the end of the Civil War and the property remained idle until 1873. At this time the James River Coal Company cleaned out the old workings and resumed production of the natural coke, marketing it as Carbonite. The mine was last worked in 1875.

The Deep Shaft was approximately 200 feet deep, cutting the "Coke seam" and C coal, and bottoming in the B coal. Levels were turned off each bed and worked along strike. The south levels went only a short distance before encountering a dike 200 feet wide that separates this operation from the Coalbrook Slope's northern workings. The Deep Shaft's north levels followed the C and B coals and ultimately connected with the Edge Hill Shaft workings near the old Belmont Hotel. A short slope that dipped 30° to the west at the bottom of the shaft was often filled with water and was used as a sump.

References: Kimball (1866), Newell (1888), d'Invilliers (1903), Lemist and Taylor (1921), Wadleigh (1934), Rilee and others (1977).

Coalbrook Slope, Trent Slope, Jos. R. Anderson and Company Mine, Carbon Hill Mine, Old Dominion Development Co. No. 1 Mine, Mule Shaft, Engine Shaft

Location: 8

Historical notes: About 1848, T. and R. Crouch drove a slope 1658 feet in the A coal. The slope was later extended to 2400 feet with the dip 16° to 35° to the west. The Mule Shaft intersected the main slope at 125 feet. This shaft passed through the C and B coals, intersected the main slope at the A coal, and was used for ventilation and raising water from the mine.

Levels turned off the main slope at irregular intervals. The main level was located 1360 feet downslope and was turned north and south to follow the strike of the coal. The south main level was 1400 feet long. A 30-foot roll was encountered 1000 feet along this level, otherwise the bed was consistent. The north 1360-foot level went 700 feet before encountering a dike. This dike separates Coalbrook from the south levels of the Deep Shaft.

Before 1860, tunnels were turned near the base of the main slope and connected with the B and C coals. Another slope (Little Incline or No. 3 Slope) followed the C coal downdip with levels working off of it. Some B coal was mined from this slope. The Engine (or "Indian") Shaft was sunk 185 feet to intersect the No. 3 Slope (Figures 12, 13, and 14).

During the Civil War, Joseph R. Anderson and Co. used the Engine Shaft for the main portal and worked to the rise on the C and B coals. The coal mined during this period was used by the Tredegar Iron Works for the Confederate war effort.

By 1903, all mineable coal above the 1000-foot level had been taken out. Coalbrook was the mine name used at this time. Several attempts were made to work this mine after 1903. The last attempt to reopen the mine failed in 1944.

The main slopes were 8 to 9 feet wide and the gangways 7 feet wide. Initially, small carts were used to haul coal up the slope, but later, cars capable of 3350-pound loads were used. The coal was loaded onto rail cars at the mine and moved to loading facilities in Richmond (Figure 15).

A small amount of coke was extracted at three places in the mine. In all cases, the occurrence of coke was local and the coal incompletely coked.

Measured section (Kimball, 1866)

Feet	Description
100±	Sandstone, shale and minor coke
4-6	C coal
10-12	Rock parting
3-4	B coal
40	Rock
3-6	A coal

References: Russell (1892), Daddow and Bannon (1866), Kimball (1866), Daddow (1875), Newell (1888), Woolfolk (1901), d'Invillers (1903), Loeber (1927), Swartout (1930), Wadleigh (1934), Eavenson (1942), Rilee and others (1977).

Cottrell's Pits

Location: 9 (not field located)

Historical notes: These pits were mentioned in 1835 and were abandoned by 1841.

References: Kimball (1866), Eavenson (1942).

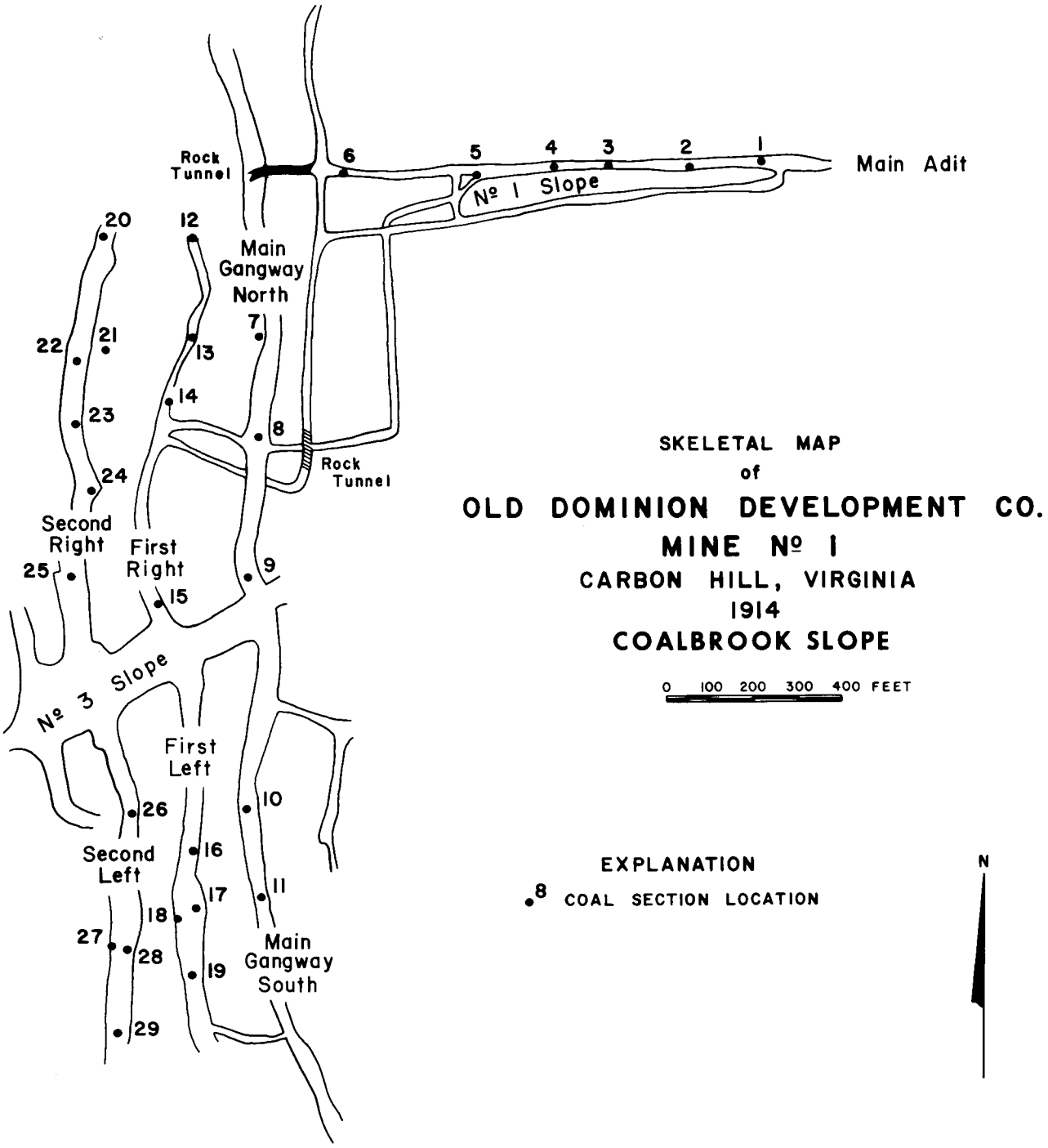

Figure 12. Skeletal map of the Coalbrook Slope.

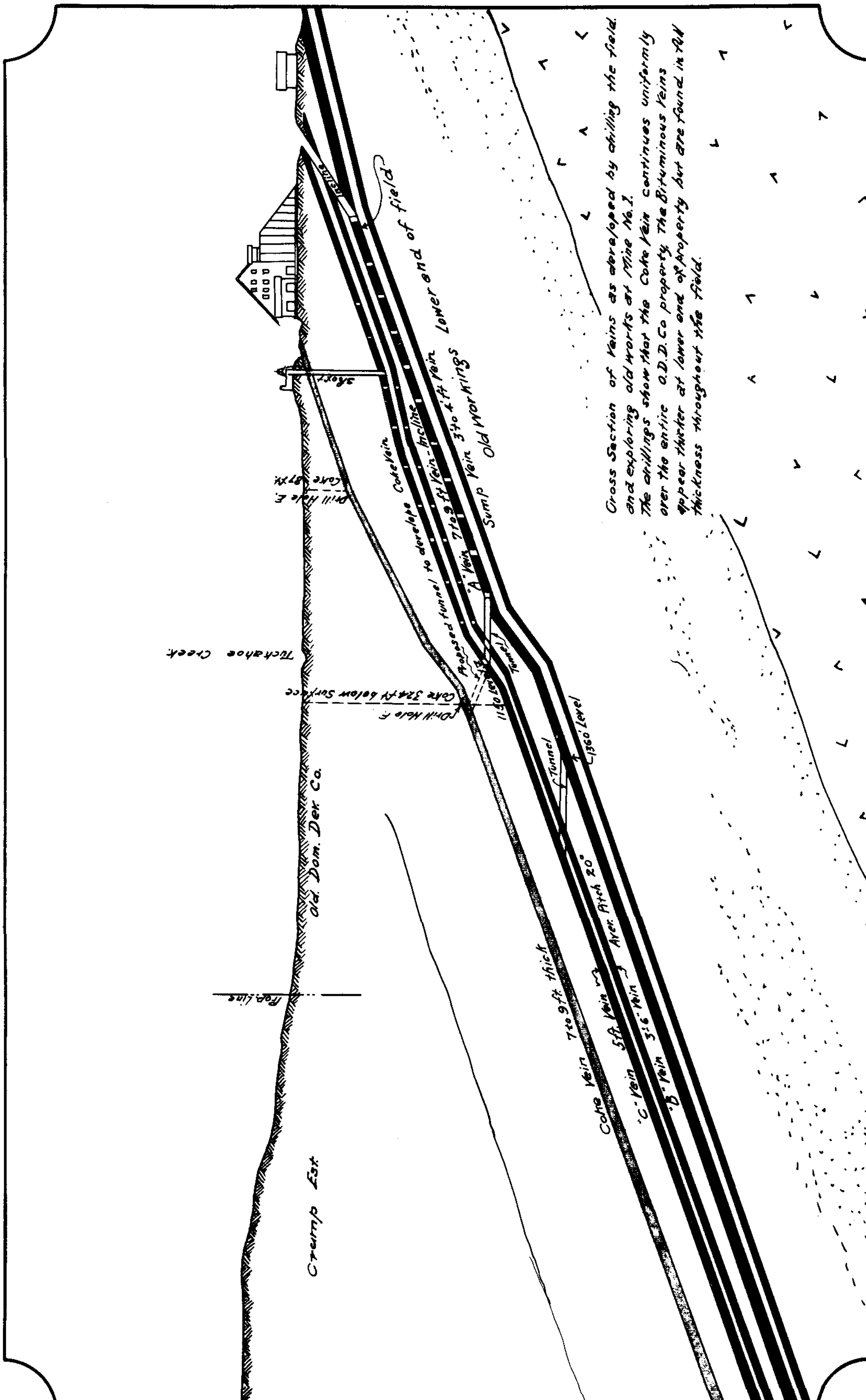

Figure 13. Cross section of the Coalbrook Slope.

(3)

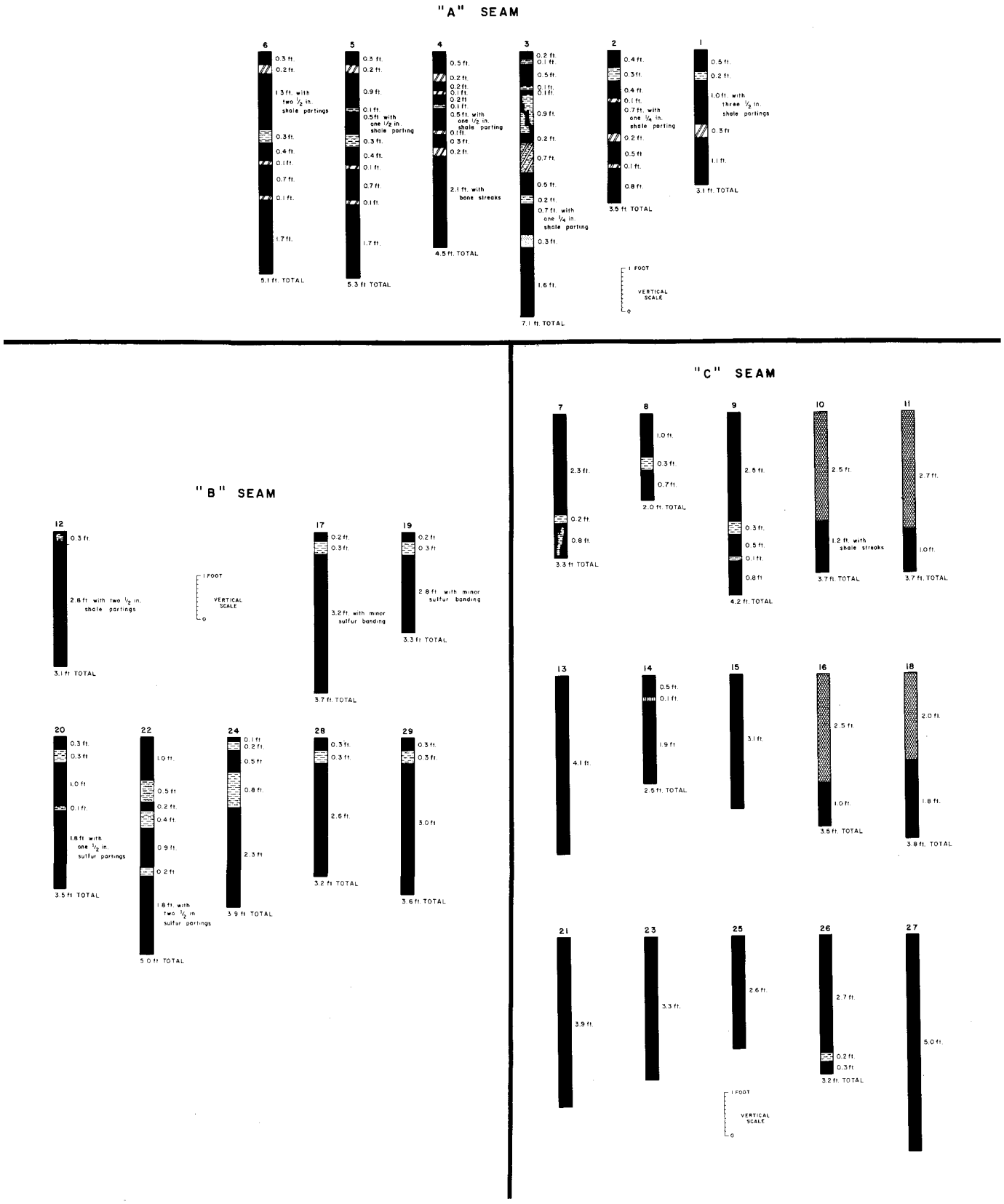

Figure 14. Coal sections of the "A", "B", and "C" coals. Coalbrook Slope.

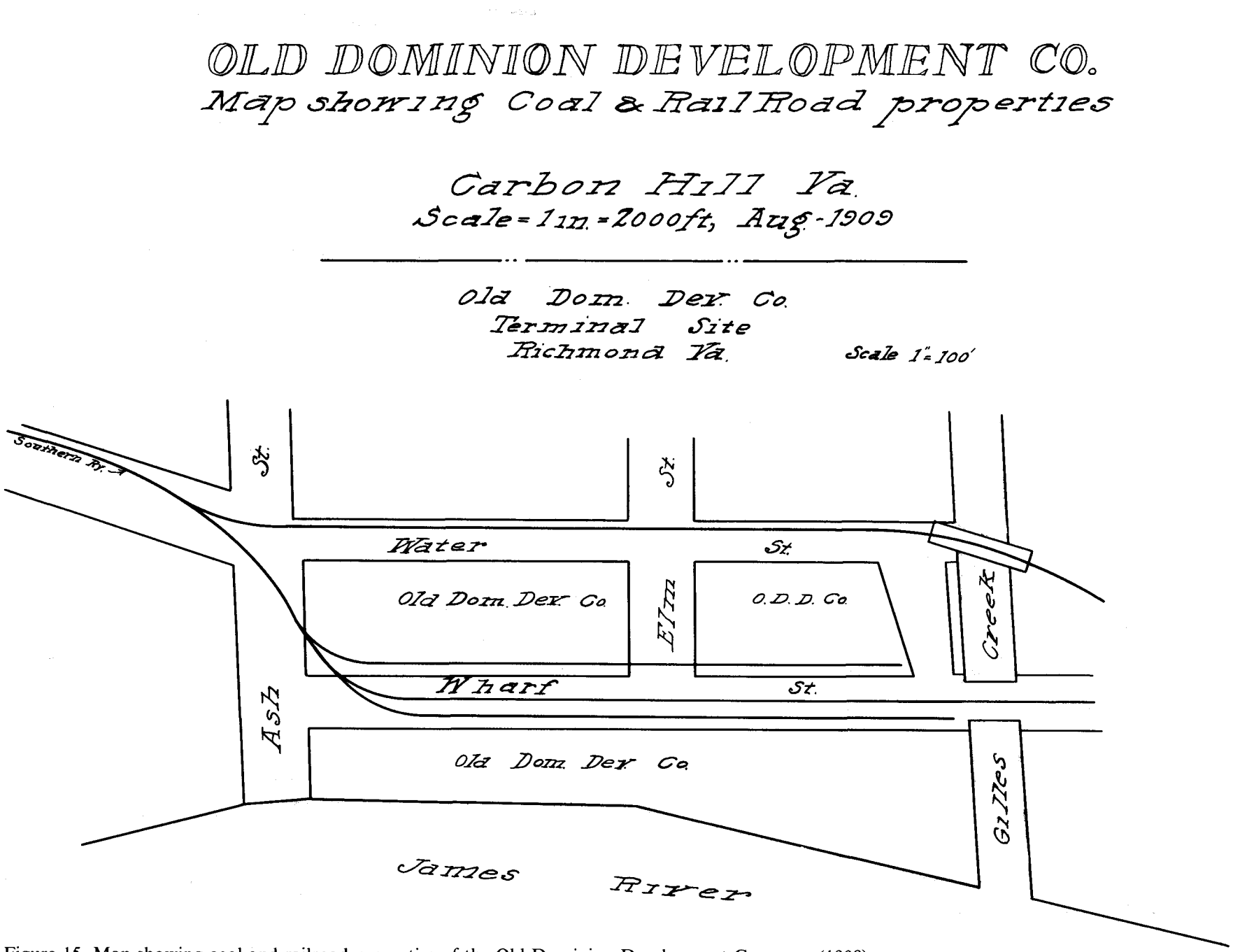

Figure 15. Map showing coal and railroad properties of the Old Dominion Development Company (1909).

Lucy White Tract Pits

Location: 10

Historical notes: Several shallow pits were worked in a 22- to 24-inch coal on this property. Most production was for home use, but some was loaded into wagons and transferred to the Tuckahoe and James River Railroad.

Reference: Newell (1888).

Tuckahoe Shaft

Location: 11 (not field located)

Historical notes: The Tuckahoe Shaft was worked and abandoned before the Civil War by the Tuckahoe Coal Company. As many as five major beds and several minor coals were found in this mine.

References: Wooldridge (1841), Johnson (1846), Heinrich (1878), Newell (1888), Russell (1892), Roberts (1928), Eavenson (1942).

Tippecanoe Shaft

Location: 12

Historical notes: This mine was worked in 1841 and probably was closed before the Civil War. A dike cut through the coal and locally altered it to natural coke. Only a small amount of coal was mined from this shaft.

References: Johnson (1844), Kimball (1866), Roberts (1928).

Wickham or Wigham Pits

Location: 13

Historical notes: These pits were worked and abandoned before the Civil War.

References: Newell (1888).

Deep Run District

This area is one of four outlier basins in which the coal measures have been preserved (Plate 1). The coals dip steeply (up to 74° to the east) on the western margin of the basin and more gently (20° to the west) on the eastern margin. The western margin of the basin is interpreted to be fault controlled (Shaler and Woodworth, 1899; Goodwin, 1981). Coal mines were in operation in this district by 1761. These early mines were outcrop pits and slopes but shafts were later used to extract the coal. At least three coals, with a cumulative thickness of 19 feet, were mined.

Deep Run Pits, Springfield Pits, Duvall's Pits, Burton's Pits, Ross and Curry Pits, Barr's Pits

Location: It is not possible to differentiate individual pits in this district. All of them are generally referred to as the Deep Run or Springfield pits.

Historical notes: The Deep Run Coal Pits were operated in 1761, and probably earlier, by Samuel Duval. Several people and companies intermittently worked these pits until 1924. Among these are John Barr in 1835, Richardson in 1842, and J.C. Deaton in 1846. By the mid-1800s, coal was transported from the mines to the Tuckahoe Canal by cart where it was loaded into barges and pulled to the James River and Kanawaha Canal at Lorraine and then to Richmond. Later, the coal was taken from the mines on the Tuckahoe and James River Railroad (a spur of the Fredericksburg, Richmond and Potomac Railroad) which delivered it either to the James River Canal (later to the Richmond and Alleghany Railroad) or the Fredericksburg, Richmond and Potomac Railroad main line near Glen Allen.

Three coals were mined in the Deep Run Pits, but a fourth may exist.

Measured Section (Kimball, 1866)

Feet	Descriptions
10	Coal
35	Parting
3	Coal
—	Parting
6	Coal

References: Lyell (1847), Kimball (1866), Rogers (1884a), Wortham (1916), Loeber (1927), Roberts (1928), Swartout (1930), Wadleigh (1934).

Midlothian District

This district is on the east-central margin of the main basin beginning at the James River and continuing south to the end of the coal measures, to about State Road 604 in Chesterfield County (Plate 1). Included in this district are the Stonehenge, Union, Cunliffe, and Black Heath basins.

The Stonehenge and Union basins are separated from the main basin by erosion. They represent areas of severe deformation of the Triassic strata. Several rolls and minor faults in the strata caused mining problems, but most were rectified by methods used at the time of mining. The Black Heath and Cunliffe basins are a part of the main basin. They are structurally the same as the Stonehenge and Union basins but have not been eroded to the same extent (Figure 16).

Four coals are found in this district. The uppermost coal averages 5 feet in thickness with 1.5 feet of shale partings. The second coal is 1 foot thick and is located in the 47-foot sandstone and shale interval between the first and third coals. The third coal averages 12 feet in thickness, including 0.2 to 2.0 feet of shale partings. An unnamed 14-foot coal is separated from the third coal by 10+ feet of sandstone and shale. Average dip of the

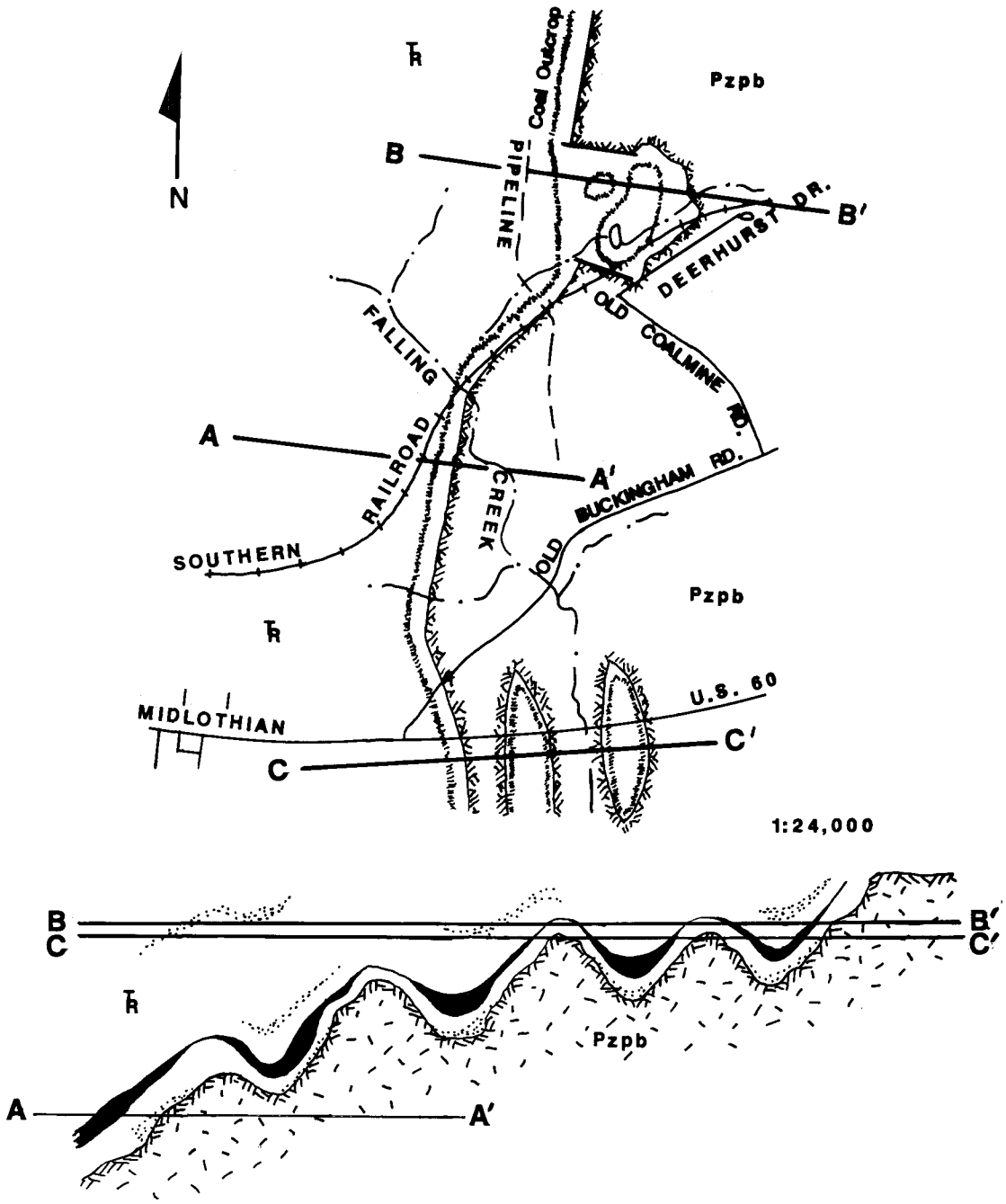

Figure 16. Relationship between sub-basins near Midlothian. Differences in sections based on extent of erosion.

coal in the main basin is 22° to the west. Details of the coal geology are discussed under the Grove Shaft.

Trabeau Pits, Burfoot Pits, River Pits

Location: 14

Historical notes: Three coals were encountered in these mines: an upper bed of natural coke, a middle coal 3 feet thick, and a lower coal 1 foot thick. The first mining was in 1778 and the mine was active in 1790 and 1815 to 1819. In June, 1817 the coal quality was advertised as excellent for manufacturing purposes, as testimonials from Bellona Furnace, Union Air Furnace, Crown Factory, a rolling and slitting mill, and the Nail Factory (Figure 17) indicate. However, coal taken from near the outcrop at the Burfoot Pit (circa 1835) was described as not suitable for anything but domestic fuel. The mines were sold in 1835 to Thomas M. Burfoot and leased to Standford, Duval and Company. This company sank shafts 50 to 250 feet deep south of the old Trabeau Pits. Water was a problem during construction and a steam-powered water pump was used to keep the shaft dry while it was being dug. Fifty men were employed at this time.

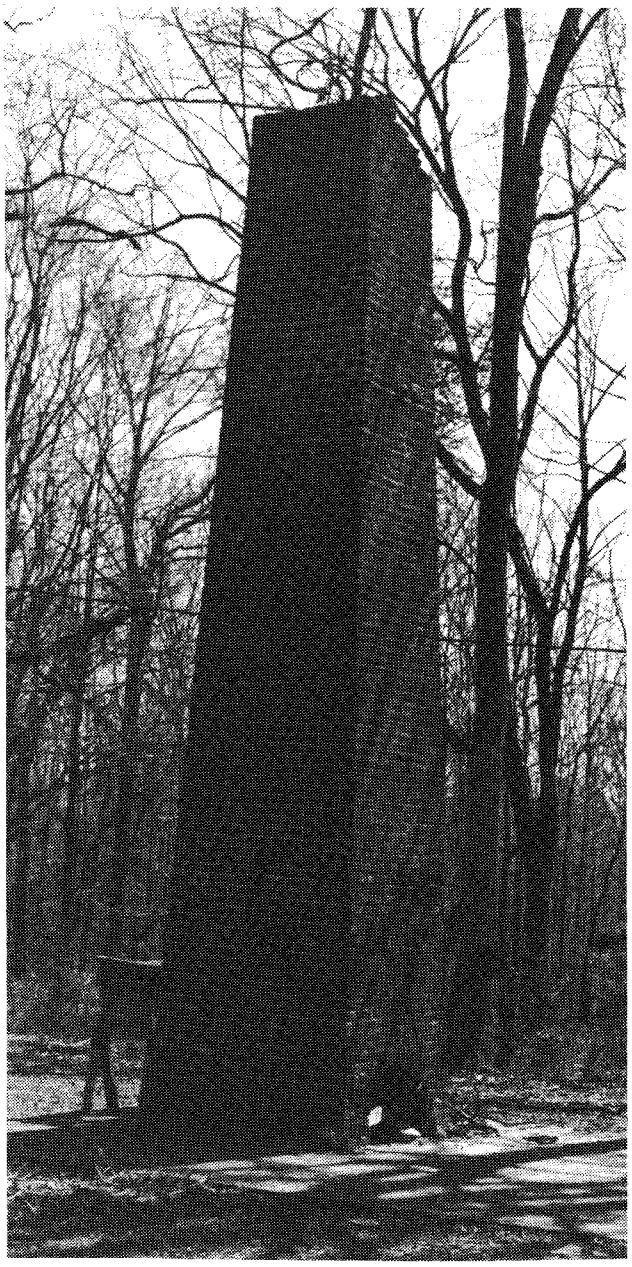

Figure 17. Nail factory chimney near Manakin (1979).

References: Shaler and Woodworth (1899), Roberts (1928), Wadleigh (1934), Eavenson (1942), Routon (1949).

Major Clarke Pits

Location: 15

Historical notes: Before 1842 coal was mined at these pits.

References: Wadleigh (1934), Eavenson (1942), Routon (1949).

Salle's Pit

Location: 16

Historical notes: This shaft mine was operating in 1790 when it was sold by Colonel Heth to Wills, Brown and Company. It was again sold in 1839 to the English Company along with an adjoining tract and the Maidenhead Pits. "Iron ore" and natural coke were discovered near these workings during construction of a rail line from the Black Heath mines to the James River, but no further development of the "ore" is mentioned.

References: Shaler and Woodworth (1899), Roberts (1928), Wadleigh (1934), Eavenson (1942), Routon (1949).

Dickenson Pit

Location: 17

Historical notes: One bed of coal 9 to 12 feet thick was mined here just below the surface. A hole drilled 800 feet west of this pit by the Richmond Syndicate in 1930 encountered coal at a depth of 487 feet.

References: Wadleigh (1934).

National Industrial Engineers, Incorporated Strip

Location: 18

Historical notes: Strip mining began in March 1938. By the fall of 1938 two 50-foot draglines had exposed the top of a coal reportedly 80 feet thick. Operations ceased at this locality within a very few years.

Reference: Routon (1949).

Bingley Slope

Location: 19

Historical notes: The Army of the Confederate States of America operated this slope mine from 1861 to 1865 (Figure 18). The mine recovered outcrop coal in the northern Black Heath basin.

Reference: Shaler and Woodworth (1899).

Black Heath Pits, Chesterfield Mining Company Pits

Location: 20

Historical notes: This mine was opened about 1788 by Heath Mining Company. In 1836 the Black Heath Pits were on fire but were still worked by the Chesterfield Mining Company. Cannon foundries in Richmond used coal from thin mine in 1838. A violent gas explosion occurred on March 18, 1839 resulting in several deaths. Sir Charles Lyell descended an 800-foot shaft on this property in 1844 and reported a 40-foot coal resting on granite. The slope at the bottom of the shaft was 1350 feet long. Another violent gas explosion in 1844 killed 11 men. The mine was working in 1854 to 1855 but was abandoned before the Civil War. By 1887 all that remained of the colliery was a pond and in 1985 the pond was filled with debris from subdivision development.

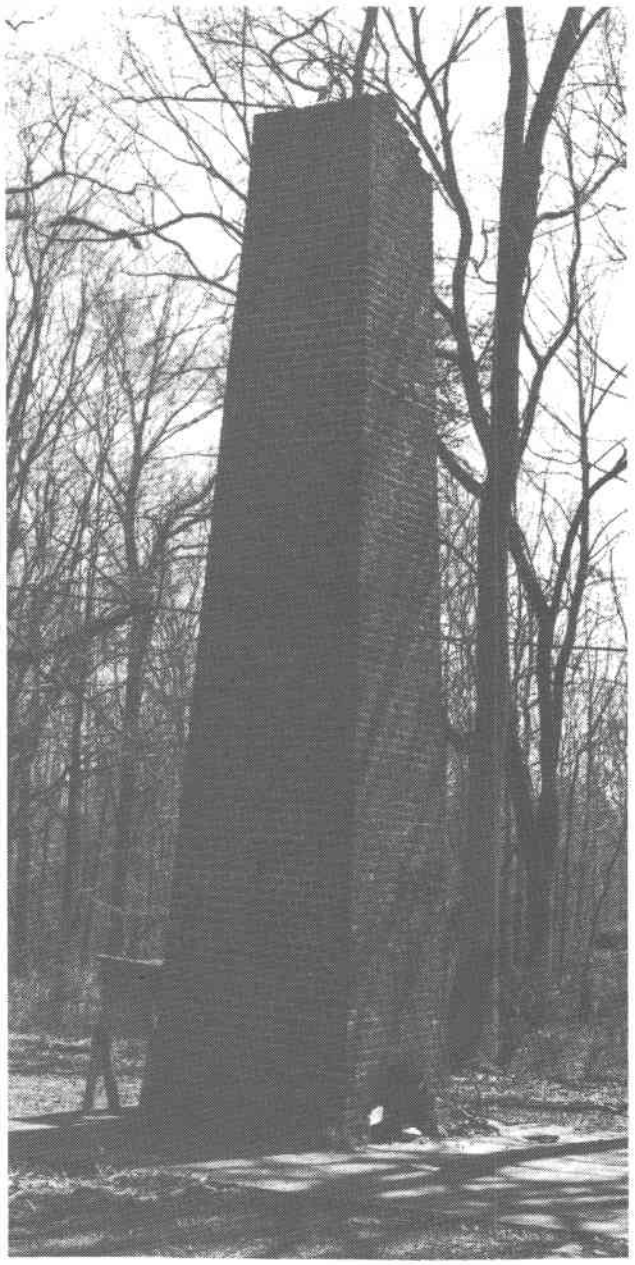

Figure 17. Nail factory chimney near Manakin (1979).

References: Shaler and Woodworth (1899), Roberts (1928), Wadleigh (1934), Eavenson (1942), Routon (1949).

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Historical notes: Before 1842 coal was mined at these pits.

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Historical notes: One bed of coal 9 to 12 feet thick was mined here just below the surface. A hole drilled 800 feet west of this pit by the Richmond Syndicate in 1930 encountered coal at a depth of 487 feet.

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Historical notes: Strip mining began in March 1938. By the fall of 1938 two 50-foot draglines had exposed the top of a coal reportedly 80 feet thick. Operations ceased at this locality within a very few years.

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References: Taylor (1835), Daddow and Bannan (1866), Rodgers (1884b), Clifford (1888), Wadleigh (1934), U.S. Bureau of Mines (1934).

Buck and Cunliffe Pits, Buck Pits, Cunliffe Pits

Location: 21

Historical notes: Located in the Cunliffe Basin these shaft mines were working in 1824 but were mined out by 1842.

References: Wooldridge (1841), Wadleigh (1934).

Jewett Coke Shaft

Location: 22

Historical notes: Opening in 1882, this shaft extended 137 feet to the "Coke seam." A slope was then dug on this bed for 325 feet at a dip of 30° to the west.

Measured Section (Clifford, 1888)

Feet	Description
2.5	Whin rock
6.0	Hard shale
1.0	Shale, dark
2.0	Coke
1.0	Shale
2.7	Coke
1.3	Shale
1.8	Coke
0.1	Shale
9.0	Coke
0.2 +	Fire clay

References: Clifford (1888), Shaler and Woodworth (1899), Roberts (1928), Wadleigh (1934).

Gowrie Shafts

Location: 23

Historical notes: The Gowrie Shafts were worked by George E. Swann in 1821 and by 1839 they were owned by Murchie, Mosely and Brander. Two shafts, 160 and 460 feet deep, were located on the property. The mines employed up to 40 men and produced 111 tons daily from a 6-foot coal. The coal was suitable for grate use and steam generation. The operation encountered structural problems and was abandoned about 1841.

References: Taylor (1855), Roberts (1928), Wadleigh (1934), Eavenson (1942), Routon (1949).

Blunt Shaft, Thompson Shaft, Wills Shaft, Willis and Michaels Shaft, Aetna Shaft, Etna Shaft

Location: 24

Historical notes: These shaft mines opened before 1804 and were owned and operated by Thompson Blunt. The operations were leased to Wills, Brown and Company (known as the Wills Shaft) and were later leased to John Heth. One shaft was 400 feet deep with two slopes near the bottom. The sedimentary strata are vertical in part of the shaft and porphyritic granite was encountered at the base. One slope was worked with mules and the other with a steam hoist. Ninety men worked a 30-foot coal with partings and produced about 140,000 tons annually.

References: Taylor (1835, 1855), Rogers (1884b), Clifford (1888), Eavenson (1942), Routon (1949).

Fearnought Shaft

Location: 25

Historical note: Located south of the Etna Shafts on the south side of the Southern Railway System.

References: Shaler and Woodworth (1899).

Wooldridge Pits, Old Midlothian Pits, Road Shaft

Location: 26

Historical notes: Coal was reportedly discovered on this property when coal chips were turned up by wagon wheels using the Buckingham Road. One of the oldest mines in the area, it was first mentioned in 1790 and was working during 1800 and 1824. In 1838 the site was known as Wooldridge's Old Pits. When the mine was worked out in 1841 it was known as the Road Shaft. A coal that was 35 feet thick, and locally thicker, was mined by means of the shaft. Coal was moved from the face to the bottom of the shaft by mules; coal and water were raised by a steam-driven hoist. Coal was moved to Manchester originally by wagon on the Midlothian Turnpike, and later on the Chesterfield Railroad.

References: Cox and Heinrich (1888), Roberts (1928), Wadleigh (1934), Routon (1949), Ritz (1975).

Bailey Pits

Location: 27

Historical notes: This small mine was operated in the early 1800s and was closed by 1860.

References: Wooldridge (1841), Wadleigh (1934).

Hanson Shaft

Location: 28

Historical notes: The English Company operated and mined at this locality in the early 1900s.

Reference: LaPrade (1900).

Woodrow Pit

Location: 29

Historical notes: This pit was on the Manders tract in 1900.

Reference: LaPrade (1900).

Figure 18. Bingley Slope (circa 1862, from Shale and Woodworth, 1899).

Maidenhead Pits, English Company Pits, Heath Pits

Location: 30

Historical notes: These mines were opened about 1821 by the Black Heath Company of Colliers. Coal was hauled by wagon on the Midlothian Turnpike to Manchester for 9 cents per bushel. The property had several shafts from 150 to 700 feet deep. Colonel John Heath purchased these mines in 1839 along with Salle's Pits and an undetermined adjoining tract. In 1840 or 1841 Colonel Heath went to England to attract capital to invest in these mines. While he was there, an explosion occurred in the Maidenhead Pits killing 53 of 56 men. Less severe explosions, which killed or burned several men, had occurred several times in years prior to this. One shaft (where the explosion occurred) was 700 feet deep; the other was 600 feet deep. The mines worked a 25-foot coal with partings and were capable of producing 30,769 tons of coal per year.

References: Cox and Heinrich (1888), Roberts (1928), Wadleigh (1934), Eavenson (1942), Routon (1949), Ritz (1975).

Railey Pits, Mills Pits, Mills, Reid and Company Pits, Mills Creek Pit, Mills and Reid Creek Pit

Locations: 31 and 32

Historical notes: These pits opened in the late 1700s mining a coal that was as much as 40 feet thick but absent in places. The mines and property of Nicholas Mills were leased to Harry Heath at 2 cents per bushel (about 61 cents per ton) on May 13, 1811. In 1829, Mills and Beverly Randolph obtained a charter to build a railroad from the mine to docks in Manchester on the James River. Prior to this time coal was hauled by cart on the Midlothian Turnpike. Claudius Crozet was hired to design the railroad and Moncure Robinson oversaw construction. The Chesterfield and Manchester Railroad was completed in 1831 and consisted of wooden rails topped with iron straps. A large embankment at the mine began the all downhill 13-mile run to the river. When the loaded cars neared the river, a block and tackle system was attached to empty cars at the docks. The empty cars were then pulled uphill by the weight of the loaded cars. Two mules, which rode in the last coal car, were then used to pull the empty

Figure 18. Bingley Slope (circa 1862, from Shale and Woodworth, 1899).

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cars back to the pits. The total cost of building the railroad was $150,000. In the first year of operation the railroad made $22,000. Transportation costs from the mines to the docks at Manchester dropped from 10 cents a bushel to 3 cents.

References: Chesterfield County Court House Deed Book 9, p. 7-10, May 13, 1811 and Book 7, p. 540, May 13, 1812, Schmitz (1895), Roberts (1928), Wadleigh (1934), Routon (1949), Claflin (1978).

Bell Shaft

Location: Included with 31

Historical notes: The Bell Shaft, located on the Railey Hill tract, was owned by Nicholas Mills. The 400-foot shaft was on fire in 1823. After a fire damp explosion of December 24, 1833, the trace of the mine could be seen on the ground's surface. The mine was still on fire in 1848 and the fire spread to the Rise Shaft. The mine was being worked by Chesterfield Coal and Iron Manufacturing Company at the time of abandonment.

References: Taylor (1835), Heinrich (1873), Schmitz (1895), Roberts (1928), Wadleigh (1934), Routon (1949), Claflin (1978).

Union Pits

Location: 33

Historical notes: This mine was opened about 1824, was mentioned in 1827 and 1838, and was closed by 1841. It was reopened in 1880 by Jacob Beach and produced 1638 tons annually from a 8-foot coal. These are the only mines in the Union Basin.

References: Shaler and Woodworth (1899), Roberts (1928), Wadleigh (1934), Eavenson (1942), Routon (1949).

Greenhole Shaft

Location: 34

Historical notes: The first mention of mining at this shaft was in 1790. The coal was reportedly discovered when a deer kicked up coal on snow as it jumped a creek. Nicholas Mills owned the shaft in 1837 and a 100-foot shaft was reported in 1840. The mine was owned by the Midlothian Company in 1841, but was worked out.

Measured section (Clifford, 1888)

Feet	Description
9	Coal
0.2	Shale
17	Coal
4	Soft black clay

References: Rogers (1884b), Clifford (1888), LaPrade (1900), Roberts (1928), Wadleigh (1934), Eavenson (1942), Routon (1949).

Pacebri Pit

Location: 35

Historical note: This shaft mine was operated by the Creek Company before 1840.

Reference: Mr. L.B. Anderson, Midlothian, Virginia (personal communication, 1978).

Agaze Shaft

Location: 36

Historical note: The Creek Company operated this 400-foot shaft during 1873.

References: Heinrich (1873), Schmitz (1895).

White Chimney Shaft, Old Midlothian Pit

Location: 37

Historical notes: The Midlothian Coal Mining and Manufacturing Company dug this shaft in the early 1800s. It encountered coal at 360 feet and the base of the coal reportedly is in contact with granite. In December 1856 an attempt was made to empty the mine of water and work to the rise, but water broke through old workings, flooding the mine, and drowning several men. A 500-HP pump was used in 1858 to dewater the mine, and production continued until a mine fire in 1861 forced abandonment.

References: Lyell (1847), Heinrich (1876), Schmitz (1895).

Sinking Shaft

Location: 38

Historical notes: In about 1865 an 8-by 14-foot shaft was dug by Col. George Wooldridge who was in charge of the Midlothian Coal Mining and Manufacturing Company. The company borrowed $180,000 from Mr. Burrows of Albion, New York, to dig the shaft. The shaft was dug to a depth of 1015 feet and a hole was drilled an additional 322 feet without encountering coal. The superintendent was killed during this operation. Because of the outlay of money with no return, the Midlothian Coal Mining and Manufacturing Company property was sold at public auction in 1869. Another unsuccessful attempt was made in 1874 to discover coal in this shaft.

References: Russell (1892), Schmitz (1895), Shaler and Woodworth (1899), Woodworth (1902), d'Invilliers (1904), Jones (1916), Wadleigh (1934).

Pump Shaft, Midlothian Pit, Middle Shaft

Location: 39

Historical notes: The Pump Shaft was one of four shafts put in by the Midlothian Coal Mining and Manufacturing Company about 1836; the others are the Grove, Middle, and Woods shafts. In the fall of 1839, 36 feet of coal was encountered at a depth of 716 feet in the Pump Shaft and work on the other three shafts was suspended. A mule-driven windlass was used to remove spoil during construction of the shaft. When completed, the shaft was 11 feet square and divided into four sections, by timbers, for haulage and ventilation. A slope was driven in the coal near the bottom of the shaft, where the dip averaged 30° to the west. Drifts were turned every 60 feet and measured 16 feet wide and 10 feet high. Initially, mules were used to move coal by cart from the working face to the bottom of the shaft. Here the coal was lifted by a mule-windlass on the surface. The mules that were kept in stalls underground were reported to be very healthy due to the atmosphere of the mine and excellent care. Later, a steam engine was put in at the bottom of the shaft to raise coal from the slope and a second engine at the surface raised coal and water. Once on the surface the baskets, or cowe's, used in raising the coal were placed on a hand railway and pushed several feet where the coal was dumped, screened, and handloaded into railroad cars.

Ventilation was achieved by placing wooden brattice in the center of the main drifts to separate incoming and outgoing air. The circulation was produced by a furnace at the base of the upcast shaft. When more ventilation was needed, the fire in the furnace was increased. Care had to be exercised as accumulations of methane gas could be ignited by the furnace.

In 1840, 3000 bushels of coal (42 tons) were raised by 150 men and 25 mules. By 1867 the Midlothian Coal Mining and Manufacturing Company failed, and the mine was sold at auction in 1869. Two million tons of coal were produced and shipped from this mine from 1839 to 1867.

Figure 19. Fan housing at the Grove Shaft ruins (1979).

Pump Shaft, Midlothian Pit, Middle Shaft

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Figure 19. Fan housing at the Grove Shaft ruins (1979).

Measured Section (Cox and Heinrich, 1888)

Feet	Description
570	Sandstone and shale
1.5	Slate with *Calamites*
43.8	Sandstone and shale
8	Sandstones with *Calamites*
48	Sandstone and slaty shale
2.5	Slate and long vegetable stems
6.5	Sandstone
5.5	Slate with numerous *Calamites*
14	Sandstone
13	Black rock (carbonaceous?)
5	Slate
36	Main coal
5	Sandstone - not laminated
4	Slate
1	Coal
7	Sandstone
3	Slate
773.8	Total section

References: Lyell (1847), Cox and Heinrich (1888), Schmitz (1895), d'Invilliers (1904), Roberts (1928), Wadleigh (1934), Routon (1949).

Grove Shaft, Murphy Slope

Location: 40 and 41, respectively.

Historical notes: The Grove Shaft was dug in about 1836 to 622 feet by the Midlothian Coal Mining and Manufacturing Company. Work was suspended on this shaft when coal was encountered in the Pump Shaft which was being dug at the same time. Later, an exploration slope was begun in the coal 517 feet down the Grove Shaft. This slope followed a 4-foot coal 230 feet to the northwest. When the Midlothian Coal Mining and Manufacturing Company failed in 1869, due to the unsuccessful attempt to reach coal in the Sinking Shaft, Mr. Burrows of Albion, New York, bought the Midlothian tract and put O.J. Heinrich, a prominent English mining engineer of that day, in charge.

Clearing out at the Grove Shaft began in March 1873 and two rock tunnels were driven west from the old slope into the coal. A small ventilation-return shaft was dug south of the main shaft, and entered the up-cast chamber. The main shaft measured 11 feet square and was divided into halves by a wooden brattice. The north side was used for air return which was accomplished by heat and smoke from a boiler at the base of the shaft. Among other uses, this boiler served the blacksmith's shop. Later, a Guibal fan, 23 feet in diameter with a hub length of 7 feet, was used to make the draft for ventilation (Figure 19). The fan was driven by a steam engine with a 14-inch cylinder and a 30-inch stroke. The south half of the main shaft was divided into two compartments for hoisting and downcast. Hoisting cages were 4 feet square and were operated by mule hoist. One cage held about 110 pounds of coal. Later, a direct-acting engine with a 24-inch cylinder and 5-foot stroke, driven by a double drum 10 feet in diameter, was used for lifting.

Double rock tunnels located 603 feet downshaft were driven horizontally 530 feet to the west. They cross-cut the 4- and 12-foot coals before terminating in the upper 14-foot coal. From here, levels branched out north and south to work the coal (Figures 20 and 21).

A methane gas explosion, touched off by a lamp, killed several men on May 20, 1876. After this, O.J. Heinrich was discharged and Mr. Dodd was put in exclusive charge.

An incline, known as Dodd's Incline, was driven into the middle or 12-foot coal, where the rock tunnels intersected that coal. The incline had a direction of N66°E, a slope of 20°, and a length of 1980 feet. Levels were driven north and south off Dodd's Incline at irregular intervals. Because of the large coal thickness, stopes were used to mine the coal in this section of the mine.

On February 3, 1882 another methane explosion killed 34 men. This was caused by a roof fall that broke the central brattice, disrupted ventilation and caused the accumulation of methane gas. The mine caught fire from the explosion and was sealed off.

At the time of the explosion another slope was being dug on the 12-foot coal. This incline began at the No. 11 level, or about 900 feet above the end, of Dodd's Incline. This "New Incline" was never completed after the explosion of 1882, but had been driven 1000 feet updip toward the eastern outcrop and 375 feet downdip.

By the fall of 1883, most of the effort was still being directed towards cleaning up the mine after the 1882 explosion. The coal from the mine was used as fuel for the various hoisting engines.

Mr. Burrows died in the late 1880s and the property lay idle until 1894 when it was purchased by a Pennsylvania company. This company began prospecting east of the Grove Shaft without success. They then began cleaning up the Grove Shaft workings but this became too costly and again the property lay idle.

In 1902 a syndicate of Richmond people bought the Midlothian tract and put Meriwether Jones, a mining engineer, in charge. He reopened the Grove Shaft and also dug a double track slope 900 feet south of the Grove Shaft. This slope connected with the old undip slope of Dodd's Incline and was used for a hoistway and downcast. The Grove Shaft was used as an upcast and escapeway.

In 1904, it was determined that all the commercial coal had been mined above the No. 9 level of Dodd's Incline and to the south between the Dodd's and

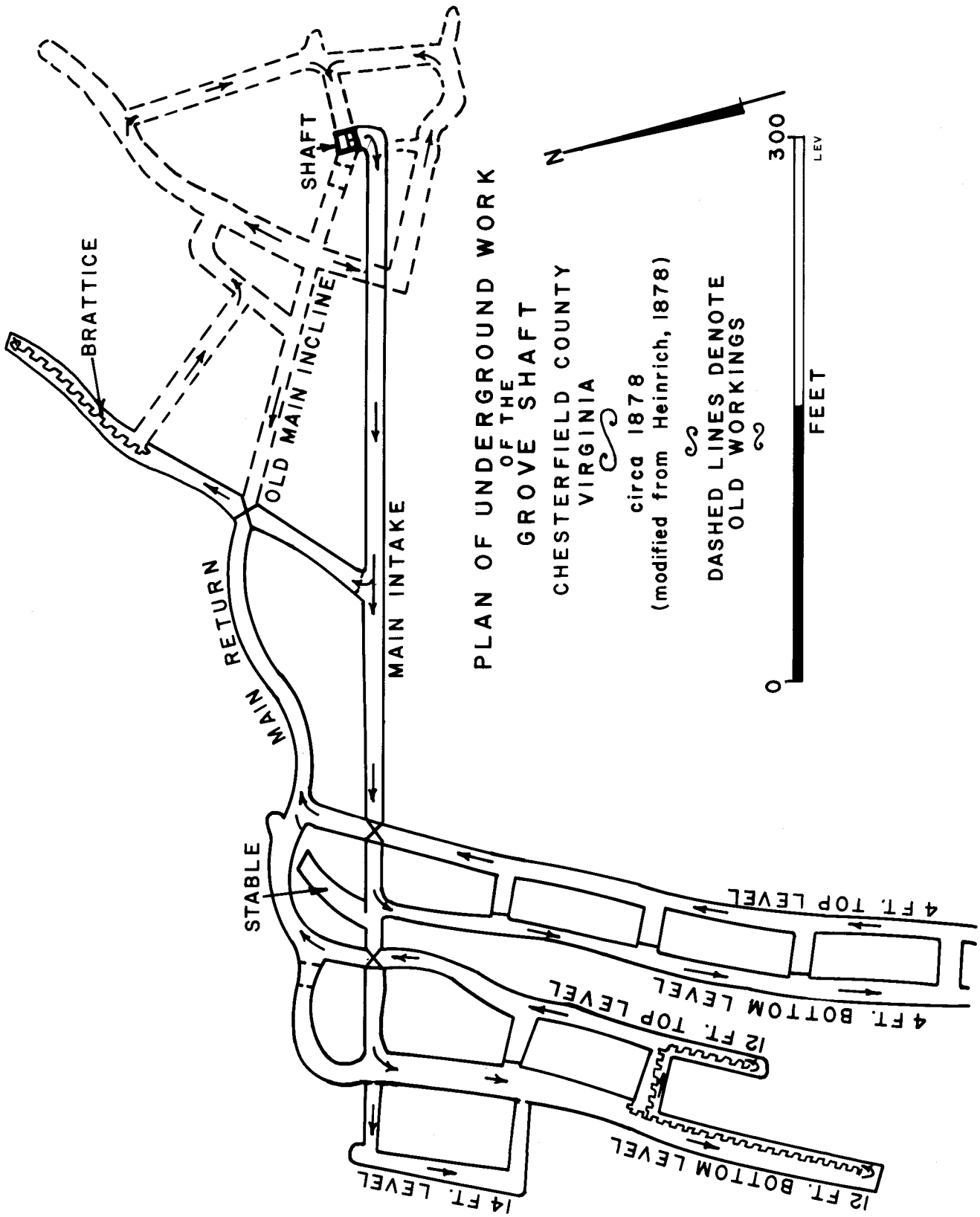

Figure 20. Plan of underground work of the Grove Shaft.

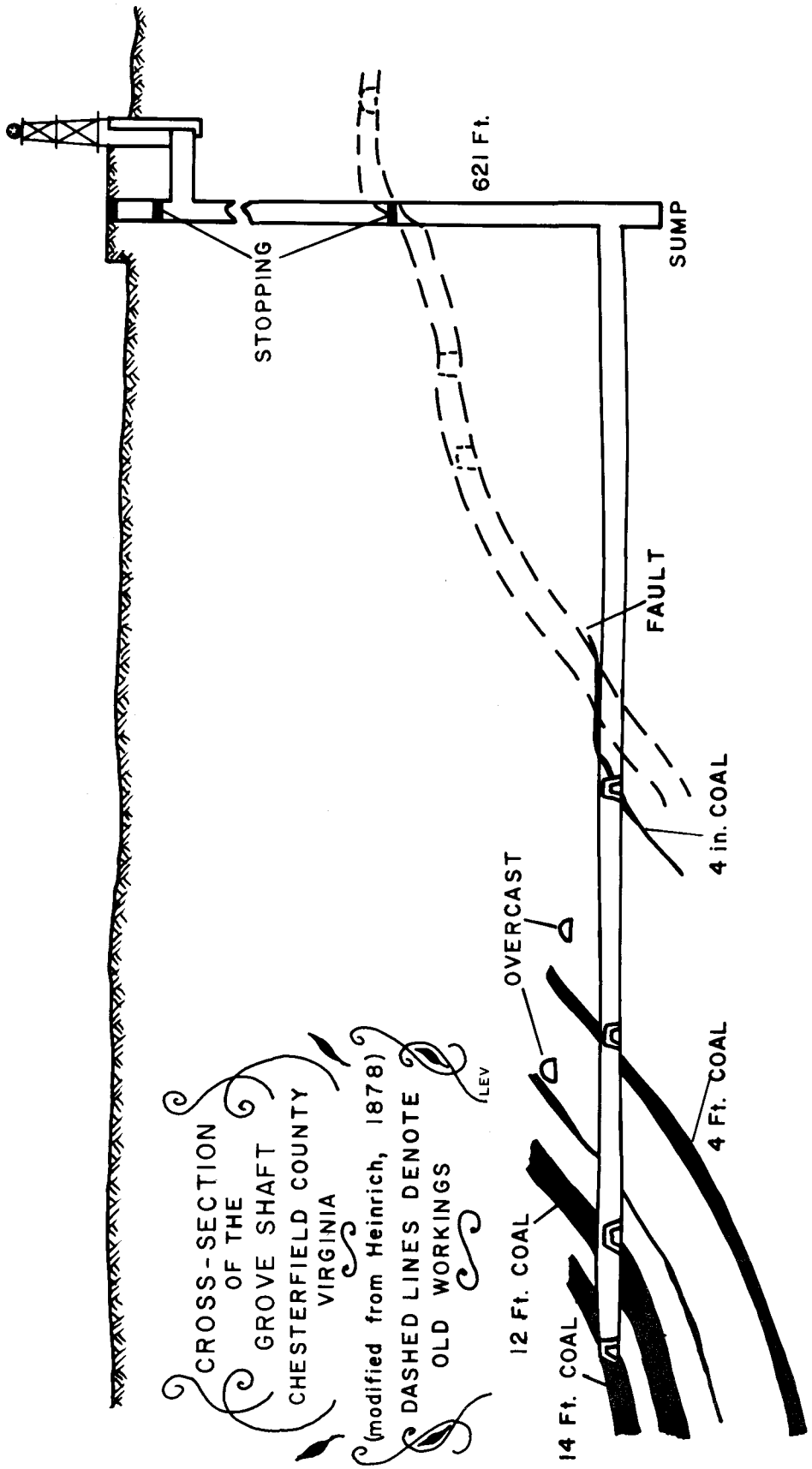

Figure 21. Cross section of the Grove Shaft.

Figure 22. Grove Shaft ruins (1978).

New Inclines. Again, the mines were idled.

In 1920 the property was taken over by the Murphy Coal Corporation. This company made use of the previous owners' improvements in the new slope and invested in modern machinery, both above and below ground. The new equipment included: two 250-HP boilers for pumping and hoisting, high-volume water pumps, new rails in the incline, several 1-ton cars, a 200-foot long tipple, a large bin, engine and winding houses, and an office building. The Grove Shaft was used for emergency purposes and had a large steam pump and hoisting machinery located on the surface.

In July, 1923, the length of the Murphy Slope was 2330 feet in a N65°W direction. The angle of incline was 19° at the surface but increased to 70° in places due to rolls. Vertical depth at the deepest point was 1240 feet. In 1923 50,000 tons of coal were produced.

Mining operations ceased sometime before 1925 but pumps were kept running to keep the mine from filling with water. The "Midlothian Mines" were abandoned and never worked again after the pumps were shut down in the late 1920s (Figure 22).

Geology of the Grove Shaft

Mining on the Midlothian tract has been dictated by a number of northeast trending structural rolls that cause pinching of the coals. From the base of the Grove Shaft, the strata rose westward for 750 feet before assuming the normal dip to the west. At the top of this buckling, the C coal is 26 inches thick. Elsewhere, the C coal averages 48 inches.

Three major rolls have been recognized in the Grove Shaft workings. The first, known as the "60-foot roll," is located approximately 725 feet above the intersection of the Dodd's and New Inclines at the No. 11 level. The second, 15 feet wide, is about 275 feet below No. 11 level. A third roll is located on the updip side of the Grove Shaft in the New Incline. These rolls affect the thickness and nature of the coals. Above the 15-foot roll, the 12-foot B coal is characterized by at least two large shale partings and in many places has additional partings of bone and shale from 0.1 to 0.3 foot thick. In the B coal above the No. 11 level, the uppermost shale parting is from 1.1 to 1.8 feet thick. This parting separates the B coal into two benches, the top bench 2.3 to 2.9 feet thick and the lower bench 1.3 to 1.8 feet thick. Below the No. 11 level in the B coal, a 2.5-foot shale parting separates a 4.9-foot upper coal (with a 0.2-foot bone zone) from a 2-foot lower coal.

References: Heinrich (1876), Cox and Heinrich (1888), Schmitz (1895), Shaler and Woodworth (1899), d'Invilliers (1904), Jones (1916), Roberts (1928), Tredwell (1928), Wadleigh (1934).

Creek Company Pits

Location: 42

Historical notes: At the Creek Company Pits, a coal was mined that was 6 feet thick. This coal was separated from the main coal by a 6-foot shale and sandstone parting. The mines were in operation before 1814. In 1839 to 1840, 250,000 to 300,000

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bushels of coal were produced. One shaft was in operation in 1841 and was 380 feet deep. Mules were used to haul coal from the face to the base of the shaft where it was hoisted by a steam engine. The coal was shipped to docks at Manchester on the Chesterfield Railroad.

References: Kimball (1866), Cox and Heinrich (1888), Roberts (1928), Wadleigh (1934), Eavenson (1942), Routon (1949), Ritz (1975).

Stonehenge Pits

Location: 43

Historical notes: Three coals were mined on this tract: the top bed was 12 to 16 feet thick, the second 28 inches, and the third 4.5 feet thick. The coal was used for locomotive fuel in the 1800s. Numerous shafts from 50 to 400 feet deep were on this property owned by Martin Riley and later by his heirs. The mines were opened in 1796 and closed in 1832. John J. Werth and Company reopened the mines in 1848 and worked them until 1896.

References: Roberts (1928), Wadleigh (1934), Eavenson (1942), Routon (1949), Ritz (1975).

Woods Shaft

Location: 44

Historical notes: The Woods Shaft was one of four shafts sunk by the Midlothian Coal Mining and Manufacturing Company about 1836 (Pump, Middle, Woods, and Grove shafts). The depth of the shaft was 625 feet and the depth to coal was 300 feet. This shaft was temporarily abandoned in the fall of 1839 when work concentrated on opening the Pump Shaft.

References: LaPrade (1900), Roberts (1928), Wadleigh (1934).

Dinny Pit

Location: 45

Historical note: This small mine was located on the F. C. Dinny/McTyre tract in 1900.

Reference: LaPrade (1900).

Clover Hill District

This district is on the southeast margin of the Richmond basin, beginning near the junction of State Roads 664 and 655 and continuing south across the Appomattox River to an area west of Whites Store (Plate 1).

Three coals are present in this district. The top coal is 3 to 5 feet thick and is separated from the main coal (which is 7 to 20 feet thick) by 10 to 30 feet of sandstone and mudstone. A 40 to 50 foot interval of sandstone and mudstone separates the main coal from the bottom coal, which is 4 to 6 feet thick.

Early mining was by the slope method but was complicated by a squeeze in the strata, which pinched out the coals for a surface distance of 100 feet. This so-called "Garrett Trouble" is located approximately 1300 feet along the surface west of the coal outcrop. Mining was terminated downdip when this structure was encountered. When the "Garrett Trouble" was delineated, shafts were located to the west of the roll and mining was able to continue.

The Clover Hill district was the last mining area to be developed in the Richmond coalfield, beginning in the early 1800s.

Coate's Pits

Location: 46

Historical notes: A 2-foot coal was mined by Mr. Hall of Petersburg during the early 1800s. This mine marks the northernmost occurrence of coal in the Clover Hill district.

References: Tuomey (1842), LaPrade (1900).

Hill Shaft

Location: 47

Historical notes: The Hill Shaft was opened about 1822 and worked about 5 or 6 years. Production was from a 5 foot thick coal.

References: Tuomey (1842), Roberts (1928), Wadleigh (1934), Eavenson (1942).

Cox Pits, Clover Hill Pits

Location: 48

Historical notes: Coal was reportedly discovered on the land of James H. Cox in 1839 when heavy rains exposed a coal bed on the side of a hill near Clover Hill. A slope mine was constructed from the outcrop east of the "Garrett Trouble" but was shortly abandoned (Figure 23). Coal dip at the surface was 40° to the west. The Clover Hill Coal Mining and Manufacturing Company was organized by Cox in 1840 and two 240-foot shafts were dug to coal west of the old slope, 336 feet west of the coal outcrop (Figure 24). A 14-foot coal, including 3 feet of shale parting, was mined by two parallel drifts that were connected at various intervals. These drifts were inclined 30° to the west. Coal was hauled up from the working face to the bottom of the shaft in carts that were pulled by mules. The coal was raised from the shafts by a small steam engine, which also raised water using a bucket hoist. Mule-drawn wagons moved the coal from the mine to loading facilities on the Appomattox River at Epps Falls. From there, boats with a 7-ton capacity carried the coal to Petersburg. A round trip took four days, and the cost was $2.38 per ton.

By 1845 the Clover Hill Railroad was completed from the Clover Hill mines to the Appomattox

River, replacing the wagon road. Including transportation costs, Clover Hill coal sold for $5.60 per ton in Richmond in 1848.

Because of the success of this rail line, the Clover Hill Mining and Manufacturing Company began building an 18-mile railroad to the Richmond and Petersburg Railroad at Chester Station. This spur, completed on October 1, 1847, was a branch line of the Richmond and Petersburg Railroad. From 1847 to 1848 this line hauled 78,107 tons of coal from the Clover Hill area, of which 56,880 tons were shipped to other east-coast ports. The remainder was consumed in Richmond and Petersburg.

By 1866, the Clover Hill Railroad built its own landing at Osborn's, on the James River. However, the Dutch Gap Canal, built during the Civil War, diverted the river and caused a sandbar to develop in front of the Clover Hill Railroad's wharf making the landing useless. In April, 1867, a mine explosion at the Clover Hill Pits temporarily closed the mines. A cholera epidemic that year further depressed mining activity. The Clover Hill Coal Mining and Manufacturing Company's mines and railroad were sold in foreclosure to the Brighthope Mining Company in 1877. The Brighthope Railway Company continued haulage from this and other mines in the district until the late 1800s.

References: Tuomey (1842), Kimball (1866), Bladon (1883), Cox and Heinrich (1888), Schmitz (1895), Woodworth (1902), d'Invilliers (1904), Jones (1916), Wortham (1916), Roberts (1928), Wadleigh (1934), Eavenson (1942), Ritz (1975), L. Lush (personal communication, 1979).

Moody and Johnson Pits

Location: 49 (not field located)

Historical notes: A 100-foot shaft to the coal was located on the property of Mr. Anderson and leased to Messrs. Moody and Johnson. Production from a coal at this mine and coal from the Cox Pits totaled 7000 tons in 1840. This coal, with coal from other Clover Hill operations, was transported to Epps Falls on the Appomattox River by wagon and later by rail.

References: Tuomey (1842), Wadleigh (1934), Eavenson (1942), Ritz (1975).

New Slopes

Location: 50

Historical note: These were slope mines working in the 1890s.

Reference: Schmitz (1895).

Beaver Slope

Location: 51

Historical note: This slope, located on the east side of the "Garrett Trouble", was part of the Brighthope Coal Company operations in 1877.

References: Schmitz (1895), Wadleigh (1934).

Brighthope Shafts

Location: 52

Historical notes: These shafts, owned by the Clover Hill Mining Company were dug in 1844. Boilers placed at the bottom of one shaft were used as a

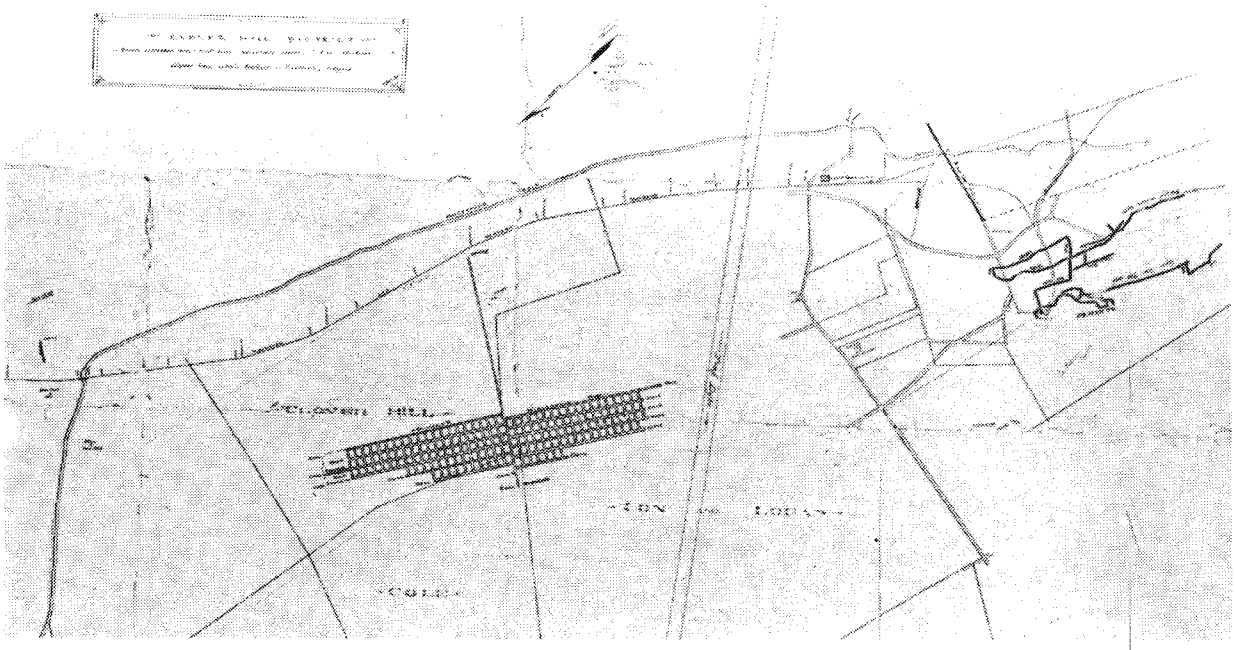

Figure 23. Mine map of Cox and Brighthope mines.

power source and for updraft ventilation. A methane gas explosion in 1859 killed 17 miners and was probably set off by the boilers. Another explosion, due to these same boilers, killed 69 miners in 1873, and yet another explosion left the mine on fire later that same year. After this accident the pumps were stopped and the workings allowed to flood. The Brighthope Railway Company (Figure 25) was formed in 1877 and purchased the foreclosed Clover Hill Railroad and mines. The Brighthope shafts were drained and reopened by 1880. In 1888, Brighthope coal sold for $3.50 per ton wholesale and $4.50 per ton retail. In 1889 the Brighthope Railway was sold to the Farmville and Powhatan Railroad, which discontinued mining.

Measured Section (Schmitz, 1895)

Feet	Description
783±	Sandstone and shale
4	Coal
14	Sandstone and shale
1	Coal
12	Sandstone and shale
1.2	Coal
41	Sandstone and shale
5	Upper main coal
5±	Shale
13-26	Lower main coal
40	Sandstone and shale
4	Lower coal
250	Sandstone and shale
	Gneissic basement
1,176±	

Measured Section (Schmitz, 1895)

Detailed section of the Lower Main Coal

Feet	Description
2.0	Coal
0.8	Shale
0.8	Coal
0.3	Shale
3.8	Coal
0.3	Shale
1.1	Coal
0.1	Shale
1.1	Coal
0.3	Bone
2.1	Coal
0.1	Shale
1.8	Coal
0.1	Shale, clay
0.9	Coal
11.5	Total coal
2.0	Total partings

References: Cox and Heinrich (1888), Schmitz (1895), Roberts (1928), Wadleigh (1934).

Pump Slope

Location: 53

Historical note: The Pump Slope was connected to the Brighthope Shaft's workings, probably to dewater them.

References: LaPrade (1900), Wadleigh (1934).

Hall's Retreat Slope

Location: 54

Historical note: This mine was possibly an entry to the Brighthope mines.

References: LaPrade (1900), Wadleigh (1934).

Raccoon Slope

Location: 55

Historical notes: This slope is located to the east of the "Garrett Trouble". Only one coal, 7 to 8 feet thick, was mined at this slope. A gas explosion occurred in 1863 but the mine was soon reopened. Another explosion occurred in 1879 but did not disable the mine. Because of a royalty dispute the mine closed in 1884.

References: Schmitz (1895), Shaler and Woodworth (1899), Roberts (1928), Wadleigh (1934), Eavenson (1942), Ritz (1975).

Rudd Mine

Location: 56 (not field located)

Historical notes: A.A. Rudd worked this mine during the summer and fall in the 1920s for local use. Average annual production from the mine was 100 to 200 tons.

Reference: Roberts (1928).

Rowlett Pits, Appomattox Company Pits

Location: 57

Historical notes: Several closely spaced slopes, collectively known as Rowlett Pits, were opened about 1821 by some "gentlemen in Petersburg." After two years of work the effort was abandoned and it is not clear how much coal was encountered. The property lay idle until 1842 when the Appomattox Comany put in exploration pits near Rowlett Pits, discovered a workable coal of unknown thickness, and mined it for several years.

References: Wooldridge (1841), Tuomey (1842), Eavenson (1942), Ritz (1975).

Huguenot Springs/Manakin District

This district is on the west side of the Richmond basin between U.S. Highway 60 and State Highway 6

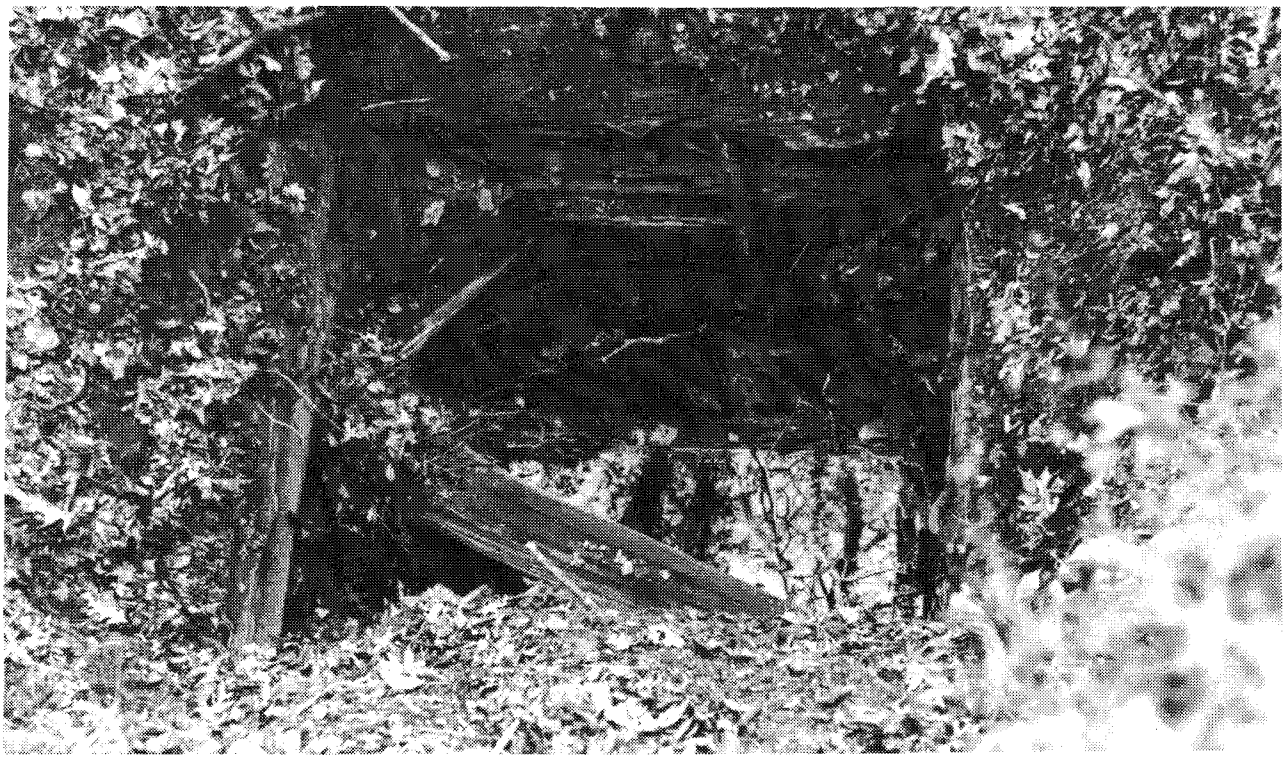

Figure 24. Cox Shaft (1979).

(Plate 1). At least two coals were mined: the upper coal was 7 to 12 feet thick and was separated from the lower 8- to 15-foot coal by a shale parting ranging from 5 to 12 feet thick. Several other coals have been noted in this area; DeBow (1860) mentions three coals and Brown (1937) measured a section containing seven coals. This district is plagued by structural problems which made conventional mining difficult. Dip measurements in the mines ranged from 20° to 70° in both the west and east directions. Russell (1892) attributed this structure to graben-type faulting and noted the mines were centered in fault blocks to obtain maximum coal thickness. When mining neared the edge of the block the coal typically would pinch and roll, and then thicken again in the next block.

Collectively or individually, depending on when a mine was active, all the pits north of the James River were known as the Dover or Manakin Mines. The first report of coal in the wilderness west of Richmond was in this area in 1701. Later several small slope mines were operated on the outcrop in the 1700s and 1800s by Graham, Barr, Deaton, Cottrell, and others. The total surface area disturbed by these pits was approximately 50 acres. The mining was primitive and proceeded haphazardly. Coal was pulled out of the mine by mule-drawn boxes or "coaves" and no attempt was made to separate shale and other impurities from the coal. The Dover Coal Mining Company was operating several shafts near Manakin in the mid-1800s but the company failed in 1860 due to a large financial burden.

Two coals are present in the area of the Dover Mines. The upper is generally 7 to 12 feet thick. The lower coal averages over 8 feet thick and is locally 15 feet thick. These coals are separated by 5 to 12 feet of shale. A third coal has been suggested, based on a correlation with the coals at Carbon Hill (Jones, 1916).

Mining activity in this district was hampered by the presence of parallel, north-trending normal faults. Displacement along the faults was as much as 10 feet. The strike of the strata near the faults changed abruptly from northeast to southeast, with dips ranging between 15° and 90° . The nature of the coals indicates that there was slippage contemporaneous with deposition. Near the faults, the coals pinch and are characterized as thin beds that are slickensided and intermixed with dark shale and bedded calcite veins. Conversely, toward the center of the fault blocks, the coal attains its maximum thickness and purity.

Locust Shaft

Location: 58

Historical note: The Locust Shaft was operated in the early 1800s and was less than 150 feet deep.

References: DeBow (1860), Kimball (1866), Russell (1892), Shaler and Woodworth (1899), Jones (1916), Roberts (1928), Treadwell (1928), Routon (1949), Brown (1952).

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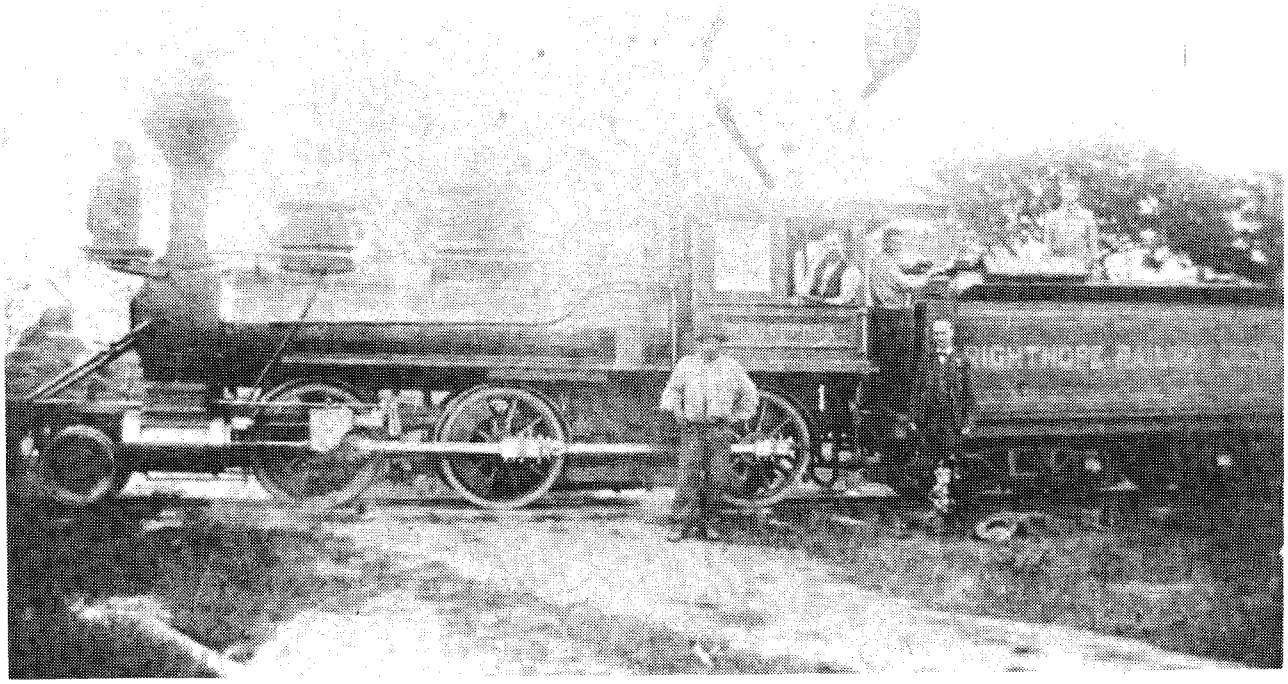


Figure 25. Brighthope Railway Company locomotive and tender (circa 1890, courtesy Rosemary Bagby).

Gate Shaft

Location: 59

Historical note: A 12 foot thick coal was worked from this shaft before 1860.

Reference: DeBow (1860).

Deep Shaft

Location: 60

Historical notes: The Deep Shaft was dug in the early 1800s past an upper coal and into a lower coal about 360 feet below the surface. An additional 40 feet was dug for a sump.

Reference: DeBow (1860).

Aspinwall Shaft

Location: 61

Historical notes: This was a Dover Coal Mining Company mine that was opened in the mid-1800s by General Charles P. Stone, superintendent of the Dover Company mines. The Aspinwall Shaft consisted of two circular bricklined shafts about 50 feet apart. Both shafts were 10 feet in diameter; one shaft was 300 feet deep and the other 935 feet deep. A 6-foot coal was worked on a slope in this mine. During construction of a slope, methane issued freely from the coal and ventilation was needed. This shaft was considered salvageable in 1916.

References: Woolfolk (1901), Jones (1916), Roberts (1928), Swartout (1930), Wadleigh (1934), Brown (1937).

Storehouse Shaft

Location: 62

Historical notes: Coal was discovered near here about 1701 and by 1750 a 6- by 14-foot shaft was dug 325 feet to the coal. The mine was worked originally by Anderson and Moody and later by the Dover Coal Mining Company. A level 200 feet long was driven from the shaft base to work a 7-foot coal, which was locally known as the Cottrell coal.

References: Woolfolk (1901), Treadwell (1928), Swartout (1930), Eavenson (1942).

Canal Shaft

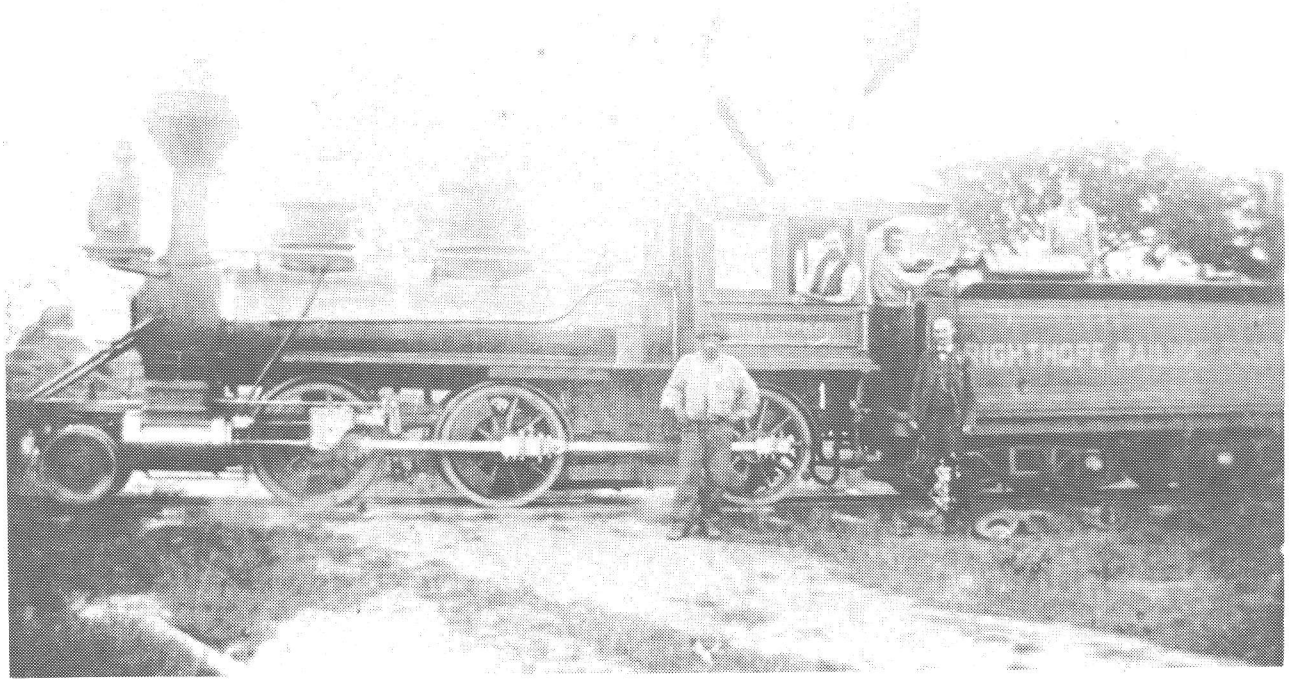
Location: 63

Historical notes: This shaft was originally owned by the Tredegar Iron Manufacturing Company and was sold to the Dover Coal Mining Company in the early 1800s. General Charles P. Stone was put in charge at this time.

The shaft was 275 feet deep and there was a 500-foot slope at the base. Ventilation was accomplished by dividing the 6- by 8-foot shaft in half with wooden brattice.

After an attempt to open the Aspinwall Shaft, operations of the Canal Shaft continued in a small way and finally closed when the owner, Mr. Deaton, died.

References: DeBow (1860), Jones (1916).



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Aspinwall Shaft

Location: 61

Historical notes: This was a Dover Coal Mining Company mine that was opened in the mid-1800s by General Charles P. Stone, superintendent of the Dover Company mines. The Aspinwall Shaft consisted of two circular bricklined shafts about 50 feet apart. Both shafts were 10 feet in diameter; one shaft was 300 feet deep and the other 935 feet deep. A 6-foot coal was worked on a slope in this mine. During construction of a slope, methane issued freely from the coal and ventilation was needed. This shaft was considered salvageable in 1916.

References: Woolfolk (1901), Jones (1916), Roberts (1928), Swartout (1930), Wadleigh (1934), Brown (1937).

Storehouse Shaft

Location: 62

Historical notes: Coal was discovered near here about 1701 and by 1750 a 6- by 14-foot shaft was dug 325 feet to the coal. The mine was worked originally by Anderson and Moody and later by the Dover Coal Mining Company. A level 200 feet long was driven from the shaft base to work a 7-foot coal, which was locally known as the Cottrell coal.

References: Woolfolk (1901), Treadwell (1928), Swartout (1930), Eavenson (1942).

Canal Shaft

Location: 63

Historical notes: This shaft was originally owned by the Tredegar Iron Manufacturing Company and was sold to the Dover Coal Mining Company in the early 1800s. General Charles P. Stone was put in charge at this time.

The shaft was 275 feet deep and there was a 500-foot slope at the base. Ventilation was accomplished by dividing the 6- by 8-foot shaft in half with wooden brattice.

After an attempt to open the Aspinwall Shaft, operations of the Canal Shaft continued in a small way and finally closed when the owner, Mr. Deaton, died.

References: DeBow (1860), Jones (1916).

River Pits

Location: 64

Historical notes: The River Pits were originally operated by Wills, Brown and Company in the 1700s. Later, they were owned and worked by the Dover Coal Mining Company. When abandoned prior to 1860, the workings were slope mines in a 20 foot thick coal, 396 feet below the James River. All dewatering was accomplished by a bucket hoist.

References: DeBow (1860), MacFarlane (1875), Rogers (1884b).

Towne Pit, Towne and Powell Pit

Location: 65

Historical note: Located near the east end of Sabot Island, this mine was constructed in the early to mid-1800s by Dr. Towne.

References: Jones (1916), Eavenson (1942).

Bladon Pits, Scott Pits, Woodward Pits, Kennen Pits, No. 13 Slope

Location: 66 and 68

Historical notes: The original mine was constructed by Mr. Bladon on the Scott Estate. This mine sloped under the James River and was worked for only a few years. Sometime after 1880, another attempt to mine coal on the Scott property was made by O'Neil, Haston and Gabney Company. The company began a slope called the No. 13 and planned to put a rope conveyor across the James River to the Chesapeake and Ohio Railway (now CSX Transportation, Inc.). Money ran out before the conveyor could be built or coal produced.

References: Rogers (1884b), Woodworth (1901), Jones (1916), Roberts (1928).

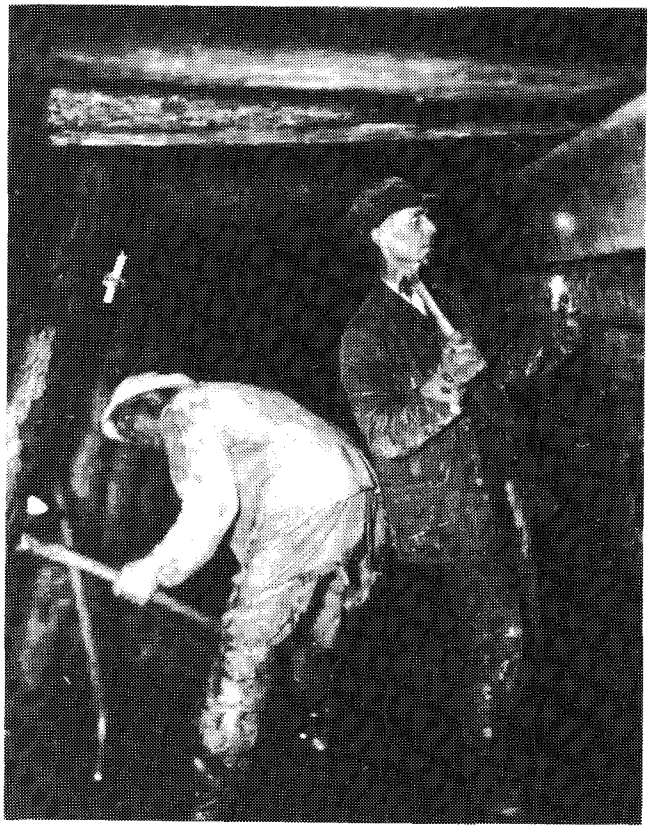

Figure 26. Workings in the Chesterfield Coal Company mine (circa 1935).

Norwood Mine

Location: 67

Historical notes: This mine was opened about 1878 and was operating in 1885. There may have been mining in this area as early as 1835. This was a slope mine, 300 feet long, with an average inclination of 23° to the west. Two coals of irregular thickness were mined. Three faults with 5 to 6 feet of displacement were encountered in mining operations. These faults were parallel, striking northeast, and dipping 50° to 70° to the east. A fourth fault was encountered at the base of the slope and had greater displacement, but was otherwise similar to the other three. The mine site was reclaimed in 1987.

Measured Section (Russell, 1892)

Feet	Description
10-200	Sandstone and shale
5-7	Coal (with partings)
10-12	Shale
6	Coal (with partings)

References: Russell (1892), Shaler and Woodworth (1899), Jones (1916), Roberts (1928).

Powhatan Pits, Finney's Pits

Location: 69

Historical notes: The Powhatan Pits of the Old Dominion Coal Company were originally worked by Captain Finney in the early 1800s. Two shafts were operated for ventilation and haulage. One shaft was 105 feet deep, the other 180 feet deep. From the bottom of the shafts, a 680-foot slope was driven in coal. The slope ranged in inclination from 25° to 30° to the east. Three coals were encountered; the main coal was 2 feet thick at the base of the slope and thickened to 7 feet at the working face.

References: Lyell (1847), Rogers (1884b), Cox and Heinrich (1888), Russell (1892), Shaler and Woodworth (1899), Jones (1916), Roberts (1928), Wadleigh (1934), Eavenson (1942).

Chesterfield Coal Company Pits

Location: 70

Historical notes: The Chesterfield Coal Company was chartered in 1932 by R.H. Marshall, G.H. Cox, and J.B. and S.F. Dickenson. J. B. Dickenson was mine manager and W.C. Rudd was mine foreman (Figure 26). As originally planned, three air shafts were to be

River Pits

Location: 64

Historical notes: The River Pits were originally operated by Wills, Brown and Company in the 1700s. Later, they were owned and worked by the Dover Coal Mining Company. When abandoned prior to 1860, the workings were slope mines in a 20 foot thick coal, 396 feet below the James River. All dewatering was accomplished by a bucket hoist.

References: DeBow (1860), MacFarlane (1875), Rogers (1884b).

Towne Pit, Towne and Powell Pit

Location: 65

Historical note: Located near the east end of Sabot Island, this mine was constructed in the early to mid-1800s by Dr. Towne.

References: Jones (1916), Eavenson (1942).

Bladon Pits, Scott Pits, Woodward Pits, Kennen Pits, No. 13 Slope

Location: 66 and 68

Historical notes: The original mine was constructed by Mr. Bladon on the Scott Estate. This mine sloped under the James River and was worked for only a few years. Sometime after 1880, another attempt to mine coal on the Scott property was made by O'Neil, Haston and Gabney Company. The company began a slope called the No. 13 and planned to put a rope conveyor across the James River to the Chesapeake and Ohio Railway (now CSX Transportation, Inc.). Money ran out before the conveyor could be built or coal produced.

References: Rogers (1884b), Woodworth (1901), Jones (1916), Roberts (1928).

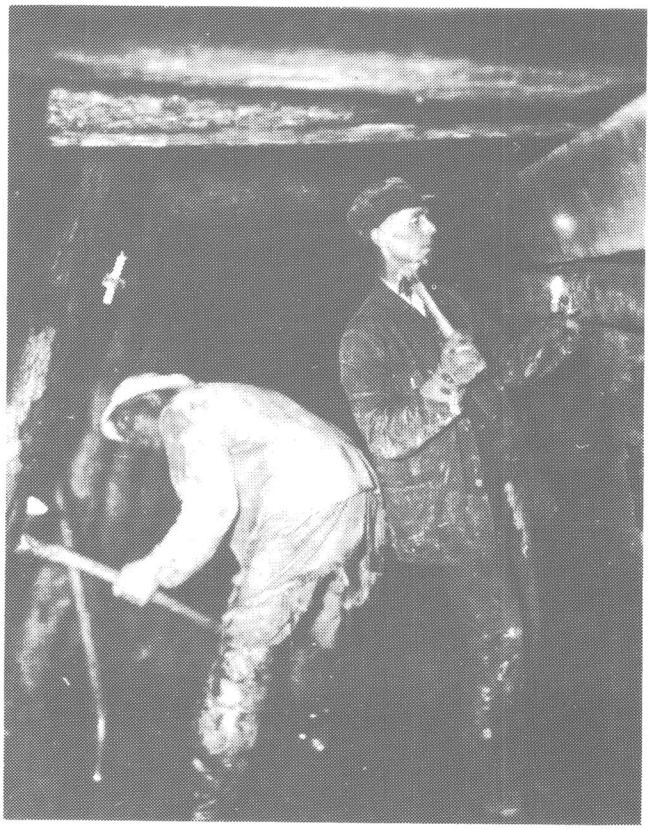

Figure 26. Workings in the Chesterfield Coal Company mine (circa 1935).

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Historical notes: This mine was opened about 1878 and was operating in 1885. There may have been mining in this area as early as 1835. This was a slope mine, 300 feet long, with an average inclination of 23° to the west. Two coals of irregular thickness were mined. Three faults with 5 to 6 feet of displacement were encountered in mining operations. These faults were parallel, striking northeast, and dipping 50° to 70° to the east. A fourth fault was encountered at the base of the slope and had greater displacement, but was otherwise similar to the other three. The mine site was reclaimed in 1987.

Measured Section (Russell, 1892)

Feet	Description
10-200	Sandstone and shale
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Historical notes: The Powhatan Pits of the Old Dominion Coal Company were originally worked by Captain Finney in the early 1800s. Two shafts were operated for ventilation and haulage. One shaft was 105 feet deep, the other 180 feet deep. From the bottom of the shafts, a 680-foot slope was driven in coal. The slope ranged in inclination from 25° to 30° to the east. Three coals were encountered; the main coal was 2 feet thick at the base of the slope and thickened to 7 feet at the working face.

References: Lyell (1847), Rogers (1884b), Cox and Heinrich (1888), Russell (1892), Shaler and Woodworth (1899), Jones (1916), Roberts (1928), Wadleigh (1934), Eavenson (1942).

Chesterfield Coal Company Pits

Location: 70

Historical notes: The Chesterfield Coal Company was chartered in 1932 by R.H. Marshall, G.H. Cox, and J.B. and S.F. Dickenson. J. B. Dickenson was mine manager and W.C. Rudd was mine foreman (Figure 26). As originally planned, three air shafts were to be

dug and later two slopes put in. One slope was dug 225 feet with an inclination of almost 45°. The slope was served by a single track with sidings. One-ton cars were hoisted by steam-powered engines. Some hand sorting of the coal was done on the outside. Seven men worked in this mine in 1937 and produced 15 tons of coal per day. Plans called for the second slope to be worked when production reached 50 tons per day but it is not known if this was achieved. The mining permit expired in 1941.

Three coals were reported in this mine: a 4 foot thick coal located 117 feet downslope, 82 feet in vertical distance below the surface; a 5 foot thick coal located 179 feet downslope, which is 125 feet vertically below the surface; and a 7-foot coal 200 feet downslope. In places, the middle and lower coals nearly came together, totalling 14 feet of coal with partings. The overburden and intervening strata were arkosic sandstone and the roof and floor rocks were shale. Extensive roof support was needed because of the incompetent nature of the overlying sandstone.

References: Richmond Times-Dispatch (Nov. 26, 1937), Virginia Geological Survey field investigations by R.O. Bloomer (Dec. 6, 1937).

Old Dominion Pits

Location: 71

Historical notes: These pits were worked in the early 1800s by the Old Dominion Coal Company. A 125-foot shaft encountered three coals: the uppermost coal was 2 feet thick, the middle coal was 4 feet thick and the lowest coal 3 feet thick.

References: Cox and Heinrich (1888), Russell (1892), Shaler and Woodworth (1899), Jones (1916), Roberts (1928), Wadleigh (1934), Eavenson (1942).

Mines of Undetermined Location

The following mine names have been mentioned in the literature in reference to a mining district but locations were not determined. Notations following the mine names give all the information available.

Carbon Hill District

Anderson Pit, Graham Pit

Notes: This 450-foot shaft operated before 1840. Two coals were mined at this locality. The upper coal was 6 to 16 feet thick and separated from the lower 4 to 8 foot thick coal by 30 feet.

References: Roberts (1928), Wadleigh (1934), Brown (1937).

H.J. Cook Mine

References: Roberts (1928), Wadleigh (1934).

Jones Pit

References: Russell (1892), Wadleigh (1934).

Sycamore Shaft

Note: This shaft was 75 feet deep and was abandoned by 1888.

Reference: Newell (1888).

Waterloo Pits

References: Roberts (1928), Wadleigh (1934).

Wooldridge Pits, Ellyson's Pits

Reference: Routon (1949).

Midlothian District

Bellona Arsenal Shafts

Reference: Wadleigh (1934).

Bolling (or Boiling) Pit

Note: A Black Heath basin mine operating sometime during 1842 to 1880.

Reference: Shaler and Woodworth (1899).

Diamond Hill Pit

References: Roberts (1928), Wadleigh (1934).

Forbes Pit

Note: This mine worked a coal 3.5 feet thick.

References: Roberts (1928), Wadleigh (1934), Routon (1949).

Garden Wall Pit

Note: This may be the Gardenhole Shaft.

Reference: Brown (1937).

Hill's Pits

Notes: Three mines, collectively known as Hill's Pits, were worked and abandoned before 1860. One shaft was about 400 feet deep and worked a coal as much as 30 feet thick.

References: Daddow and Bannon (1866), Taylor (1835).

Jack Pit Shaft

Note: The Jack Pit Shaft was reported to be located near the Grove Shaft.

Reference: d'Invilliers (1904).

Rise Shaft

References: Schmitz (1895), Wadleigh (1934).

Clover Hill District

Jawbone Shaft

References: Roberts (1928), Wadleigh (1934).

Mann Shaft

References: Roberts (1928), Wadleigh (1934).

Vaden Shaft

References: Roberts (1928), Wadleigh (1934).

Huguenot Springs/Manakin District

Randolph Shaft

References: Roberts (1928), Wadleigh (1934), Brown (1937).

Spencer Pit

Reference: Roberts (1928).

Mines of Undetermined District

Dale Shaft

Reference: Wadleigh (1934).

Dietrick's Pit

Reference: Kimball (1866).

Garrison Shaft

Reference: Wadleigh (1934).

Hancock Pits

Reference: LaPrade (1900).

Morgan Shaft

Reference: LaPrade (1900).

Park Hill Shaft

References: Roberts (1928), Wadleigh (1934).

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APPENDIX I
RESULTS OF ANALYSES OF RICHMOND BASIN COAL AND COKE

Documented analytical results of coal and coke from the Richmond coalfield began in the 1840s at about the same time as the rapid growth in production. In order to satisfy customer needs for their various uses, a uniformity in quality of coal shipments was important. For example, in order to produce coal-gas for illimination, the basic coal should have a high percentage of volatile matter in order to maintain maximum gas quantity. Additionally, too much ash and/or sulfur may produce an unacceptable product.

Standards of analyses were not set forth until the early 1900s and methods of collection are unknown. Averages from the following list were not calculated because of the uncertainty of the basis for analyses, that is, as received, moisture-free, or moisture- and ash-free. If a specific coal was analyzed, its name is noted in parenthesis after the mine name. Several samples of the same coal from one mine are indicated by (av) following the mine name. Abbreviations for the parameters listed below are: SG = specific gravity, H_2O = water (percent), VM = volatile matter (percent), FC = fixed carbon (percent), A = ash (percent), S = sulfur (percent), and Btu = British thermal unit.

NATURAL COKE

Reference	Location	SG	H_2O	VM	FC	A	S	Btu
Lyell, 1847	Towne and Powell Pits					4.7		
Taylor, 1855	Chesterfield County			9.8	80.3	9.7		
Taylor, 1855	Chesterfield County			16.0	70.0	14.0		
Taylor, 1855	Chesterfield County			17.0	68.0	15.0		
Taylor, 1855	Chesterfield County			10.7	83.3	6.0		
Heinrich, 1878	Carbon Hill District		1.6	9.6	79.9	8.9		
Heinrich, 1878	Tuckahoe Shaft	1.3	1.1	11.9	75.1	11.8	0.5	
Heinrich, 1878	Carbon Hill District	1.2	1.6	14.3	81.6	2.2	0.3	
Raymond, 1883	Jewett Coke Shaft	1.4	2.0	15.5	79.3	3.2	4.1	
Raymond, 1883	Jewett Coke Shaft	1.4	0.7	11.1	81.5	6.7	1.6	
Russell, 1892	Richmond Coalfield (av)			12.5	79:9	6.5	0.3	
Woodworth, 1901	Midlothian District		1.7	18.4	67.1	12.9	4.7	
Woolfolk, 1901	Carbon Hill District		0.9	5.8	86.7	6.6	0.6	
Treadwell, 1928	Gayton Shaft		0.4	13.6	80.1	5.1	0.1	
Treadwell, 1928	Gayton Shaft		0.3	7.0	78.0	17.5	0.2	
USBM, 1944	Midlothian District		3.1	9.3	79.4	8.2	2.2	13080
Roberts, 1928	Gayton Shaft		2.5	16.3	70.2	10.5	1.3	

DEEP RUN DISTRICT

Reference	Location	SG	H_2O	VM	FC	A	S	Btu
Johnson, 1846	Deep Run Pits	1.4	1.8	19.8	67.9	10.5		
Lyell, 1847	Deep Run Pits					4.7		
Taylor, 1855	Deep Run Pits			25.2	69.8	5.0		
McFarlane, 1875	Barr's Pit			24.0	70.8	5.2		
McFarlane, 1875	Barr's Pit			22.8	54.9	22.2		
McFarlane, 1875	Barr's Pit			24.7	65.5	9.8		
McFarlane, 1875	Barr's Pit			24.3	56.1	22.6		
McFarlane, 1875	Deep Run Pits			25.2	69.9	5.0		

CARBON HILL DISTRICT

Reference	Location	SG	H_2O	VM	FC	A	S	Btu
Johnson, 1846	Couch and Sneed's Shaft	1.4	1.8	23.9	59.9	14.3	0.5	
Taylor, 1855	Richmond Coalfield			32.0	59.3	8.8		
Taylor, 1855	Randolph Shaft			30.5	66.2	3.4		
Taylor, 1855	Coalbrook Slope			29.0	66.5	4.5		

Taylor, 1855	Crouche's Pits			30.0	64.6	5.4		
Taylor, 1855	Scott Pits			33.7	60.9	5.4		
Taylor, 1855	Waterloo Pits			26.8	55.2	18.0		
Taylor, 1855	Wills Shaft			28.8	66.6	4.6		
Heinrich, 1878	Carbon Hill Mine (A)		1.4	20.6	60.8	17.2		
Heinrich, 1878	Carbon Hill Mine (B)		0.4	18.7	71.0	10.0		
Robertson, 1873	Carbon Hill Mine (C)	1.2	1.6	29.1	63.4	5.7	0.1	
Robertson, 1873	Carbon Hill Mine (B)	1.2	1.8	21.9	68.1	7.9	10.0	
Robertson, 1873	Carbon Hill Mine (C)	1.3	0.8	32.4	58.8	6.9	1.1	
Robertson, 1873	outcrop	1.3	1.1	27.9	61.0	8.9	1.1	
Woolfolk, 1901	Carbon Hill Mine (A)		0.8	26.7	69.2	3.4	0.6	
Woolfolk, 1901	Carbon Hill Mine (B)		9.9	26.9	66.9	5.2	1.1	
Woolfolk, 1901	Carbon Hill Mine (C)		0.7	25.2	66.1	7.9	1.0	
Taylor, 1855	Scott Pits	1.3						
Miller, 1913	Old Dominion Pits (B)		2.1	23.6	56.9	17.7	2.2	12200
Miller, 1913	Old Dominion Pits (C)		2.8	25.7	62.5	9.0	1.4	13493
Miller, 1913	Old Dominion Pits (B)		0.1	24.9	67.0	7.4	1.3	14393
Miller, 1913	Old Dominion Pits (C)		1.1	25.9	57.6	15.3	1.5	13042
d'Invilliers, 1904	Old Dominion Pits (C) (av.)		0.7	25.2	59.1	13.7	1.2	
d'Invilliers, 1904	Old Dominion Pits (B) (av.)		0.7	25.4	59.5	12.8	1.6	
d'Invilliers, 1904	Old Dominion Pits (A) (av.)		0.7	22.7	55.6	20.9	2.1	
Jones, 1916	Richmond Coalfield		1.3	33.5	57.1	6.2	2.0	
Wadleigh, 1934	Scott Pits		2.1	32.9	60.3	4.7		13920
Wadleigh, 1934	Scott Pits		1.8	32.1	59.3	6.8		13840
Wadleigh, 1934	Gayton Shaft (A)		0.8	26.7	69.2	3.4	0.6	
Wadleigh, 1934	Gayton Shaft (B)			26.9	65.9	5.5	1.1	
Wadleigh, 1934	Coalbrook Slope			23.7	63.7	12.6		13850
Eby and Campbell, 1944	Gayton Shaft (C)			26.4	64.3	9.3	1.5	13880
Eby and Campbell, 1944	Gayton Shaft (C)		2.5	16.3	70.3	10.9	1.3	
Eby and Campbell, 1944	Gayton Shaft (B)			24.1	58.2	17.7	2.2	12460

MIDLOTHIAN DISTRICT

Reference	Location	SG	H_2O	VM	FC	A	S	Btu
Silliman, 1842	Midlothian Pit	1.3		33.6	58.3	7.7		
Johnson, 1846	Midlothian Pit	1.4	1.2	27.3	61.1	10.6		
Johnson, 1846	Creek Shaft	1.3	1.5	29.7	60.3	8.6	2.9	
Johnson, 1846	Black Health Pits	1.3	1.9	30.7	58.8	8.6	2.0	
Johnson, 1846	Midlothian Pit (av.)	1.3	2.5	29.8	53.0	14.7	0.1	
Johnson, 1846	Tippecanoe Shaft	1.3	1.8	34.2	54.6	9.4	0.4	
Johnson, 1846	Midlothian Pit	1.3	0.7	33.5	55.4	9.4	2.3	
Johnson, 1846	Midlothian Pit	1.4	1.0	28.7	56.1	14.1	1.0	
Taylor, 1855	Stonehenge Pits			36.5	58.7	4.8		
Taylor, 1855	Maidenhead Pits			32.8	64.0	3.2		
Taylor, 1855	Heath Pits			37.7	62.4	2.8		
Taylor, 1855	Mills and Reid Creek Pits			38.6	57.8	3.6		
Taylor, 1855	Wills Shaft			32.5	62.9	4.6		
Taylor, 1855	Greenhole Pits			31.2	67.8	2.0		
Taylor, 1855	Heath Pits			35.8	53.4	10.8		
Taylor, 1855	Heath Pits			28.4	66.5	5.1		
Taylor, 1855	Heath Pits			28.8	61.7	9.7		
Heinrich, 1878	Midlothian Pit		2.0	31.6	58.3	7.7		
Heinrich, 1878	Midlothian Pit			31.6	61.1	7.1		
Heinrich, 1878	Grove Shaft		1.0	38.2	54.3	6.5	1.5	

Heinrich, 1878	Midlothian Pit (av)		1.0	36.5	46.7	15.8	2.2	
Robertson, 1873	Midlothian Pit	1.3	1.1	34.6	57.7	6.6	0.1	
Wortham, 1916	Midlothian Pit		0.7	31.4	54.9	10.6	2.4	
Taylor, 1855	Grove Shaft	1.4						
Taylor, 1855	Forbes Pit	1.3						
Treadwell, 1928	Midlothian Pit		1.4	32.8	59.7	6.2	1.4	14290
Treadwell, 1928	Murphy Slope		1.1	36.6	54.7	7.8	1.1	13894
d'Invilliers, 1904	Grove Shaft		0.7	30.2	48.4	19.4	1.3	
d'Invilliers, 1904	Grove Shaft		0.7	34.0	50.0	11.8	3.6	
d'Invilliers, 1904	Grove Shaft		1.1	29.3	49.1	18.7	1.8	
d'Invilliers, 1904	Grove Shaft		0.6	30.8	56.2	10.1	2.2	
d'Invilliers, 1904	Grove Shaft		0.7	31.2	59.3	7.3	1.6	
d'Invilliers, 1904	Grove Shaft		0.7	30.8	54.2	11.6	2.9	
d'Invilliers, 1904	Grove Shaft		0.6	32.3	51.5	19.0	2.7	
d'Invilliers, 1904	Grove Shaft		0.6	31.8	53.4	11.4	2.8	
d'Invilliers, 1904	Midlothian Pit		1.9	29.5	52.3	13.6	2.7	
d'Invilliers, 1904	Midlothian Pit		1.5	29.8	60.5	6.3	1.9	
d'Invilliers, 1904	Midlothian Pit		1.6	28.5	56.9	10.9	2.1	
d'Invilliers, 1904	Midlothian Pit		1.3	31.8	59.8	6.1	1.0	
d'Invilliers, 1904	Midlothian Pit		1.0	29.1	55.6	12.4	2.1	
d'Invilliers, 1904	Midlothian Pit		1.2	29.0	49.1	16.0	4.6	
Jenny, 1949	Midlothian Pit		2.7	33.4	54.3	9.6		
Eby and Campbell, 1944	Morgan Shaft		6.6	31.3	54.8	7.3	1.8	13210
Eby and Campbell, 1944	Morgan Shaft		7.7	16.4	64.1	11.8	1.7	11960

CLOVER HILL DISTRICT

Reference	Location	SG	H_2O	VM	FC	A	S	Btu
Wooldridge, 1841	Clover Hill Pits	1.3		38.5	55.0	6.5		
Lyell, 1847	Clover Hill Pits					9.9		
Taylor, 1855	Winterpock District			29.1	65.5	5.4		
Robertson, 1873	Clover Hill Pits	1.3	1.8	23.9	56.2	7.6	0.5	
Robertson, 1873	Cox Pits (av)		1.3	31.0	56.8	10.1	0.5	
Ashburner, 1888	Racoon Slope		1.3	32.5	57.1	7.2	2.0	

HUGUENOT SPRINGS/MANAKIN DISTRICT

Reference	Location	SG	H_2O	VM	FC	A	S	Btu
Roberts, 1928	Powhatan Pits			32.3	59.9	7.8		
Wadleigh, 1934	Scott Pits		2.1	32.9	60.3	4.7		13920
Wadleigh, 1934	Scott Pits		1.8	32.1	59.3	6.8		13840
MacFarlane, 1875	Dover Mines			28.3	66.8	4.9		
Heinrich, 1878	Dover Mines			26.0	66.5	4.5		
Heinrich, 1878	Dover Mines			29.0	66.5	4.5		

APPENDIX II
SUMMARY OF DRILLING IN THE RICHMOND BASIN, 1897 TO 1985

Well Name (Date)	Total Depth in Feet (Lithology at TD)	Comments from Records (All measurements in decimal feet)
A. and R. Oil Company, Martin 1-A (1968)	620 (Sandstone)	
A. and R. Oil Company, Martin 1-B (1968)	520 (Sandstone)	
A. and R. Oil Company, Martin 2-A (1968)	520 (Sedimentary)	
A. and R. Oil Company, Martin 2-B (1968)	414 (Sedimentary)	
Cornell Oil Company, Bailey No. 1 (1981)	7438 (Granite)	Coal: 2.0 at 6149, 3.0 at 6266, 2.0 at 6504, 5.0 at 6606, 1.0 at 6659; basement at 7110
Cornell Oil Company, Horner No. 1 (1981)	6329 (Siltstone)	Trace of coal near TD
Gray Lumber Company No. 1 (1978)	1552 (Diabase)	No coal; arkosic sandstone
Merrill Natural Resources, Inc., Adamson, No. 1 (1982)	2780 (Granite)	Gray shale, siltstone and sandstone
Merrill Natural Resources, Inc., Cashion No. 1 (1981)	200 (Diabase)	No coal
Merrill Natural Resources, Inc., Cashion No. 2 (1980)	1675 (Crystalline)	Coal: 4.0 at 1162, 9.5 at 1176, 1.0 at 1186, 1.0 at 1190, 1.0 at 1200; basement at 1620
Merrill Natural Resources, Inc., Chalkley No. 1 (1981)	1510 (Crystalline)	No coal; basement at 1190
Merrill Natural Resources, Inc., Chesapeake Corporation No. 1 (1982)	3080 (Siltstone)	Predominantly siltstone; 3 oil shows between 2650 and 2970
Merrill Natural Resources, Inc., Continental Can Corporation No. 1 (1982)	2700 ("Gravel")	No coal; predominantly sandstone; oil shows at 960 to 2030

Merrill Natural Resources, Inc., Continental Can Corporation No. 4 (1982)	2700 (Sandstone)	No coal; predominantly sandstone; oil shows at 2100 to 2360
Merrill Natural Resources, Inc., Georgia-Pacific Corporation No. 1 (1982)	2320 (Sandstone)	Predominantly siltstone and sandstone
Merrill Natural Resources, Inc., Gordon No. 1 (1980)	1820 (Sandstone)	No coal
Merrill Natural Resources, Inc., Hudgins No. 1 (1981)	2700 (Siltstone)	Predominantly sandstone; trace of coal at 1260 and 2390
Merrill Natural Resources, Inc., Turner No. 1 (1981)	2030	No coal; oil seeps and gas shows reported; this well was also called the Turner Test
Merrill Natural Resources, Inc., Turner No. 2 (1981)	2770 (Siltstone)	No coal; oil seeps reported
Merrill Natural Resources, Inc., Turner No. 3 (1981)	2775 (Siltstone)	No coal
Phillips Coal Company, Anderson AM-1 (1981)	900 (Slate)	Upper 240 feet, sandstone and shale; 240 feet to TD, slate and metasiltstone
Phillips Coal Company Carter VAPW-2 (1981)	510 (Sandstone)	No coal; interbedded sandstone and dark shale
Phillips Coal Company, Ciejek VAPW-1 (1981)	340 (Sandstone)	No coal
Phillips Coal Company, Gray Lumber Company CS-2 (1981)	1220 (Siltstone)	Sandstone and siltstone; 2 carbonaceous zones
Phillips Coal Company, Robins CS-1 (1981)	1660 (Siltstone)	Sandstone and shale; coal zone 1060 to 1070 feet
Phillips Coal Company, Saunders VAGO-1 (1981)	557 (Sandstone)	No coal; sandstone and black shale
Phillips Coal Company, Waldrow VACH-1 (1981)	218 (Sandstone)	Coal: 1.5 at 118, 3.0 at 158, 3.0 at 193, 15.0 (with partings) at 202

Phillips Coal Company, Waldrow VACH-2 (1981)	501 (Sandstone)	Coal: 2.5 at 145, 2.0 at 164, 3.2 at 194, 5.5 at 198
Richmond Syndicate No. 3 (1930)	497 (Granite)	Coke: 14.7 at 290; coal: 1.7 at 339, 1.3 at 369, 0.5 at 452
Richmond Syndicate No. 4 (1930)	584 (Granite)	Coke: 14.8 at 492
Richmond Syndicate No. 5 (1930)	487 (Sandstone)	No coal
Richmond Syndicate No. 7 (1930)	2087 (Shale)	Coal: 0.6 at 116, 0.8 at 173; 11 petroleum shows between 960 and 1846; gas in hole
Richmond Syndicate No. 8 (1931)	1072 (Sedimentary)	No coal
Salisbury Drill Hole (1898)	2380 (Sedimentary)	Coke: 13.2 at 2320; tools lost and hole was abandoned
Shore Petroleum Company, Hicks No. 1 (1985)	4488± (Crystalline)	Basement at 4400± feet
Southeast Salisbury Tract (1897)	2337 (Sedimentary)	Coal: 19.0 at an unreported depth
Vulcan Materials CH-1 (1980s)	106 (Sandstone)	Predominantly sandstone and conglomerate
Vulcan Materials CH-2 (1980s)	80 (Sandstone)	Sandstone entire hole

APPENDIX III
GAS OR DUST EXPLOSIONS IN THE RICHMOND COALFIELD

Date	Location	Comments
1810	Heath Pits	Several killed[2]
1817	Wills Shaft	None killed[2]
1818	Heath Pits	Some killed
1826	not located	Some workmen killed[2]
1835	Bell Shaft	Explosions have been occasional[1]
1836	Chesterfield County	Unknown[2]
1839	Black Heath Pits	40 killed[1]
1839	Maidenhead Pits	Explosions occurred several times[1]
1840-41	Wills Shaft	Several explosions[1,2]
1844	Black Heath Pits	11 killed
1850	Cox Pits	7 killed[2]
1850	Brighthope Shaft	1 injured[1]
1851	English Company Pits	Unknown[2]
1854	English Company Pits	20 killed[2,1]
1855	Black Heath Pits	3 killed[2]
1855	Midlothian Pit	55 killed[2,1]
1855	Brighthope Shaft	—
1859	Brighthope Shaft	9 killed[2]
1860	not located	1 injured[1]
1862	Midlothian Pit	—
1863	Raccoon Slope	17 killed[2]
1867	Brighthope Shaft	69 killed[2]
1872	not located	2 injured[1]
1875	Raccoon Slope	3 killed[2]
1876	Grove Shaft	8 killed[2]
1881	Grove Shaft	—
1882	Grove Shaft	32 killed[2]
1909	Carbon Hill Mine	6 killed[1]
1910	Carbon Hill Mine	10 injured[1]
1911	Carbon Hill Mine	7 killed[1]
1912	Carbon Hill Mine	Two explosions at this mine during year, 10 killed[1]

[1]Davies, J.F. and H.B. Humphrey, 1934

[2]H.B. Humphrey, 1959

APPENDIX IV
INDEX TO COAL MINES

APPENDIX V
INDEX TO COAL COMPANIES

APPENDIX VI
INDEX TO RAILROADS, RIVERS, AND CANALS

MINERAL DEVELOPMENT MAP OF THE RICHMOND COALFIELD VIRGINIA

1988

GERALD P. WILKES

1:50,000

NORTH

1 Saunders
2 Eureka
3 Turpus
4 Gayton
5 Edge Hill
6 Barbershop
7 Deep
8 Coalbrook
9 Cottrells
10 Lucy White
11 Tuckahoe
12 Tippecanoe
13 Wickham

TUCKAHOE AND JAMES RIVER RAILROAD (1840)

TUCKAHOE CANAL (1828)

CARBON HILL DISTRICT

DEEP RUN DISTRICT

ALL MINES IN THIS DISTRICT REFERRED TO AS DEEP RUN OR SPRINGFIELD PITS

(RF&PRR FOLLOWS WESTERN CONTACT)

RICHMOND, FREDERICKSBURG AND POTOMAC RAILROAD (1836)

0 800 FEET

A A'

TUCKAHOE CREEK

COALBROOK SLOPE

0 FEET 2600

58 Locust
59 Gate
60 Deep
61 Asplnwall
62 Storehouse
63 Canal
64 River
65 Towne
66 Bladon
67 Norwood
68 Bladon(?)
69 Powhatan
70 Chesterfield
71 Old Dominion

CHESSIE SYSTEM

SABOT

ISLAND

HUGUENOT SPRINGS MANAKIN DISTRICT

E E'

0 2000

LUCK STONE CORP. BOSCOBEL QUARRY

PHILLIPS COAL CO., SAUNDERS VAGO- 1

PHILLIPS COAL CO., CARTER VAPW- 2

JAMES RIVER AND KANAWHA CANAL (1795) RICHMOND AND ALLEGHANY RAILROAD (1880)

TUCKAHOE AQUADUCT

TUCKAHOE AND JAMES RIVER RAILROAD (1840)

TUCKAHOE CANAL (1828)

TUCKAHOE BASIN

RICHMOND, FREDERICKSBURG AND POTOMAC RAILROAD

CARBON HILL DISTRICT

LORRAINE

CHESSIE SYSTEM RAILROAD

CSX TRANSPORTATION, INC.

MIDLOTHIAN DISTRICT

NORMAL POOL ELEVATION 117

14 Trabeau
15 Maj. Clarke
16 Bailey
17 Dickenson
18 Natl Ind. Eng.
19 Bingley
20 Blackheath
21 Buck And Cunliffe
22 Jewett
23 Gowrie
24 Blunt
25 Fearnough
26 Woolridge
27 Bailey
28 Hanson
29 Woodrow
30 Maidenhead
31 Bailey
32 Bailey
33 Union
34 Greenhole
35 Pacebri
36 Agaze
37 White Chimney
38 Sinking
39 Pump
40 Grove
41 Murphy
42 Creek
43 Stonehenge
44 Wood
45 Dinney

MERRILL NATURAL RESOURCES, ADAMSON NO. 1

RICHMOND SYNDICATE NO. 8

RICHMOND SYNDICATE NO. 5

SALISBURY DRILLHOLE

RICHMOND SYNDICATE NO. 4

RICHMOND SYNDICATE NO. 7

RICHMOND SYNDICATE NO. 3

S.E. SALISBURY

PHILLIPS COAL CO., CIEJEK VAPW- 1

FARMVILLE AND POWHATAN RAILROAD (CHARTERED 1854, FARMVILLE TO MOSLEY)

RICHMOND AND DANVILLE RAILWAY (1850)

NORFOLK SOUTHERN CORPORATION

VULCAN MATERIALS CO., CH- 1, CH- 2

MOSLEY

FARMVILLE AND POWHATAN RAILROAD (MOSLEY TO BERMUDA HUNDRED)

MERRILL NATURAL RESOURCES, GORDON NO.1

CORNELL OIL CO., HORNER NO.1

SHORE PETROLEUM CO., HICKS NO. 1

MERRILL NATURAL RESOURCES, TURNER NO. 1

MERRILL NATURAL RESOURCES, TURNER NO. 2

MERRILL NATURAL RESOURCES, CHESAPEAKE CORP. NO. 1

MERRILL NATURAL RESOURCES, HUDGENS NO. 1

MERRILL NATURAL RESOURCES, GEORGIA-PACIFIC NO. 1

TIDEWATER AND WESTERN RAILROAD (COMPLETED 1890) (1905)

CORNELL OIL CO., BAILEY NO. 1

PHILLIPS COAL CO., ROBINS CS- 1

MERRILL NATURAL RESOURCES CONTINENTAL CAN CORP. NO.1

GRAY LUMBER CO. NO. 1

MERRILL NATURAL RESOURCES, CONTINENTAL CAN CORP. NO. 4

MERRILL NATURAL RESOURCES CASHION 1&2

PHILLIPS COAL CO., WALDROW VACH 1&2

A.&R. OIL MARTIN 1-B, 1-A, 2-A, 2-B

MERRILL NATURAL RESOURCES, CHALKLEY NO. 1

PHILLIPS COAL CO., GRAY LUMBER CO. CS-2

EPPS FALLS

PHILLIPS COAL CO., ANDERSON AM- 1

MIDLOTHIAN DISTRICT

BLACKHEATH BASIN

CUNLIFFE BASIN

NORFOLK SOUTHERN CORP.

Buckingham Plank Rd.

UNION BASIN

MIDLOTHIAN TURNPIKE

CHESTERFIELD AND MANCHESTER RAILROAD

STONEHENGE BASIN

C C'

STONEHENGE BASIN UNION BASIN C'

0 2000 FEET

CLOVER HILL RAILROAD (1845) BRIGHTHOPE RAILROAD (1877) EPPS FALLS TO OSBORNS BY 1850) EPPS FALLS TO BERMUDA HUNDRED)

D D'

CLOVER HILL DISTRICT

FARMVILLE AND TIDEWATER AND POWHATAN AND WESTERN RAILROAD (1890) (1905)

COALBORO

CLOVER HILL RAILROAD (1845) BRIGHTHOPE RAILROAD (1877)

CLOVER HILL DISTRICT

46 Coste's
47 Hill
48 Cox
49 Moody & Johnson
50 New
51 Beaver
52 Bright Wood
53 Pump
54 Halls
55 Raccoon
56 Rudd
57 Rowlett

WINTERPOCK CREEK

RACCOON SLOPE

0 FEET 800

KEY

CENOZOIC
- TERTIARY GRAVEL
- OTTERDALE SANDSTONE

MESOZOIC (TRIASSIC)
- VINITA BEDS
- SHALE
- COAL MEASURES
- BOULDER BRECCIA
- CONGLOMERATE

PRECAMBRIAN, PALEZOIC
- PETERSBURG GRANITE
- GRANITE GNEISS
- METAVOLCANICS
- METASEDIMENTS

- SLOPE MINE, ABANDONED
- SHAFT MINE, ABANDONED
- MINE TYPE UNKNOWN
- DRILL HOLE
- MODIFIED LAND (1:50,000)
- MODIFIED LAND (1:24,000)
- RAILROAD ACTIVE
- RAILROAD ABANDONED (TERMINUS)
- CANAL ABANDONED
- TRIASSIC/ CRYSTALLINE ROCK CONTACT
- COAL OUTCROP
- A A' LINE OF CROSS-SECTION