

PHILADELPHIA & READING RAILROAD, BLACK ROCK TUNNEL  
Pennsylvania Historic Railroad Bridges Recording Project  
Beneath Black Rock Hill, southwest of Black Rock Dam  
Phoenixville vic.  
Chester County  
Pennsylvania

HAER No. PA-520

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PA  
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD  
National Park Service  
1849 C Street, NW  
Washington, DC 20240

HISTORIC AMERICAN ENGINEERING RECORD

PHILADELPHIA & READING RAILROAD, BLACK ROCK TUNNEL

HAER No. PA-520

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Location: Beneath Black Rock Hill, southwest of Black Rock Dam, Phoenixville vicinity, Chester County, Pennsylvania.

USGS Quadrangle: Phoenixville, Pennsylvania (7.5-minute series).

UTM Coordinates: 18/456285/4443645 (east portal)  
18/455790/4444060 (west portal)

Dates of Construction: 1835-37.

Basis for Dating: Plaque on tunnel.

Dates of Alteration: 1858-59, 1888-89, 1936, 1994.

Designers: Moncure Robinson, Chief Engineer; Wirt Robinson, Assistant Engineer; William H. Wilson, Resident Engineer; Philadelphia and Reading Railroad.

Builders: James Appleton and Mr. O'Moriarty.

Present Owner: Norfolk Southern Railroad.

Present Use: Railroad tunnel.

Structure Types: Cast-in-place concrete lining; rock lining.

Significance: Black Rock Tunnel is the second railroad tunnel built in America and the first tunnel with vertical construction shafts. The Philadelphia and Reading Railroad has made significant contributions to America's transportation history and the history of the anthracite coal industry. In 1871 it was the largest corporation in the world. Moncure Robinson made significant contributions to the engineering and development of America's early railroads.

Historian: Richard M. Casella, October 1993.

Project Information: Black Rock Tunnel was recorded in October 1993 by the Cultural Resource Group of Louis Berger & Associates, Inc., East Orange,

New Jersey, for Consolidated Rail Corporation, Philadelphia, Pennsylvania. The recordation was undertaken pursuant to a Memorandum of Agreement between Conrail and the Pennsylvania Historical and Museum Commission in association with Conrail's program to increase vertical clearances on its lines across Pennsylvania. Project personnel included Richard M. Casella, Architectural Historian, Ingrid Wuebber, Historian, and Rob Tucher, Photographer.

This report was transmitted to the Library of Congress as part of the Pennsylvania Historic Railroad Bridges Recording Project, conducted by the Historic American Engineering Record (HAER) during 1999 and 2000, under the direction of Eric N. DeLony, Chief. The project was supported by the Consolidated Rail Corporation (Conrail) and a grant from the Pennsylvania Historical and Museum Commission (PHMC). Jet Lowe, HAER photographer, produced large-format photographs.

## DESCRIPTION

The Black Rock Tunnel is located in Phoenixville, Pennsylvania approximately 0.5 miles southwest of the Black Rock Dam on the Schuylkill River. The tunnel runs in a northwest direction through Black Rock, a small hill which forces the Schuylkill River off course to the northeast and into a tight hairpin curve. The west end of the tunnel terminates at the edge of the river where the tracks are carried across on a stone arch bridge.

The tunnel is 1,931' long, 21' high and 23' wide. The east and west portals are of identical construction, consisting of stilted elliptical arches of cast-in-place concrete. The concrete portal facewalls are decorated with V-shaped grooves to represent joints between rusticated voussoirs and rusticated ashlar stonework. It appears that this detail was built into the concrete forms. The east portal has a narrow facewall extending approximately 16" to each side of the portal to meet the vertical rock walls of the approach cut. The east portal extends approximately 4' into the tunnel to meet the natural rock. The west portal facewall extends approximately 8" to each side of the portal to meet coursed ashlar retaining walls which extend out from the portal approximately 30'.

The tunnel is driven through hard graywacke which required only partial lining totaling approximately 160 linear feet. A cast-in-place concrete lining extends from the west portal into the tunnel 100' and is identical in cross-section to the portal. Construction joints in the concrete lining every 4' suggest that the formwork used for the portal was moved along and multiple pours of concrete were made. It is also possible that multiple forms, 4' in width were used. This concrete work appears contemporary with the portals, which were constructed during the widening of the tunnel in 1936. The remaining 60' of lining is of random rubble construction and

consists of three short individual sections, each approximately 20' in length and spaced roughly 50' apart. These linings were constructed in 1894 to support veins of soft rock and are located between 250' and 350' in from the west portal. The tunnel carries a single track down the center.

## HISTORICAL INFORMATION

### General Background

The Reading Railroad Company, formerly the Philadelphia & Reading Railroad (P&R) was once the largest corporation and the largest carrier of anthracite coal in the world. The transportation system was characterized by three separate functions. In southeastern Pennsylvania and New Jersey, the P&R was primarily a commuter line between Philadelphia and the suburbs. In northeastern Pennsylvania, the railroad was largely an anthracite carrier. The P&R also serviced the rural hinterland of eastern Pennsylvania and it was this last part of the system that was incorporated into the main line of Conrail (Brown 1946:26; Holton 1989:xi).

In 1831 a convention was held at Bull Tavern in Phoenixville, Pennsylvania to promote a railroad along the Schuylkill Valley to join Philadelphia with the Susquehanna River. In 1833 the state of Pennsylvania authorized the Philadelphia and Reading Railroad company to build an eighteen-mile line between the two locations. The railroad was financed by Philadelphia financiers and prosperous Schuylkill Valley farmers and businessmen. Moncure Robinson was appointed Chief Engineer and is credited with surveying and laying out the route of the railroad as well as designing the track and railbed. He hired his cousin, Wirt Robinson, to be Assistant Engineer, and William H. Wilson as Resident Engineer in Charge. Robinson's survey was laid out only as far as the Flat Rock Tunnel on the west side of the Schuylkill River because the Reading's managers feared land speculators would inflate prices on the Philadelphia side of the river. The remainder of the route to the Delaware riverfront at Port Richmond was selected in secrecy (Bogen 1927:21; Broehl 1958:n.p.; Holton 1989:23, 317).

Construction of the line was begun in 1835 and required the driving of three tunnels, the Black Rock, Flat Rock and Pulpit Rock, as well as nine bridges over the Schuylkill. The line was completed from Pottsville to Philadelphia on 10 January 1842. Terminal facilities and wharves were built at Port Richmond on the Delaware for transshipment of coal to northern ports (Bogen 1927:27,28).

The completion of the railroad to the coal fields presented a clear threat to the prosperity of the canals, those with vested interests in the canals fought hard against it. In 1842 two railroad bridges near Mill Creek were burned by canalmen, who were caught and convicted, however, many other cases of vandalism against the railroad's property went unsolved. Within two years, coal tonnage shipment by the Philadelphia & Reading had surpassed that of the canals (Lower Merion Historical Society n.d.:n.p.).

The Philadelphia & Reading Railroad was noted for the narrow 22' width of its right-of-way. Iron bars were installed on coach windows to prevent careless passengers from sticking a head or limb out of the window and losing it to a passing train. The P&R subsequently

increased the clearance between its tracks, along cuts and through its tunnels several times as the widths of cars increased and safety standards were adopted (Horton 1989:62,75).

The Philadelphia & Reading was known as an innovative railroad company, introducing several important developments in railroad technology. Richard B. Osborne, who had replaced Wirt Robinson as Principal Assistant Engineer in 1843, designed the world's first iron railway bridge. The bridge was fabricated in the company's Pottstown shops and installed on the main line near Manayunk in 1845. The bridge continued in service until 1901 (Burr 1905:18). The P&R was also the first to use stone ballast in railway construction (1836), the first with a double-tracked rail line and iron coal cars (1843), the builder of the first armored car for use in the Civil War, and the first to install a fixed signal on an American railroad (1886) (Broehl 1958:58; Holton 1989:66, 340, 341).

By the mid-1850s the Philadelphia & Reading was the country's largest freight carrier. The railroad was insured of a constant supply of coal by leasing numerous mines. During this period, the company's president, John Tucker, instituted a series of expansions. The Philadelphia & Reading connected with lines to the north and west, providing access to Albany, Buffalo, Canada and Pittsburgh. Gradually, the railroad consolidated over one hundred and thirty-three lines (Broehl 1958:n.p.; Holton 1989:78-79).

The Philadelphia & Reading continually suffered from financial constraints. Initial construction of the railroad had saddled the company with a huge debt, making it necessary to maintain an unusually high level of operations in order to remain profitable. Major improvement projects in the 1850s included widening the clearance between tracks to six', laying heavier rail, and enlarging the Flat Rock and Black Rock tunnels (Horton 1989:124).

By 1870 the Philadelphia & Reading was the nation's first railroad to operate its own maritime fleet of coal vessels with sixteen colliers sailing from Port Richmond to Baltimore, New York and Boston. The railroad had also grown into the largest corporation in the world. The town of Port Reading, New Jersey, was constructed as a major coal port for New York in 1889 (Broehl 1958:n.p.; Holton 1889:339).

The Philadelphia & Reading railroad went bankrupt for the third time in 1893. The Reading Company was formed later that same year and the Philadelphia & Reading absorbed into the new corporation (Horton 1989:339).

When the first signs of the decline of anthracite coal transportation appeared, the Reading Company smoothly shifted to being a more diversified freight carrier, relying on fast locomotives and expeditious operations at forty-three interchange points with connecting railroads. During the World Wars the railroad was instrumental in shipping steel from the Phoenixville Iron Company, as well as moving troops and carrying the wounded to the Valley Forge General Hospital. The Reading Company remained one of the ten largest tonnage carriers in the United States through the 1950s. Its strategic location, encompassing parts of Eastern Pennsylvania, New Jersey and Delaware formed a bridge between the Eastern Seaboard and the West (Broehl 1958:n.p.; *Daily Republican* 1949:n.p.; Holton 1989:336).

### History of the Black Rock Tunnel

The Black Rock Tunnel was the second railroad tunnel constructed in America after the Staple Bend Tunnel on the Allegheny Portage Railroad built in 1831-1833. It is the first tunnel in America in which vertical shafts were sunk to allow tunneling to progress simultaneously on more than two headings (Drinker 1878:29).

According to a newspaper article in the *American Republican* on 16 November 1852, the tunnel was begun in December 1833 and completed in September 1837. However, all the other sources consulted put the construction period as 1835 to 1837. It is possible that the approaches were begun in 1833 and that actual underground tunneling began in 1835. The engineers on the project were Moncure and Wirt Robinson assisted by William H. Wilson (*American Republican* 16 Nov. 1852). There were two contractors on the project; James Appleton began the project and a Mr. O'Moriarty completed construction (*Daily Republican* 1949:n.p.).

The tunnel was hand drilled through graywacke, a hard metamorphic slate. The rock was blasted with black powder and advanced at an average rate of 40' per month at the end headings and 33' per month at the shaft headings (Vose 1873:102). Several hundred immigrant laborers worked on the project. Total cost of the tunnel was \$178,992 or \$92.65 per foot (Drinker 1878:124).

In 1858, the tunnel was widened from 19' to 23' to accommodate new wider gauge track and wider cars. Over 300 men were employed in the project on two shifts, day and night, with 150 men per shift (*Jeffersonian* 30 Oct 1858). Hand drilling was again employed, however blasting technology had progressed slightly. Black powder was still used but electric detonation with a galvanic battery had been introduced. The powder was loaded into tin cartridges before being taken into the tunnel. The cartridges kept the powder dry in the hole, which, in conjunction with electrical fuses, greatly reduced the incidence of premature detonation and misfires and their usual accompaniment of lost lives. The widening removed 6,656 cubic yards of rock, required 5,675 blasts, and cost a total of \$21,511, or \$3.23 per cubic yard (Drinker 1878:742-743; *Village Record* 1858). Trains continued operating on one track through the tunnel while the second track was used for removal of the rock in ore cars. The movement of the trains was controlled with a telegraph system run through the tunnel to signal the approaching trains, as well as the status of work in the tunnel (*Jeffersonian* 27 Nov 1858).

To remove the smoke and dust in the tunnel from the blasting and the passing locomotives, iron chimneys, 30' high and 4' in diameter, were erected over the five shaft openings on the hill above the tunnel. The chimneys were equipped with fire grates in which fast fires were burned to create a strong draft up the shafts, and draw fresh air into the tunnel at its openings (*Jeffersonian* 30 October, 27 November, 1858).

In 1876, the P&R began running parlor cars over the line, which due to their added height, required the laying of a third set of tracks down the middle of the tunnel. This was accomplished by laying each new rail in the middle of each of the two existing tracks. The work was overseen by Elias Shuck, trackmaster for the P&R (*Daily Local News* 1876).

During heavy rains, water running off the hillside into the Schuylkill River at the south end of the tunnel caused numerous problems for the railroad. Flooding in the tunnel was so

severe that on one occasion passenger cars were awash with muddy water on their passage through the tunnel. In several instances the quantity of mud and stone washed onto the track was sufficient to block the passage of trains. In 1882 the railroad constructed a viaduct, 160' long, over the top of the tunnel and under the Phoenixville Canal to drain the runoff into the river (*Daily Local News* 1882).

In 1884, the P&R announced that the Black Rock Tunnel, as well as the Flat Rock and Pulpit Rock Tunnels, would again be enlarged, this time to accommodate the new Wortens' coal dust burning locomotive. The Wortens' locomotive was taller than other engines used by the P&R at that time. The work, however, was not immediately undertaken (*Daily Local News* 1884).

In 1886, the railroad again announced that it was widening the approaches to the tunnel at its south end for passage of the wider Pullman cars of the Baltimore and Ohio Railroad Company. The railroad would then switch the cars to the center aligned passenger tracks to achieve the necessary side clearances through the tunnel (*Daily Local News* 23 Aug 1886). Finally construction began in 1889, the benefits justifying the expense. A reporter for the *Daily Local News* visited the site in May and found thirty-five men engaged in drilling and blasting, as well as "a score of dispatchers, operators, switchmen and watchmen on hand both day and night" (*Daily Local News* 1889). The contractor, R. A. Malone and Sons, indicated that a night shift would be added soon and that the work was expected to take nine to twelve months. The work took considerably longer and a lawsuit was ultimately filed against the contractor by the railroad for overcharging (*Daily Local News* 1889, 1892).

In 1894, several sections of the tunnel were arched in areas where veins of soft rock were collapsing from time to time, blocking the trains and threatening derailments (*Daily Local News* 1894).

Enlargement of the tunnel was again undertaken by the railroad in 1935 so that the tracks could be moved farther apart to meet new clearance regulations. The Philadelphia contracting firm of Young Brothers, Inc., was awarded the work. The contractor utilized railcar mounted drilling machinery and scaffolding to effect the work, which took several months (*Daily Republican*, 1935, 1936).

#### The Engineers of the Black Rock Tunnel

Moncure Robinson (1802-1891) began his career in engineering in Virginia when he surveyed lands for the state and assisted in locating the James River Canal. He visited the Erie Canal during its construction in 1821 and came away an advocate of railroads. Robinson studied engineering at the Ecole des Ponts et Chaussees in Paris in 1825. Upon returning to the U.S. in 1828, he worked for the state of Pennsylvania until 1830, surveying and locating the Pottsville & Danville Railroad and the Allegheny Portage Railroad. He went back to Virginia between 1830 to 1832 and designed and built four railroads: the Petersburg & Roanoke, the Richmond & Petersburg, the Richmond & Fredericksburg, and the Winchester & Potomac. For the Richmond and Petersburg Railroad he designed and built a 2,844' lattice bridge over the James River. Between 1835-1840 Robinson went to work for the Philadelphia and Reading Railroad where he

built their main line which included numerous bridges and three early tunnels, the Black Rock, the Flat Rock and the Pulpit Rock. Robinson is also known for designing the "Gowan and Marx" locomotive, considered a significant improvement in that technology at the time (ASCE 1972:103; *Engineering News* 1891:463).

William Hasell Wilson (1819-1897) began his engineering career in volunteer service for the Pennsylvania state engineering staff as a surveyor in 1827. He was employed as a surveyor and engineer with the Philadelphia & Columbia Railroad from 1828 to 1834. Wilson joined the Philadelphia and Reading Railroad in 1835 as Assistant Engineer and directed the construction of the Black Rock Tunnel, the Schuylkill River bridge at Phoenixville and sections of the line between Pottstown and Bridgeport. His long career in the railroad business included positions as Chief Engineer with the Philadelphia & Columbia, the West Chester & Pennsylvania, and the Phoenixville and Cornwall railroads. He also served as President of the Philadelphia & Erie, the Belvidere-Delaware, and the Philadelphia & Trenton railroads. Wilson worked for the Pennsylvania railroad as a construction manager and later developed their real estate department from 1874 to 1884 (*American Republican* 16 November 1852; ASCE 1972:130)

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