PHILADELPHIA & READING RAILROAD, FLAT ROCK TUNNEL
Pennsylvania Historic Railroad Bridges Recording Project
Beneath Flat Rock Hill, west of Schuylkill Expressway (I-76)
West Manayunk vic.
Montgomery County
Pennsylvania

HAER No. PA-539

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
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Location:	Beneath Flat Rock Hill, west of Schuylkill Expressway (I-76), West Manayunk vicinity, Montgomery County, Pennsylvania.
USGS Quadrangle:	Germantown, Pennsylvania (7.5-minute series).
UTM Coordinates:	18/479300/4431320 (east portal) 18/479110/4431525 (west portal)
Date of Construction:	1840.
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 & Reading Railroad.
Present Owner:	Norfolk Southern Railroad.
Present Use:	Railroad tunnel.
Structure Types:	Cast-in-place concrete lining; rock lining.
Significance:	Flat Rock Tunnel is one of the earliest railroad tunnels built in America. The Philadelphia & Reading Railroad 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:	Flat 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 (Conrail), 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 grants from the Pennsylvania Historical and Museum Commission (PHMC). Jet Lowe, HAER photographer, produced large-format photographs.

DESCRIPTION

The Flat Rock Tunnel is located in Manayunk, Pennsylvania, a section of Lower Merion Township in Montgomery County. The tunnel is approximately 0.4 mile south of the Flat Rock Dam on the Schuylkill River, running in a northwest direction through a small hill on the south bank of the river.

The tunnel is 937' long, 21' high, and 24' 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 tunnel is driven through gneiss, which required only partial lining, totaling approximately sixteen linear feet. The cast-in-place concrete lining, resting on a coursed ashlar benchwall, extends into the tunnel 12' at the east end and 4' at the west end. These short linings were constructed at the same time as the portals, which date from 1935 according to local newspaper articles (*Daily Republican* 1935, 1936).

Historical views of the tunnel indicate that the original portals were constructed of cut and chamfered stone voussoirs and coursed, smooth-ashlar facewalls. The facewalls featured two massive pilasters flanking the portal openings and constructed of a single column of stacked rusticated stone blocks. These portals were removed in 1859 during the first enlargement of the tunnel and were replaced with simple quarry-faced coursed ashlar portals with an overhanging coping (John Milner Architects 1993:7-9, 11). There is no remaining physical evidence of either of the earlier portals.

Both portals have narrow facewalls which extend approximately 16" to each side of the portal to meet coursed ashlar retaining walls. The retaining walls extend out from the portals approximately 25' and exhibit decorative tooling, including chamfering and vermiculated faces. Presently, 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 in 1871 the largest corporation and the largest carrier of anthracite coal in the world. The transportation system of the P&R 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 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 organize and promote a railroad along the west side of the Schuylkill River to join Philadelphia and Reading. Officers for the company, who were elected at the meeting, included Matthias Pennypacker, President; William Jones and Moses Robinson, Vice Presidents; and John Morgan, Samuel Shearer, and William Rogers, Secretaries (Pennypacker 1872:177). In 1833 the state of Pennsylvania authorized the Philadelphia & 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 R. 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 P&R's managers feared that 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—Black Rock, Flat Rock, and Pulpit Rock—and the erection of nine bridges over the Schuylkill. The line was completed from Pottsville to Philadelphia on January 10, 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, and those with vested interests in the canals fought hard against it. In 1842 two railroad bridges near Mill Creek were burned by canalmen. Although in this case the perpetrators were caught and convicted, many other cases of vandalism against the railroad's property went unsolved. Within two years, coal tonnage of the P&R 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 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 P&R was known as an innovative railroad company and introduced 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. It 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 Railroad was the country's largest freight carrier. The railroad was assured 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 P&R connected with lines to the north and west, providing access to Albany, Buffalo, Canada, and Pittsburgh. Gradually, the railroad consolidated over 133 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 of the 1850s, which included widening the clearance between tracks to 6', laying heavier rail, and enlarging the Flat Rock and Black Rock tunnels, were also very costly (Horton 1989:124).

By 1870 the Philadelphia & Reading had become 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. Port Reading, New Jersey, was constructed as a major coal port for New York in 1889.

The Philadelphia & Reading Railroad went bankrupt in 1893. The Reading Company was formed later that same year and the Philadelphia & Reading was absorbed into the new corporation (Broehl 1958:n.p.; Holton 1989:339).

When the first signs of the decline of anthracite coal transportation appeared, the P&R 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 P&R 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 an important connection between the Eastern Seaboard and the West (Broehl 1958:n.p.; *Daily Republican* 1949:n.p.; Holton 1989:336).

History of the Flat Rock Tunnel

The Flat Rock Tunnel, built in 1840, was the ninth railroad tunnel to be constructed in the United States. It was the last of three tunnels to be constructed by the Philadelphia & Reading Railroad on their line between the two cities; the two tunnels that preceded it were the Black

Rock Tunnel in Phoenixville (1835-1837) and the Pulpit Rock Tunnel in Port Clinton (1839-1841) (Drinker 1878:30, 978).

The engineers on the project were Moncure and Wirt Robinson, assisted by William H. Wilson (*American Republican* 1852). The tunnel was hand drilled through gneiss, a hard metamorphic rock, and blasted with black powder (Drinker 1878:30). The cost of the tunnel's masonry portals, including 5,663 square feet of cut stone and sixty-two barrels of cement, was $9,852.90 (Osborne 1885:n.p.).

In 1858, the tunnel was widened from 19' to 23' to accommodate new wider-gauge track and wider cars. The distance between the two tracks was increased from 4' to 6', and 1' of additional side clearance was added. More than 100 men were employed in the project, which began in December of 1858 and was completed in the spring of the following year. The work was accomplished without the interruption of rail service. Trains continued to operate on one set of tracks through the tunnel while the second set of tracks 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 status of approaching trains as well as the status of work in the tunnel (*Jeffersonian* 1858a, 1858b). Hand drilling was again employed during widening of the tunnel, but blasting technology had progressed slightly. Although black powder was still used, 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 drilled hole, which, in conjunction with the use of electrical fuses, greatly reduced the incidence of premature detonation and misfires and their usual accompaniment of lost lives (Drinker 1878:742-743; *Village Record* 1858).

The tunnel was widened again in 1875 to accommodate larger freight cars. In the following year the P&R began running parlor cars over the line, and the added height of these cars required the laying of a third set of tracks down the middle of the tunnel where the tunnel height was greatest. This was accomplished by laying each new rail in the middle of each of the two existing sets of track (*Daily Local News* 1875, 1876).

In 1884, the P&R announced that the Flat Rock Tunnel, as well as the Black Rock and the Pulpit Rock tunnels, would again be enlarged, this time to accommodate the new Worten's coaldust-burning locomotive. The Worten's 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).

A serious accident between a passenger train and a freight train occurred at the tunnel in 1892. An eastbound passenger train to Philadelphia, running late and at higher than normal speed, was accidently switched to the westbound track. It met the westbound freight train head-on at the tunnel, resulting in seven people being killed and forty injured (*Lower Merion Historical Society* n.d.:n.p.).

In 1935, Federal regulations required the enlargement of the Black Rock Tunnel to meet new safety regulations for clearance (*Daily Republican* 1935). Although the Flat Rock Tunnel is not specifically mentioned in the source, it appears from the similarity of the workmanship and materials that work on the Flat Rock Tunnel was undertaken at the same time and possibly by the

same contractor. The work at the Black Rock Tunnel was accomplished by the Philadelphia contracting firm of Young Brothers, Inc. The contractor utilized railcar-mounted drilling machinery and scaffolding and completed the work over several months (*Daily Republican* 1936).

The Engineers of the Flat 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 and 1832 and there designed and built four railroads: the Petersburg & Roanoke, the Richmond & Petersburg, the Richmond & Fredericksburg, and the Winchester & Potomac. For the Richmond & Petersburg Railroad he designed and built a 2,844' lattice bridge over the James River. Between 1834-1840, Robinson went to work for the Philadelphia & Reading Railroad, for which he built the main line, including numerous bridges and three early tunnels, the Black Rock, the Flat Rock, and the Pulpit Rock. He traveled to England in 1836 to inspect railways under construction there and to secure a loan of two million dollars for the completion of the Philadelphia & Reading. Robinson is also known for designing the "Gowan and Marx" locomotive, considered a significant improvement in locomotive technology at the time (American Society of Civil Engineers 1972a: 103, 1972b:88; Brown 1949: 17; *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 & 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 Railroad, the West Chester & Pennsylvania Railroad, and the Phoenixville & Cornwall Railroad. He served as President of the Philadelphia & Erie Railroad, the Belvidere Delaware Railroad, and the Philadelphia & Trenton Railroad. Wilson worked for the Pennsylvania Railroad from 1868 to 1874 as Chief Engineer of Construction and from 1874 to 1884 as manager of the real estate department (*American Republican* 1852; American Society of Civil Engineers 1972a:130).

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