Baltimore and Ohio Railroad,
Kingwood Tunnel
Tunnelton Vicinity
Preston County
West Virginia

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WRITTEN HISTORICAL AND DESCRIPTIVE DATA

PHOTOGRAPHS

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WV-16

BALTIMORE AND OHIO RAILROAD: KINGWOOD TUNNEL

Date: 1849-57, 1903, 1912

Location: Tunnelton Vicinity, Preston County, West Virginia

Owner: B & O Railroad

Significance: The Kingwood tunnel was the major tunnel on the B & O mainline between Baltimore and Wheeling. Its construction involved the invention of new tunneling techniques and the use of prefabricated iron arch segments. It was the longest tunnel in America in 1852.

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Transmitted: Daniel Clement, 1984.

BALTIMORE AND OHIO RAILROAD: KINGWOOD TUNNEL

In 1849, the B&O Railroad set to the task of negotiating the several ranges which comprise the Alleghenies. Construction was much more difficult than on the eastern part of the line. From Cumberland, the line ascended the valley of the North Branch of the Potomac 22 miles to Piedmont. Just out of Piedmont, the line crossed the North Branch and entered Maryland once again. After an scent of 17 miles, it crossed the Appalachian fall line at Altamont (elevation 2,626 feet) and descended into the valley of the Youghiogheny River. Another ascent to Terra Alta (elevation 2,525 feet) brought it into the watershed of the Cheat River. After crossing the Cheat at Rowlesburg over one of Albert Fink's bridges, it began the long, difficult ascent of the Cheat River Grade. The construction of this section was particularly difficult, and the feat brought the B&O's engineers distinction in the railroad centers of Europe and America. In addition to extensive cut and fill, this grade was negotiated by several long runs of stone masonry embankment and two iron trestles designed by Albert Fink. The one at Tray Run was 445 feet long, 58 feet high, and 28 feet wide. All members were of cast and wrought iron and stood on stone masonry walls. The two trestles formed a remarkable example of the early use of metal in railroad engineering. At the top of the Cheat River Grade lay one of the most difficult tasks on the entire route, the construction of the Kingwood Tunnel. [1]

In the 1840's, tunneling technology was primitive at best, and no engineers, contractors, or laborers specialized in this field. At the time of the construction of the Kingwood there were no American precedents for a railroad tunnel of such length and difficulty. Consequently, the work force engaged in construction was drawn from the coal mines of nearby Cumberland. [2] Work on the tunnel began late in 1849 and the bore was completed late in 1852, though not sufficiently for the track to be layed. Since it was obvious to Latrobe that the tunnel would not be ready for the opening of the line on January 1, 1853, he directed his engineers to grade a temporary track over the ridge. This so-called "shoo-fly" track was a series of switchbacks of unusually high grade. A At each switchback there was a level portion of track long enough to accommodate the engine and one or two cars while they reversed direction. This technique eliminated the need for curves of small radius. The accepted maximum grade at the time for railroads was 116 feet per mile (2.2%). After the Civil War, this became the standard for the B&O and the major transcontinental lines then being built in the West. Yet the shoo-fly track at Kingwood had a grade of 500 feet per mile (10.5%) and was considered simply a desperation measure to meet the difficult political and financial restrictions under which the railroad labored. President Thomas Swann and Chief Engineer Benjamin H. Latrobe had promised to open the line to Wheeling by January 1, 1853, and, faced with the delay of the tunnel, they resorted to the switchback in an effort to maintain public confidence in the enterprise. This novel technique was a product of necessity. Evidently, no one was more surprised than Latrobe when the engine and car successfully negotiated the incline.* Although conceived as an expedient, the shoo-fly track seems to have worked to the company's benefit in more than a functional way. Its dramatic location and novelty made it an object of both terror and awe to travelers on the route. When the train bearing the dignitaries to Wheeling for the opening celebration came to the switchbacks, many of the passengers preferred to walk over the mountain rather than risk a ride. While difficulties with the tunnel continued, the shoo-fly track remained in service as an impressive symbol in the public mind of the B&O's engineering virtuosity. In 1854, continued rockfalls closed the tunnel and the shoo-fly track was realigned and put back in service for a time. [4] (WV-16-1)

Construction of the tunnel itself was a still more difficult task. Excavation proceeded from both ends and from six additional headings worked from three vertical shafts. The shafts, 15 feet by 20 feet and about 180 feet deep, were worked by horse gins (see photocopy of early woodcut, HAER WV-16-2). Such rigs were typical of local coal mine operations, and it is likely that the contractors of the work, Lemon, Gorman, Clark, and McMahon, gained their experience in that industry. [5] The tunneling techniques were also typical of local mining operations. Holes were drilled by hand in the face and filled with charges of black powder. Ignition of the "shot" by a fuse was a hazardous business and the source of numerous accidents. At 4,137 feet, the Kingwood Tunnel was the longest in the country when completed (it was soon surpassed by the Blue Ridge Tunnel [Blue Ridge Railroad, later C&O Railway], 1850-1858, 4,262 feet; and the Bergen Tunnel [Erie Railway], 1856-1861, 4,300 feet). After the Civil War, these methods were supplanted by the invention of the power drill (first steam, then pneumatic), nitroglycerine, and dynamite blasting with electric detonation. In all, Lemon, Gorman, and Company removed 90,000 cubic yards of material from the bore and an additional 110,000 from the deep-cut approaches. [6] (WV-16-4)

At Kingwood, the problems of primitive techniques were further complicated by the poor quality of the rock in the eastern portion of the bore. When exposed to air, it became friable and subject to collapse. [7] Despite the heavy-timber centering installed as the work progressed, the labor continued to be difficult and dangerous. One source reported that over 30 men died and 300 were injured in the construction of Kingwood and its companion, the Board Tree Tunnel (2,350 feet). [8]

Despite the timber shoring, the tunnel continued to be a source of problems for the company. Rockfalls were frequent and of such mass that they destroyed the timberwork and caused delays on the road.

* When the train reached the top, he exclaimed, "Wonderful! Wonderful! Wonderful!" [3]

Latrobe decided to erect a permanent arch in the troublesome eastern section. In July of 1854, a monthly appropriation of $6,000 was begun for this purpose and over 200 men were set to work. Arching the tunnel proved to be at least as hazardous as the original boring. When the timber was removed, the loose material which had accumulated on top came crashing down on the workers. Watchmen had to be employed to warn workers of impending rockfalls. [9] Such conditions made it nearly impossible to line the tunnel with a conventional masonry arch, and an alternative was sought. Latrobe's engineers--probably Bollman--developed a prefabricated arch which could be moved into place and installed in a very short time. This cast-iron arch was formed in two quadrants and rested on masonry side-walls; it was bolted together at the crown. Each piece was 3/4 inch thick and 3 feet wide, with two lateral ribs 6 inches deep. By means of "an ingeniously contrived hoisting car," two of these quadrants could be moved into place and erected in 5 to 10 minutes. To prolong the life of the iron, it was then coated with pitch and paint (probably pitch on the top and paint on the underside). Once installed, wooden braces were placed on top of this arch to support the tunnel roof while masons laid a second arch of sandstone between the two. The remaining space, if any, was filled with rubble. This second arch of sandstone insured the permanence of the structure against the eventual deterioration of the iron. [10]

Preparation of the bore to receive these iron segments was one of the most difficult and dangerous aspects of the work. Once the cribbing was removed, the bore was widened from 22 to 28 feet to accommodate the masonry side-walls and make room for a double track. These walls were 2 feet thick and 13 feet high, and workers had very little protection from rockfalls. [11] Approximately 1,300 feet of such construction was necessary. An additional 1,700 feet of the eastern portion was sufficiently solid to permit conventional brick arching with a minimum of hazard. By October 1856, over 2,200 feet or iron and brick arch had been installed. When the work was completed early in 1857, approximately 3,000 feet in from the eastern portal were lined; the remaining western portion had a limestone roof sufficiently solid to support itself. This last section was finally lined in 1858.

The Kingwood Tunnel served the B&O for about a hundred years. Gradual increase in the size of rolling stock forced a conversion to a single track soon after the Civil War. In 1889, the entire length was grouted with Cumberland Cement and the walls underpinned. [12] Soon after (before 1905), approximately 800 feet of the iron arch was reinforced by a brick arch which reduced the tunnel width to 19 feet. [13] In 1911, when a new tunnel was bored next to the old one, its east portal was extended to cover that of the old tunnel. The old tunnel continued in service through World War II and was finally abandoned and sealed up in the 1950's.

All the technology associated with Kingwood Tunnel was characteristic of the experimental period of American railroad engineering. The distinctive aspect of these works, the shoo-fly switchback and the use of the prefabricated iron arches, was the diligent forethought with which they were planned. While their originality may be questioned (there were related precedents in Britain and Europe), their adaptation to a unique situation speaks well of the resourcefulness of the B&O's engineering department. Pressed by the exigencies of time and money, Latrobe and his assistants evolved a system of railroad engineering practices which set the stage for the great post-war expansion. The construction of the Kingwood Tunnel demonstrated the importance of planning in large-scale undertakings. This is clearly evident in the fact that the bore was worked simultaneously from eight faces and again in the construction of the shoo-fly track. Latrobe calculated the quantity of material to be removed and realized that, given the problems encountered, the work would not be ready by the January 1, 1853, deadline. Work commenced on the switchback track, itself a difficult engineering feat, in time to complete it for the opening of the road. The uncertainty and uniqueness of the new enterprise was to a large degree neutralized by effective planning and organization of available techniques.

Footnotes

1. Edward Hungerford, The Story of the Baltimore and Ohio Railroad 1828-1928 (Baltimore, 1928), Vol. 1, pp. 240-263.

2. Ele (Eli) Bowen, Rambles in the Path of the Iron Horse (Philadelphia, 1855), p. 319.

3. W. C. Quincy, "Baltimore and Ohio Railroad Engineering Before and After the War," Engineers' Society of Western Pennsylvania Journal, Vol. VI, no. 7, p. 92.

4. American Railroad Journal, no date (1855?), p. 556.

5. Bowen, pp. 319-320.

6. Ibid., p. 320.

7. Baltimore and Ohio Railroad, 30th Annual Report (Baltimore, 1856). Annual reports hereafter cited by number.

8. Quincy, pp. 89-107.

9. 32nd Annual Report (1858); Quincy, p. 94.

10. American Railroad Journal, p. 556.

11. The Chessie System, Engineers' Office, Huntington, West Virginia, three drawings of Kingwood Tunnel, 1903, 1911, 1934.

12. Ibid., notes on drawings.

13. Ibid.