The Cog Railway on Mount Washington

David R. Starbuck

The Mount Washington Cog Railway is one of New Hampshire's most spectacular industrial sites. While there are other cog railways, it is the only one to be powered by steam, and it has taken visitors to the top of Mount Washington—the highest mountain in the northeastern United States—since 1869 when the railway was completed. Among its distinctions—and there are many—is that it was the first cog railway ever constructed, preceding those in Europe by a few years. Even today it is the second steepest cog railway in the world, with a maximum grade of over 37 percent. And it received the only exemption from the Environmental Protection Agency to burn exceptionally low-grade, high-polluting coal.

The inventor of the Cog Railway was Sylvester Marsh, born in Campton, New Hampshire, in 1803. He previously made a fortune in the meatpacking industry in Chicago, and a popular account tells that in August of 1852 he attempted to ascend Mount Washington on foot, was caught in a storm, and barely made it to the top. His experience was so traumatic that, after spending the night on the summit in the Tip Top House, he resolved to find a way to use steam power as a means of propulsion to the top.[1] His subsequent efforts led to the development and patenting of a special cog system with big gears—necessary because of the very steep grade—and an air brake. In 1858 he appeared before the New Hampshire State Legislature where he argued, successfully, for a charter to build a railroad up the mountain. Most important, with time he was able to attract money from investors and in 1865 formed the Mount Washington Steam Railway Company which brought in construction materials by railroad to Littleton, New Hampshire. Ox teams carried supplies the rest of the way, and the company constructed a Base Station at the foot of the mountain, built trestles on the mountain's west side, and began laying the track. Unlike other railways, Marsh's design had the tracks supported on continuous timber trestlework suspended on and above the surface of the ground, without any cutting or filling of the ground underneath. In addition to the two running rails—positioned 4 feet, 8 inches apart—there was a third "cog rail" or "rack" between them into which the gears beneath the locomotives safely meshed. Only in this way was it possible to keep the wheels of the locomotives from helplessly spinning on the steep and slippery rails.

It was not until August 1866 that the first trial runs began taking visitors for short distances on the newly constructed tracks, powered by the first locomotive, named *Hero,* which had been built to Marsh's specifications by Campbell, Whittier & Co. in Boston. This small locomotive, with a vertical boiler and a reduced gear ratio to enable it to climb steep grades, was subsequently renamed *Peppersass* because of its strong resemblance to a peppersauce bottle. The upright boiler hung from a pivot which enabled it to remain vertical even on the steepest slopes, and *Peppersass* transported all of the construction materials used in building the tracks.

A second locomotive soon followed, constructed by Walter Aiken of Franklin, New Hampshire. Aiken's first and subsequent locomotives all had vertical boilers and two cylinders and were fancier than the *Peppersass* in that they had wooden cabs and tenders to hold the wood they used as fuel. Aiken's influence over the operation—and his managerial and mechanical skills—resulted in his appointment as superintendent and general manager, and his role in the development of the Cog Railway became fully as important as Marsh's. Beginning about 1874, however, locomotives adopted a horizontal boiler that was slightly raised at the firebox end so the boiler would be somewhat level even on a slope. These more sophisticated models had four cylinders and were built by the Manchester Locomotive Works of Manchester, New Hampshire.

It took three years to lay the necessary three miles of track, and it was on July 3, 1869, that the first train actually reached the top of Mount Washington. It required 700,000 feet of timber for the trestlework and was built at a total cost of $125,000.[2] Dignitaries who ascended to the top of the mountain later that year included President Ulysses S. Grant, and the line up the mountain became an immensely popular tourist destination.

As designed, the railway had an average grade of 25 percent, and at top speed it was possible to ascend to the top in about an hour, with the locomotive pushing just one coach with its bumper—the locomotive and the passenger car were *not* intended to be coupled together so the coach could be independently braked. Only one track was constructed up the mountain, but often two trains would ascend together, racing each other to the top. When ascending the mountain, the locomotive was always on the downhill side of its coach,

pushing the coach to the top, and during the descent the locomotive backed down in front of the coach, lowering the coach down the mountain. As locomotives were constantly rebuilt and periodically replaced, the custom developed to name each new locomotive after its predecessor, so "first #2" gave way to "second #2," and "first #3" to "second #3," and so forth; many were given nicknames as well, such as *George Stephenson, Atlas, Hercules,* and *Tip Top.* This custom is perpetuated today with names such as *Base Station* and *Great Gulf. Peppersass,* of course, continues to be the only "#1."

Coaches could be either "open" or "closed," depending on the season (and whether the passengers were willing to be covered with soot and cinders!), and a flatcar or baggage trailer—with loads of passengers or cargo—was sometimes pulled as well. Wooden coaches could hold either 48 or 56 passengers, and metal coaches hold 56.

During the early years of the railway, workmen sometimes used a plank with a crude braking system, known as a slideboard, to facilitate their descent from the summit of the mountain. Only employees were allowed to ride the boards—which looked rather like toboggans—and typically the workers rode up on the train in the morning and rode down on the slideboards at 5:00 in the afternoon. The boards were about one foot wide by three feet long and rested on the central cog rail as they were ridden down the mountain. Slideboard riders used their hands to control long braking levers on either side of the plank—as the brake handles were pulled up, they clamped steel plates against the underside of the cog rail. Using these crude friction brakes, and positioned on slideboards with their toolboxes in front of them, workmen occasionally achieved speeds in excess of 60 miles per hour. The fastest recorded time to descend the mountain was two minutes and 45 seconds, but a more typical time down the mountain was about 10 minutes. The slideboards were in use from c1870 to 1920 and were popularly known as "Devil's Shingles" but, because of several serious accidents, they were formally banned in 1930.

Early management—Marsh and Aiken—was eventually replaced by the Boston & Maine Railroad, which owned the Cog Railway from 1895 until 1931. The B&M made numerous improvements, including the conversion of the railway from wood to coal. It was sold during the Depression to Colonel Henry Teague, who rebuilt the operation, and later Arthur Teague (no relation) made further conversions, including the construction of two sidings so trains could pass one another. The track switches at these sidings had to be unusually complicated to handle the cog and driving gears, and throwing one of these switches requires nine distinct hand movements.

During the early 20th century, the Cog Railway incurred its first fatality when *Peppersass*—long since retired—was discovered in the Baltimore & Ohio station in Baltimore and brought back for a demonstration in 1929. After some speeches to the assembled group, the locomotive's boiler was fired up and it ascended most of the way to the summit; however, on the way down, a tooth broke on a gear wheel, it slipped out of the cog rail, and the runaway locomotive raced down the track and crashed. One of the passengers, a photographer, was killed when he leaped from the tender. However, the wrecked locomotive was pulled from the ravine where it landed, rebuilt, and subsequently put on display at the Base Station where it is today.[3]

A much more serious accident occurred in September 1967 when a rail switch was left open—possibly by a passing hiker—and a locomotive and its passenger coach both jumped out of the cog rail, went out of control, and left the track. Eight people were killed and another 75 injured, resulting in a state investigation and increased safety precautions ever since.

In addition to other distinctions and honors, the Cog Railway was declared a National Historic Mechanical and Civil Engineering Landmark in 1976. Even today, its appearance is much the same as always, and thousands of passengers from around the world ascend Mount Washington each year on the Cog Railway. Trains belching great clouds of gray and black smoke that leave passengers covered with cinders make hourly departures for the summit, traveling at four miles per hour. A slow and noisy round-trip from the Base Station to the summit and back takes about three hours and consumes about one ton of coal and 1,000 gallons of water.[4] Pieces of coal are, in fact, littered alongside the tracks.

Seven locomotives are currently operative—and the older locomotives have been rebuilt many times—and when anything breaks, all of the replacement parts have to be fabricated by railway machinists at the Base Station. Because Mount Washington is covered with snow nearly six months a year, the railway is open to passengers only from late April through October. Still, during the summer months, the Cog Railway provides the finest steam-powered experience in the world, albeit on the mountain that has the fiercest weather in the eastern United States!

Acknowledgments

I wish to thank the New Hampshire Historical Society (NHHS) and its Special Collections Curator, Sherry Wilding-White, for the use of the stereographic images in this article and for allowing me to reproduce the patent model of Marsh's steam engine that now resides in the collections. The NHHS possesses literally thousands of images of the Cog Railway, including hundreds of different stereographic images. All of the stereographs in this article were originally published in the 1860s and 1870s and were typically purchased by visitors to the White Mountains, usually in large sets of as many as 50 or 60 images. All but two of the stereographs here were published by Kilburn Brothers of Littleton, N.H. (figures 4-7, 9-15, 17-19). It must be noted that the very steep grade suggested in some of the stereographs—especially figures 11,12,14—is the result of the photographer tilting his camera; the tracks are definitely *not* as inclined as these scenes would suggest.

Notes

1. There are several popular accounts of Sylvester Marsh and the railway he created. Among the more useful are Donald Bray, *Cog Railway* (Mount Washington, N.H.: Mount Washington Railway Company, 1991); Donald H. Bray, *They Said It Couldn't Be Done: The Mount Washington Cog Railway and Its History* (Dubuque, Iowa: Kendall/Hunt Publishing Company, 1984); Glen M. Kidder, *Railway to the Moon* (Littleton, N.H.: Courier Printing Company, 1969); Ellen C. Teague, *Mount Washington Railway Company* (New York: Newcomen Society in North America, 1969); and Peter E. Randall, *Mount Washington: A Guide & Short History,* 3d ed. (Woodstock, Vt.: Countryman Press, 1992), pp. 35–54.
2. The cost of construction is variously reported, as reflected on the State Historic Marker erected at the site: "MOUNT WASHINGTON COG RAILWAY Completed in 1869 for $139,500, this unique railway was built through the genius and enterprise of Herrick and Walter Aiken of Franklin and Sylvester Marsh of Campton. Over three miles long, the average grade to the 6,293-foot summit is one foot in four. Made safe by toothed wheel and ratchet, it is the second steepest in the world and the first of its type."
3. Winston Pote, "The Last Climb of Old Peppersass," *New Hampshire Profiles* 9, 8 (August 1960):17–23.
4. See Bray, *Cog Railway* (n. 1 above), p. 2; and Nancy Roberts, "After 125 Years, Cog Railway Still Keeps on Chuggin'," *Sunday Monitor,* October 2, 1994, p. B5.

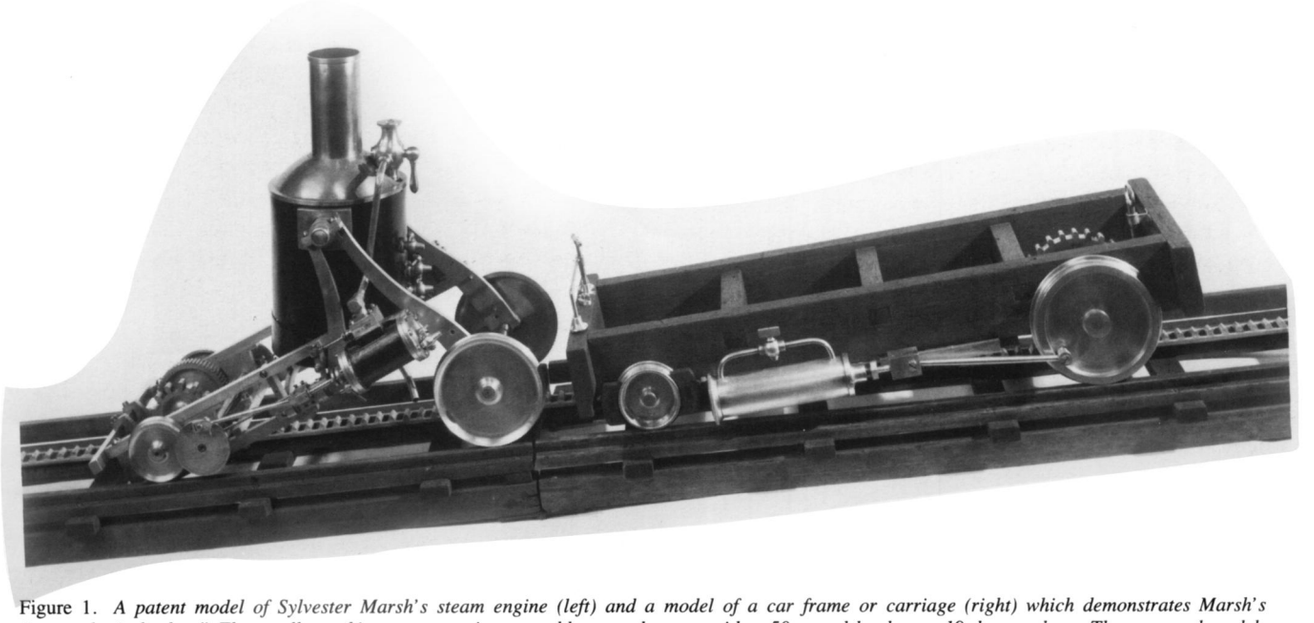

Figure 1. *A patent model of Sylvester Marsh's steam engine (left) and a model of a car frame or carriage (right) which demonstrates Marsh's "atmospheric brakes." The small, working steam engine was able to push a car with a 50-pound load up a 19-degree slope. These rugged models were built in 1865 at a total cost of $500 and are now in the collections of the New Hampshire Historical Society.* Courtesy of the New Hampshire Historical Society, F2784.

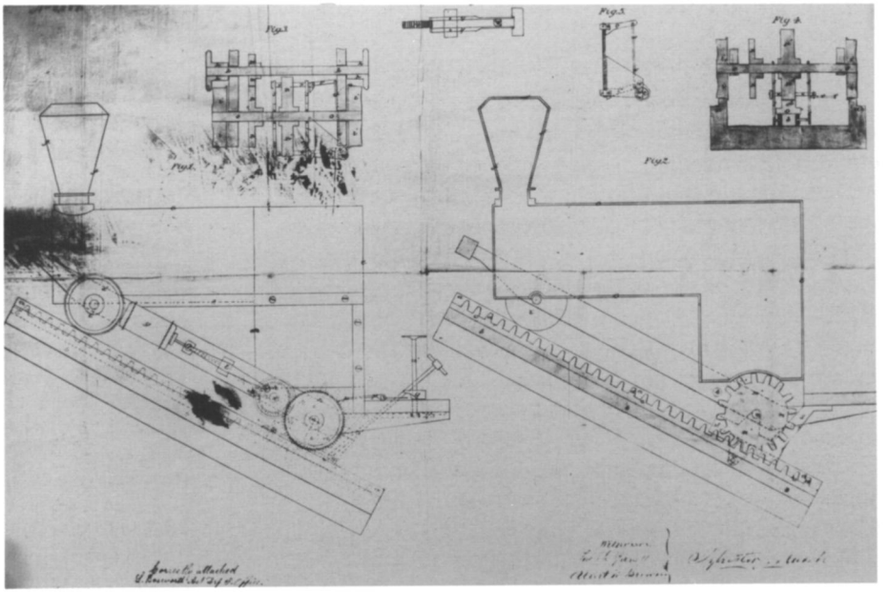

Figure 2. *Patent drawing of Sylvester Marsh's unique cog design.* Courtesy of the New Hampshire Historical Society, F4198.

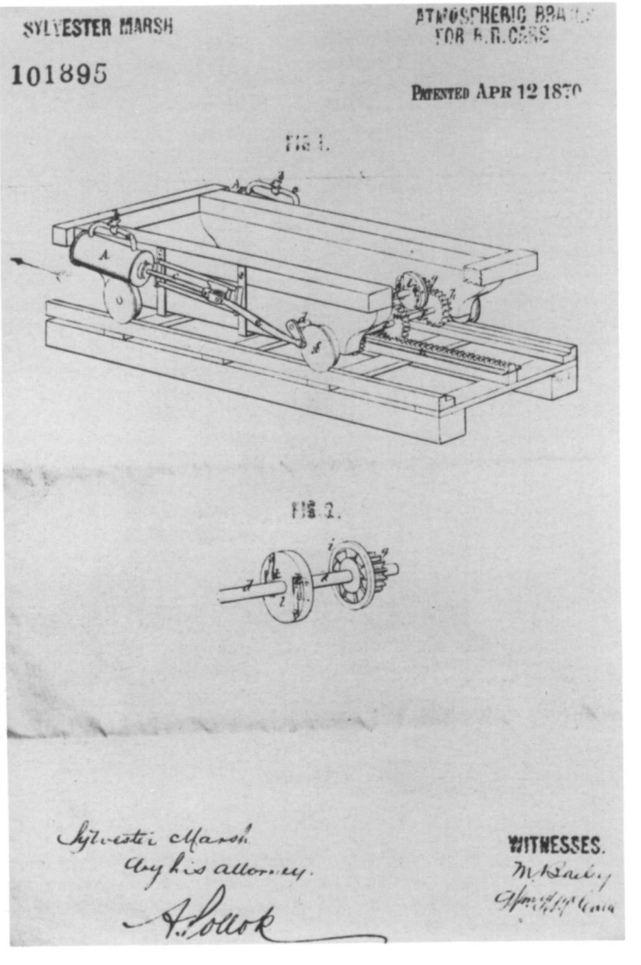

Figure 3. *Patent drawing of Sylvester Marsh's ATMOSPHERIC BRAKES FOR R.R. CARS, patented April 12, 1870.* Courtesy of the New Hampshire Historical Society, F4199.

Figure 4. *Locomotive #1*, Old Peppersass, *before the addition of a fuel and water bunker, with a special car for invited guests. The date was August 29, 1866, and this was the official run that demonstrated the ability of the locomotive to ascend safely to the top of Mount Washington. Sylvester Marsh is believed to be the gentleman standing just to the left of the man leaning on a long stick; and Charles Aiken is standing next to the vertical boiler with an infant in his arms.* Courtesy of the New Hampshire Historical Society, stereograph S37.

Figure 5. Old Peppersass *with a flatcar load of passengers, c1867. Photo taken before the addition of a fuel and water bunker on the rear of the locomotive. The individuals standing by the boiler are probably Daniel Kidder and Charles Aiken (right), early mechanics and engineers of the railway.* Courtesy of the New Hampshire Historical Society, stereograph S21.

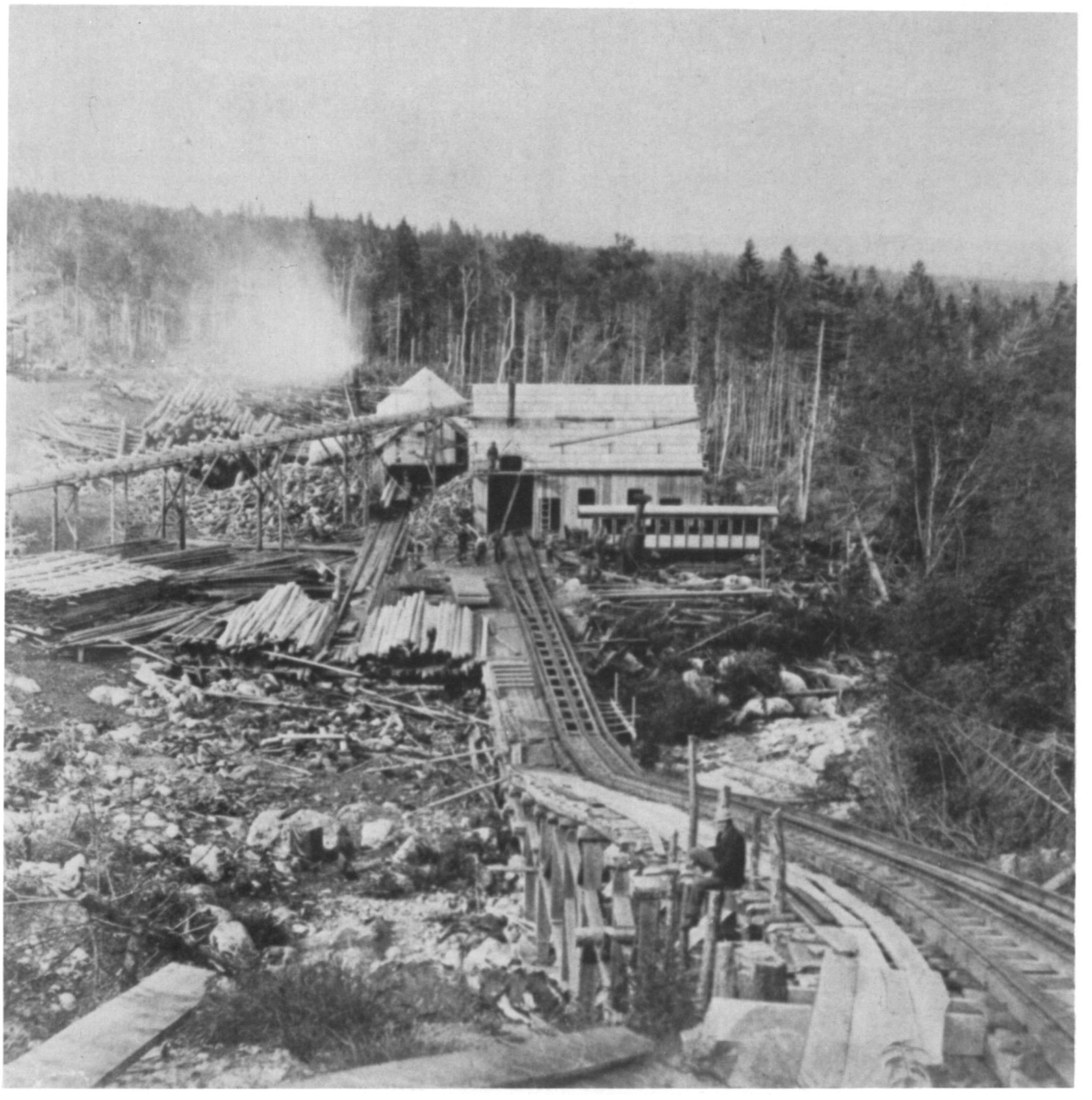

Figure 6. *A scene at the base of the Cog Railway during early construction, c1867–68.* Old Peppersass *and the early "closed" coach are alongside the newly constructed enginehouse and shops. There is a sawmill in the background, and a viaduct (left) is carrying water from Ammonoosuc Brook to the mill and railway.* Courtesy of the New Hampshire Historical Society, stereograph S11.

Figure 7. *Cog Railway locomotive first #3 resting on the original strap-iron rails at the Base Station, c1870.* Courtesy of the New Hampshire Historical Society, stereograph S23.

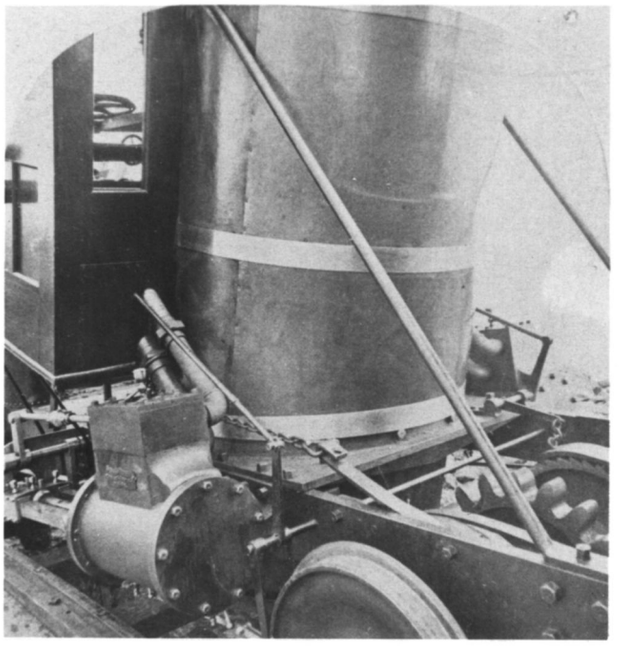

Figure 8. *Cog Railway locomotive, close-up of first #3, showing how the gears and brakes were mounted, c1869–70. The builder's plate on the vertical steam cylinder reads: "Walter Aiken Franklin, N.H." The locomotive is resting on the original strap-iron rails.* Courtesy of the New Hampshire Historical Society, stereograph S7.

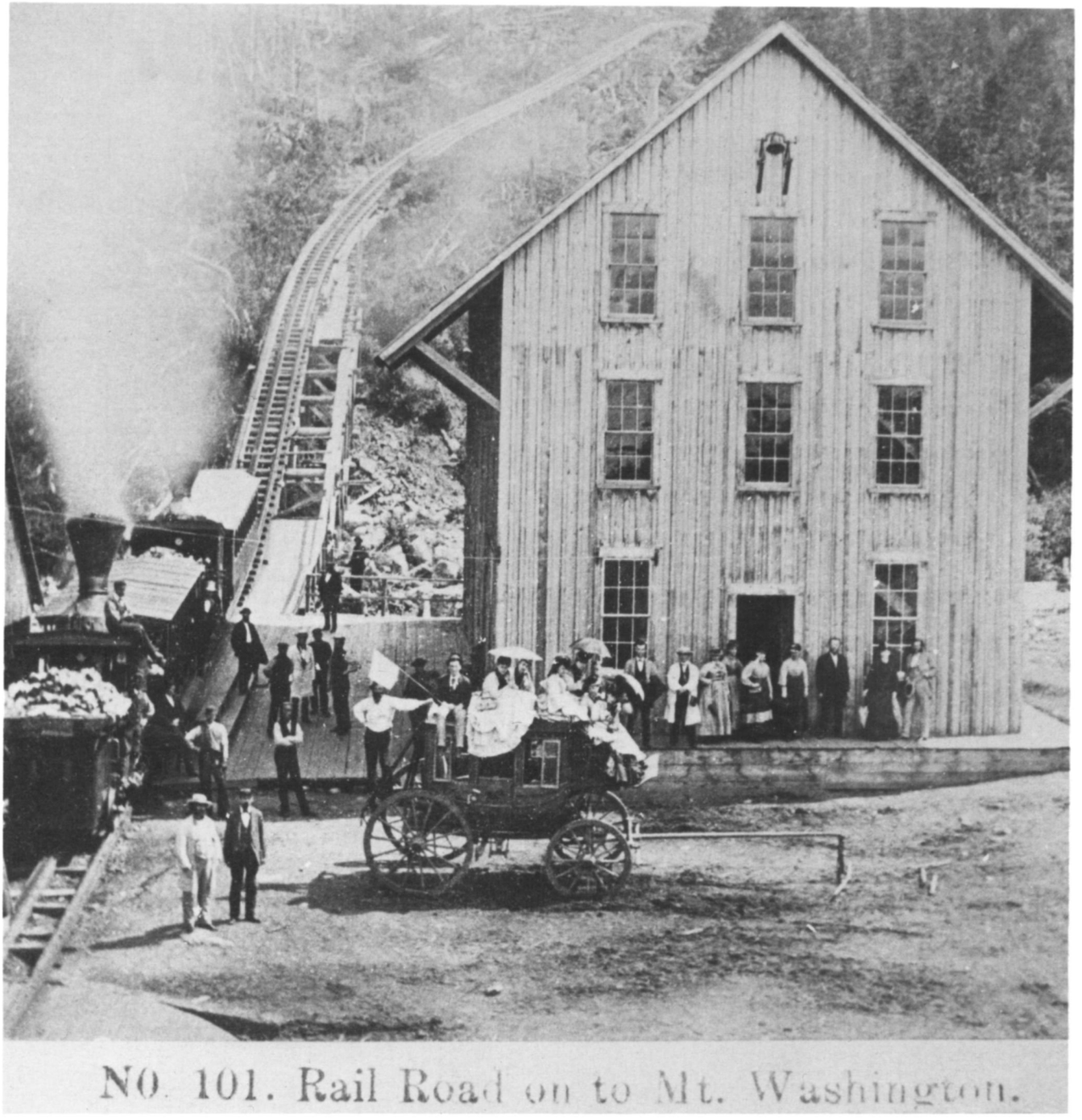

Figure 9. *The new depot (first floor), offices (second floor), and crew quarters (third floor) appear at the right, c1870; the bell that formerly was on the cab roof of locomotive #2 is visible just under the gable. At the left are locomotives second #2 (with "open" coach) and first #3 (with "closed" coach), about to leave the Base Station for the summit of Mount Washington.* Courtesy of the New Hampshire Historical Society, stereograph S17.

Figure 10. *Cog Railway locomotives second #2 (foreground) and first #3, at the Base Station and about to ascend Mount Washington. Both train crews are posing by locomotive #2.* Courtesy of the New Hampshire Historical Society, stereograph S33.

Figure 11. *Cog Railway locomotive second #2* (George Stephenson) *with first "open" coach (at left), and locomotive first #3 with "closed" coach (at right), just after leaving the Base Station, c1869–70.* Courtesy of the New Hampshire Historical Society, stereograph S13.

Figure 12. *An early view of Jacob's Ladder, the highest and steepest trestle on the Cog Railway, inclined at a grade of 37.41 percent, 300 feet long, and rising to a maximum height of 25 feet above the ground. The caption reads "Jordan am a hard road."* Courtesy of the New Hampshire Historical Society, stereograph S35.

Figure 13. *Cog Railway locomotive first #6* (Tip Top) *just after leaving the Base Station, c1874. This was the first locomotive with four cylinders and a cab roof overhang. The builder's plate on the side of the cab reads: "Manchester Locomotive Works, N.H.–1874." Trestle work from the original track may be seen behind the locomotive.* Courtesy of the New Hampshire Historical Society, stereograph S27.

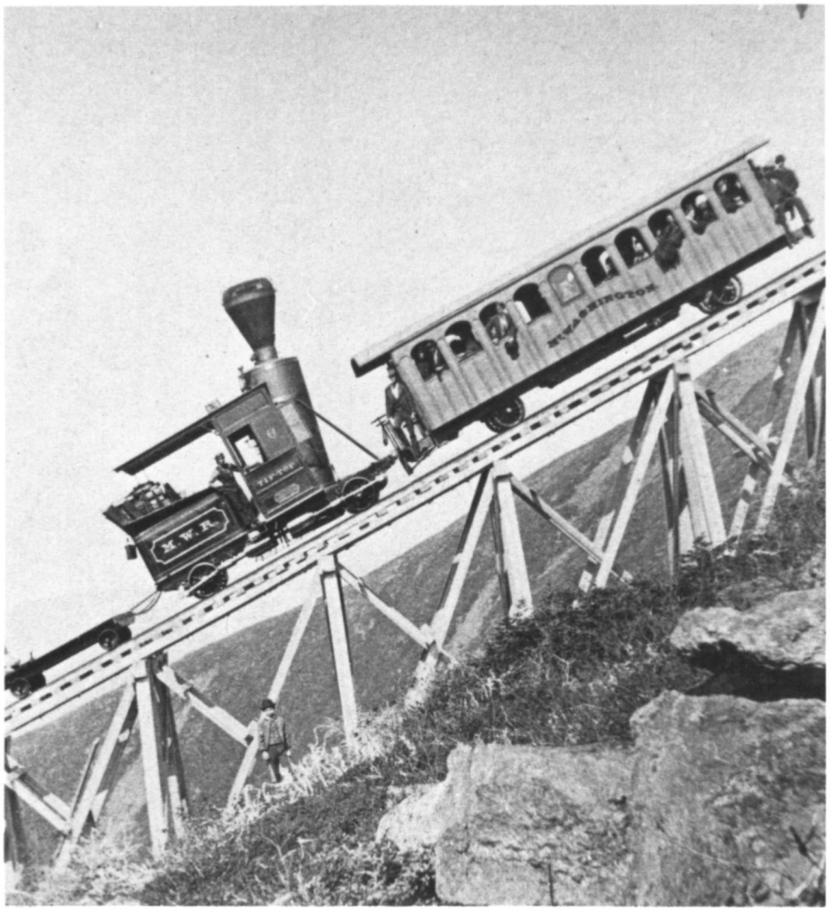

Figure 14. *Cog Railway locomotive first #6* (Tip Top) *with an "open" baggage trailer on the rear (left) and a "closed" coach in front, ascending Jacob's Ladder, c1874.* Courtesy of the New Hampshire Historical Society, stereograph S29.

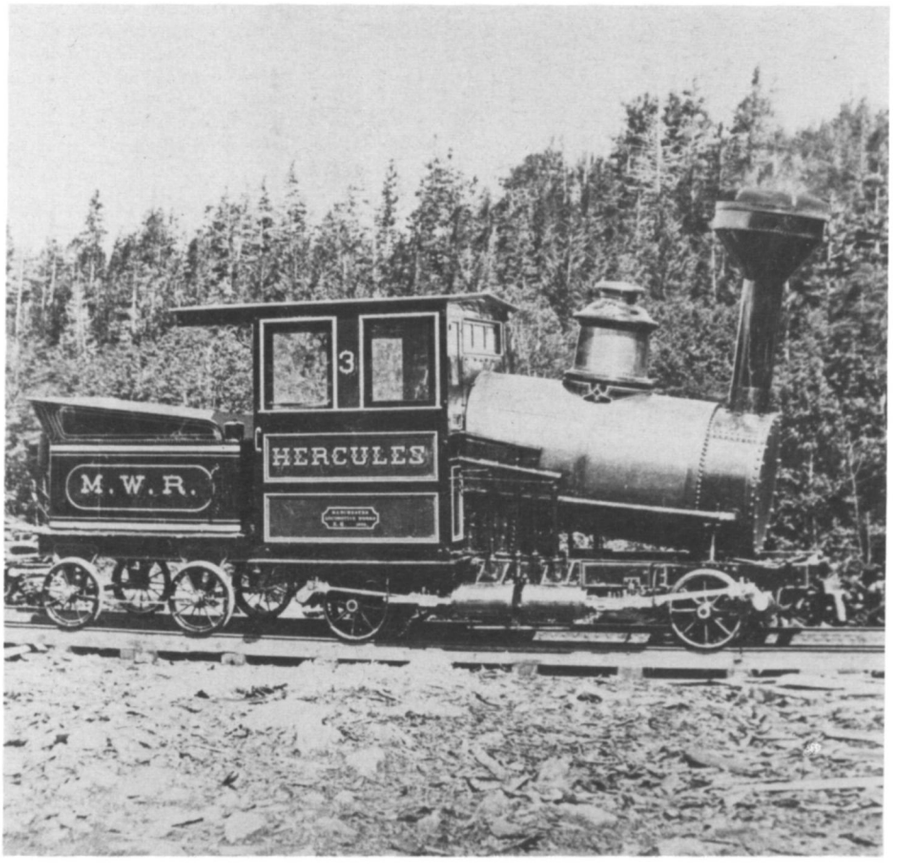

Figure 15. *Cog Railway locomotive second #3* (Hercules) *at the Base Station, c1874. This was built in 1874 by the Manchester Locomotive Works in Manchester, New Hampshire. Unlike earlier locomotives on the railway, the* Hercules *and subsequent models had horizontal boilers.* Courtesy of the New Hampshire Historical Society, stereograph S31.

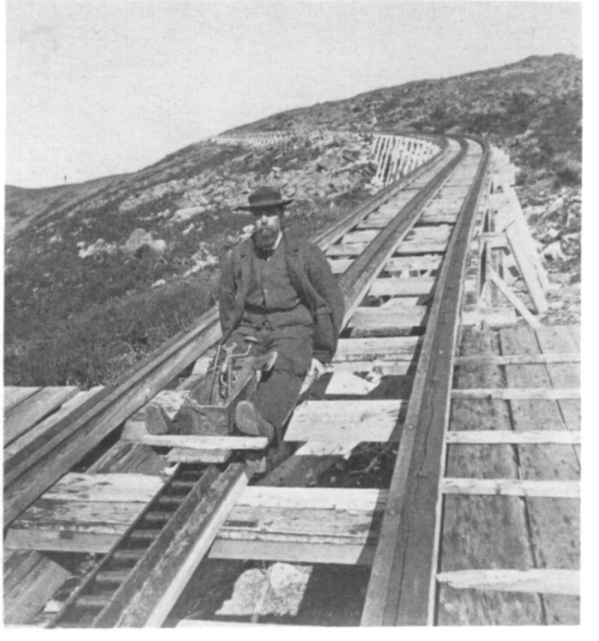

Figure 16. *A workman descending Jacob's Ladder on a slideboard, or "Devil's Shingle," c1870. Note the toolbox sitting in front, between the workman's feet. The original strap-iron rails were still in use, and the platform used at Jacob's Ladder for unloading and loading passengers is visible at the right.* Courtesy of the New Hampshire Historical Society, stereograph S5.

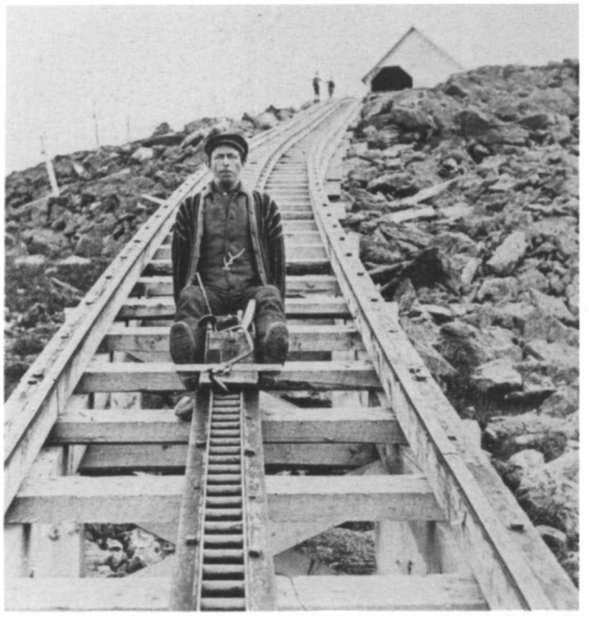

Figure 17. *A workman about to leave the summit of Mount Washington on a slideboard for a trip down the railway, c1870–71. The newly built enginehouse-depot is visible at the rear.* Courtesy of the New Hampshire Historical Society, stereograph S19.

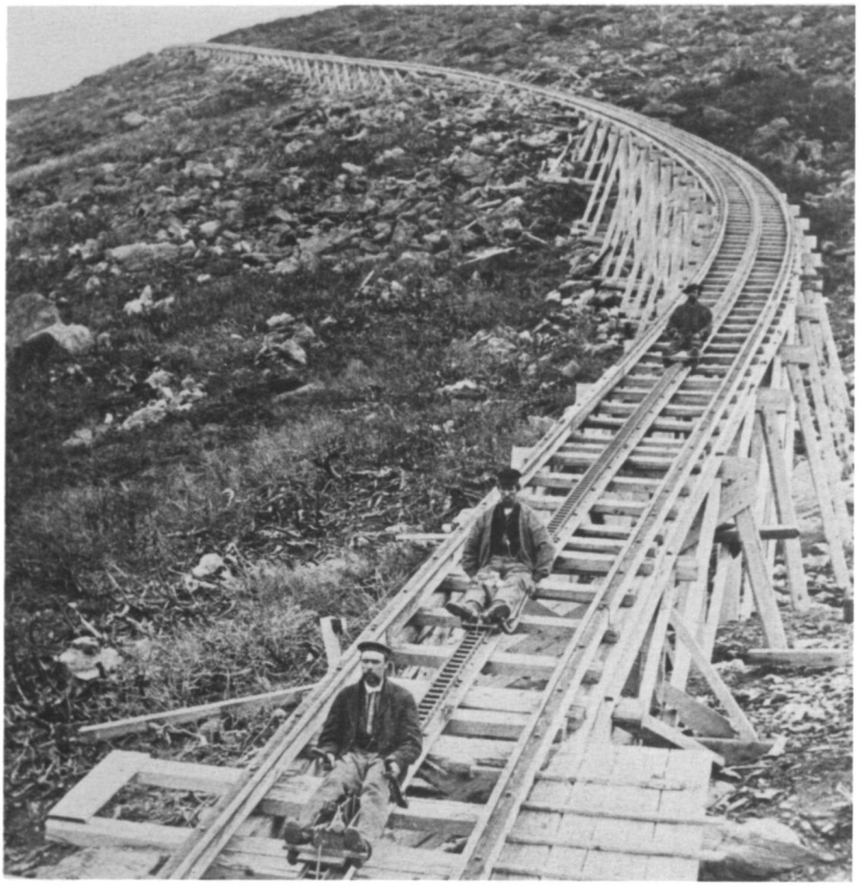

Figure 18. *Three workmen descending Jacob's Ladder on slideboards, c1871–73.* Courtesy of the New Hampshire Historical Society, stereograph S25.

Figure 19. *Two slideboard riders approaching the base of Mount Washington, c1880. The rider in the foreground is using his hands to operate the braking levers on his slideboard.* Courtesy of the New Hampshire Historical Society, stereograph S34.

Figure 20. *The fully restored* Peppersass *as it appears on display at the Base Station, 1994.* Photo by the author.

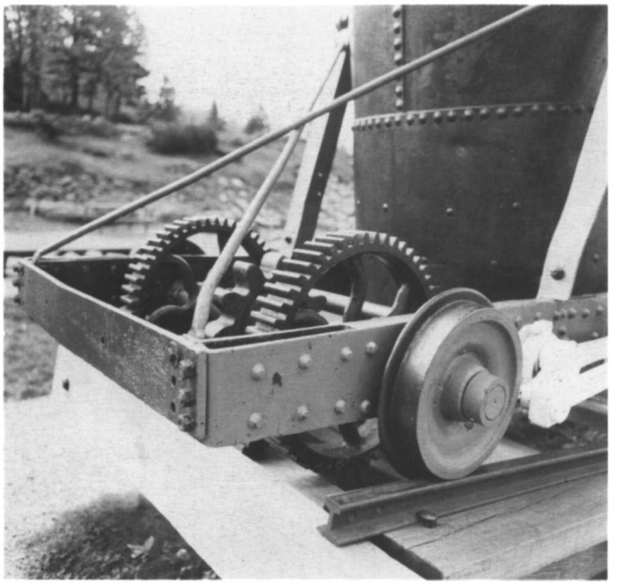

Figure 21. *A closeup of the cog and driving gears on the restored* Peppersass, *1994*. Photo by the author.

Figure 22. *Cog Railway locomotive, the current #6* (Great Gulf), *at the Base Station, 1994. Great clouds of steam are generated by the boiler, which is under a lot of pressure*. Photo by the author.

Figure 23. *Cog Railway locomotives #3 and #6 (background) at the Base Station, 1994. Both are pushing "closed" coaches, and the boilers are building up pressure before ascending the mountain.* Photo by the author.

Figure 24. *Cog Railway locomotive #6 (*Great Gulf*) arriving at the Base Station, 1994. The locomotive precedes its "closed" coach into the station, slowing its descent as it "lowers" the coach into the station.* Photo by the author.

Figure 25. *Closeup of the Cog Railway's running rails and the central cog rail which receives the cog gear positioned underneath the locomotive, 1994.* Photo by the author.

Figure 26. *The coal loader at the Base Station that fills the coal tenders, 1994.* Photo by the author.

Figure 27. *The hose at the Base Station used to fill the boilers with water, 1994*. Photo by the author.

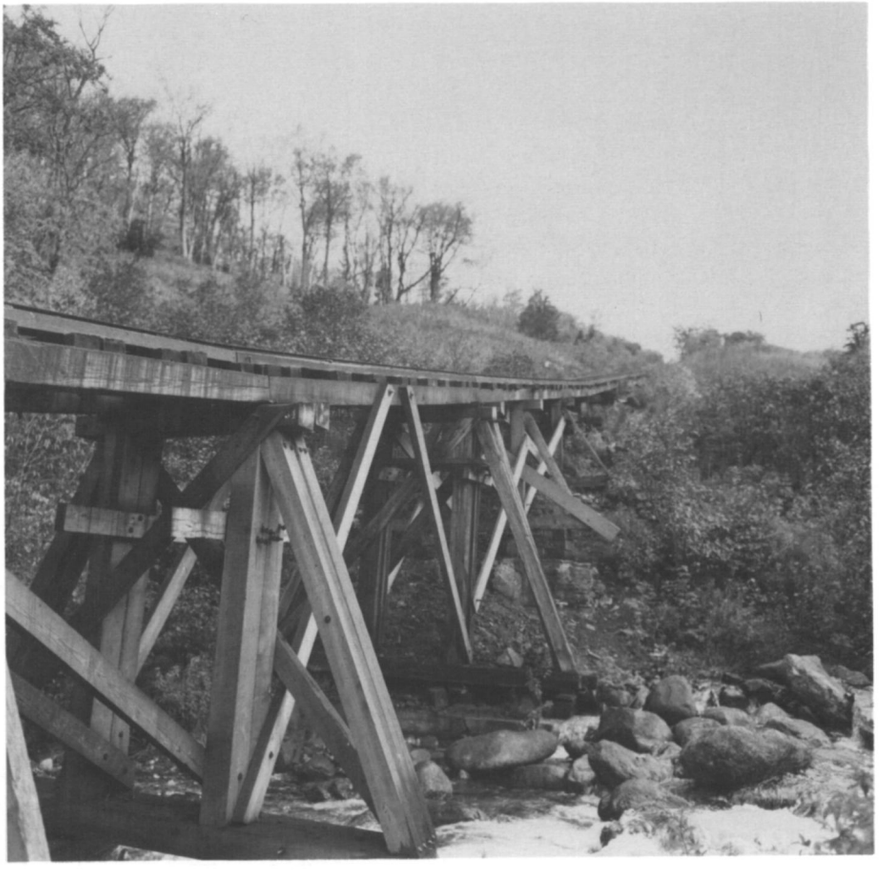

Figure 28. *Some of the wood trestlework just upslope from the Base Station, 1994*. Photo by the author.