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STEAM *Glory* 3

Holiday 2012

Thrilling ride on an NYC Niagara p. 62

**SPECIAL
COLLECTOR'S
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**Pros and cons
of Santa Fe
steam p. 76**

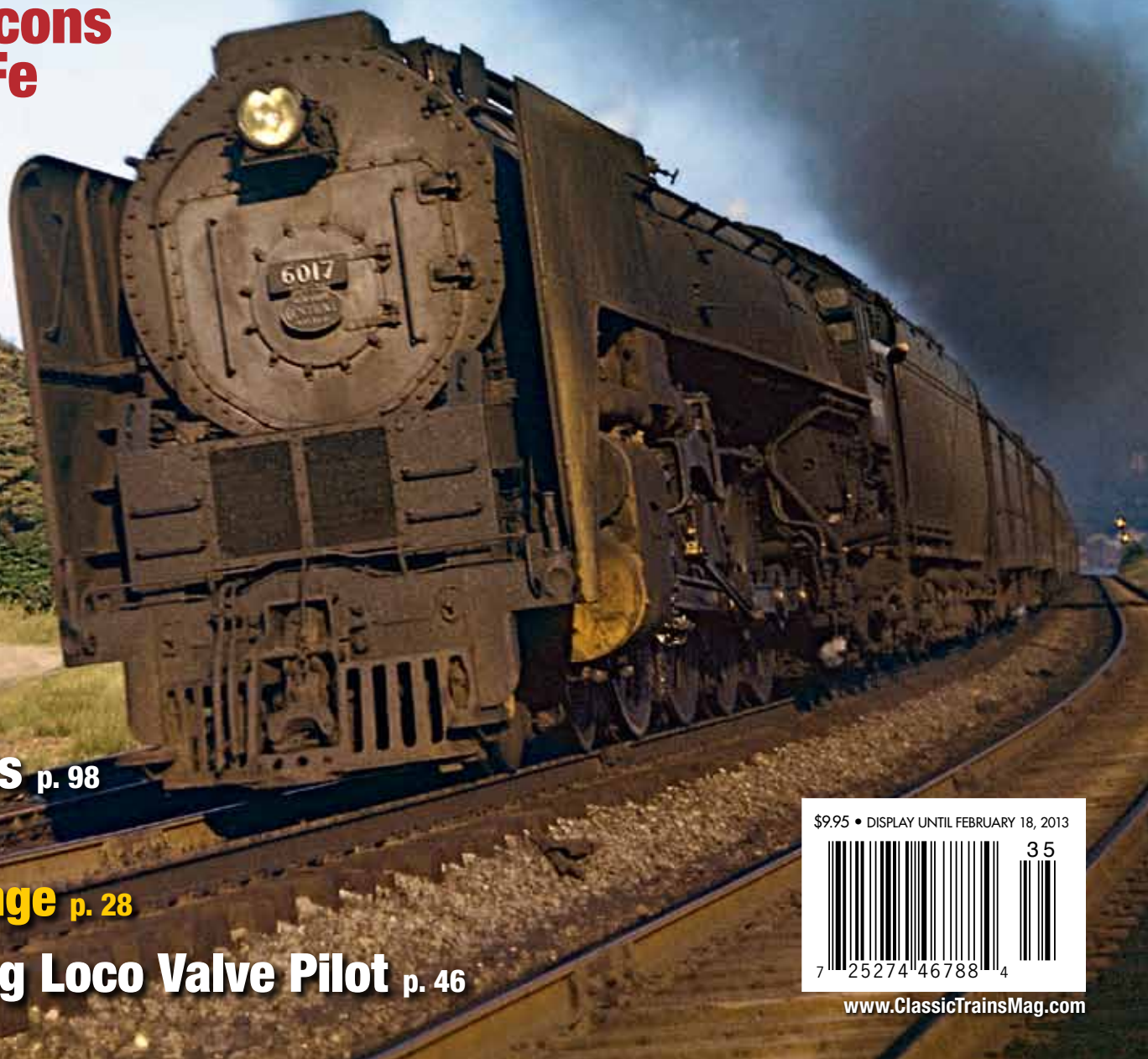
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PLUS

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only Mallets p. 98**

**Fireman on
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More from the lost world of steam

Welcome to STEAM GLORY 3, the third CLASSIC TRAINS Special Edition celebrating the magnificent locomotives that once powered North America's railroads. As with its two predecessors, this issue features a mix of technical studies, first-hand accounts from engine crewmen, railfan recollections, and compelling photographs.

Leading off on page 8 is a reassessment of the Pennsylvania's controversial T1 4-4-4-4s. "Water Holes for Iron Horses" [page 40] looks at one of the most important aspects of steam-era railroading. A little-known but highly effective device—the Loco Valve Pilot—is examined in a major article beginning on page 46. We present the history of the B&O's Buffalo Division, a colorful bastion of steam [page 66]. The story of six unusual 0-6-6-0s—Canada's only articulated locomotives—begins on page 98.

"Firelight in the Sky" [page 28] recounts the life of a Minnesota fireman a century ago. On page 62, another fireman recalls a harrowing trip on a New York Central Niagara. A man who fired and ran several classes of Santa Fe steam power reflects on their various characteristics [page 76].

In "Class Appreciation" [page 20] a diesel-age train-watcher tells of his fascination—sparked by a collection of old photos—with the North Western's 4-4-2s. On page 86, we visit the world of "real" (*i.e.*, steam) railroading experienced by a young man when he visited the Rio Grande narrow gauge in the early 1960s.

In addition to the pictures illustrating the various articles, we've scattered a series of two-page spreads throughout the issue featuring rare color and black-and-white photos.

I hope you enjoy our latest look back at the lost world of steam.

Robert S. McGonigal

B&O Pacific 5232 lays down a trail of smoke as it hustles Pittsburgh–Buffalo train 252 near Carbon Center, Pa., in October 1955. See page 66 for more about steam on this corner of the B&O.

JAMES KREUZENBERGER



STEAM *Glory* 3

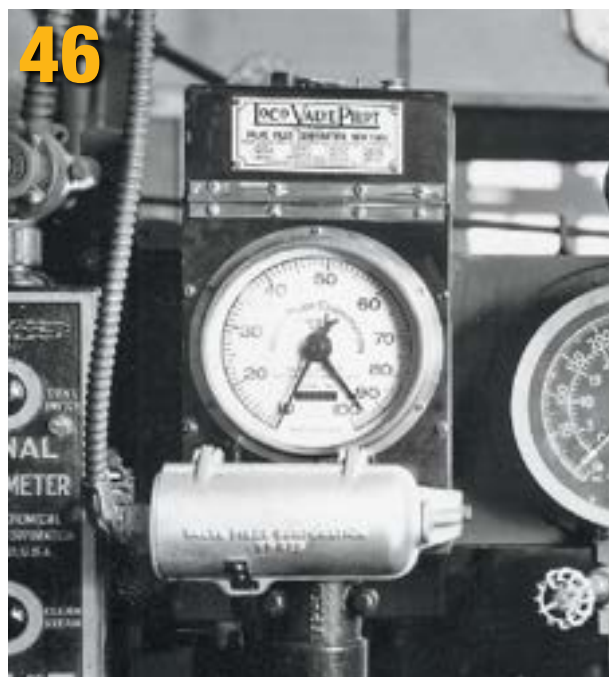


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On the cover: New York Central 4-8-4 Niagara 6017, one of the last great steam designs, leans into a curve with the New York–Chicago *Pacemaker* near Poughkeepsie, N.Y., in October 1946. *Bill Price photo*

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CONTRIBUTORS

DAVID BELL ["Experiencing 'Real Railroad,' page 86] grew up in southern California, then moved to northern California to teach; since 2001 he has lived in Reno, Nev. He was associated with the Golden Gate Railroad Museum for about 11 years in a number of capacities. After a career teaching college geology since 1965, he still engages in that with a part-time position at Western Nevada College in Carson City. In addition, he works four days a week on the Virginia & Truckee Railroad both as conductor and ticket agent. He plans another trip to the Cumbres & Toltec Scenic in 2013. This is his first story in a CLASSIC TRAINS publication.



JACK ELWOOD ["An Insider's View of Santa Fe Steam," page 76] advanced to the position of Road Foreman of Engines before he retired from the Santa Fe. He now lives in Fresno, Calif. Among his 11 previous bylines in CLASSIC TRAINS publications are stories about steam freight operations on Cajon Pass, the first run of the *Super C*, and the hectic times for engine crews during World War II. Jack is pictured in 1983 at the throttle of Durango & Silverton 2-8-2 No. 476.



KINCAID HERR ["Water Holes for Iron Horses," page 40] was the longtime editor of *Le&N Magazine*, the road's official house organ. He authored a 43-part history of the railroad that ran in the magazine beginning in January 1939, later published as a book.

F. L. JAKES ["Firelight on the Sky," page 28], who lived between 1887 and 1969, was an acclaimed wildlife artist. After World War I he did commercial art in Duluth, then joined the staff of the American Museum of Natural History in New York. From about 1950 until his retirement, Jakes designed and painted diorama backgrounds at the Bell Museum of Natural History in Minneapolis. His work with museums took him from the Arctic Ocean to the South Seas, the Galapagos, Newfoundland, and Europe.

JAMES KREUZENBEGER [photos in "B&O's Buffalo Division," page 66] was born in Duluth, Minn., in 1914. He died in 2010 in Overland Park, Kans., his home for many years. He was an expert on the Duluth Street Railway, compiling a collection of photos and records, and writing an unpublished history. Jim traveled around North America during the 1940s and 50s, photographing railroads and streetcars. After Jim's death, his widow donated his photos to the Minnesota Streetcar Museum, of which he was a longtime member. The museum in turn donated non-Minnesota photos to appropriate museums and historical societies.



OMER LAVALLEE ["Canada's Only Articulateds," page 98] was a prominent Canadian railway historian. A Montreal native, he joined Canadian Pacific Air Lines in 1942, then transferred to Canadian Pacific Railway. He established CP's corporate archives in 1973. He wrote several books and articles about CP subjects and was instrumental in founding the Canadian Railway Historical Association and its museum in Delson, Que. He completed his 0-6-6-0 article in 1991, a year before his death at age 67.

ART PETERSON ["Class Appreciation," page 20] has contributed numerous photos to CLASSIC TRAINS and other publications through his extensive collection, the Krambles-Peterson Archive. The collection was begun more than 75 years ago by Art's uncle, longtime Chicago Transit Authority official George Krambles, and Art has continued to add to it since George's death in 1999. Art notes that once he showed an enduring interest in trains and transit, George proceeded to give him the education of a lifetime in the business. He has worked for transit agencies, equipment vendors, and consulting engineering firms since 1972. This is his second article in a CLASSIC TRAINS publication.

DAVE STEPHENSON ["Pennsy's T1 Reassessed," page 8] has had a lifelong interest in railroads, stemming from when he accompanied his father to the family's victory garden during World War II. The garden bordered on the Pennsylvania's busy main line in Lan-

caster, Pa. After graduation from Virginia Tech with a degree in industrial engineering, Dave worked for manufacturing companies and several engineering consulting firms in the private sector, then went to the Interstate Commerce Commission and its successor, the Surface Transportation Board. Now retired, Dave lives near Reston, Va. His current interests are railroad history and steam locomotive performance. He is a member of, and has written articles for, several railroad historical societies. He also does volunteer work for the N&W Historical Society Archives and the O. Winston Link Museum. This is his first article in a CLASSIC TRAINS publication.

ERWIN WILLIAMS ["A Niagara Falls," page 62] hired out with the New York Central in 1942. He retired from Conrail as a locomotive engineer in December 1983 and has lived in Nokomis, Fla., since January 1984. This is his second CT byline, following "The Cab Card" in 2011's WORKING ON THE RAILROAD.

BOB WITHERS ["B&O's Buffalo Division," page 66] is retired from a career as a reporter with the *Herald-Dispatch* in Huntington, W.Va., where he still lives. He thanks Bob Rathke, Bill Howes, Paul Pietrak, Scott Symans, the Western New York Railroad Archive, and the B&O Railroad Historical Society for their help with his article, Bob's ninth in a CLASSIC TRAINS publication.

CHRIS ZAHRT ["The Amazing Loco Valve Pilot," page 46] is a machinist with the Strasburg Rail Road. A native of Winamac, Ind., he started his railroad career as a volunteer at the Hoosier Valley Railroad Museum. After earning a degree in mechanical engineering at Purdue University, he worked for the Ohio Central Railroad, Grand Canyon Railway, Steam Operations Corp., Rio Grande Scenic Railroad, and the Georgia State Railroad Museum. He has had several articles published in TRAINS magazine, but this is his first in a CLASSIC TRAINS publication. ■



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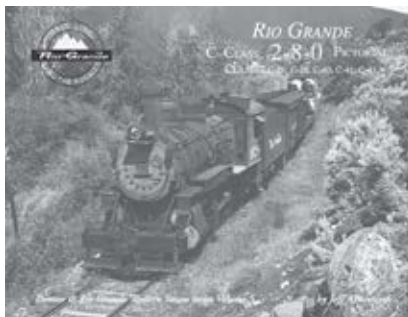
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PENNSY'S T1

reassessed

In a setting that valued simplicity, and with diesels on the way, America's final 100-mph steam locomotive was a good machine that was "too much, too late"

BY DAVID R. STEPHENSON

The first two Pennsylvania Railroad T1 4-4-4-4 passenger locomotives appeared in spring 1942. It was a new age. America had just entered World War II. There was optimism, pessimism, risk, fast change, and rapid obsolescence. The T1 was a new theory, a new product, and a new look, like nothing else before it. The two engines' nicknames reflected their futuristic features: one was tagged "Buck Rogers"; the other, "Flash Gordon."

The PRR T1 is one of the most microscopically examined locomotives of all time. Nonetheless, until recently, its history has been primarily based on myth and lore. A few dramatic events were embellished and repeated over and over. Its history suffered from too much entertainment and not enough research. The real story is better than the legend.

Baldwin Locomotive Works developed the duplex-drive concept upon which the T1 was based in the early to mid-1930s as a solution to steam-distribution and dynamic-augment problems inherent in large 4-8-4s. They were valid concerns at the time, as the machinery parts of 4-8-4s became larger in the quest for more power. Heavy pistons and main rods were hard to balance, and standard piston valves were not efficient at handling high steam flows at speed. The duplex idea spread power generation over four smaller cylinders and lighter machinery, but retained the 4-8-4's rigid frame. The idea was to obtain more efficient steam usage and have a locomotive that would be easier on the track structure. Baldwin worked independently through the 1930s to develop a prototype for demonstration purposes.

The first U.S. railroad to implement the

duplex concept was the Baltimore & Ohio, which in May 1937 built a single 4-4-4-4 at its Mt. Clare shops in Baltimore. Numbered 5600, it also bore the name of B&O's motive power boss, George H. Emerson. The first set of cylinders was in the usual location under the smokebox. The second set was reversed and mounted under the firebox. This arrangement proved to be less than ideal because the size of the cylinders and firebox were constrained, there were long steam passages to the rear cylinders, and the rear cylinders suffered from roadbed dust kicked up by the locomotive. The *George H. Emerson* ran sporadically until 1943, then was stored and eventually scrapped. Although not much is known about the *Emerson's* performance, it seemed to fare well enough in B&O's operations. However, it was not considered successful and B&O did not develop the duplex idea any further.

The next duplex, and the immediate predecessor of the T1, was PRR's S1, a 6-4-4-6 designed by a committee that included all major U.S. locomotive builders and built at the road's Altoona, Pa., shops. Its great weight, some 608,000 lbs., necessitated six-wheel engine and trailing trucks. Its driving wheels were a heady 84 inches in diameter. In contrast to B&O's example, this duplex had its four cylinders located in the "normal" positions. Built in 1939, No. 6100 was a big hit at the 1939-40 New York World's Fair as a showpiece for American railroads. However, the S1's daily usefulness was the exact

During the T1's all-too-brief heyday, No. 5526 roars through Van Wert, Ohio, with the Chicago-New York *Manhattan Limited*.

RICHARD E. DILL





Two K4s Pacifics accelerate a mail and express train, brought in from the east by a GG1 electric, out of Harrisburg in March 1946. The T1 was intended to end doubleheading on PRR's "Blue Ribbon Fleet" of east-west passenger trains, and to be the equal of a GG1.

CHARLES A. BROWN

opposite. Most of what was learned from it was negative. It was immense, slippery, and impractical. However, it could easily haul 15- and 16-car trains at 100 mph, which indicated that the four-cylinder, rigid-frame idea worked.

TWO PROTOTYPES

B&O's *Emerson* and PRR's S1 showed that the duplex concept was valid from an engineering standpoint, but it had consequences that may not have been considered in the initial stages of development. A pair of two-axle engines would be sensitive to rail conditions. As result, particular attention had to be given to locomotive components (e.g., suspension, sanding), the railroad's physical plant, and proper handling methods. PRR

decided to try Baldwin's idea, which was more realistic than the oversized S1.

The T1 was designed to power PRR's fleet of heavy, limited-stop trains between the East Coast and the Midwest. East of Harrisburg, Pa., these were hauled by single 4,620 h.p. GG1 electrics; to the west, doubleheaded K4s Pacifics were usually required. The T1 was not intended to be Pennsy's next general-service locomotive. Its most notable specification was that it should be capable of hauling 880 tons at 100 mph. Built by Baldwin, the first two, Nos. 6110 and 6111, were completed on April 22 and May 21, 1942. As he had for the S1, Raymond Loewy designed the external shrouding, whose "yacht nose" prow was like no other locomotive's.

The T1's were about the same size and

weight as the largest 4-8-4s. However, their boilers were relatively small, comparable to a large 4-6-4 or a medium-size 4-8-4. This was a compromise dictated by PRR weight restrictions. Poppet valves were intended to make up for this difference by using available steam more efficiently than conventional piston valves.

There is considerable evidence that suggests the initial two T1's suffered from both design flaws and manufacturing defects. The former should be viewed in light of the fact that the T1's were radically new machines incorporating many new ideas. The design flaws found in 6110 and 6111 included poor drafting, inadequate suspension equalization, erratic adhesion, inaccessible valve-gear boxes, and faulty tender coupling.

The manufacturing problems are less defensible. Baldwin was an experienced locomotive builder, and should have had better quality control. The defects included poor bearing tolerances, leaking joints, ineffective sanders, and loose piping.

Plenty of attention has been given to the T1's early troubles, and PRR did have its hands full sorting things out. What has not been adequately noted is that the two prototypes were improved during three years of modifications. PRR did not sit around wondering what happened. In spite of the enormous amount of wartime traffic the railroad had to move, development continued and changes were made. In addition, the two T1's were thoroughly tested over the road and on the Altoona test plant.

No. 6110 was subjected to a total of 59 test-plant sessions between April 25 and July 3, 1944. These included full-throttle and part-throttle tests at various speeds and cut-off settings. Performance was evaluated at speeds from 38 to 100 mph, with cut-off varying from 50 percent to as low as 10 percent. Test duration ranged from 18 minutes to 170 minutes. Technicians tried some 14 different front-end arrangements to improve drafting.

Several unusual things were noted during the tests, among them power output, steam rate per unit of output, and steam temperature. The 6110 developed 6,666 indicated horsepower at 100 mph and 6,100 locomotive drawbar horsepower at 76 mph. At 76 mph and 20 percent cut-off, a water rate of 13.6 lbs. per indicated horsepower was posted, which has been credited as the lowest ever recorded. Several other runs showed similar results, indicating that the poppet valves did their job well. The steam temperature for the T1 as it was initially configured for the tests was higher than desirable from a maintenance standpoint. However, high superheat temperature was one of the factors enabling the T1's high performance. The hotter the steam, the more work is available. The T1 may have set a record there as well, with a maximum superheat of 381 degrees.

The Altoona tests indicated that the T1 had great performance potential and would deliver this performance at low fuel and water cost. What they didn't show was that the T1 would be a demanding locomotive to operate and that business as usual would not be good enough.

WHAT ABOUT A 4-8-4?

As the T1 evaluation progressed, PRR President Martin Clement asked whether Norfolk & Western's class J 4-8-4 would be suitable for PRR service. James W. Symes, then vice-president of PRR's Western Region, arranged to borrow N&W No. 610 from December 5, 1944, through January 3, 1945. Running out of Chicago on the fast Fort Wayne Division, the J acquitted itself very



B&O 5600 of 1937 (top, at Washington in 1940) was the first U.S. duplex; it shared a 4-4-4-4 wheel arrangement with the T1, but its rear engine was "backwards." Two years later came PRR's "Big Engine," class S1 No. 6100 (at Fort Wayne in 1941); the colossal 6-4-4-6 was too large for general use, but it sold PRR on the duplex-drive concept.

TOP, R. V. NIXON; ABOVE, R. W. CARSON



PRR and Baldwin drew on what they learned from the S1 when designing the two prototype T1's of 1942, the first of which, No. 6110, pauses at Englewood, Ill., on June 8, 1945.

V. O. HARKNESS

well, earning high praise from all those involved in its operation. It made or bettered the schedule with PRR's heaviest and fastest trains, accelerated the trains quickly, rode smoothly at all speeds, steamed well with a clear stack at high steam rates, was easy to inspect and maintain, and operated at up to 111 mph.

However, the T1 program had momentum. A few weeks after the class J tests, PRR retrofitted the 6110 and 6111 with modifications that were also scheduled for the upcoming production lot. In March 1945, the War Production Board allowed PRR to order 50 T1's, 25 from Altoona and 25 from Baldwin. The order was split to get the locomotives on the road as soon as possible. PRR and Baldwin began to accumulate material

and started work on the production T1's in June. Nonetheless, Symes resumed his search for an alternative.

PRR continued to evaluate the two prototypes on a daily basis. They were given difficult assignments in regular passenger service between Harrisburg and Pittsburgh from September through November 1945. Average train size for all runs was 15.2 cars, with about 40 percent of the runs at 17 cars or more, and a maximum train size of 21 cars. The two T1's made up considerable running time, some under adverse rail conditions, with these large trains.

These tests confirm that PRR was not viewing the T1's performance through rose-colored glasses. The engines could move the trains, and the tests proved that they were



As it was working out the bugs in the T1 prototypes, PRR borrowed an N&W J for tests. The 4-8-4 (at Englewood), performed well, but PRR sent it home and ordered more T1's.

PAUL EILENBERGER



No. 5526, one of the 50 production T1's, still lacks some sheet-metal streamlining as its front-end throttle gets some attention at the Baldwin plant on November 30, 1945.

CHARLES A. BROWN

not nearly as skittish as their reputation suggested. Given decent preparation and a competent crew, there were very few problems over the road. It was another story if neglected and dispatched with reportable defects or operated in an inappropriate manner. This happened more frequently than one would expect, particularly considering the microscope they were under.

Tempering this, it is likely that many contemporary 4-8-4s could have performed in a similar manner, albeit without the caveats of thorough preparation and crew ability. But PRR seemed to focus on performance potential, not on reliability or possible staffing problems. The road also seemed to overlook maintenance, preparation, and operation standards that would have to be considerably higher than those required by its hundreds of K4's.

As the prototype tests went on, Symes requested diesels for his Western Region in September 1945, and suggested canceling some of the T1's. However, it was felt that too much material had already been ordered, and that the need for new passenger locomotives was too urgent. In spite of Symes' efforts to change direction, the 50 T1's remained in production.

The 50 production T1's, Nos. 5500-5549, were built between November 16, 1945, and August 27, 1946. They included modifications to improve their performance and reliability, e.g., improved suspension equalization, reduced streamlined shrouding, and better sanders. However, PRR chose not to use Type B poppets, which were available by that time. These would have eliminated the inaccessibility problems of the Type A's.

T1 VS. K4

Inevitably, the T1 was compared with the renowned K4, PRR's standard passenger engine since about 1920. The K4 was as simple as you can get and reliable as an anvil. Its performance was achieved by matching an excellent boiler with properly proportioned running gear. It had piston valves, a stoker, one air pump, two sanders, and two mechanical lubricators. It did not have "frills" such as a feedwater heater, aftercooler, extra air pumps, or multiple sanders.

The K4 had a dome throttle, a single three-axle engine set, and a relatively high factor of adhesion. It was not fussy about handling or maintenance. It was forging of crude operation and would rise to almost any occasion if treated well. Servicing was straightforward.

In contrast, the T1 had all the accessories: four to eight sanders, a Hancock exhaust steam injector, two air pumps, an aftercooler, a front-end throttle, and four sets of poppet valves. It was a mechanic's wonderland of moving parts. It had large steam passages, insignificant steam-circuit losses, and low back pressure. These qualities gave the T1 its

HOW THE DUPLEXES STACKED UP

Wheel Arrangement	4-4-4-4	6-4-4-6	4-4-4-4	4-4-4-4	4-4-4-4
Railroad	B&O	PRR	PRR	PRR	PRR
Class	N1	S1	T1	T1	T1
Road numbers	5600	6100	6110	6111	5500-5549
Date built	1937	1939	1942	1942	1945-1946
Cylinders (bore x stroke in inches)	18x26 ¹ / ₂	22x26	19 ³ / ₄ x26	19 ³ / ₄ x26	19 ³ / ₄ x26
Boiler pressure (psi)	350	300	300	300	300
Driver diameter (inches)	76	84	80	80	80
Tractive effort, rated (lbs.)	65,000	72,000	64,640	64,640	64,640
Tractive effort, booster (lbs.)	none	none	none	13,500	none
Tractive effort, total (lbs.)	65,000	72,000	64,640	78,140	64,640
Factor of adhesion, rated	3.70	3.91	4.15	4.14	4.33
Total direct htg. surf. (sq. ft.)	677	660	490	490	490
Indirect heating surface (sq. ft.)	4,220	5,001	3,719	3,719	3,719
Evaporative heating surface (sq. ft.)	4,897	5,661	4,209	4,209	4,209
Superheating surface (sq. ft.)	1,312	2,085	1,430	1,430	1,430
Total heating surface (sq. ft.)	6,209	7,746	5,639	5,639	5,639
Grate area (sq. ft.)	80.5	132.0	92.0	92.0	92.0
Weight on drivers (lbs.)	240,350	281,440	268,200	267,840	279,910
Weight on engine truck (lbs.)	61,200	135,100	100,200	102,360	99,570
Weight on trailing truck (lbs.)	90,000	191,630	128,800	138,200	122,720
Total engine weight (lbs.)	391,550	608,170	497,200	508,400	502,200
Tender capacity, coal (tons)	23.0	26.5	41.0	41.0	42.6
Tender capacity, water (gallons)	22,000	24,230	19,500	19,500	19,200
Total weight, engine and tender (lbs.)	741,550	1,059,920	930,200	941,400	944,700



A T1 leaves a cloud of brakeshoe smoke in its wake as it brings a train down off the mountain into Altoona on March 15, 1947. This is the as-built condition of the 50 production T1's, before the addition of steps and number-board/marker-light boxes to the front end.

CARL M. JOHNSON

performance potential, but also set the stage for trouble.

Given decent handling, a T1 could work wonders over the road. Its front-end throttle made it much more responsive than a K4. However, despite a factor of adhesion comparable to a 4-8-4, if handled poorly, a T1 could slip, stall, and do other things to remind the crew who was in charge. Servicing had to be thorough to get a T1's available power to the rail. Compared to a K4, a T1 had up to four times the number of sanders to check, many new appliances, hidden accessories, and hard-to-access poppet valve gear cases.

TALES FROM THE ROAD

Two runs involving the same locomotive several days apart illustrate how perfor-

mance could vary.

In the first example, No. 6110 was given one of the best crews. They took a 21-car passenger train over the Middle Division, rain and fog the whole way, with just two slips recorded. They left Harrisburg 6 minutes late and arrived 2 minutes early at Altoona. There were at least three intermediate stops and no difficulties were encountered at any of them.

Three days later things were different. PRR memos describe an engineman's improper handling of the 6110 during poor rail conditions ascending the west slope of the Alleghenies. "After we had taken sand at Conemaugh," the report states, referencing a point 2.5 miles east of Johnstown, "the engineman had the train moving and if he had

left the throttle in its position, the locomotive would have hauled the train away, but he jerked it open, the locomotive slipped, the train stalled and we had to put a pusher on to get the train away."

The engineer also allowed 6110 to slip so badly that the PRR official in the cab stated that "... I was afraid we would do some damage to the locomotive before the engineman noticed the slip and closed the throttle."

How crews operated the T1's had a major impact on performance. Improper handling was the major contributor to the slipping legend. Flogging a T1 would get you nothing but trouble.

Australian railroad historian Neil Burnell interviewed many T1 crewmen at length and a consistent story line emerged. Although



No. 5527 sweeps under a signal bridge at Whiting, Ind., in the afternoon of March 29, 1947. In 17 miles, the duplex will nose up to a bumping post at Chicago Union Station.

DAVE WALLACE



A 1948 or '49 equipment display at Harrisburg featured two E7's and, appropriately in the background of this photo, T1 5548. Diesels eclipsed the duplexes almost immediately.

JAY WILLIAMS COLLECTION

some of the crews preferred the K4 for ease of handing, they all liked the T1 for its ability to make up time. The men stated that once you learned to handle them, they were fine locomotives. They steamed easily, rode well, and could make up time with any train. As far as slipping goes, they said the T1's were no worse than any other locomotive as long

as you handled them properly. PRR's training policy could be hit-or-miss, so most of the crews said they learned by doing. Some engineers learned faster than others; some never got the hang of it. The crews summarized things this way: The T1's weren't nearly as bad as their reputation; they were just different from the K4.

Lore has it that the T1's never made decent monthly mileages. However, the T1's posted the highest systemwide monthly mileage of *any* PRR steam locomotive. Official mileage reports for April 1946 show that No. 5504 was the highest-mileage T1 at the time, posting 40,642 miles since its in-service date of September 5, 1945, an average of 8,294 miles per month. During April, 5504 posted 10,793 miles; 5512 tallied 11,442 miles; and 5508 racked up 10,942 miles. By comparison, PRR's first E7 passenger diesels, which arrived in September 1945, were averaging about 11,500 miles per month. T1's could make competitive mileages when given a chance.

Offsetting this, the fleet average for the 30 T1's in service in April 1946 was about 7,244 miles a month, substantially less than the E7's. More telling than that, diesel mileage increased as time went by, so that by October 1947 the fleet average was about 19,620 miles per month. By this time, with all 52 T1's in service, fleet mileage had slowly declined to about 6,738 miles per month, with the K4's even lower.

There are indications that PRR's dispatching policy adversely affected the monthly mileage. In order to cut costs, T1's were being favored for runs where they could replace doubleheaded K4's. If a T1 was ready for service, but not assigned immediately, its opportunity to accumulate miles would be compromised.

However, one significant event occurred that would make the T1's performance irrelevant: PRR lost money for the first time in 1946. This got the corporation's attention. In addition, competitor New York Central, like virtually all other railroads, was dieselizing its passenger trains. About the same time as the last production T1 was delivered, PRR made its decision to dieselize all first-line passenger trains, exactly the ones the T1's were supposed to handle. They were out of a job by the time they were built.

C&O, N&W: WANT TO BUY A T1?

Once PRR made the commitment to dieselize, it tried to find an application for the T1 on railroads still committed to coal-burning steam locomotives such as N&W and Chesapeake & Ohio. PRR approached C&O first.

C&O had its own reasons to be interested in new locomotives. There were two groups of 4-8-4s on the property in late 1946, all showing signs of extensive use during the war. In addition, the older 4-6-2s and 4-8-2s were almost completely worn out by this time. Although passenger traffic was declining, C&O decided to increase its passenger fleet, and agreed to host a T1.

The tests ran September 4-14, 1946, and involved two T1's, 5511 and 5539. All tests were conducted in regular passenger service. No. 5511 was tested from Huntington, W.Va., to Clifton Forge, Va.; Clifton Forge to Toledo, Ohio; and Toledo to Hinton, W.Va. No. 5539 was tested from Huntington to Charlottesville, Va., and Charlottesville to Cincinnati.

C&O's test report and correspondence showed that overall performance was good to commendable. Both T1's steamed well, rode well, and showed no excessive tendency to slip. Interestingly, information in PRR files indicated that the engines' performance was not quite as glossy. However, there was no argument that they could perform well even when given low quality coal, or pushed to the limit in heavy grade territory. They were operated at wide-open throttle most of the time and no complaints were recorded about slipping. They were given no quarter in attempts to maintain schedules.

When 5511 arrived, there were signs that PRR's preparation and maintenance were inadequate, and C&O had to make some adjustments. It should have done very well on the more level parts of the system where it was tested. However, 5511's performance was not as good as expected and the valves were thought to be out of calibration.



Even as diesels were coming on strong, PRR tinkered with the T1's. No. 5500 (top, at Cincinnati with two K4's) was re-equipped with Franklin rotary cam valve gear, while 5547 (at Pittsburgh in '48) got Walschaerts, prompting a change in classification to T1a.

TOP, DONALD P. CAMPBELL; ABOVE, BERT PENNYPACKER



In June 1948, while on the N&W for evaluation, PRR 5515 backs toward its test train at the station in Roanoke, Va. Instead of buying T1's, N&W built three more J-class 4-8-4s.

O. H. BORSUM

The second T1, 5539, was also poorly prepared. On C&O's Mountain Subdivision, it had to start trains under conditions that were beyond its capacity, but contrary to all anecdotes, did not slip during the attempts.

Worse, C&O evaluated the two T1's using inconsistent standards. Their performance was criticized because uncorrected road test

data was compared to Altoona test plant measurements, and as a result, the locomotives appeared deficient when they actually weren't.

The C&O tests were a case of "almost, but not quite." The performance potential was there, and could be impressive, but it was offset by problems that wouldn't go away. As a



In its final months of operation, T1 5527 on a 27-car eastbound mail and express train creeps up to a stop signal at Huntingdon, Pa., on June 21, 1951. By this time diesels were on all top passenger trains, leaving locals and mail trains for the dwindling T1 fleet.

EDWARD THEISINGER

result, neither of the two T1's gave a clear account of itself.

Regardless of the test results, the T1 was not what C&O needed. Boosters would have been required to run them successfully on the Mountain Subdivision, which would have added cost. For the rest of the railroad, the T1's high-speed capability was not useful because existing 4-6-4s were adequate.

From this point forward, the T1's settled into their place in Pennsy's passenger fleet and did what was expected of them. They performed well if dispatched with working sanders, proper lubrication, and a competent crew. Too often they got none of those. At least 10 were equipped with smaller cylinders. Rotary cam poppet valves were retrofitted on No. 5500 in 1948, and Walschaerts valve gear on the 5547 in 1949. The T1's spent their lives in an atmosphere of continuing development.

In 1948, PRR made one last effort to find a home for the T1's. It suggested that N&W, majority owned by the PRR but with a proud tradition of homegrown steam, might be interested in testing a T1. N&W proposed a series of tests to develop comparative performance and operating economies of the T1 and its own class J. N&W's finest met PRR's newest in one of the more obscure events in late steam history.

PRR loaned No. 5511, a veteran of the 1946 C&O tests, to N&W from June 9 to 26, 1948. N&W ran the T1 on test trains between Roanoke and Christiansburg, Va., and compared the results to similar tests made in 1945 with class J 604. Additional tests took place between Poe and Suffolk, Va.

The test report shows that the J had the performance advantage in heavy grade territory. At most commonly found passenger-train speeds, the J used less coal and water for the same unit of output. The T1 fared better during the high-speed tests. As speed increased into the 75 and 85 mph ranges, the T1 used less coal and water than the J for the same unit of output. The T1 also covered more distance at these higher speeds in comparative acceleration tests. Adhesion was not an issue at any time.

The N&W tests indicated that the duplex was not economically superior to a highly refined conventional 4-8-4 at normally encountered operating speeds. This is significant because the J was designed for conditions on N&W, which were considerably different from those on most railroads. Overall, N&W coaxed good performance out of 5511, but it wasn't enough to persuade the railroad to buy.

WHAT KILLED THE T1?

The T1's did what they were designed to do and more. They could easily pull 1,000-ton trains at 100 mph, and do it on less steam than a conventional 4-8-4. But they were a complicated bag of tricks, with many new features sprung on a conservative railroad at an inopportune time. In hindsight, if PRR wished to stick with steam, it needed a straightforward 4-8-4—simple, reliable and tolerant, much like the K4. Instead, it specified (and got) a highly specialized, completely different, and very demanding locomotive.

PRR retired the T1's early and rapidly. To many observers, this confirms that they were

a defective design and couldn't perform. This wasn't the case. Dieselization was occurring because of competitive pressures and PRR's financial distress. The existence of the T1 had nothing to do with it. Time, money, and corporate will ran out for the T1 in the face of PRR's postwar economic problems and the diesel's superior features.

When their primary assignments went to diesels, the duplexes were ill-suited for secondary jobs. This wasn't unusual with modern steam power. As more capability was packed into a single locomotive, it became less flexible with respect to lower-grade assignments. PRR had literally hundreds of simpler, cheaper, go-anywhere K4's to handle its remaining secondary passenger operations. Toward the end of steam, available assignments decreased and neglect increased. The T1 required too much attention to be useful in this environment.

The only other alternative use for the T1's would have been freight service. PRR had begun to rebuild 40 of its M1a 4-8-2s into M1b's in 1945 with higher boiler pressure and increased capacity in the medium-speed range. As a result, it had a supply of virtually new, yet still familiar, simple, and reliable locomotives for freight operations as dieselization progressed. PRR had no incentive to bother with the T1 because it offered no advantage over the M1b.

Economics ruled from 1946 on, and no steam locomotive could come close to the EMD E7. PRR realized what it had to do. Technological change and economic factors overwhelmed the T1 just as surely as they engulfed the best and worst and all the rest



End of the duplex dream: No. 5531 is among 39 T1's awaiting the cutting torch at Sharpsburg, Pa., in 1952. Pennsy steam lasted another five years, during which time the remaining passenger engines were 4-4-2s, 4-6-0s, and 4-6-2s designed in the 1910s and '20s.

J. J. YOUNG JR.

of steam. The entire process was cost-driven.

Save money where you can; cut your losses where you must—that's how corporations work. The T1 may have been different; ultimately, PRR wasn't. The last T1's were set aside by 1952 and scrapped in the mid-'50s.

Other contemporary modern passenger locomotives fared no better. C&O's newest 4-8-4s and 4-6-4s were built in 1948, the last and most modern conventional steam passenger locomotives from Lima and Baldwin; they were retired by 1956. NYC's Niagaras were built in 1945 and by any standard were highly successful, yet they were cold by 1956. N&W built its final J's in 1950; they didn't make it to 1960.

DUPLEX DEAD-END

The duplex idea never caught on and the Pennsylvania remained its only U.S. proponent. In addition to the T1's, PRR tried duplexes for freight, building one class Q1 4-6-4-4 in 1942, an improved Q2 4-4-6-4 in 1944, and 25 more Q2's in 1945. The Q2's carry the same mixed legacy as the T1's: immensely powerful at speed, but complex and temperamental. They worked the west end of the PRR, which in the road's generally

west-to-east dieselization program dropped steam relatively early.

In one way, the duplexes were a solution to an anticipated problem that did not materialize. During the late 1930s and early '40s, conventional locomotive design changed. New materials were developed, lighter reciprocating and rotating parts were incorporated, and counterbalancing was improved. As things turned out, large 4-8-4s did not have the problems that were predicted. Consequently, the duplex solution no longer had a problem to solve.

For example, Union Pacific's 80-inch-drivered 4-8-4s, built during 1939–44, had no problems with sustained high-speed operation. N&W's class J's rode on drivers of just 70 inches, but were unmatched for acceleration and getting heavy trains over mountain grades. NYC's Niagara indicated that performance similar to that of the T1 could be obtained from a compact conventional 4-8-4. Most important, none of these examples deviated from one of the basic tenets of locomotive design: simplicity.

The T1's were too much, too late, but they deserve better than being painted with the broad, black brush of failure. They were a

significant development in steam locomotive technology. When placed side by side with a GG1, they presented a striking picture of the Pennsylvania Railroad's progressiveness coming into the postwar period. Unfortunately, the T1's were designed and built to a performance specification that focused on the unrealistic. The specialization and complexity incorporated to achieve the performance worked against them in day-to-day operations. Who gets the blame: those who proposed the questionable performance standard, those who developed the overly complex design, or the locomotive that met the specification in spite of itself?

In the end, the T1 appeals to the imagination more than anything else. As David P. Morgan noted in the November 1959 issue of *TRAINS*, it was the last steam locomotive specifically designed and built to run at the century mark. And that's where a T1 could not be denied—going really, really fast with almost any train that could be tied to its tender. Once past about 70 mph, very few locomotives could stay with it or operate as economically. But that's not where the bread-and-butter operation was. Real life was more mundane, and a harsh judge of the T1. ■

STEAM *photos*



EXTRAORDINARY EXCURSION: Canadian National 4-8-4 6167 skirts the Petawawa River near Radiant, Ont., with 17 cars of railfans on September 14, 1963. The Upper Canada Railway Society special left Toronto at 10:40 the previous night with 13 cars, including 7 sleepers, and ran overnight to Ottawa, where 4 coaches were added. It then went west to North Bay, stopping at Brent to drop the coaches, which returned to Ottawa. Ontario Northland FP7's took the train overnight up to Temagami. On the 15th, the train ran back to North Bay, then on south to Toronto.

JAMES A. BROWN





CLASS

appreciation

Photographer A. W. Johnson's coverage of C&NW 4-4-2s struck a chord in a diesel-era railfan

BY **ART PETERSON**

PHOTOS FROM THE KRAMBLES-PETERSON ARCHIVE

I was born in 1954 and thus grew up in the diesel era. My family lived in the northern suburbs of Chicago, and my boyhood was filled with the diesel-powered freight, intercity, and commuter trains of the Chicago & North Western. When I asked my parents or other relatives about steam, a typical response was, "You'd leave town wearing a white dress shirt and by the time you got to your destination it was gray!" What steam I saw was either cold en route to scrapping or preservation, or in the context of Dick Jensen's various Grand Trunk Western fantrips.

However, through my uncle, the traction historian and transit-agency administrator George Krambles, I got to meet a fascinating array of people who had seen steam first-

hand. These included such luminaries as Rogers E. M. Whittaker, John W. Barriger III, Arthur D. Dubin, and Alfred W. Johnson. George and Art worked with Al in the late 1960s when they were overseeing the rescue of the Pullman Company's glass-plate and film negatives from the Pullman plant on the city's far South Side. Al, who was one of the pioneers in Chicago-area railroad photography, was cleaning up the Pullman negatives prior to their shipment out of Chicago for preservation. His extensive coverage of C&NW steam locomotives and trains, coupled with George's residency in nearby Oak Park, led to many weekend visits to Al to talk about his recollections, view his contact prints, etc.

Engines and trains long since departed came alive through Al's expert camera work. Later, when George bought Al's collection, he and I worked through the cataloguing and filing of the negatives, prints, and papers, consolidating them with George's own extensive collection. The number of negatives of North Western class D Atlantics in Al's collection suggested he had a real affinity for those graceful turn-of-the-century engines and some of the assignments they held down, such as trains on the Freeport line and Aurora Branch.

In addition to his own photographs, Al collected extensively, whether it was through trading contact prints or by copying larger-size prints. This provided coverage of the D's

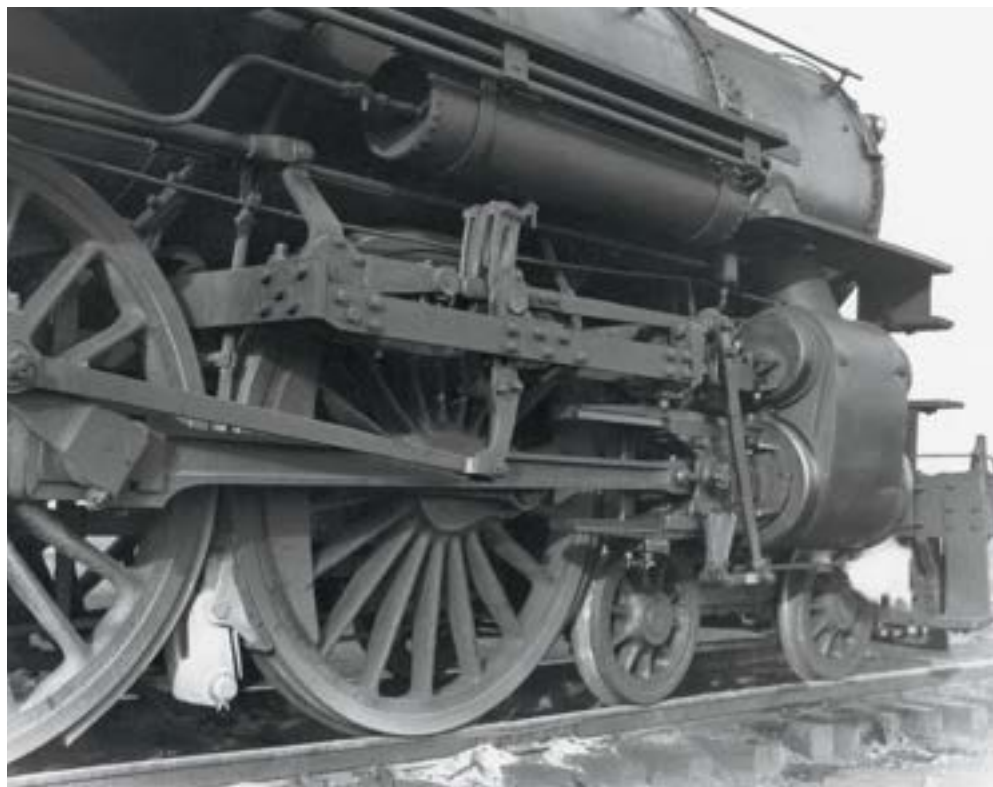


TRAFFIC-STOPPER Class D 1098, with Stephenson valve gear, blocks Pearson Street with a Chicago-bound suburban train making its station stop in Des Plaines on August 14, 1931. This was one of the longer-lived D's. It was renumbered to 398 (the second D to hold that slot) on March 1, 1951, to clear a number block for a group of diesels on order. Sister 1096 became 396 at the same time. The 1098/398 was retired less than a year later, on February 15, 1952.

A. W. JOHNSON

predating his own earliest work, which dated from 1916 or so.

Discussions with other railfans of Al's work led to a much better understanding of the C&NW and its operations in the era he documented. Chief among these were North Western aficionados Wally Ferret, Bob Janz, and Lloyd Keyser. In addition, having access to the Internet provided much-needed insight into the state of locomotive engineering around the time the 4-4-2 wheel arrangement was first developed, the technological innovations included in the class D's, as well as how the engines behaved during their careers. In the end it adds up to a personal appreciation of the class more than a century after they had first gone to work.



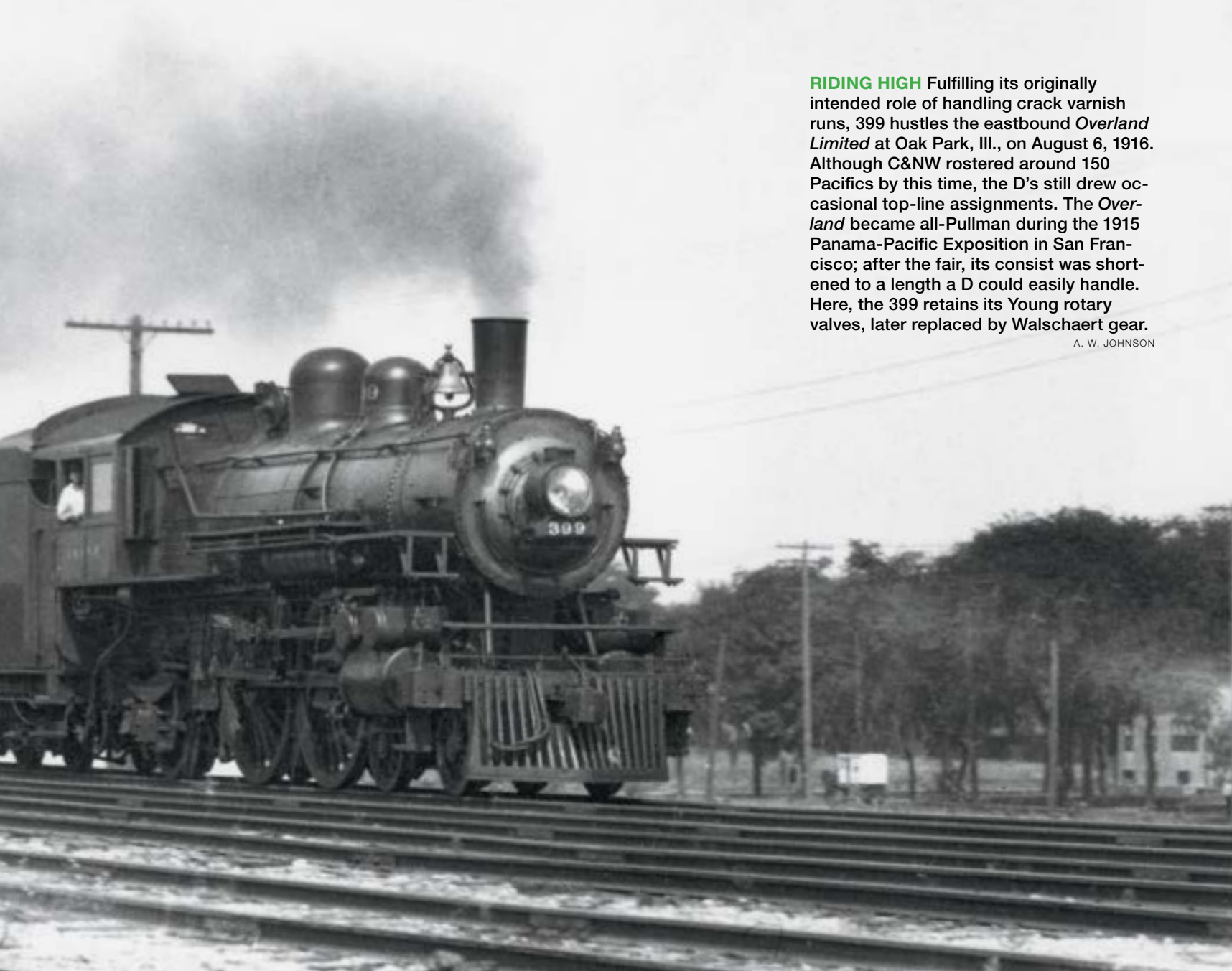
CLASS D CLOSE-UP No. 392 shows all details of the Walschaerts valve gear (which replaced the original Young gear in 1921) in this 1929 view at West Chicago. The eccentric crank is to the extreme left, with the eccentric rod angling down and to the right to connect to the reverse link mid-photo. The crosshead and crosshead link are directly behind the cylinder. The combination lever connects the crosshead link to the valve stem.

A. W. JOHNSON



THE FIRST OF THE LAST C&NW 390, Alco serial No. 45702, is shown in a December 1908 builder's photo. The 390's (last 10 of the 91 D's built, 1900–08, all by Schenectady) came with Young rotary valves and Walschaerts valve gear. North Western employee O. W. Young patented the improved valve design, intended to enhance efficiency by eliminating the eccentric crank and other high-maintenance hardware. The 390 was changed to piston valves in June 1924 and scrapped in March 1940.

COPY NEGATIVE BY A. W. JOHNSON

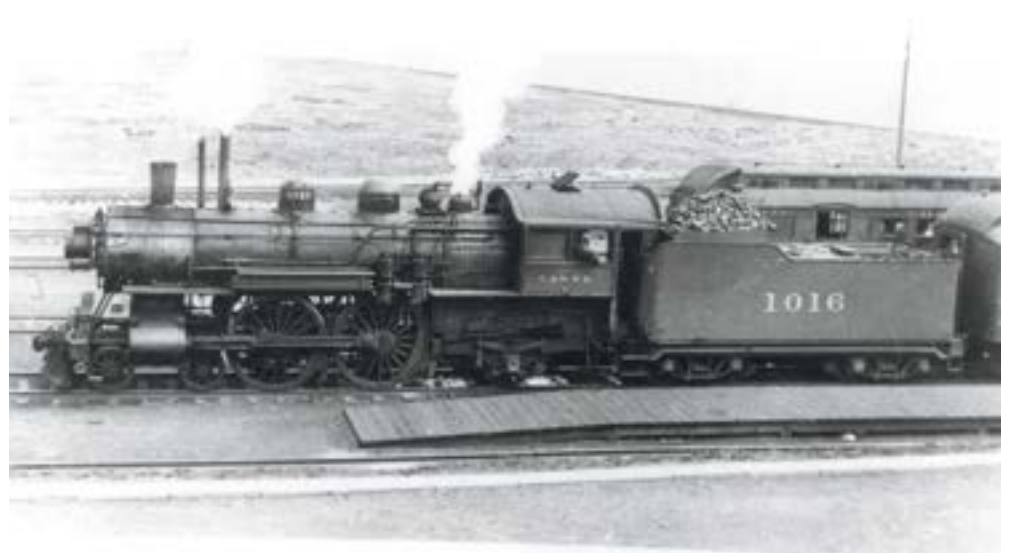


RIDING HIGH Fulfilling its originally intended role of handling crack varnish runs, 399 hustles the eastbound *Overland Limited* at Oak Park, Ill., on August 6, 1916. Although C&NW rostered around 150 Pacifics by this time, the D's still drew occasional top-line assignments. The *Overland* became all-Pullman during the 1915 Panama-Pacific Exposition in San Francisco; after the fair, its consist was shortened to a length a D could easily handle. Here, the 399 retains its Young rotary valves, later replaced by Walschaert gear.

A. W. JOHNSON

BORN WITH THE CENTURY The second class D to be built, part of a three-engine order filled in July 1900, awaits departure from C&NW's station on the Milwaukee lakefront. This Stephenson-equipped engine weighed about 22,000 lbs. less than a D with Walschaerts valve gear. In principle, the Stephenson gear permitted greater efficiency, but on a smaller engine, such as an Atlantic, access to and maintenance of the valve gear, located beneath the boiler, was difficult. As built Nos. 1015-1024 had 80-inch drivers. This group was later retrofitted with 81-inchers, consistent with the later production class D's.

COPY NEGATIVE BY A. W. JOHNSON





LOCAL TALENT Freeport line train 700 departs West Elgin, Ill., on June 10, 1934. The 700-series trains with their frequent assignment of class D's were a favorite subject of Al's. In addition, the presence of Bowman (and other) dairy cars on these trains, and the rural nature of much of the line, combined to create some tremendous period views. Credit for the development of the Atlantic wheel arrangement goes to Atlantic Coast Line, which received the first 4-4-2s in the mid-1890s. Santa Fe rostered the most Atlantics, 178. Less than a dozen Atlantics have been preserved; of these, only one C&NW class D, the 1015, survives, at the Museum of Transportation in St. Louis.

A. W. JOHNSON



OUT OF WELLS STREET Engine 1313, built in 1906, departs the mainline side of the old Wells Street Terminal. Suburban trains used the tracks closer to the Chicago River, out of view to the right. This was C&NW's main station until the opening of the elevated Chicago Passenger Terminal across the river at Madison and Canal streets in 1911.

COPY NEGATIVE BY A. W. JOHNSON



CLASS D ON HIGH Atlantic No. 126 steams across Waller Avenue in Chicago with Sunday-only train 581 on February 11, 1934. The local left North Western Station at 9:02 a.m. and was scheduled to arrive at West Chicago, 30 miles out, 1 hour 6 minutes later. The light two-car consist was well within the 126's capabilities.

The at-grade tracks in the foreground are those of the Chicago Rapid Transit Lake Street Branch. Successor CTA, the C&NW, and the on-line communities later cooperated to relocate the rapid transit line onto unused right of way on the C&NW elevation, where it remains today as CTA's Green Line to Oak Park.

A. W. JOHNSON



CLASS D FROM ABOVE Chicago-area railfan Tom Desnoyers worked as a grade-crossing gateman in the late 1940s. From his elevated cabin he captured this photo of No. 395 starting a west-bound suburban train at Main Street in Glen Ellyn, on June 10,

1949. The 395 became notable as the last North Western class D to be retired, in November 1954, following its starring role on a Chicago-Milwaukee-Madison-Chicago farewell excursion train on September 12, four days before author Peterson was born.

TOM DESNOYERS

STEAM *photos*





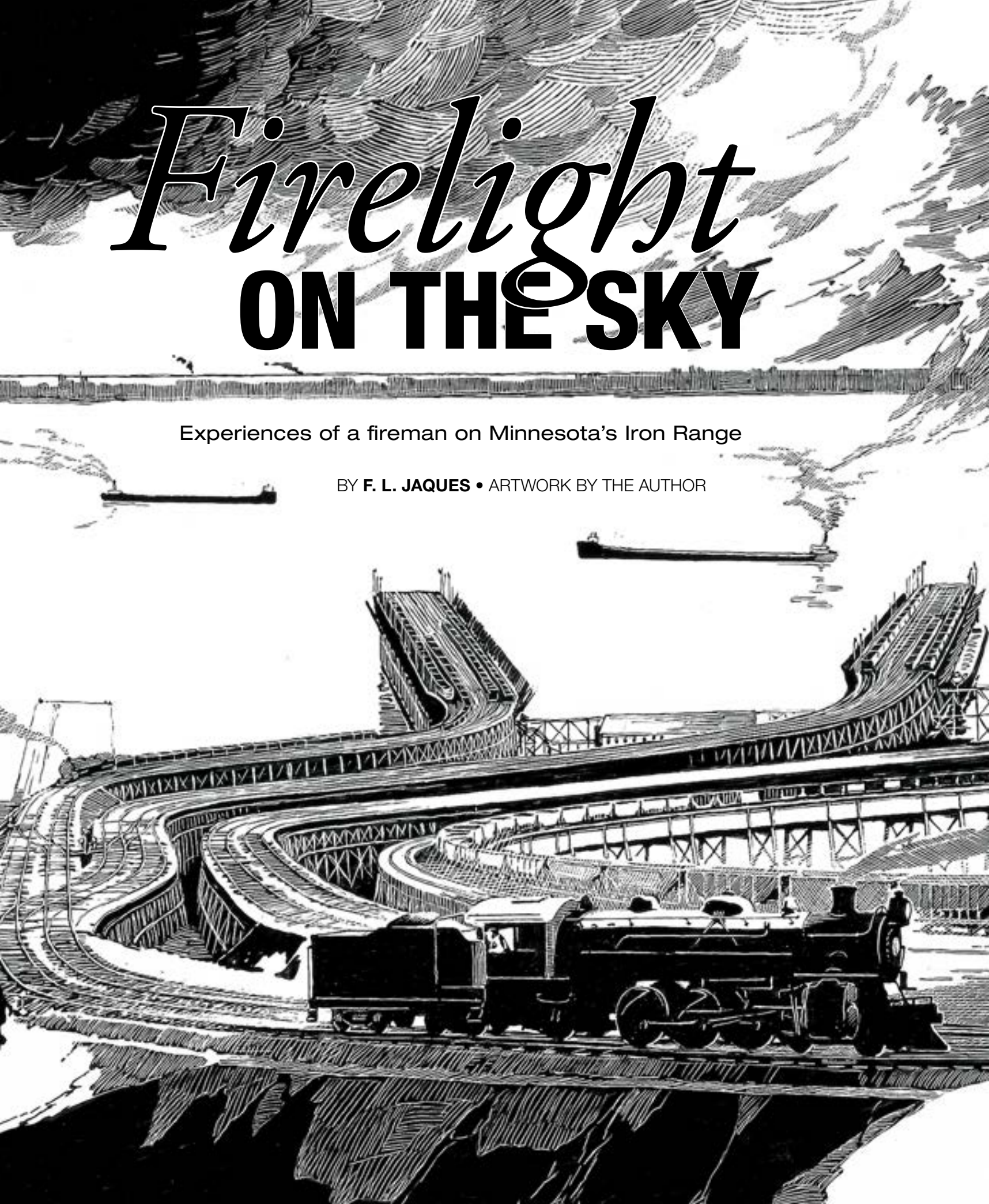
CARRYING LOGS TO HOQUIAM: Northern Pacific class W-3 Mikado 1752 barks into Hoquiam, Wash., with another load of logs to feed the many mills in the Hoquiam-Aberdeen area. The 135 W-3's were the backbone of NP's freight fleet. Six years after these 1952 photos, sister 1713 made the last run of NP steam in revenue service.

TOM MILLER, STEPHEN THOMPSON COLLECTION

Firelight **ON THE SKY**

Experiences of a fireman on Minnesota's Iron Range

BY F. L. JAKUES • ARTWORK BY THE AUTHOR





DM&N ore docks, Duluth



In early spring 1913, at Proctor, Minn., headquarters of the Duluth, Missabe & Northern Railway, a young fellow low in spirits and low in financial resources appeared, looking for a job as a fireman. I was that young fellow. Boomers and old-timers were there hunting for work, but “They’re not hiring” was the usual reply.

I found I would have to spend an indeterminate time as a “wiper” before I could hope to become a fireman.

So I became a wiper.

The memories of that spring are all mixed up with the smell of steam. The atmosphere of a railroad waking up from its winter hibernation, as the Minnesota iron ore roads did each year when the Great Lakes were re-opened for navigation, was thrilling. Mallets were whooshing by, picking up speed into the yards after climbing the 2.2-percent grade from the docks with empty ore cars, or easing by with loads, backing down to the docks.

These Mallets, 2-8-8-2s numbered 200 to 207, were built in 1910. They were hand-fired. Their low-pressure exhaust—a continuous roar—was either music or an annoyance to thousands of people in West Duluth for years. Since much of the 7-mile track between the docks and Proctor was visible from most of West Duluth, the great columns of black smoke together with the exhausts left little doubt that there was a train on the hill. These engines worked almost exclusively on the hill for many years. I’m sure their ghosts can be heard still on a dark night.

Wipers in 1913 didn’t wipe anything but the spout of an oil can. They filled the sand dome, filled the tank with water, the oil cans

with oil. Principally they cleaned fires.

Wipers worked in pairs. Someone would poke his head into the dark sand house (the only warm place in the yards, with nice soft sand to lie on) and shout, “Hog for Kelly!” Kelly and his helper would go out into the night and clean the fire, leaving the grates clean and the boiler with enough steam to get the engine into the roundhouse.

Cleaning the fire started with pulling the good fire to the rear of the firebox and shaking the ash through the front grates. This often meant removing clinkers, great hot sheets that had to come out through the firedoor and be dumped overboard. By this time the far end of the hook, or rake, was red hot and so soft as to be useless. You took it out and pounded it over something until it was reasonably straight, and let it cool. Your end was pretty hot too. Gloves didn’t last long.

Then you pushed the good fire forward and cleaned the rear grates. This left all the fire in the front of the firebox. It remained so, with additions of fresh coal, until the engine was called for service and the fireman took over and spread the bank.

Nobody on the DM&N worked on Sunday—well, hardly anybody. The wipers did: 12 hours. On Sunday the engines were spotted in long lines with their fires banked.

On my first Sunday I—who 48 hours before had never been on the deck of a locomotive—was given a long line of engines to look after. The job consisted of going down the line, climbing up on each one, putting on the blower to raise steam, starting the injector to keep the crown sheet covered, and putting a few scoops of coal on the banked fire. After

midnight Sunday the engines began going out on the road again.

A wiper’s job wasn’t glamorous. After a few long, hot nights I began to feel I wasn’t cut out to be a railroad man and pulled the pin.

A few days after I had quit railroading forever I turned up at Two Harbors, headquarters of another ore-hauler, the Duluth & Iron Range Railroad. I was looking for a job firing. And I got it. (DM&N and D&IR later merged to form the Duluth, Missabe & Iron Range.)

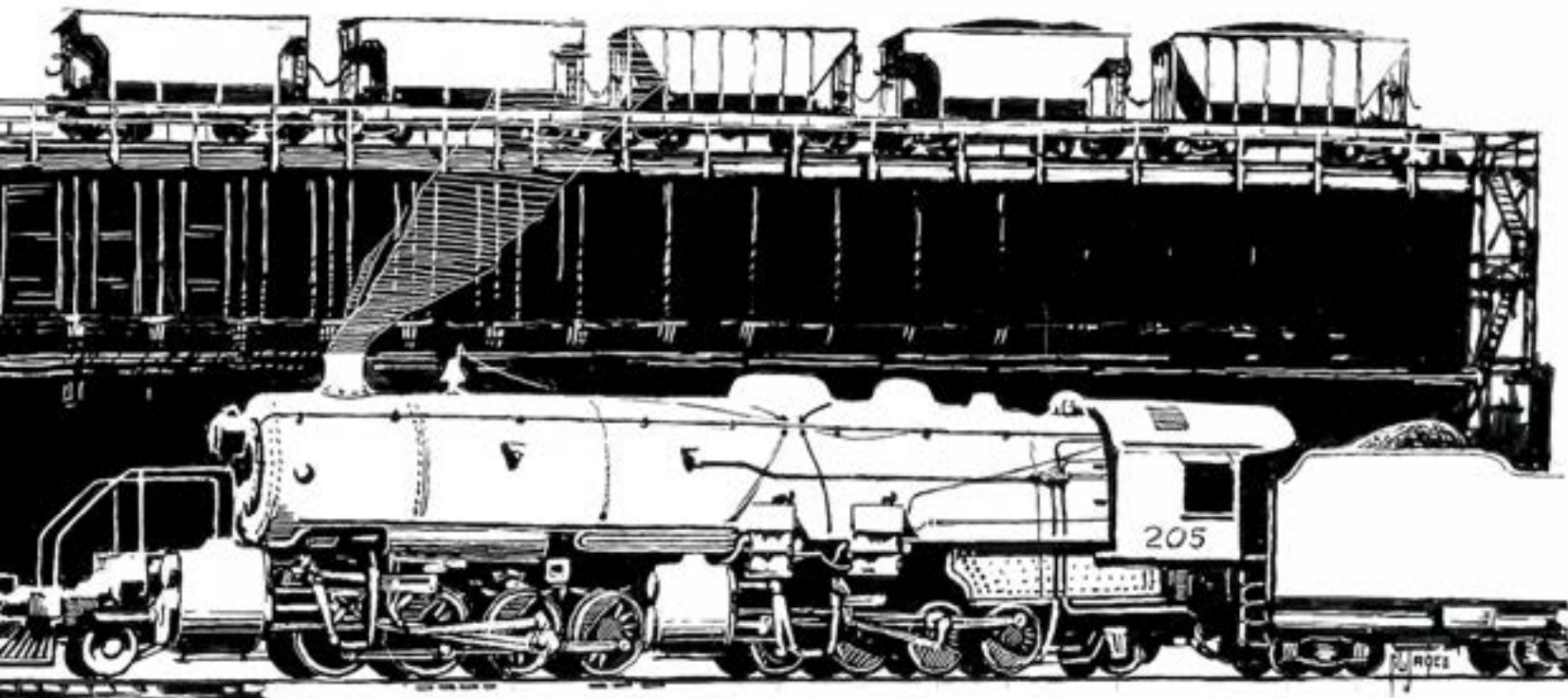
Next morning I reported to an engineman named Vanvolkenberger (“Vanvolk” on the board) as a student fireman. I had one student day in the yards.

The following day I showed up for work as the youngest man in point of seniority, and was promptly bumped from my one-day job and found myself scheduled to work nights.

I didn’t start off very well. We stalled with the first cut of loads to be shoved up onto the ore docks. How much it was my fault I’m not sure. Enginemen could beat you out of steam when you least expected it. It was a sort of initiation. They shouted to the world for someone who could really fire a locomotive—all very embarrassing.

The yards at Two Harbors were unique. The tracks fanned out to five docks. They went through the yards and through a confusion of red and green switch lights where a half dozen other engines were working. You

This story is adapted from two articles in January and February 1962 *TRAINS* magazine.



DeIR Consol and Mallet, Two Harbors

shoved a cut of loads on whose head car a switchman stood with a light—one light among many. You watched that light weaving through the yards and hoped you kept watching the right one.

The loads had to be spotted exactly right over the pockets in the docks. The pockets were the same length as the cars, and the cars were slowly pushed ahead until the first car was over the last pocket. Then the switchman pulled the air. This was hard on the docks, so the practice had to be stopped. Then it was much more difficult to spot the cars correctly.

Much of a tallowpot's duty was relaying signals to his engineman. "Back up," "Go ahead," "Kick 'em," "Easy," "Three cars . . . two cars . . . one car . . . that'll do." Farm boys said, "Whoa"—which wasn't good, even if it was an iron horse. "Stop" was too much of an order. You don't order an engineer to stop; you sort of ask him to stop. So "that'll do" seemed best. Except, of course, in an emergency, when it was "Dynamite!" or "Big hole!"

Hard work characterized the world of a new fireman of 1913. Working extra, you caught a different job, a different engine, and a different engineman nearly every trip. And the trips depended on a regular man laying off, which might be for a variety of reasons. This meant you got more trips at night, and possibly more hard trips.

There was the caste system. The engineman's seat was softer than the fireman's, but the head brakeman's folding seat, just ahead of the fireman's, was the hardest. And I'll say

a good word for the head brakeman. Many of them had wide experience, were good firemen, and if you were really in trouble they would put in a few fires. Enginemen sometimes would do that too.

In the middle of the boiler backhead, down low, was the firedoor. It had a chain on it so you could pull it open or closed. There was the scoop (and, let's hope, a spare one back on top of the tender), a coal pick, a rake, a broom, and a water jug.

The memories of that spring are all mixed up with the smell of steam.

Removable wooden boards, or gates, were between you and the coal, which was banked against the gates head high. You soon had to remove those gates and pull coal forward so you could reach it with the scoop.

Over the firedoor on a shelf was the engineman's long-spouted oil can, a can of valve oil, and the engineman's torch. In the left-hand seat box were two lanterns, spare water glasses, matches, torpedoes, flares, sticks of hard grease for the rod bearings, and perhaps an extra pair of gloves for an emergency.

On either side of the boiler was an injector. This could deliver upwards of 500 pounds of water a minute. The injector had to

be on steadily whenever the throttle was open on the road. To boil that much water required up to 100 pounds of coal per minute. Sometimes you used both injectors!

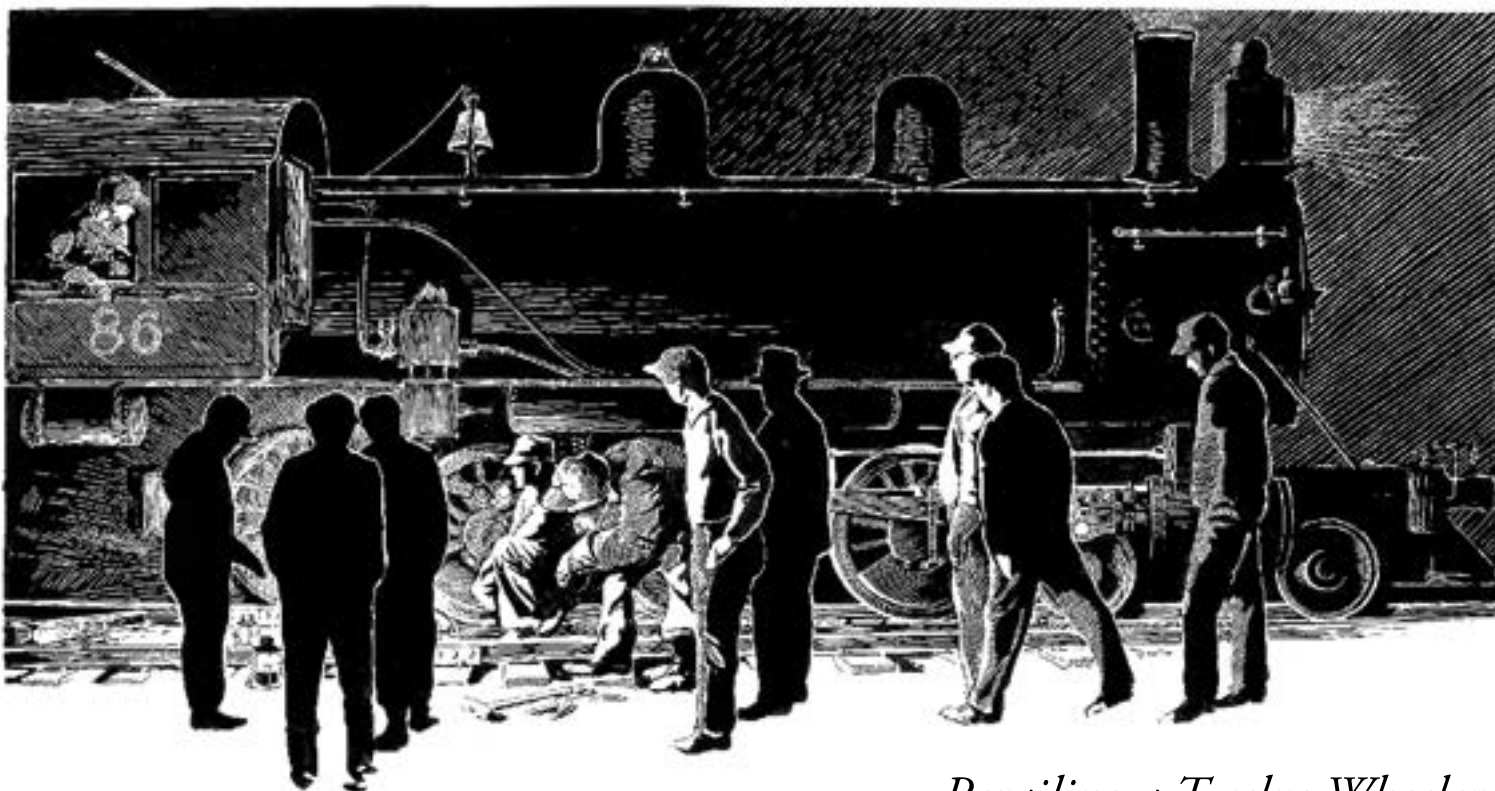
There was the blower, to keep a draft on the fire while standing, and a squirt hose, with which you washed the deck.

All the lights burned oil, and the cab lights usually blew out when you backed up. If you forgot to light the headlights and markers just before dusk while standing, you had to go out and light them while running, which wasn't easy. When you were in a siding, meeting another train, you put out the headlight by moving a sheet of metal from behind the light to a slot in front of it, or you could hold the scoop in front.

The bell had to be rung approaching road crossings or wherever people were about. It was heavy, and ringing it was hard unless it had been recently oiled. To do that, the bakehead (another of many terms for "fireman") crawled up on the boiler with the oil can.

The water glass on many of the engines was still a simple exposed glass tube, which was dangerous and broke frequently.

Day or night a record of a fireman's work was written on the sky. In the daytime the color of the smoke was diagnostic. Anyone in the know, anywhere within sight, could tell whether or not you had a good fire. If the stack was clear they could count your scoops of coal by the black puffs in the sky. To look back and see them was good. At night, if the bakehead was "fanning the fire," the number of scoops of coal could be counted by the



Rerailing a Twelve-Wheeler

glare of firelight on the sky. That could sometimes be seen for a long distance.

The trick with fanning the fire was to get the coal in without the fire door being open much. An open door cooled the fire and, in excess, resulted in leaky flues. Personally, I think putting in 8 or 10 scoops as fast as you could was just as good, but it wasn't the approved method. You got a scoop of coal, pulled it toward you, grabbed the chain with the left hand and yanked the door open, threw in the coal, grabbed the chain and yanked the door shut. The trouble here was that the chain, gyrating madly, sometimes was not there when you grabbed for it.

Most of the coal was burned along the sides or the rear corners, but if a good clear fire wasn't sufficient to supply enough steam, then you had to overfire, which resulted in a less efficient fire requiring still more coal, and usually in a bad fire. The surface of a bad fire was hard to see, since air from an open fire door created a brilliant flame. The hook was called the "joy prong" because raking the fire would bring up the steam pressure. But the use of the hook also caused clinker. You couldn't win!

Some engines formed clinker just as a matter of course, even if you had a good fire to start with. I didn't have much trouble with clinker on road engines. My difficulty was in overfiring light engines working a light throttle. I just didn't have the patience to wait for the fire to burn.

A tallowpot's pay for a round trip ran from \$5 to a little over \$6, depending on time and miles. The pay was flat; there were no de-

ductions for retirement funds or fringe benefits. But the company had a scheme of its own. A worker starting the first of the month wasn't paid until the middle of the following month. If my calculations are correct, the company had my money an average of three weeks before I got it, and drew interest on it.

The company, rightly assuming that I was broke, didn't bother about watch inspection until I'd had a payday. Then for \$28 I bought a watch with a nickel case.

I had been warned about watch inspection. But nobody had warned me about Mr. Jones, the traveling fireman. Mr. Jones hated all firemen and possibly everybody. He was just chock full of discipline. He didn't want firemen to burn so much coal. Firemen didn't want to burn so much coal either, so there should have been no trouble.

One day I was called to fire the round-house goat, 0-4-0 No. 14. When I got aboard there was hardly any coal in the tender, so I filled it with perhaps four tons. I didn't know Mr. Jones was watching the records—that every estimated pound of coal that was put aboard the engine while I was there was charged against me.

Those in the know who were firing the 14 took only enough coal to last them the duration of their shift, since the engine wasn't going more than a few hundred yards from the coal dock anyway. This accounted for the empty tender. The previous fireman had guessed well.

All that day we sat around, loading scrap iron with a crane and magnet. My engine-man was elderly and held this job by prefer-

ence since it didn't call for much action. He spent the day picking ingrowing hairs out of his face with tweezers, and I burned perhaps a few hundred pounds of fuel. But Mr. Jones by letter accused me of burning four tons—he didn't subtract the three-plus tons still left in the tender that night.

After a few uneventful nights in the yard, I deadheaded north to Ely, Minn., on the Highball, a mixed consist with one coach and a caboose. Most of the jobs up there consisted of "loading stockpile" (spotting empties to be loaded from stockpiled ore with a steam shovel). Trains of ore were made up, cars were delivered to the mines, and loads picked up. Some of it was mainline work. Engines were usually 4-8-0s.

A call came one afternoon while I was asleep in Two Harbors. I was to deadhead north on the passenger train. There was no time for me to eat and no food on the train. Boats were in and the next day was a holiday at the mines. They proposed to load stockpile.

At Eveleth the engineman and I, still without food, relieved the crew on one of the 4-8-0s. These engines had long, between-the-drivers fireboxes—it was just about as far as you could throw!

A few minutes after we started the two front pairs of drivers stepped off onto the ties at a switch. Trying to rerail, we soon had all 12 wheels off the track. Two other engines with full crews came to help. There followed a futile night: rerailers slipped, then we would get some of the wheels on, only to have them come off again. Finally, after daylight, I found

a way to wedge a piece of rail into a frog in such a way that it couldn't slip, and the two engines pulled ours back on the rails.

We limped back into Eveleth and on the way met another engine on a curve in a cut. Since everyone was on watch we didn't bump. This was yard track and nobody was in error. It just wasn't our night. In Eveleth, after finding something to eat, I was directed to the dirtiest boarding house in all my experience. I never found the proprietor, so at least it cost me nothing.

Loading stockpile one morning, my engineman needed sleep, or maybe he just didn't want to work. He said, "You take her. I'll be in the caboose." I didn't see him again until noon.

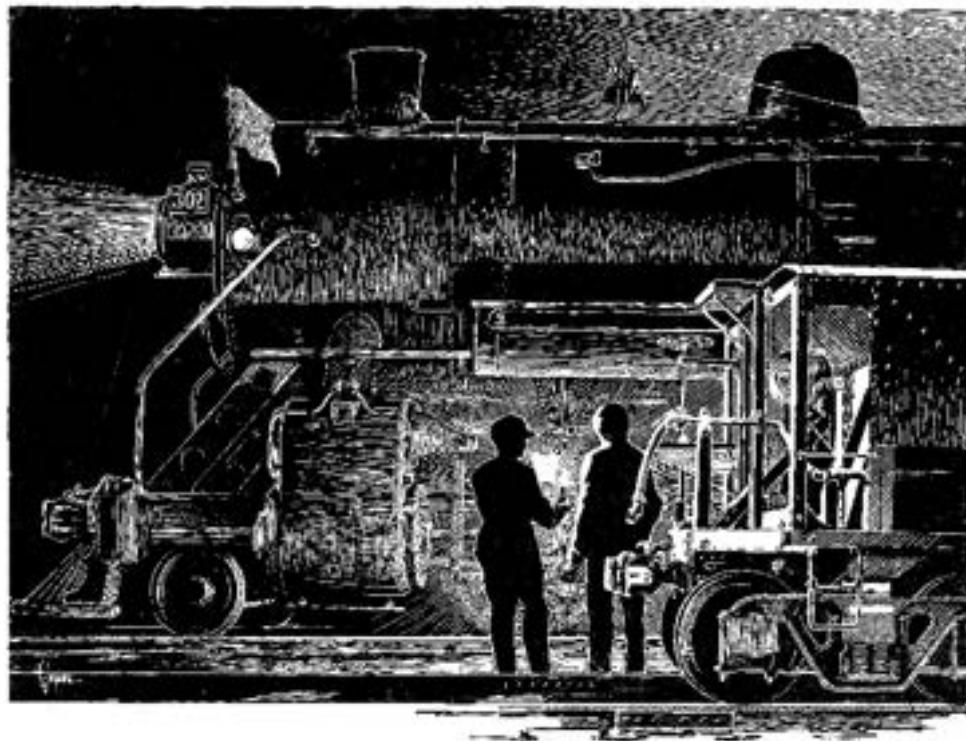
It wasn't really that difficult. Picking up a few ore empties, spotting them at the shovel, and, when they were loaded, putting them down on top of the previous loads. Nothing was involved but heaving over the Johnson bar and working the throttle and the air. Except that I didn't know what I should do about the valve oil. Lubrication in 1913 was a tricky business and required much attention. Valve oil was fed to the cylinders, literally a visible (through a glass) drop at a time. The company was close with its valve oil, and the oil left in the can was measured at the end of the day. One man was supposed to have made a record, using only a pint during a turn on ore. I can't help wondering what this oil economy cost in repairs.

I was called back to Two Harbors and the tall, likable engine dispatcher asked me to sign in. They were short of road firemen, and next morning, much to my satisfaction, I was marked up on the road. My satisfaction didn't last long. I caught the 95, a Consolidation with the reputation of being the Duluth & Iron Range's worst steamer.

Most of these 90's, the first wide-firebox 2-8-0s on the D&IR, were good engines. They were later equipped with mechanical stokers, air reverse, piston valves, superheaters, and other modern equipment. Some were hard riders, though one just out of the shops rode beautifully.

The D&IR was double-tracked to the Mesabi Range. At Allen Junction the main single track continued to the Vermilion Range at Tower Junction, then 20 miles farther to Ely and 4 miles on to Winton, where there were several sawmills. Except on the 13 miles down into Two Harbors from the north, there were no signals. Running throughout was left-handed, and the signals on this section were also on the left-hand side. Trackside trees were cut far back from the curves, and running was by the sight system. Speed with ore was limited to 25 mph.

Sometimes on a Saturday when the boats were in, ore extras left Two Harbors every 15 minutes, except for an hour before the time of the passenger trains. There were two first-



D&IR Mikado

class trains each way a day, plus the Highball. With the exception of the Highball, which might be hours late and wasn't a passenger train anyway, the first-class trains ran on time. The extras simply cleared their time. No extra was to pass the varnish while the varnish was standing at a station, and log trains were to stop on the main while the passenger trains passed on the other track in the opposite direction.

Tonnage ratings for the Consolidations were 40 empty cars northbound, about 37

A few minutes after we started the two front pairs of drivers stepped off the rails.

loads southbound. Cars were rated at 50 tons but were regularly overloaded.

My first road trip was to Tower Junction and return—at 45 miles each way, the longest trip on the D&IR.

I spread the bank, blew up the fire, and put out the white flags. We ran under the base of the docks with cylinder cocks open, tied onto 40 empties, and were off. Highball!

I had a bad start. While washing the deck with the hose, some of the hot water hit my engineman on his hairless head, which annoyed him. But he was a good sport and put in a fire once in a while, as did the brakeman. Then honeycomb began to form on the flue

sheet; we threw coal at it to knock it off. When the door began to snap shut I knew I had clinker.

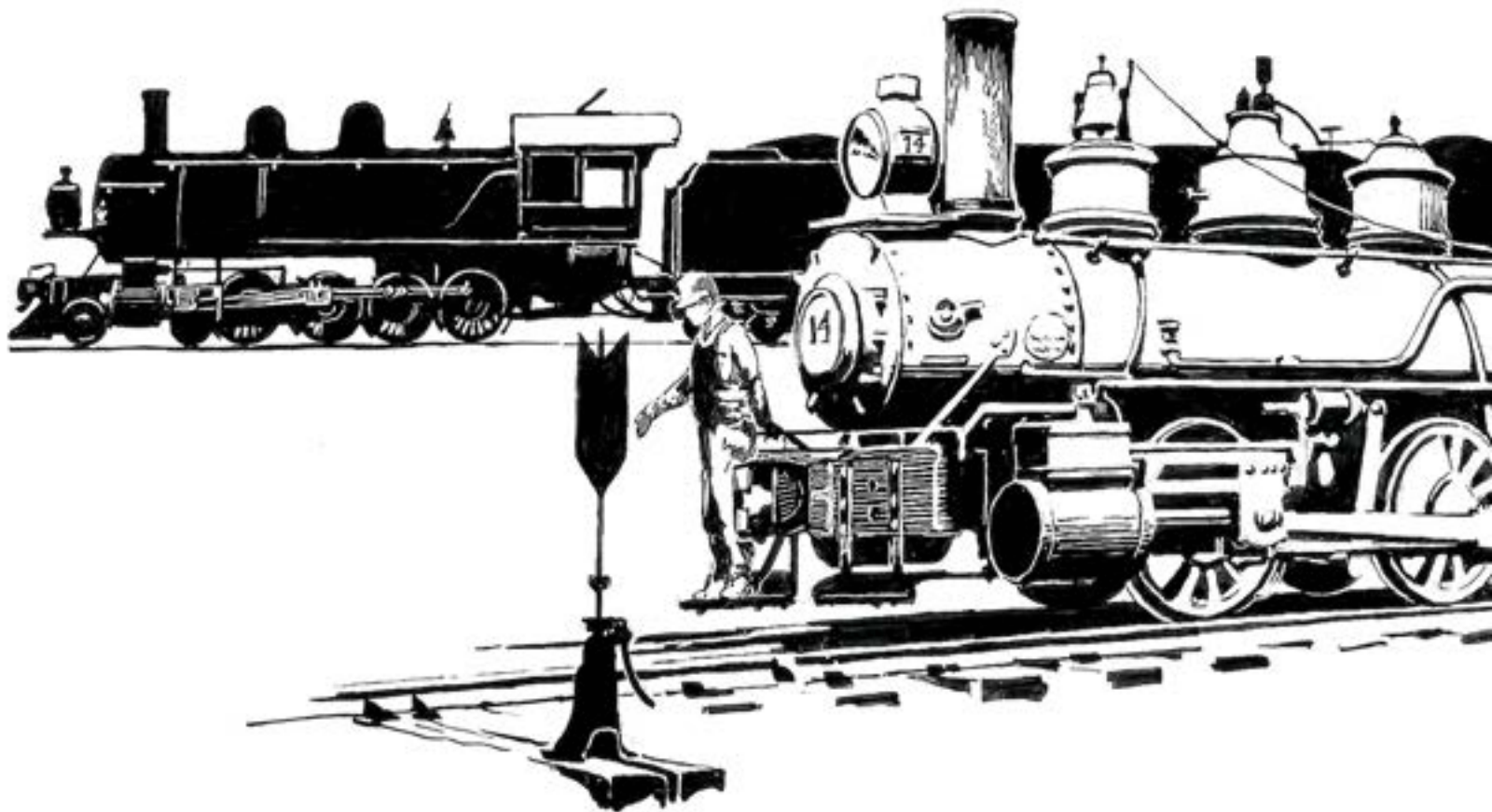
At Highland, top of the hill, we removed the clinker and took water. From Highland to Tower it was easy. Just beyond Highland was a track crew with the off-track equipment of the day—a mule. He stood close to the track with utter indifference. He knew he was in his proper place; why worry about an engine, however huge?

Returning with loads from Tower Junction, we came to a stiff little hill up to Mud Lake. We had a helper on the hill and the engineman said proudly that his son was fireman on the helper and that now we were "going up pretty good." I sensed from that remark that I wasn't doing too well.

Finally, on the last grade up to Highland where trains were weighed and from where everything was downhill, I would see a milepost, say, Milepost 45. "Let's see now," I'd think, "Two Harbors is Mile 27, add 13 for the hill. Therefore Highland is Mile 40, which is still 5 miles away." By the time we came to the next milepost some 10 minutes and several fires later, I would have forgotten in my fatigue and I would have to do my figuring all over again.

From Highland to Two Harbors you didn't need to add another scoop of coal. I just put on the injector occasionally to keep the safety valves quiet.

Drifting down the hill, watching the drivers roll was very pleasant indeed. Nothing to do but watch those signals and, with Lake Superior opened out, the steamers on the



water and Two Harbors and its docks spread out below. At times such as this you knew you earned your salt.

Before daylight the callboy came to my bedside and made me sign the book. Callboys were quite an institution, the telephones of the period. They found you or you missed the trip. So all your off hours weren't your own—only the 8 hours when you were entitled to rest after you went off duty.

I was called for the "Duluth Log." The engine that day was one of the 50 series—"Blind Goats," little Consolidations with small fireboxes and large cylinders. They were slippery and notoriously poor steamers. The vertical boilerhead reached to the back of the cab, and the engineman couldn't see the water glass without crawling out of his seat. He just gave the glass a quick look. The water at that instant might have been forward in the boiler—it didn't matter to him. He filled her up.

My engineman was, I think, having family troubles and was not in a good humor. I don't remember his name; I'll call him Bill. We were to pick up logs at Knife River, the terminal of the Duluth & Northern Minnesota, a logging railroad.

We were to deliver the logs to a mill in West Duluth. There we turned on the wye, ran around the logs, and with caboose just back of the engine, began backing the logs up

onto the unloading dock on a considerable grade. One brakeman was on the caboose, another on the logs farther along. Both were visible from the cab, but the curve was on my side. When I saw both men gave washout signals, I yelled, "Dynamite!" Bill actually argued with me—"Why?"—and didn't stop. One of our logs, loaded too high, had caught and damaged an overhead footbridge.

After getting clear of the damaged bridge, we resumed shoving the loads upgrade. Over and over, Bill would yank the throttle open and the drivers would slip. I was disgusted and just sat there. I thought that if the steam pressure got low enough the engine couldn't slip and we could get up to the unloading area. Finally Bill noticed the lack of pressure and yelled, with some verbal trimmings, "Get some steam on that boiler!" So I did, and we made it. Finally we got our empties and headed back for Knife River.

At Knife River we turned the engine on the D&NM's armstrong turntable and started back with another string of logs.

Since I had no lunch with me, my friend on the other side of the boiler offered me a sandwich, which I didn't want. These circumstances had taken away my appetite; besides, I was proud. But Bill yelled, "Eat that sandwich!" That was an order.

The firing still wasn't going too well. When we got to the top of the hill at Lakeside

for the second trip to Duluth, Bill had her full of water and I had her full of coal. Since there was no more room for cold water she howled all the way through Duluth. I don't think the pops ever closed.

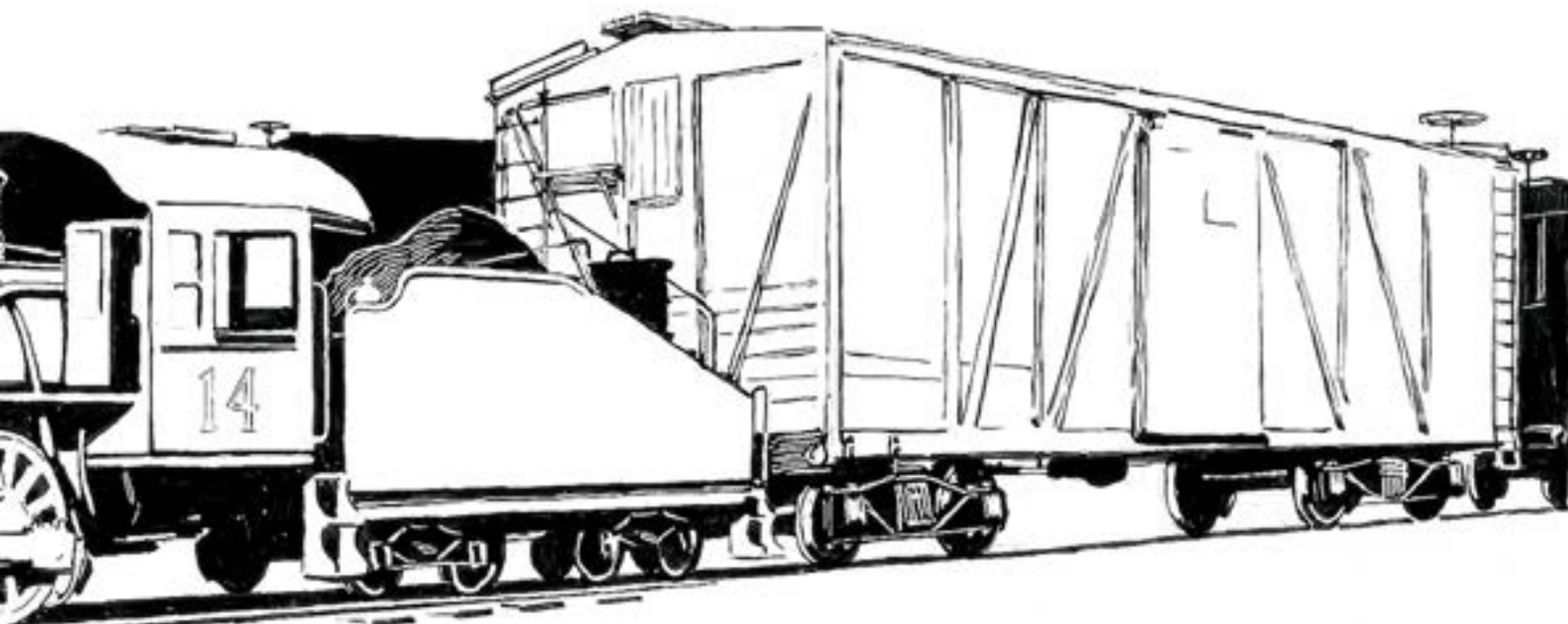
We limped into Two Harbors with the caboose and the 16-hour law on our tail. This was a classic example of how not to build an engine, fire an engine, or run an engine.

Next day I got a letter from our Mr. Jones, the traveling fireman, asking why I hadn't taken the white flags off the smokebox when we got in.

The Duluth & Iron Range had two double-track ways down to Two Harbors. The older Drummond Line, well ballasted, was not used.

I now became a fireman on a name train! I was called for the "Freezer," which ran with only a caboose northbound and paid a higher rate for bringing a single southbound refrigerator car at the end of the usual loads of ore. At the junction to the Drummond Line I took off our white flags and we ran to Drummond and return as the weekly first-class train. Operated to hold the franchise, it carried no passengers.

Once, while I was working out of Ely, I noted a stiff grade up to Aurora out of Allen Junction. We were approaching this grade with a train of coal, so I put in a heavy fire,



D&IR roundhouse goat, Two Harbors

forgetting the slow order at the foot. The engineman shut off for the slow order and the black smoke rolled, smothering the train. Guess who was in the caboose? Mr. Jones.

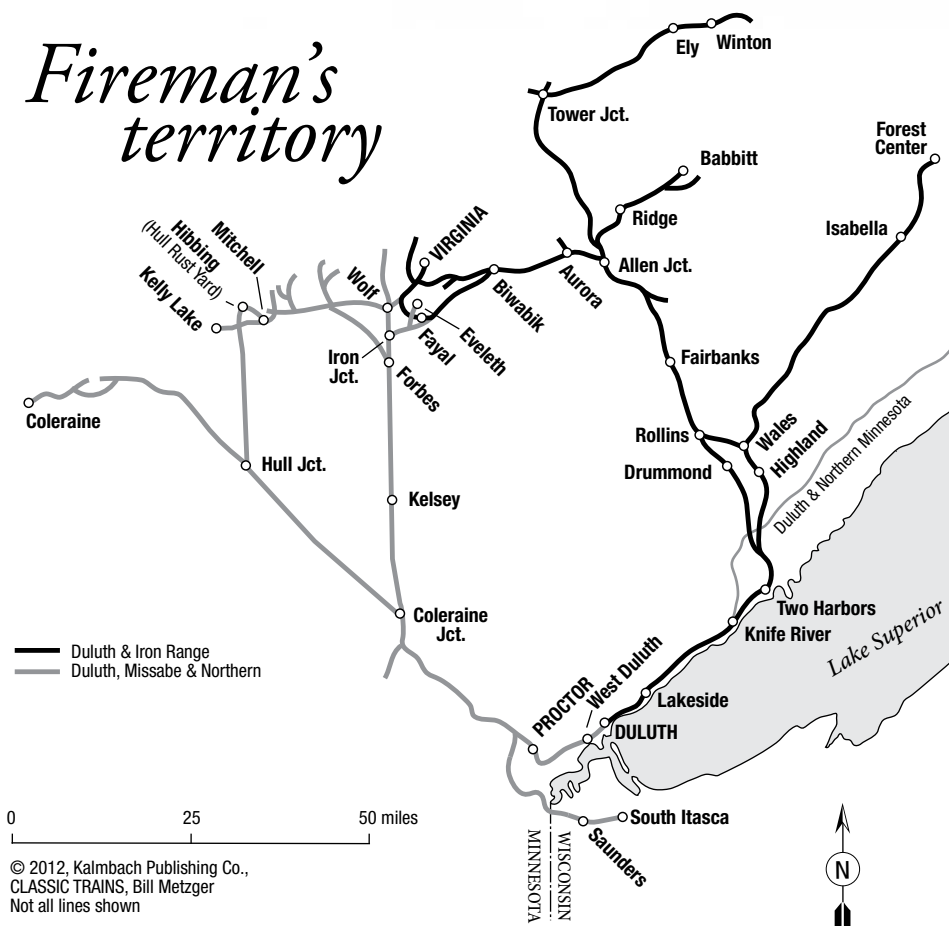
Late in the summer we had much fog, especially in the mornings. Frequently we hit a couple of torpedoes. There was no way of knowing when they had been placed. The brakeman in the cab was a blessing at times such as these. He had nothing to do but watch for red lights ahead, which meant a caboose in front of us.

A pleasing change was the night I was called on the "Ridge Log," on one of the Twelve-Wheelers. We took water at Allen Junction. Two big tool boxes on the tender appeared in the dark to be flat with a plank between to stand on. I gave the water spout a good shove so it would lock in place and I stepped out on one of the boxes. It proved to be round on top. I pinwheeled over the side, grabbed the side of the tender with one hand, pulled myself back up, and said nothing about it.

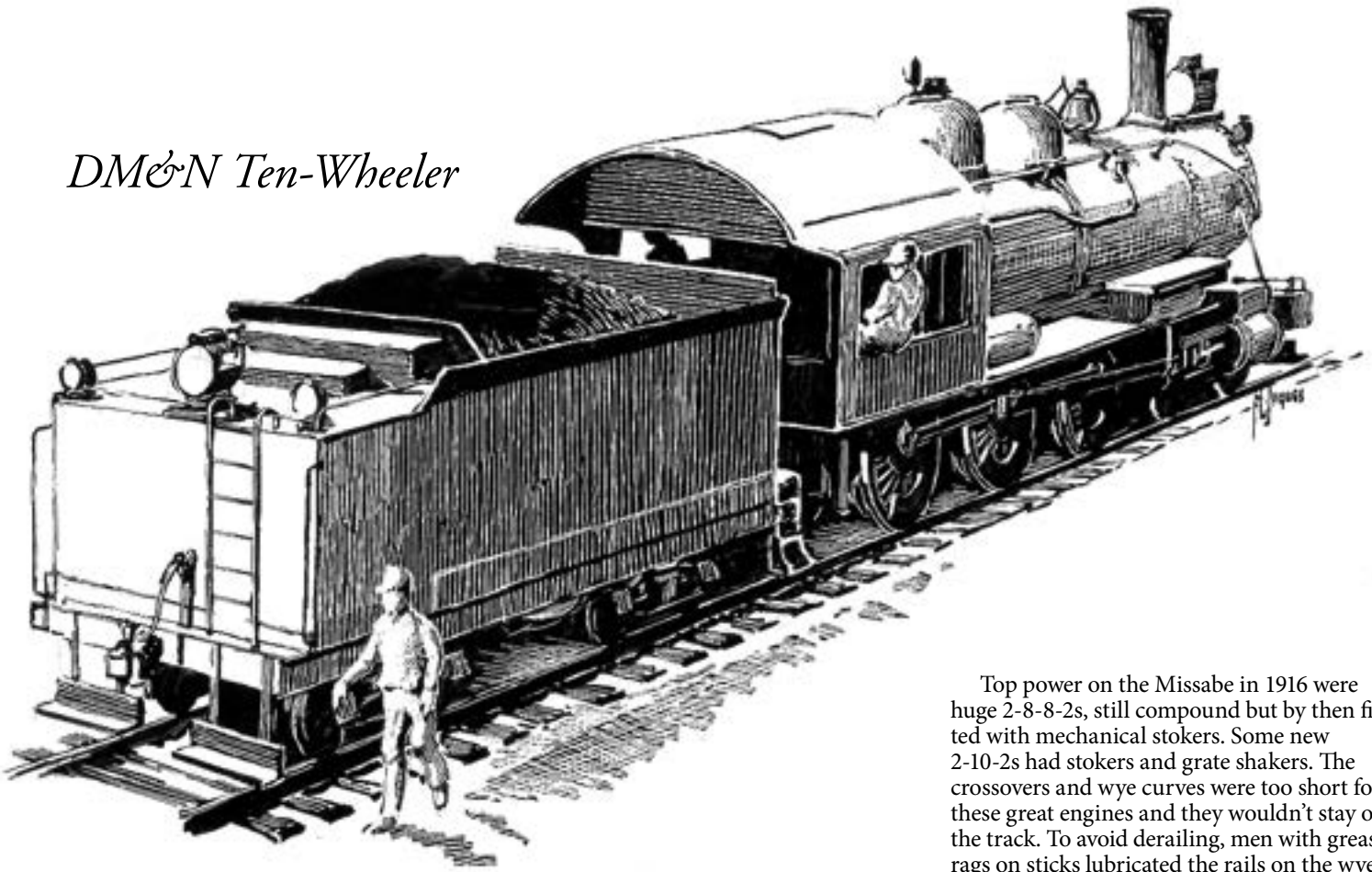
The odor of damp logs at Ridge was good, and we came back at dawn with a big box of blueberries on the running board. When we tied up at Two Harbors my hogger remarked, "When you're going to do those gymnastics off the tender you might let me know, so I can watch."

When I drew a Mikado, I was lucky. They

Fireman's territory



DM&N Ten-Wheeler



had electric lights, air-operated bell ringers and reverse, and Butterfly firedoors. On my first trip with one I had a boomer brakeman who was familiar with 2-8-2s on other roads, and he taught me how to fire one. With good coal, you could carry a very thin fire that danced over the whole grate area, and it was beautiful to see.

Our first four Mikados, Nos. 300–303, came from Baldwin. One morning the 302 was on the incoming track with the left cylinder head blown out. This was repaired, the engine made a trip on ore the same day, and I was marked up on her at 11:30 that night.

For me, who was a little short on one end, it was too far between the coal and the fire-door treadle. When my foot slipped off just as I was aiming a scoop of coal for a front corner, there was a bit of janitor work to do!

After stopping one night behind another extra at Allen Junction, my engineman left to walk forward to the lunchroom, saying, “You bring it in.” A green tallowpot, but too proud to admit it, I took over. How did I release the air? I remembered a phrase from a book I’d read years before: “Don’t forget the kickoff.” So I didn’t. And I brought in the train.

One night when we tied up at Two Harbors I received a letter from our Mr. Jones, who said I’d gotten in on the 303 the day before with more than 10 tons of coal on the tank. I hadn’t, and I’d had enough of Mr. Jones, so I quit.

Three years later, in 1916, I was back on the Duluth, Missabe & Northern, my name at the bottom of the firemen’s list. That honor entitled me to the least desirable job, which was working not on but around and below the ore docks at West Duluth. I had a room at Proctor, headquarters of the road, and my day started at 4:30 a.m. when the callboy roused me out of bed. After breakfast I waited in the yards for the next Mallet with empties dropping down to the docks. I rode the engine down, got off at the

My day started at 4:30 a.m. when the callboy roused me out of bed.

land end of the docks, and walked five or six blocks to pick up my engine, an old 2-8-0.

At 7 p.m., after a 12-hour day, I was waiting at the docks for the next train of empties up the hill. I tried for the caboose. The Mallets had stokers, but they didn’t work too well, and if I were in the cab I might feel obliged to help the fireman. I’d already shoveled 6 or 8 tons of coal and I’d been up since 4:30. If I got a train within a few minutes, I had only an hour more until I got home—in plenty of time to get up at 4:30 the next morning. That was the life!

Top power on the Missabe in 1916 were huge 2-8-8-2s, still compound but by then fitted with mechanical stokers. Some new 2-10-2s had stokers and grate shakers. The crossovers and wye curves were too short for these great engines and they wouldn’t stay on the track. To avoid derailing, men with greasy rags on sticks lubricated the rails on the wyes.

Nos. 319–350 were Consolidations with fireboxes over the drivers. By 1916 they had been fitted with generators and superheaters. The 300’s, up to about 318, were 2-8-0s with between-the-drivers fireboxes, and they used saturated steam.

I caught the 332 for a turn of ore. My hog-head was, by reputation, a rapper. We left our empties and picked up 65 loads at the Hull Rust yard. Climbing out of Hull Rust without a helper was easy. I felt good, which was a mistake. When we got on the flat muskeg—the “hemlock drag”—we didn’t drag. We did something like 45, and those low-wheeled Consolidations weren’t built for that. The firedoor was too big and too close to the deck and to the grates. The terrific heat burned my overalls and my left foot through my shoe. Worked at too long a stroke, that short engine had a superheated exhaust that was fierce enough to give me a bad headache. When the engineman patted me on the shoulder and said, “That’ll take her in,” the words were sweet. Next day I was sent, much to my relief, to the north end.

Two Consolidations, Nos. 306 and 309, left an impression. The 306 was a free-steamer; after it had been sitting for hours, a few scoops of coal would raise immediate pressure. One could have a thin fire of slack coal and still have plenty of steam. Once the draft was so strong it nearly cleaned the grates! The 309 was sluggish. She would heat up in time, and there was ample steam after the throttle was closed. She formed clinker quickly. A

half hour after the fire had been cleaned the door would slam shut, showing that little draft was getting through the grates.

That fall my roustabout job nights was with the 306. The engineman was young and a fast runner—too fast. We delivered empties and picked up loads from a new open pit mine. From the mine there was a curve where, when the track was new and stiff, one pair of drivers slipped off the rails three times in one day. Then we went through a bog where the grade was filled each day and sank 6 inches or so each night.

We joined the northbound main facing traffic just south of the Hull Rust yard. The loads had to be pulled over the switch—southbound over the northbound tracks—and I was the flagman, since the two brakemen were back on the train. The only clue to a northbound train was light on the sky beyond the hill to the south. Sometimes an extra showed over the hill while we were on the main, and since there were no signals I had to run out, light a fusee, and hop back on as quickly as possible.

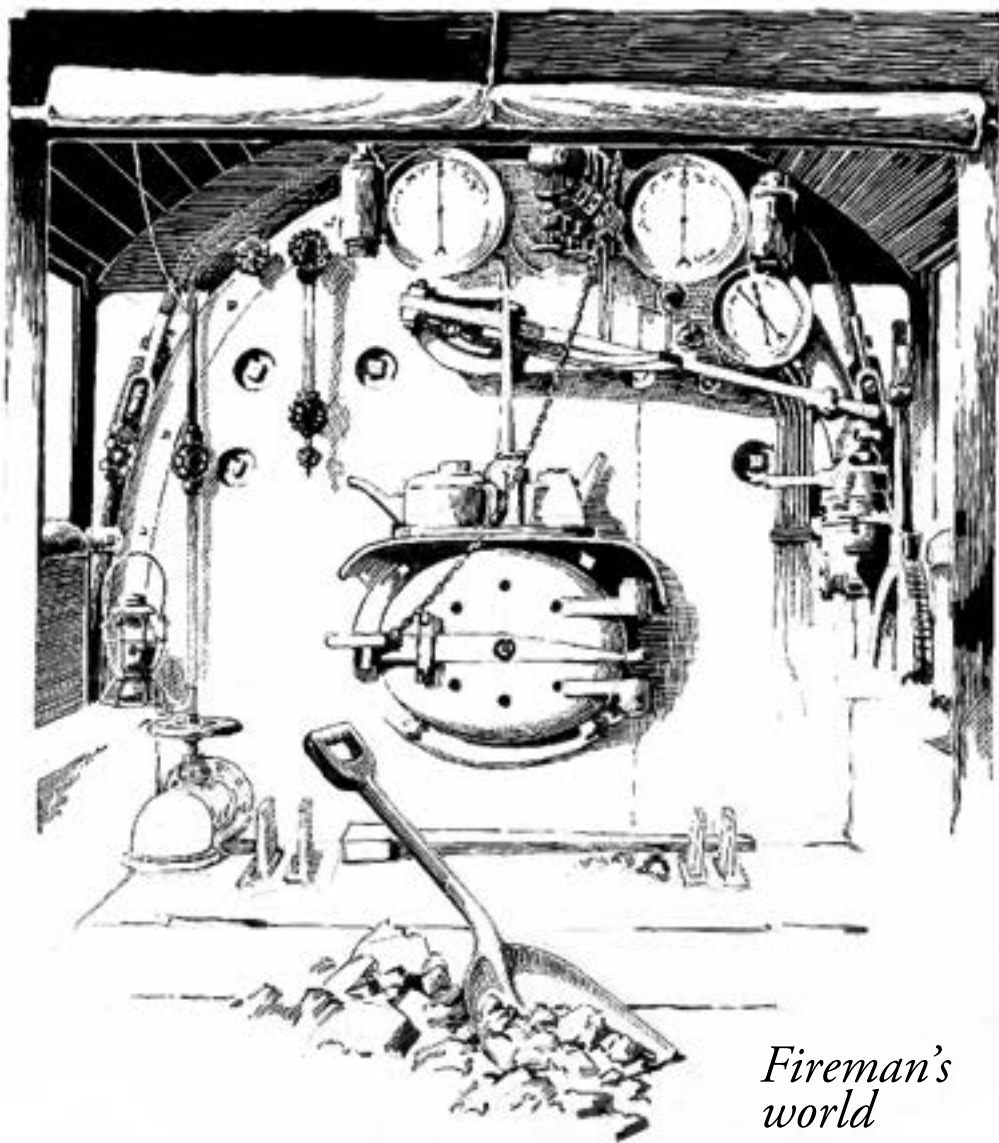
One dark night the conductor, who was walking down through the yards, asked us to pick him up when our work was done. With a caboose back of our tender, we backed much too fast down a track that looked clear to all of us. It wasn't—there were loads on it. Two brakemen were in the caboose. Fortunately, the conductor way down the track saw what was happening. He swung his lantern so hard that its flame went out, but the engineman saw it and stopped. It was a near thing. The brakemen could not possibly have survived.

October was usually a bad month for snow. Snow results in slippery rail much more so than with rain—and when there is snow in the coal it won't slip off the scoop readily. Canvas was hung over the gangways and the back of the cab. This had to be rolled up each time I put in a fire.

When the 306 had four broken staybolts in a group right in front of my seat we had to run her down to Proctor light one Sunday forenoon. The shop repaired her and she doubleheaded the local back that same night. They looked for me, but luckily I was at a vaudeville show in Duluth—my first entertainment in months.

Occasionally I fired the varnish. The passenger crew pulled in on the wye at Mitchell, making a straight-air stop, leaving the air on the cars. Any engine working in the neighborhood grabbed the rear and ran the 2 miles to Hibbing, while the regular crew ate lunch and oiled around.

The schedule for the 2 miles to Hibbing was 4 minutes. This included a stop at the Great Northern crossing, a station stop, and a stop at the Winston Deare crossing. No engine built could haul six steel cars 2 miles with four starts and four stops in 4 minutes. But we tried, and ended up with little steam, fire, or water.



Fireman's world

For two weeks we hauled gravel out of the Hull Rust pit to help fill the previously mentioned bog. Johnson, my engineman, was easygoing. While we were loading flatcars with a steam shovel he would sit with his feet up on the air valve reading Western novels. Since we had to spot a car several times to load it, I would say, "Back up," and he would kick off the air with his foot; the cars would roll back. "That'll do." He'd kick it on again without looking up.

An engineer named Jones and his fireman who had been working together carried out a two-man strike. They had had it with the boarding house at Mitchell—which truly was nothing to boast about. One evening Jones and his fireman objected to the meat at the boarding house, saying it was "dog meat." What they meant was that the meat was fit only for dogs. But a dog had been killed in the yards the day before, so you can guess what the proprietor thought they implied. The two men went to Hibbing for dinner while the superintendent settled the "strike."

On my last two days of railroading I fired for Jones on a little Ten-Wheeler. It had exploded some years before, blowing the boiler off the right of way without killing the engineer. He was, however, partially disabled and became the roundhouse foreman at Proctor.

The 4-6-0's injector wouldn't work if the tank was less than half full, and there was a patch on the fire side of the crown sheet, but Jones could handle that engine. Where others would make two or three runs trying to push cars up onto the various coal docks, working water in the cylinders in the process, Jones pushed them up with no trouble at all. It was magic. He taught me how to fire an engine, working a light throttle. A few days more with him and I would have been a real fireman.

But I was called back to Proctor where, rather than catch a cold-weather trip on one of the 2-8-0s (all of which needed attention from the shops), I laid off. By the time the ore season began in 1917, World War I had started for us. That took me away from Minnesota, and I never went back to railroad work. ■

STEAM *photos*



RACING HUDSONS: In an extraordinary Kodachrome from 1939 or '40, two 4-6-4s race east on the Burlington Route's triple-track main line just west of Western Springs, Ill. Out in front for the moment is a standard Hudson with a heavyweight consist, while catching up is one of the two streamlined S-4A's, pinch-hitting for a diesel on the stainless-steel *Denver Zephyr*. Today, the Tri-State Tollway goes underneath BNSF's triple-track near this spot.

H. W. BARBER, BILL BARBER COLLECTION





MID-AMERICAN MONARCH: Illinois Central 4-8-2 2619 strides north with a freight near Richton Park, Ill., in September 1955. As the last of the 20 2600-series Mountain types built at IC's Paducah, Ky., shops during 1942-43, this was the final steam locomotive to join the IC roster.

GEORGE KRAMBLES, KRAMBLES-PETERSON ARCHIVE





WATER TOWER A Chicago & Illinois Midland 2-10-2's tender is filled from a classic lineside wooden storage tank at Cimic, Ill., in 1951.

WESLEY N. STEAD

Water holes for **IRON HORSES**

More is involved in supplying the railroad with water
than merely turning on the faucet

BY **KINCAID HERR**

Water is something the American public takes for granted, with an occasional reminder from the local water company that it is not quite as free as air. This is correspondingly true even of some railroaders, who may feel that their employer has solved its water problems when it has assured itself of a plentiful supply of *aqua pura* for the coolers in the day coaches. Such a concept has no relation to reality; in fact, water is a peer of coal, wood, and steel, for water makes steam and steam makes the wheels go!

In 1940, the Louisville & Nashville alone used nearly 3 million tons of coal for converting water into steam and for other purposes. This would make a sizable fire in anyone's furnace. However, the road's parallel use of more than 7 billion gallons of water would have been amply sufficient to have quenched this blaze. Seven billion gallons is obviously a lot of water, and its procuring, storing, treating, and subsequent supplying to locomotives and shops, and various other thirsty facilities, is one of the biggest jobs the railroad has. In fact, of the thousands of commodities the railroad uses annually, water not only weighs the most in the aggregate, but is the greatest in volume as well; the water used annually on the L&N alone would form a lake 1 mile square and 35 feet deep.

Water in an ideal state may deserve the appellation "H₂O" and it may then be *aqua pura* all right, but ordinary run of the mill water, such as you might encounter in a brook in your neighborhood, has a number of other ingredients whose presence in excess can play hob with the efficiency of a locomotive.

The old-time railroaders gave scant attention to the quality of the water they dumped into the tenders of their locomotives. It is said that, prior to the turn of the century, fish and other forms of marine life often found their way into the water tanks and subsequently into the tender tanks of locomotives. Today, however, the proper treatment of water is a prime consideration. Much money is spent annually for chemicals and for water treating installations that will remove harmful ingredients.

The L&N stores its water in huge tanks. Generally, these tanks have a capacity of 63,600 gallons and are of creosoted pine construction. The tank proper is 24 feet in diameter and 18 feet 9 inches deep, and rests upon a timber framework that is 22½ feet high. On the southern end of the system, where freezing is a factor that can be disregarded, the tanks are frequently not covered—evaporation and rainfall just about balance each other. Tanks formerly were smaller; a few of 50,000-gallon and 20,000-gallon capacity



WATER COLUMN Connected to a single tank by underground piping, water columns could be placed throughout an engine or passenger terminal to serve several tracks.

CLASSIC TRAINS COLLECTION

still linger in service. L&N also has a few behemoth tanks at points such as DeCoursey, Ky. (near Cincinnati); Boyles (Birmingham), Ala.; and Howell (Evansville), Ind. These are of steel construction and have capacities ranging from 100,000 to 200,000 gallons. A shop such as DeCoursey or Boyles will use nearly a million gallons of water a day and think nothing of it.

In all, the 5,200-mile L&N has 280 water stations along its line and at its various shops. These function as "middlemen" between the sources of supply and the engine tenders. The water is pumped into them by a variety of methods. Of the 280 stations, 99 receive their supply from outside sources; in these cases the water is kept at a certain level in the tank by pressure and by a float arrangement. The others break down this way: 119 have their water pumped to them by steam-operated

pumps, 2 by oil-operated pumps, 1 by a hydraulic ram, 22 by electric pumps, and 37 by gravity. The present trend in water station pumping facilities is toward electrification, for this type of pumping station costs less to operate and works automatically.

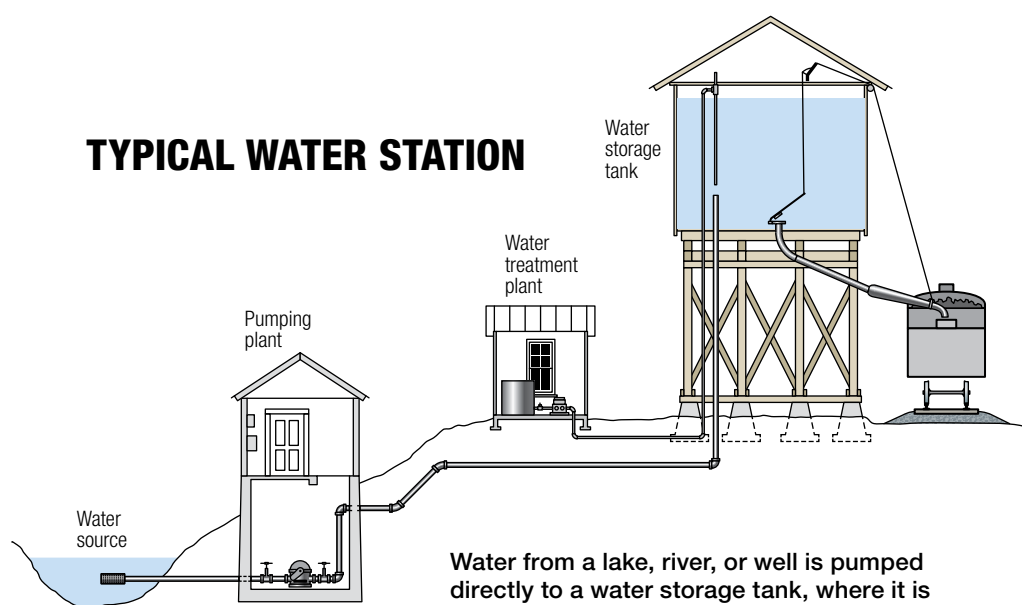
Generally speaking, the water tank is the key structure in a group of facilities that function to supply suitable water to locomotive boilers. The water is removed from the source by huge intake pipes that are screened to keep out "undesirables," as, indeed, are the tanks on the locomotives. The source may be a company-owned lake, or it may be a river, creek, well, pond, or spring.

The water is pumped rapidly and in enormous volume, some of the pumping being done at the rate of 800 to 1,000 gallons a minute. Where the pumping is done by steam, the filling of the tanks is supervised

This article, adapted from one in *L&N Magazine*, appeared in the June 1944 issue of *TRAINS* magazine.



TYPICAL WATER STATION



Water from a lake, river, or well is pumped directly to a water storage tank, where it is mixed with a treating solution pumped from an intermediate treating plant. Lowering of the spout to the tender filling position automatically opens a valve in the bottom of the tank.

by pumpers who tend the boilers and do other work around the stations. The L&N has about 200 of these pumpers. Some water stations work three shifts daily; others where the work is lighter have only the part time services of one pumper, who takes care of two stations. Sometimes the pumping machinery is installed very close to its water tank; frequently it may be several miles distant and may supply two or more tanks. At the pumping station at Dortha, Ky., for instance, a 14-inch pipe extends for nearly 4 miles to a reservoir near Corbin.

In recent years the L&N has made an effort to ensure that the water supplied to its locomotives and other facilities is of a suitable quality; hence a water softening plant is generally situated adjacent to the water tank. Housed in a modest shed, this plant consists of a cylindrical drum for the chemicals and various valves and pumps that work automatically, synchronized with the intake valve on the water tank. Thus, when a tank takes a replenishing gulp of 10,000 or 20,000 gallons, the softening plant spices the drink with a chemical solution that will neutralize, pre-

TRACK PANS By far the two most extensive users of track pans for non-stop watering were the New York Central (pictured here) and Pennsylvania.

CLASSIC TRAINS COLLECTION



TREATMENT On the N&W at Hagerstown, Md., a crewman tosses balls composed of water-treatment chemicals up to a colleague for him to drop into the tank of a Y6b.

JIM SHAUGHNESSY

precipitate, or remove those elements that might decrease the efficiency of a locomotive by eating through its boiler tubes or by depositing a scale coating on the tubes and boiler. Water treatment has proved to be so efficacious that engine failures have been vastly reduced and the lives of locomotive boilers and flues have been greatly extended.

Since water varies so greatly in its composition, a chemical solution that might be suitable for one type of water would not be for another, and water from the different sources must be analyzed periodically. L&N maintains laboratories at Louisville, Lexington, and Birmingham for this work.

The chemicals are shipped in the form of balls, bricks, powders, or liquids to the wayside softening plants and are there introduced into the water in accordance with the analysis previously made. While some water stations have softening plants, others have a bypass feeder arrangement positioned next to the tank's frost-proof box (a housing around the pipes to keep them from freezing), by means of which the water being supplied to the tank passes through a tank

containing the chemicals.

A few stations do not have a softening plant of any sort, either because the water itself is of a good quality or because the demands upon the station are very light. Since nearly all water contains a certain amount of mud, it is necessary periodically to empty the tanks and clean the interiors. The same result is achieved in locomotive boilers by the blow-down system. This operates while the train is in motion and removes not only mud, but the sludge, or deposit, caused by the chemical precipitation of the harmful ingredients in the water, and supplements the usual periodic boiler washouts at the roundhouse.

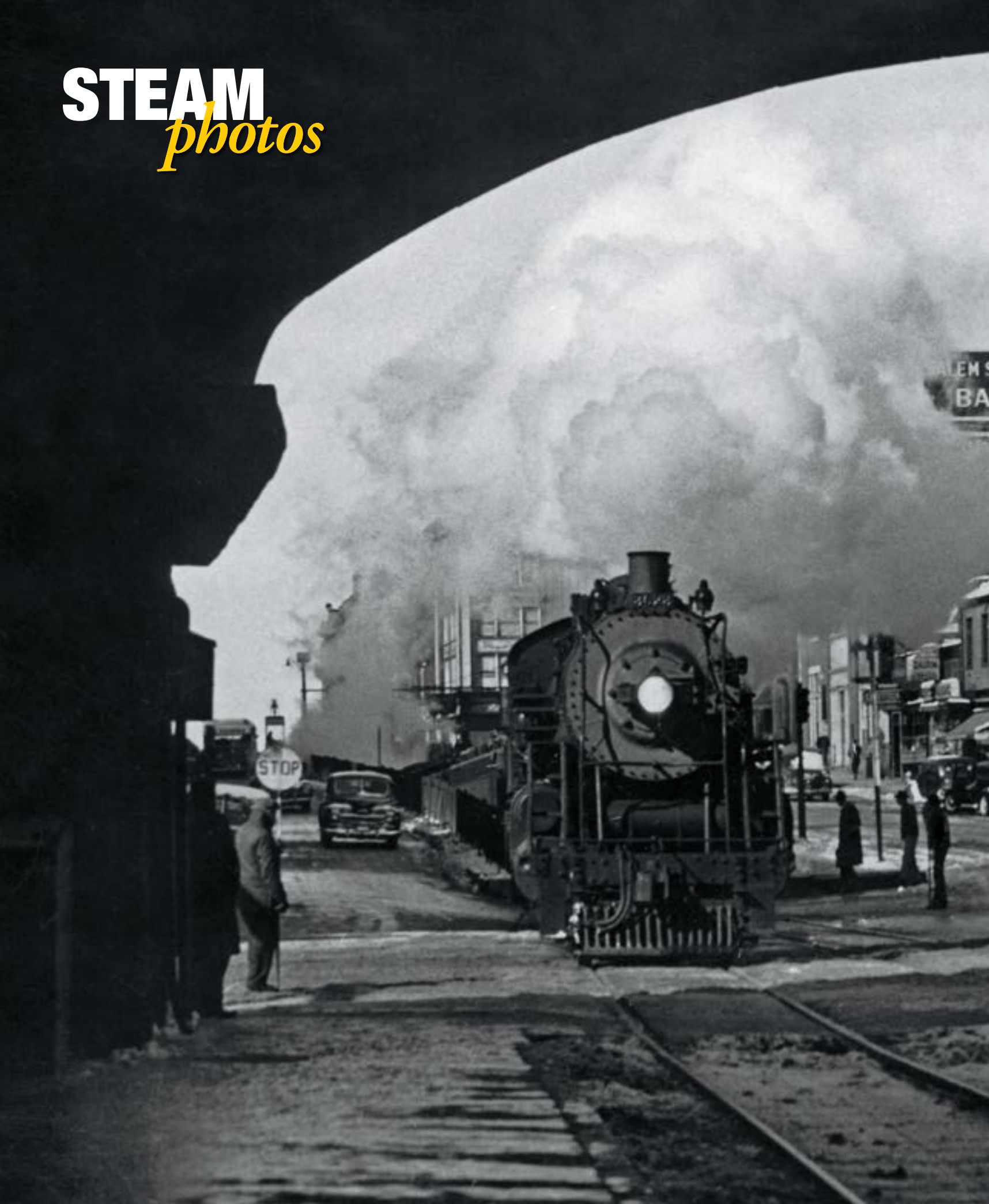
In addition to supplying water directly from a trackside tank, some railroads also use water columns or "cranes," which operate on much the same principle as a water faucet, from a nearby tank. The water, seeking its own level, is forced upward and gushes out of the spout when the fireman or hostler opens the valve. Chief advantages of water columns or crane are that they take up less room than the water tanks and that several of them can be served by one tank.

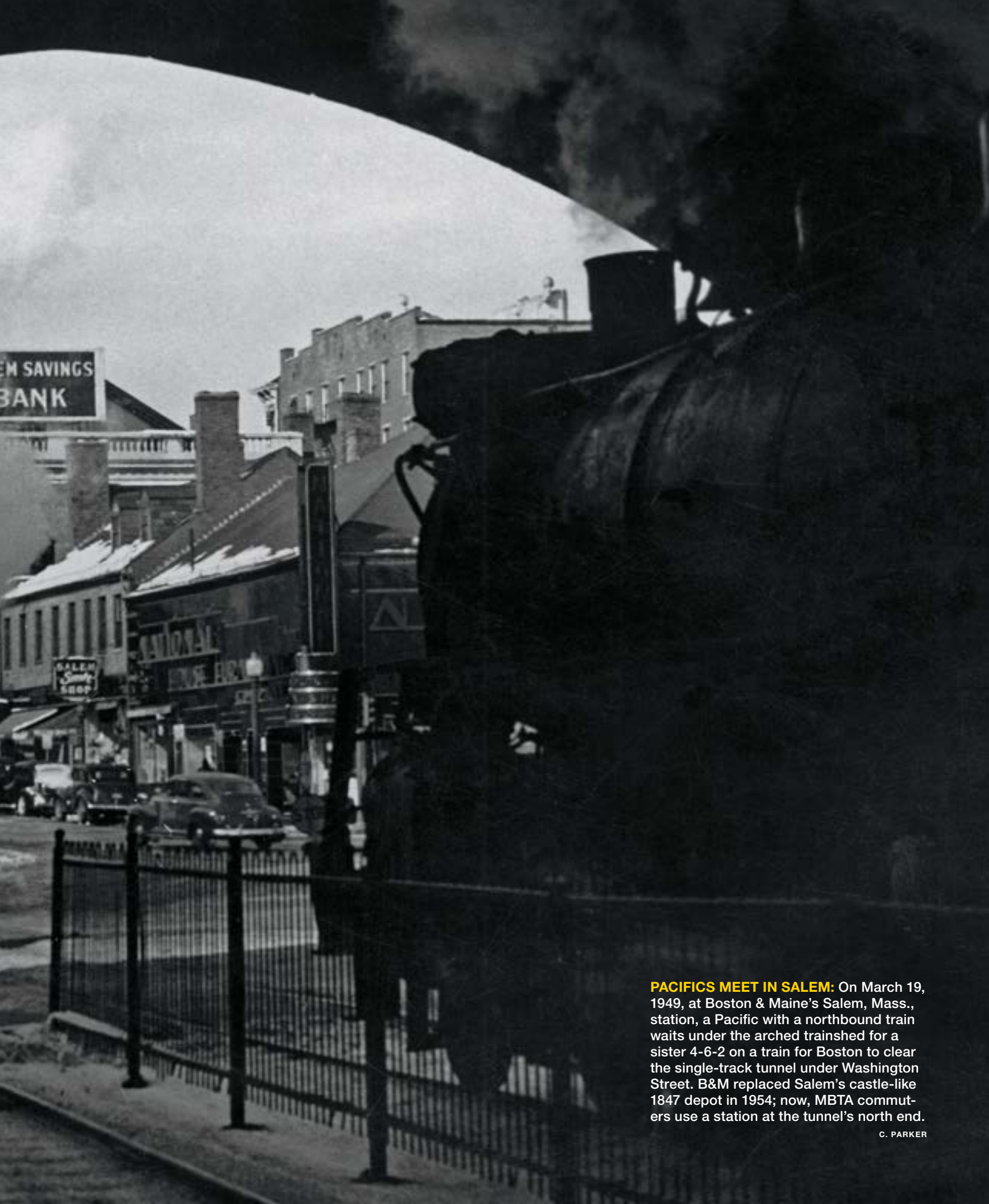
Some railroads, chiefly in the East, supply their locomotives with water from long troughs that are positioned in the center of the track and which enable the engine to take a multi-thousand-gallon gulp while traveling at speed. Nonstop operation is also achieved by the use of tenders in tandem or of super-sized tanks. L&N Pacific No. 275, which hauls the *South Wind* 205 miles nonstop between Nashville and Birmingham, has a tank capacity of 20,000 gallons, about double that of an ordinary tender.

An important man in this business of carrying water to the iron horses is the pump repairman. His title is not completely descriptive, it being his responsibility to maintain all the various pieces of water supply equipment, ranging from drinking fountains and wash basins to pumps, supply lines, tanks, and spouts. Each division has three or four pump repairmen and their helpers.

Although locomotive fuels vary by region or railroad, all steam locomotives depend on water for their power. To ensure an adequate supply, railroads spend millions each year on water holes for their iron horses. ■

STEAM *photos*





PACIFICS MEET IN SALEM: On March 19, 1949, at Boston & Maine's Salem, Mass., station, a Pacific with a northbound train waits under the arched trainshed for a sister 4-6-2 on a train for Boston to clear the single-track tunnel under Washington Street. B&M replaced Salem's castle-like 1847 depot in 1954; now, MBTA commuters use a station at the tunnel's north end.

C. PARKER

The *amazing* **LOCO VALVE**



Scientific locomotive operation: How a device created 80 years ago boosted power output, reduced track maintenance problems, acted as an event recorder, saved fuel, and helped expedite time-sensitive freight

BY **CHRIS ZAHRT**



PILOT

The distinctively shaped Valve Pilot cam box can be seen at about the 10-o'clock position outside the middle driver of J-1 5247, on train 303 near Springfield, Ohio, in 1955. Inside the cab (of an SP AC-12, inset), an instrument box housed recording tape and sported a face calibrated for miles per hour with two hands, one indicating speed, the other the cut-off setting.

MAIN PHOTO, J. PARKER LAMB; INSET, BALDWIN



Whenver it is said that an engineer is a great runner, he is really being complimented for knowing the proper cut-off to use at the proper time. The reason this skill commands such respect is that it is notoriously hard to master. As B. B. Milner, Engineer of Motive Power & Rolling Stock for the New York Central, lamented, "One of the most important factors in locomotive operation and one to which very little

attention has been paid is the 'science' involved in selecting the proper cut-off. . . . To spend time and money in the arrangement and design of a locomotive which in these days of 'high living costs' represents an investment of say \$60,000 or more, and then turn such an engine over to enginemen to run 'catch as catch can,' so far as concerns cut-off selection, is not very creditable."

Steam-era railroaders were acutely aware of this problem. Every aspect of steam loco-

motive performance, such as fuel and water consumption, drawbar horsepower, and speed, is dependent upon the proper selection of cut-off. Cut-off is the point at which the valve gear closes the main valve, stopping the admission of steam into the cylinder. Cut-off is expressed as a percentage of piston stroke (total piston travel). For example, if a valve closes after the piston has moved 14 inches on an engine with a 28-inch stroke, the engine is being run at 50 percent cut-off.



Capacity tests of 1919 on the P&LE with an H-9 2-8-2 (like No. 9593, top) helped determine optimum cut-off settings and led to cut-off/speed cards for engineers. A few years later, tests with H-10 156 (above) established the importance of constant back pressure.

TOP, JOHN P. AHRENS; ABOVE, ALCO

Cut-off is variable, and it is changed by moving a control called the reverse lever. In railroad slang, when the cut-off is shortened, (moved to a smaller percentage) it is called "hooking up." When the cut-off is lengthened, it is called "dropping down."

Varying the cut-off varies the tractive effort (pulling force) of the locomotive. Long cut-offs develop maximum tractive effort. However, as speed increases, a long cut-off will consume more steam than the boiler can produce. Therefore, the cut-off is shortened as the locomotive accelerates. For each speed, there is only one specific cut-off that will yield maximum horsepower. Unfortunately, until the 1920s the only way of determining this cut-off was "catch as catch can." Engineers relied on their experience, the sound of the exhaust, and the feel of the engine to determine when to hook up or drop down. Reliance on such subjective quantities caused locomotive performance to vary widely. Tonnage ratings were therefore based not on locomotive capacity, but on crew capability. There had to be a better way.

PULL-SPEED TESTS ON THE NYC

In 1919, determined to solve the problem of cut-off selection, the New York Central commenced a series of dynamometer-car tests to determine precise speed and tractive

effort characteristics of several classes of locomotives. A dynamometer is a car with a precisely calibrated hydraulic cylinder attached between its draft gear and frame. The pulling force of a locomotive can be determined by measuring the hydraulic pressure in the cylinder. A dynamometer car also has a highly precise speedometer. Mechanical engineers would use these instruments to plot "pull-speed" curves for the locomotive being tested.

Traditionally, the dynamometer was coupled between the locomotive and its train, and the train was run a specified distance. This documented the instantaneous power developed by the locomotive. However, it did not yield very accurate pull-speed curves, for it was nearly impossible to maintain a constant speed when the trailing tonnage approached the locomotive's maximum capacity. Upgrade, the engine would slow. Downgrade, the power output would drop to insignificance.

For the NYC tests, a second engine, called the "brake locomotive," was coupled behind the dynamometer. The engines were then coupled to more tonnage than the test locomotive could pull unassisted. The second engine would be worked just hard enough to keep the speed constant while the test locomotive handled the majority of the load.

Long periods of constant-speed running eliminated the data irregularities inherent in traditional dynamometer testing. Therefore, these "capacity tests," as they were termed, yielded highly accurate pull-speed curves. Performing these capacity tests at a variety of fixed cut-offs allowed the NYC to determine the precise cut-off needed to generate maximum horsepower at each speed.

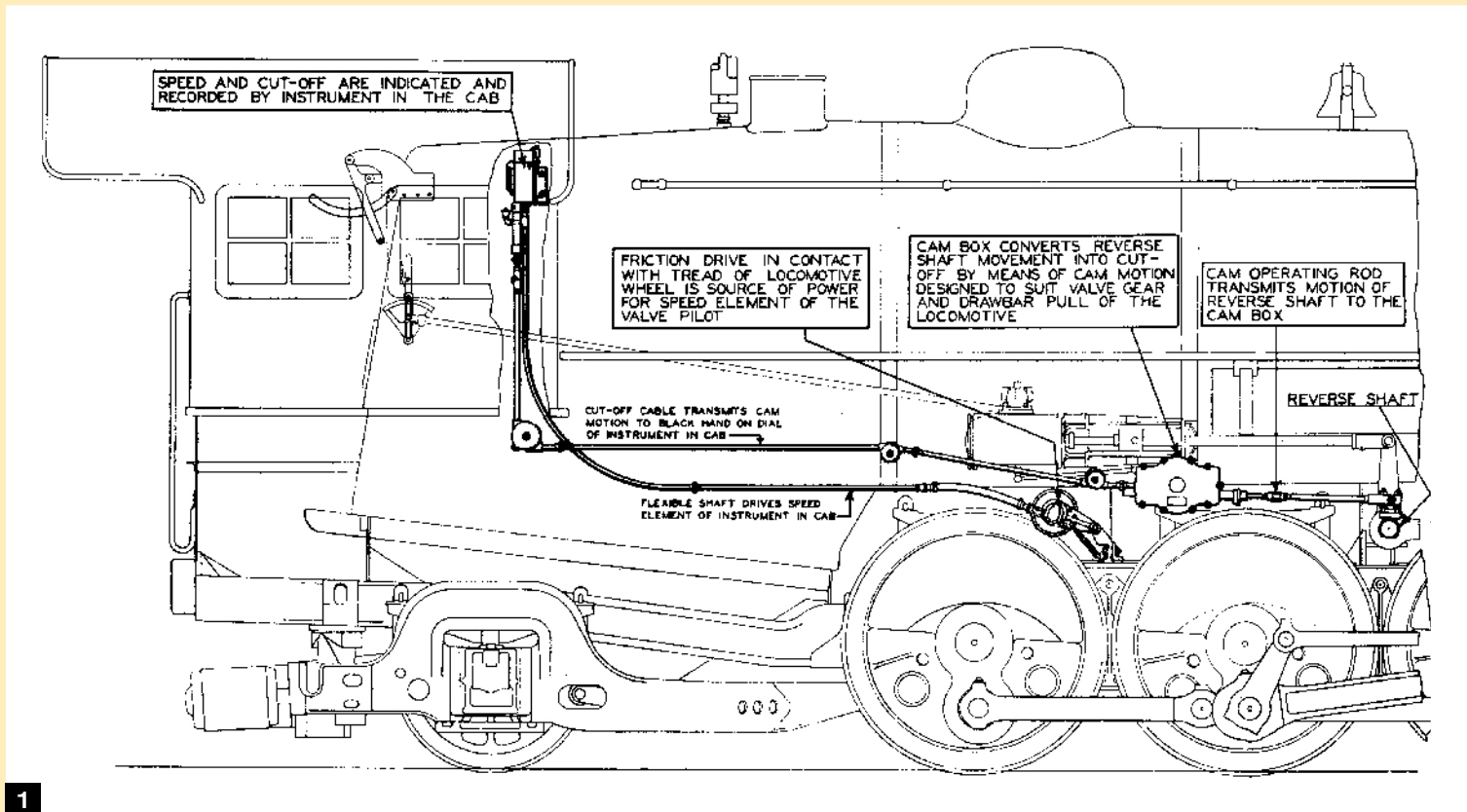
After these tests, the NYC decided to "see what there was in this cut-off selection proposition," as B. B. Milner recalled. A 77-car freight train was assembled on NYC subsidiary Pittsburgh & Lake Erie, and a dynamometer car was attached. Then an engineer whom Milner characterized as "very good" attempted to take this test train over a short, steep grade. The engineer made a run for the hill, and the H-9 2-8-2 thundered onto the grade at 17 mph. It was like hitting a brick wall. The engine struggled to a halt in less than a train length. The train backed off the grade for a second attempt. In this test, cut-off selection was determined by the officials in the dynamometer car. They unrolled the speed-pull curve for the 2-8-2 and gave the engineer the highball.

Once more the H-9 assaulted the grade, and once more the speed began to flag. Acting on orders from the dynamometer, the engineer began to "drop down." The point where they had stalled during the previous run was passed at 8 mph, but speed was falling rapidly. The final signal came, and the engineer put the reverse lever "down in the corner." With the locomotive running wide open, the speed dropped to 5 mph . . . and then started to rise. They had crested the grade. The capacity tests had proven their worth. If engineers could be told exactly when to hook up or drop down, the power of a locomotive could be increased without even picking up a wrench.

Therefore, "vest-pocket cards" that tabulated the correct cut-off/speed relationship for a variety of locomotives were distributed to NYC engineers. Unfortunately, the cards proved unwieldy in operation. They required the engineer to determine his speed by counting revolutions of the drivers in a specified number of seconds, and to then adjust the reverse lever by counting notches on the reverse-lever quadrant. Pragmatically, Milner stated, "It must be freely admitted that the very neat selection of cut-offs from this card information cannot be expected or depended upon, because . . . enginemen have other matters for their thought and time." A. A. Raymond, NYC Superintendent, Fuel & Locomotive Performance, put it more bluntly, "In a couple of months we couldn't find the cards."

While the cards were ultimately ineffectual, they were the first significant attempt to remove the guesswork from cut-off selection. They had shown the tantalizing possibilities of scientific locomotive operation. Moreover,

Loco Valve Pilot



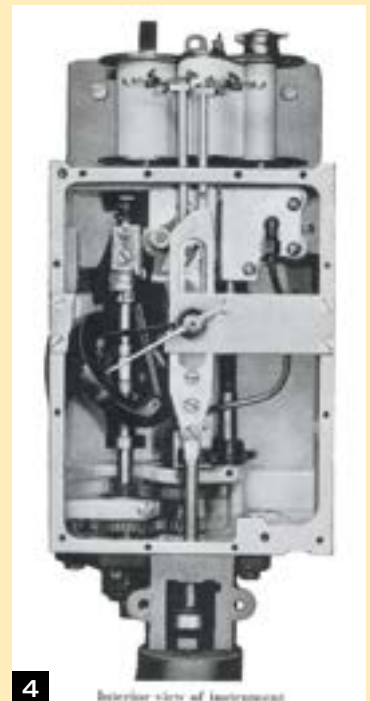
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2



3



4

Interior view of instrument

A schematic drawing (1, top) shows the general layout of the Loco Valve Pilot apparatus. The three principal elements were the friction speed drive (2), the cam box (3, with cover removed to show the cam), and the indicating and recording instrument in the cab (4, also with cover removed). The friction speed drive measured the speed of the locomotive by means of a small wheel that contacted one of the driving wheels; this was transmitted by cable to the instrument in the cab, where a red hand on the face indicated speed in miles per hour. The cam, which was custom-shaped for the particular locomotive class on which it was to be used, was linked mechanically to the engine's reverse shaft. The motion of the cam imparted by the reverse shaft was fed to the cab instrument, where it caused the black cut-off hand to rotate on the face. By adjusting the cut-off in relation to speed, an engineer could work his engine for maximum power or efficiency. The top portion of the cab instrument housed a roll of tape on which pencils recorded speed and cut-off settings during the run.



The cam box above the rear driving wheel identifies ACL 4-8-4 1807, heading out of Richmond, Va., with a freight on May 31, 1949, as a Valve Pilot-equipped engine.

AUGUST A. THIEME JR.

the data obtained during these tests proved so valuable that capacity tests became a New York Central tradition until the end of steam.

THE BACK-PRESSURE GAUGE

The next significant step in the quest for scientific locomotive operation was the installation of back-pressure gauges. "Back pressure" is the technical term for exhaust steam pressure. Although some back pressure is needed in order to create draft for the fire, it is undesirable because it opposes the force of the live steam on the opposite side of the piston. The higher the back pressure, the less power the locomotive can develop. At constant cut-off, back pressure increases as the throttle is widened, because higher pressure steam is admitted into the cylinders. As cut-off is lengthened at constant throttle, back pressure will increase because more steam is being admitted into the cylinders. Finally, as speed increases, back pressure increases because there is less time for the steam to escape the cylinder.

Because back pressure depends upon throttle setting, cut-off, and speed, it provided a simple way to quantify the locomotive's overall performance at any particular

instant. Beyond that, however, it didn't provide the engineer with much additional information. If anything, it added to the confusion surrounding proper locomotive operation. As one frustrated engineer observed, "There are many different opinions relative to this matter, ranging all the way from 5 to 25 pounds being considered the most efficient. Even our officials do not agree, as on one division the road foreman of engines instructs the men to maintain 10 pounds back pressure, while on another division the road foreman's instructions are to maintain 17 pounds back pressure."

The breakthrough was the formulation of the constant back-pressure theory. While possibly understood as early as 1919, it was best described in R. W. Retterer's groundbreaking 1925 paper "Back Pressure as an Index to Fuel Economy." Retterer, a mechanical engineer on NYC's Big Four subsidiary, presented extensive test data obtained from a 2-8-2. His key finding was that whenever the locomotive was developing maximum horsepower, its back pressure was a virtual constant independent of speed. Therefore, to get maximum capacity from their motive power, railroads merely had to determine the proper back pressure for each locomotive class.

Retterer devised a brilliantly simple method of doing just that. An H-10a Mikado, No. 156, was coupled to a test train of 2,462 tons.

As the train was accelerated from rest, a constant back pressure was maintained by manipulating the reverse lever. After traveling 10,000 feet, the speed was noted and the train was stopped. Then it backed to the starting point, a higher back pressure was specified, and the test began again. After six runs, it was found that the engine developed its maximum horsepower at a back pressure of 13 psi.

Armed with this information, Retterer then pitted the back-pressure gauge against the Sandusky Division's most efficient engine crew. In this test, engine 156 was overloaded by 200 tons and the engineer was instructed to take it over a .74-percent grade using his best judgment. The train stalled. After backing to the starting point, the 156 again assaulted the hill. This time, the back pressure was maintained at 13 psi. The H-10a crested the hill with ease, and used 12.6 percent less steam in the process. Scientific locomotive operation had finally been achieved.

The constant back-pressure theory was arguably the first improvement in locomotive operation since the invention of the variable cut-off valve gear nearly a century beforehand. For the first time in history, locomotive performance was both optimized and repeatable. This meant higher tonnage, lower coal consumption, and more profit. Back-pressure gauge proponents could be found both in the board room and in the cab. As

the NYC's E. R. Boa observed, "Our engineers think [the back pressure gauge] is the only thing on the locomotive." An efficiently run engine made life a lot easier in the left-hand seat as well. G. H. Likert, a Fuel Engineer on the Union Pacific remarked, "It was encouraging to note the interest that our firemen took to see that the engineers did go to the 25% cut-off and the standard back pressure as quickly as possible and to work the engine at that point as much as possible."

However, the back-pressure gauge was not without its problems. Valve oil in the exhaust steam could plug the line from the cylinders. Cold weather could freeze condensate in the line, rendering the gauge inoperative. More seriously, if the back pressure varied by more than 1.5 psi from the standard, maximum performance could not be achieved. It proved difficult to maintain the gauge at this level of accuracy. The pulsating exhaust pressure subjected the gauge to rapid and repeated shocks, causing wear or outright failure of its delicate mechanism. One railroad reported difficulty keeping a gauge calibrated for even 30 days.

Not all the problems were mechanical in nature. As the Baltimore & Ohio's Frederick Kerby groused, "You cannot get the engineers to read it at all times." While the gauge was well received by many engine crews, there was also an appreciable percentage of blowhards who "knew how to do it and didn't need no help." One would surmise that these were exactly the same engineers who needed the gauge the most.

The biggest problem with the back-pressure gauge was the dawn of the Super Power era. The increased steam generation in high capacity Super Power boilers rendered the constant back-pressure theory obsolete. Tests showed that over a range of speeds, back-pressure values could vary 15 psi or more when an engine with an enlarged grate was producing maximum horsepower.

ENTER THE LOCO VALVE PILOT

In 1920, Virginius Z. Caracristi applied for a patent for a "Valve-Cut-Off-Correction Instrument for Locomotive." Caracristi, an engineer of widely ranging accomplishments, had designed the Wheeling & Lake Erie's Brewster (Ohio) Shops, served as B&O's Assistant to the General Superintendent of Motive Power, and had worked with famed consultant John Muhlfeld. Over the next several years, Caracristi refined his design, and around 1925 the Distance Speed Recording Co. convinced the Erie Railroad to try a prototype device christened the Loco Valve Pilot. The test proved unsuccessful, and the device was removed in early 1927. Later that year, the NYC purchased an improved version of the Loco Valve Pilot.

In its final form, the Valve Pilot was a small yet complex mechanism that allowed maximum horsepower to be developed by



The Valve Pilot was an economical way for cash-strapped roads to boost the output of their engines. One example, NYO&W 4-8-2 452, works west at Stony Ford, N.Y., in 1942.

DONALD W. FURLER



Maine Central 4-6-2 470 steams into Waterville, Maine, on her final run, a June 13, 1954, excursion. She's displayed here today, Valve Pilot box still under her right running board.

WATERVILLE (MAINE) SENTINEL

indicating the proper cut-off for any speed. The Valve Pilot consisted of three main parts: a cam, a friction speed drive, and an indicating and recording instrument, which was located in the cab. The most prominent feature of the indicating instrument was a dial with two colored hands on it. The red hand indicated speed and was driven by the friction speed drive, which bore against one of the locomotive's driving wheels. The black hand indicated the proper cut-off, and it was controlled by the cam.

The indicating instrument also contained the Jazz Age equivalent of an event recorder. Located above the dial was a roll of graph

paper, a "cut-off" pencil, and a "speed" pencil. An intricate linkage caused the pencils to move in exact relation to the hands on the dial. When the locomotive was in motion, the paper on the roll would unwind at a rate of ½ inch per mile. The paper would pass under the pencils, producing a chart. At the end of the run, this paper "tape" would be removed, and the pencil lines would show exactly how fast and at what cut-off the locomotive was operated during its trip.

The cam was the heart of the Loco Valve Pilot. Its profile was specially machined for each class of locomotive it was applied to. The profile was determined through a com-



Wheeling & Lake Erie 2-8-4 6402 on train 96 gets orders at Warrenton, Ohio, in July 1949. The K-1's Valve Pilot cam box is just above operator Johnnie Dietrich's right shoulder.

J. J. YOUNG JR.



The customary location for the cam boxes was under the right running board, as on 0-10-2 303 (above middle driver), one of five built in 1936 for Pittsburgh's Union Railroad.

BALDWIN

plex formula that utilized valve gear measurements as well as speed-pull curves for the engine. The cam moved synchronously with the valve gear as the engine was hooked up or dropped down. The motion of the cam was transmitted by wire cable to the instrument, where it caused the black cut-off hand to rotate. If, for example, the reverse lever was moved to the 75 percent cut-off notch, the cam would cause the black hand to point to 17 mph. That meant for that particular locomotive, at 17 mph maximum horsepower would be obtained by running a 75 percent cut-off.

Essentially, the cam was a mechanical computer. Whenever he needed maximum horsepower, the engineer would simply adjust his cut-off so the black hand was in line with the red speedometer hand. When maximum horsepower was not required, the black hand was moved ahead of the red hand (hooked up) until the cut-off became so short that speed could not be maintained or the engine started "kicking" due to premature compression in the cylinders. This yielded maximum fuel economy.

Gone was the ridiculous complexity of the card and pocket watch method. Gone was the inaccuracy and ambiguity of the back-pressure gauge. Finally, the proper cut-off for each speed could be known with certainty and at a glance. Was this the answer the rail-

roads had been looking for?

To find out, the NYC ran a test with H-5f class 2-8-2 3785. In November and December 1927, the engine was operated in regular service on the River Division between Selkirk, N.Y., and Weehawken, N.J. On nine test runs, the Valve Pilot instrument in the cab was covered, and the engineers ran the engine as they normally did. The Valve Pilot was uncovered for the next eight runs, and the engineers were instructed on its use. After concluding the tests, Paul Kiefer, NYC's Chief Engineer, Motive Power & Rolling Stock, enthused that they demonstrated "a very nice saving in fuel." The Valve Pilot had emerged victorious, showing a coal savings of 8.2 percent per 1,000 gross adjusted tons per train-hour (an equal work basis). This was a revolutionary gain in efficiency, roughly equivalent to the economies generated by the feedwater heater.

The gain in power realized by the Valve Pilot allowed either the same tonnage to be hauled more efficiently, or a greater tonnage to be handled by the same locomotive. Before the test, an H-5 was rated for 2,900 tons on the River Division, and required a helper on the ruling grade at Haverstraw. After they were equipped with Valve Pilots, an H-5 was rated for 3,100 tons on the hill . . . unassisted. Such were the benefits of scientific locomotive operation.



Other railroads were quick to take notice of the revolution unfolding on the River Division, and quick to act. Within nine months of the tests, both the Central Railroad of New Jersey and the New York, Ontario & Western had purchased Valve Pilots. Others would soon follow, seeking greater efficiency or capacity. They were about to get more than they bargained for. As P&LE Superintendent of Motive Power Karl Berg observed, "There are a number of advantages in connection with this instrument that cannot be observed at first." His words proved prophetic. It wouldn't take long for the Valve Pilot to affect virtually every facet of railroading.

OPERATIONAL BENEFITS

No department was more profoundly affected by the Loco Valve Pilot than Operations. Management soon found that the paper tapes produced by the device's recorder were just as beneficial as the increased horsepower it enabled. These tapes recorded the



cut-off used by the engineer, and the speed attained over the course of his run. They were graduated in one-mile increments, so it was possible to determine exactly how the train was handled at any point on a run. Burton Flory, Supervisor of Motive Power for the NYO&W observed, "The Valve Pilot will enable you to check your engineers on speed restrictions. It will check them on their air brake operation."

Aware of the detailed train-handling information it recorded, management soon wondered if the Valve Pilot could also be used to check the fuel economy of its crews. By the 1930s, a new locomotive could cost \$100,000, and it could easily burn twice that amount in fuel over its lifetime. Obviously, fuel economy was of prime importance to management. Therefore, in 1928 the New York Central experimentally applied Valve Pilots to five class J-1 4-6-4s. These engines were used in passenger service, where speed, not tonnage, was of primary concern. The

experiment used the recorder to document how the Hudsons were handled on a large number of runs. By examining the cut-off used during the run, it was possible to determine how efficiently the J-1's were being operated. Efficiency increased as the engineer "hooked up" the valve gear.

The results were shocking. During one six-month period, only 10 percent of engineers attained a "Satisfactory" rating in fuel economy, which was defined as using cut-offs shorter than 30 percent. Subsequent tests on another railroad showed that only 14 percent of its engineers were operating locomotives efficiently, indicating that this was a widespread problem during the steam era.

Analysis of the tapes revealed that many engineers were using a constant cut-off and regulating their speed with the throttle. This is a horribly inefficient method of operation, roughly analogous to leaving your car in second gear and controlling your speed with the accelerator. Some of the guilty parties were

WM's colossal I-2 2-10-0s of 1924 became even more potent when fitted with Valve Pilots. No. 1114 helps a freight uphill at Helmstetter's Curve, west of Cumberland, Md., on today's Western Maryland Scenic.

STANWOOD K. BOLTON JR.

extra-board men with little experience, but surprisingly many were engineers with 20 to 30 years seniority. Why were the most experienced engineers also the most inefficient?

The key to understanding this paradox was the fact that most of these men had learned to run a locomotive around 1900. The locomotive of 1900 was very different from the locomotive of 1930. Typically, a turn-of-the-century locomotive was a high-pressure, saturated engine with Stephenson valve gear and a Johnson bar (manually operated reverse lever). Its large cylinders needed large valves to feed them, and large valves required a heavy valve gear to stand the resulting strain. When the engine was working at track speed, the inertial forces in the valve gear could wrench the lever out of the engineer's



Four classes of Rio Grande engines had Valve Pilots. A member of one, M-64 4-8-4 1701 (Baldwin, 1929) rushes toward Denver with train 3 near Larkspur, Colo., in 1938.

RICHARD H. KINDIG

hand the moment he unlatched it, making hooking up at speed positively dangerous.

Secondly, slide valves were harder to lubricate than the later piston valves. At shorter, more efficient cut-offs, the valves move relatively little. This makes it difficult for steam oil to coat the rubbing surfaces, especially at higher pressures. Significant valve damage could result from this imperfect distribution. A longer cut-off exposed more of the rubbing surface to the oil in the steam, resulting in better lubrication. Furthermore, the hydrostatic lubricators used at the turn of the century could become balky at high steam-chest pressure, which further discouraged full throttle operation.

For these reasons, an engineer in 1900 would likely be accustomed to partial throt-

tle operation. After the introduction of new piston-valve locomotives, many men failed to change the way they ran an engine. Valve Pilot tapes showed management it was time to teach old hoggies new tricks.

The tapes further revealed that even those engineers who knew how to properly operate a piston-valve locomotive typically hooked up too rapidly. This made it difficult to get a heavy train up to speed quickly. Valve Pilot Corp.'s John Bacon summarized, "[T]hough runners know in a general way what ought to be done, they do not know, without a guide, when or to what extent to do it."

Based on the results of this experiment, the NYC began an intensive instructional campaign. It equipped most of its J-1 fleet with Valve Pilots. When a locomotive finished its run, the tape was removed and sent to the Fuel Department for analysis. In addition to checking each engineer for economical operation, compliance with speed restric-

tions and train-handling instructions was verified by placing the tape next to a track chart. While the tapes conveyed large amounts of information, a man could analyze as many as 50 tapes an hour with a little practice. Only two employees were required to inspect every tape generated on the NYC. These men would compile a daily report, and notify the road foremen of any substandard performance. The road foremen would then ride along with the engineers who had made poor tapes to coach them on proper operation. In a little over two years, this intensive, targeted instruction resulted in fully 89.5 percent of engineers achieving "Satisfactory" performance.

One would imagine that this increased scrutiny would have made the Valve Pilot unpopular with engineers. This was emphatically not the case. J. J. Brinkworth, NYC's Buffalo Division superintendent stated, "After using [Valve Pilots] for several months,



Bessemer & Lake Erie 2-10-4 643, the only Valve Pilot engine to steam in the preservation era, nears Albion Yard, Pa., with ore from the Conneaut, Ohio, docks in the 1940s.

B&LE

drive wheel experienced the greatest wear. Speedometers were calibrated on a yearly basis on the SP, and they discovered that a mere 0.0005 inch of wear in some parts would necessitate their renewal. On the whole, however, the Valve Pilot equipment proved to be robust. "The maintenance on these devices has been very light," noted NYO&W's Burton Flory. Total maintenance costs proved to be around \$100 a year, including tapes, maintenance, and calibration.

Valve Pilot tapes proved to be beneficial to the Mechanical Department, for the tape's cut-off line yielded valuable information on the condition of motive power. The cut-off line was produced by a pencil connected to the valve gear through a linkage. Any erratic motion of valve gear caused by a mechanical problem would cause the pencil to trace a squiggle instead of a straight line on the tape. Occasional squiggles in the line could indicate that the boiler was foaming due to high concentrations of dissolved chemicals, and that the water-treatment program required tweaking. A large single scribble indicated that the crew had allowed the water level in the boiler to become too high and the engine had "worked water" (water had entered the valves and cylinders). The tapes further showed it could take 2½ miles to restore proper lubrication after working water. A constant fuzzy cut-off line could indicate "cut" or "shouldered" (shop terms that indicate wear) valve bushings, carbon build up in the valves, or a loose power reverse.

Diagnosis of problems was not limited to valves and valve gear. One locomotive produced a black smudge on its cut-off line seemingly at random. When the tape was compared to a track profile, it was found that the smudge always occurred on a left-hand curve. A thorough inspection revealed the

any Engineer will tell you that he thinks well of them." Engineers embraced the Valve Pilot, for the tapes could exonerate them during investigations arising from late trains, derailments, and accusations of speed infractions. NYC Supervisor of Fuel & Locomotive Performance R. S. Clark noted that, "In nine cases out of ten where questions of locomotive operation are involved, we find that the tape shows that the engineers have been living up to instructions."

A SKEPTICAL RECEPTION

At first, the Mechanical Department regarded the Valve Pilot with a degree of skepticism, and rightly so. With its violent shaking, blistering heat, and abrasive cinders, it is hard to think of an environment more hostile to a precision instrument than a steam locomotive. Exposed to these conditions, the Valve Pilot did indeed require maintenance. The Southern Pacific found that the friction

Loco Valve Pilot users

Atchison, Topeka & Santa Fe

Atlantic Coast Line

Bessemer & Lake Erie

Boston & Maine

Central Railroad of New Jersey

Central Vermont

Denver & Rio Grande Western

Maine Central

New Haven

New York Central

New York, Ontario & Western

St. Louis-San Francisco

Savannah & Atlanta

Southern Pacific

Union

Western Maryland

Wheeling & Lake Erie

frame was broken ahead of the front driver.

The Valve Pilot also showed that the various components on a locomotive could interact in unintended and mystifying ways. It was found on some engines that the change in main air-reservoir pressure due to releasing the brakes or blowing the air horn could cause unbidden movement of the power reverse.

MAINTENANCE-OF-WAY SAVINGS

The introduction of modern steam power caused significant headaches for maintenance-of-way forces. The high horsepower of these



New Haven power both glamorous and workaday sported Valve Pilots. At the top, I-5 Hudson 1401 backs toward the Cedar Hill roundhouse after bringing a train into New Haven. Above, R-1-a 3323, a 4-8-2 of USRA design, rides the turntable at Danbury, Conn.

TWO PHOTOS, KENT W. COCHRANE

engines gave their driving wheels a tendency to slip violently when starting or accelerating a train. Heat generated by spinning drivers was intense enough to change the crystalline structure of the metal in the surface of the rail head. Cracks frequently formed underneath these localized hard spots and begin propagating through the rail section, resulting in a broken rail.

Engine-burned rail was a widespread problem. The Southern's J. B. Akers observed that "this subject . . . is one that bothers a great many railroads. On my own railroad it has assumed serious proportions." At the very least, a burn would require grinding and welding to restore proper rail profile. However, if the rail was not ground deeply enough, it would fail even after being repaired. Therefore, it could become necessary to change out the rail when a locomotive slipped, even if the slip wasn't severe. Southern's L. S. Crane noted that "it does not take very long to produce a pretty nasty burn, about five seconds."

The Valve Pilot helped prevent engine burns. NYC's A. A. Raymond recalled, "We

had a lot of trouble with slipping, and the tape pointed the finger to the men who apparently were careless in controlling an engine that had started to slip." The tape showed how the engineer handled the slip. If the cut-off line became lighter during the slip, it indicated he had closed the throttle. The engineer could also hook up to control the slip, and the tape would show this too. A nearly vertical decrease in the speed line while the cut-off line remained dark indicated that the engineer kept the throttle open and "caught" the slip with sand. Sanding a slipping engine was terrible practice, as the instantaneous change in speed when the drivers regained traction put enormous strain on the running gear.

A more impressive form of rail damage was the "counterbalance kink." As H. R. Clarke, a Maintenance of Way Engineer with the Burlington Route observed, "Everyone is familiar with the counterbalance kink, which is a short, sharp, and decided bend in the rail, down and in, the kinks spaced an even distance apart corresponding to the circumference of the wheel doing the dam-

age and caused, usually, by an engine traveling at a higher speed than that for which it was counterbalanced."

It is impossible to perfectly counterbalance a two-cylinder steam locomotive, because the side rods rotate, the piston and crosshead assembly reciprocate, and the main rod does a little of both. The side rods can be perfectly balanced. The problem lies in balancing the reciprocating portion of the machinery. As it moves back and forth, it causes the locomotive to both "nose" (turn right and left) and shake longitudinally. To counteract this, additional weight called "overbalance" is added to the driving wheel counterweight. The overbalance partially balances the reciprocating machinery. In a vertical plane, however, nothing opposes the overbalance, so its inertial force, termed "dynamic augment," is free to hammer the rail mercilessly with every revolution of the driver. Dynamic augment increases as the square of speed, so doubling the locomotive's speed causes a quadrupling of dynamic augment.

Every steam locomotive has a speed at which its dynamic augment becomes great enough to bend the rail. Therefore, speed restrictions were placed on different classes of engines in order to prevent rail damage. These restrictions were not always adhered to, and the results could be spectacular. I. H. Schram, a Maintenance of Way Engineer on the Erie, recalled, "I woke up one morning to find 20 miles of track ruined, had to slow order it for 20 miles per hour. We removed all the rail and rebuilt the track. It took us almost all summer to get it taken care of." Another official reported that in 1937 his road "had to straighten about 22,000 rails, practically all of which were engine bent."

When rail damage occurred, Valve Pilot tapes could help identify the guilty party. Occasionally, this was the locomotive itself. Valve Pilot Corp. President William Wait recalled, "Rail damage occurred on several divisions within a short period of time and Valve Pilot tape records showed that there had been no violation of speed rules." Investigation revealed that the lead cast into the counterweight of one locomotive was missing, a not uncommon occurrence during the steam era. The resulting radical change in counterbalance caused rail damage even though the engineers complied with the speed restrictions.

A VALUABLE SALES ASSET

By enabling greater speed and economy, the Valve Pilot was a valuable asset to the Sales Department. An unlikely example was found on a small road in the Deep South.

The tendency of Central Vermont's 2-10-4s to damage rail by slipping was the main reason the road gave them Valve Pilots. No. 707 nears Brattleboro, Vt., in fall 1952.

GEORGE C. COREY





Running-board skirting hides the cam box on GS-4 4454, departing Los Angeles with SP's *Coast Daylight*. Many GS's had their Valve Pilots removed before retirement.

PAUL FREDERICKSON

"We have a very exacting westbound schedule. . . . We frequently have to leave [Savannah] from an hour to an hour and a half late, to protect the late trains of the [Florida] lines, which is necessary on account of the keen competition by other routes. In spite of this we have added 100 tons and sometimes more to these trains and are making the schedule with a greater regularity and more ease than we ever made it before." Circumstantial evidence attributes this testimonial to Savannah & Atlanta General Manager C. E. Gay Jr., and the fascinating story behind it illustrates the role the Valve Pilot played in the Sales Department.

The S&A was a 141-mile railroad that, despite its name, never actually made it to Atlanta. It owned just a handful of locomotives and was operating in receivership. Improbably, it had also decided to compete against giants like the Seaboard Air Line for perishable traffic coming out of Florida. The S&A's one ace in the hole was its interchange

with the Georgia Railroad in Camak, Ga. This yielded the most direct route between Savannah and the rail hub of Atlanta.

Like other bridge routes such as the Nickel Plate Road, the only hope for the S&A was speed. Unfortunately, for a bankrupt line in the midst of the Great Depression, new, high-capacity power wasn't an option. Therefore, it applied Valve Pilots to the aging 2-8-2s that hustled train 211, the "Fruit Express," westward. By enabling greater speed and economy, the Valve Pilot gave S&A the edge it required to secure this desperately needed traffic. As Gay aptly concluded, "I do not consider that any locomotive in main line service has complete equipment unless it has a Valve Pilot on it."

EVIDENCE IN LEGAL CASES

Another enthusiastic proponent of the Valve Pilot was the Legal Department, which was quick to grasp the benefit of documented speed and train-handling information in claims and suits. At first, they were perhaps too enthusiastic. Valve Pilot Corp.'s William Wait admonished lawyers that "Copies [of tapes] should be made for general use as

needed in . . . preparation for trial, for past experience has shown that with careless handling the original too soon and too easily loses its legibility because lead pencils and the like used as pointers in discussion frequently leave marks on the tape which confuse and becloud the issue."

One can only imagine legalese being replaced with more colorful railroad terms when a hapless legal team realized their best evidence had been inadvertently destroyed by a pencil. Also, the plaintiff's bar was quick to call into question the accuracy of the Valve Pilot, leading Wait to continue, "as soon as possible after the accident, the accuracy of the instrument should be determined by calibration."

Despite these hiccups, railroad legal departments soon found that an unsoiled and properly calibrated Valve Pilot tape was a potent force on the courtroom floor. In *Stokes v. Southern Pacific*, a single tape saved damages of \$49,380 for a grade crossing accident when it proved that the engineer was traveling at the posted speed limit and had applied the brakes before the accident. That's not a bad return for a \$1,200 device.

A TOOL WITH MANY USES

Lima, Alco, and Baldwin all produced engines equipped with the Valve Pilot. Baldwin was so enthusiastic about the device that it became an authorized sales agent in 1936. However, it was the railroad, and not the builder that had the ultimate say on installation. The decision to apply Valve Pilots hinged on the complex interplay between railroad profile, traffic composition, locomotive design, and motive power utilization.

Gradient was one of the biggest factors governing Valve Pilot usage. Locomotives could be hooked up on moderate grades. However, as Valve Pilot Corp.'s John Bacon noted, "On heavy grades, where it is necessary to put the reverse lever in the corner and leave it there, that is all there is to it, and selection of cut-off plays no part in the operation of locomotives." Low grades allowed roads such as the Atlantic Coast Line and the Frisco to get the maximum benefit from the device.

What, then, made mountain railroads such the Western Maryland and the Rio Grande Valve Pilot proponents? For WM, it was its famously well-engineered main line. Eastbound trains faced a maximum 0.8 percent grade in crossing the Alleghenies. Dynamometer tests showed that WM's mammoth I-2 Decapods could climb this grade at an average cutoff of just 66 percent.

The Rio Grande was considerably more rugged, with grades of 2 percent approaching Moffat Tunnel, and 3.5 percent on Tennessee Pass. While passenger-hauling M-64 and M-68 4-8-4s were equipped with Valve Pilots, freight applications were limited to a smattering of dual-service M-67 4-8-2s and the entire class of L-105 4-6-6-4s. The L-105's were used west of Grand Junction where, excepting Soldier Summit, the grades were comparatively moderate.

The type of traffic handled was also a determining factor for roads purchasing Valve Pilots. Western Maryland and Rio Grande were similar in that they were both mountain railroads with a considerable volume of time-sensitive bridge traffic. They used the Valve Pilot to wring every possible horsepower out of their freight engines. The combination of punishing grades and a preponderance of low-priority coal traffic likely caused the Chesapeake & Ohio and Norfolk & Western to eschew the Valve Pilot.

The New York Central used the Valve Pilot to increase the fuel economy of its passenger power. A study found average annual fuel savings of \$1,891.56 for each J-1 Hudson. In 1934, that would buy three brand-new Studebaker trucks. This savings was realized by the 10.68-percent reduction in fuel consumption the Valve Pilot made possible, multiplied by the phenomenal 18,000 miles a month the J-1 fleet averaged. Intensively utilized locomotives would show greater dollar savings than those that spent more of their time in



SP's final classes of cab-forwards were unusual in having their cam boxes mounted on the fireman's side; AC-11 No. 4272's is visible above the third driver (top). SP also specified Valve Pilots for its coal-burning, rear-cab AC-9 2-8-8-4s; No. 3800 was the first of 12.

TOP, BALDWIN; ABOVE, LIMA

the roundhouse. In contrast to the J-1's, a Pennsylvania Railroad K4s Pacific averaged just 7,000 miles a month, and would therefore not realize nearly as great a savings. For similar reasons, locomotive size was also a decisive factor. Valve Pilots were rarely applied to anything smaller than 4-6-2s and 2-8-2s, for in order to generate appreciable fuel savings, the Valve Pilot had to be bolted to something with a ravenous appetite.

Capacity and fuel economy were not the only reasons for purchasing Valve Pilots. The Central Vermont was primarily interested in stopping rail damage caused by high speeds and excessive slipping of its underbalanced 2-10-4s. Despite placing a 35 mph restriction on these engines, rail renewal was nearly a weekly necessity. Valve Pilot tapes identified the guilty engineers, and as one relieved official commented, "There has been no rail damage from our 2-10-4 locomotives since the valve pilots [sic] were installed."

Locomotive design was also a factor. In order to woo the Santa Fe, the Valve Pilot Corp. applied one of their devices to brand new 2-10-4 No. 5000. Dynamometer testing demonstrated that the 5000 was an awesome machine, but it generated no orders for additional Valve Pilots. The likely reason was that No. 5000 was equipped with 60 percent limited cut-off. Limited cut-off achieved fuel savings by increasing both boiler pressure and valve lap. Greater lap restricted admission (valve opening) to a predetermined cut-off amount. Greater boiler pressure compensated for the reduced admission, allowing the engine to generate tractive effort equal to a lower-pressure, full-travel engine. Since the

Valve Pilot yielded efficiency gains by indicating proper cut-off selection, limited cut-off reduced its effectiveness. NYC J-1 Hudsons, with 86 percent maximum cut-off, achieved 10 percent fuel savings with the Valve Pilot. Central Vermont T-3-a 2-10-4s, equipped with 62.6 percent limited cut-off, realized only 4 percent.

Limited cut-off was not without its drawbacks, however. Difficulty was experienced in starting some limited cut-off engines. Also, the smoother torque curve generated by limited cut-off engines tempted designers to lower the factor of adhesion (ratio of weight on drivers to tractive effort) below the commonly accepted minimum of 4. The violent slipping of the CV 2-10-4s, likely at starting, can be explained by their low 3.71 factor of adhesion. Also, higher boiler pressure required heavier rods and crank pins, exacerbating the balance problem experienced by this class of engine.

Locomotives fitted with Valve Pilots tended to keep them until retirement. One notable exception is Southern Pacific's GS-6 class, which lost their Valve Pilots around the time they began their final assignments in Bay Area commute service.

Bessemer & Lake Erie 2-10-4 No. 643 is the only Valve Pilot-equipped engine to have operated in the preservation era. Although that engine's future operating prospects are dim, Valve Pilots may see action on two other locomotives: Boston & Maine 4-6-2 No. 3713, which is undergoing an extensive restoration at Steamtown, and Frisco 2-8-2 No. 1352, which has recently been acquired by a non-profit group intent on restoration. ■

STEAM *photos*



LITTLE FELLOWS: The Crossman Co. operated a clay-extraction facility at Sayreville, N.J., just west of South Amboy, until about 1966. Two photos from February 22, 1951, show the pint-sized Vulcan 0-4-2T's with saddle tanks and rudimentary coal tenders that worked Crossman's 49-inch-gauge rail system. Trucks replaced the little trains in the late 1950s.

TWO PHOTOS, EDWARD THEISINGER



BIG BOY: Union Pacific 4-8-8-4 No. 4003 comes to grips with 85 cars as it departs East Laramie, Wyo., for Cheyenne on September 19, 1958. Ahead: Sherman Hill.

HENRY R. GRIFFITHS; JIM GRIFFITHS COLLECTION



A NIAGARA

A New York Central fireman's joy at drawing a 4-8-4 out of Albany, N.Y., is dampened when the engine breaks down on the road

BY ERWIN WILLIAMS

In early spring 1950, I was working the fireman's extra freight list on New York Central's Mohawk Division between Albany and Syracuse, N.Y. I was qualified to work as a fireman on passenger trains as well, but my seniority would not let me hold the extra passenger list.

One day, however, the passenger extra list was shorthanded for men and I was lucky enough to be called for a mid-afternoon passenger local. The train originated in New York, and after departing Albany was to stop at Schenectady, Amsterdam, Little Falls, Utica, Rome, and Syracuse.

My engineer was the epitome of an old-time steam passenger hogger. He was tall, ramrod straight, and had a good head of white hair and a neat white trimmed mustache. He always came to work in clean starched pinstriped overalls, polished shoes, and a bow tie. His first name was Walt but everyone called him "the Duke," and he was a gentleman through and through. I had worked with him on many trips, both in freight and passenger service.

I arrived at the Albany Union Station crew room about 40 minutes before train time. Walt was already there, and we registered on duty. I signed his time slip and we both consulted the bulletin books for any speed restrictions, track gang locations, etc. When this was done we got into our overalls.

Our conductor came from the station-master's office to talk with Walt, and we all compared watches. Walt and I then walked up the platform along Track 1 to Tower B at the west end of the depot. We sat on a baggage cart and talked until we saw the train approaching. I was elated to see a 4-8-4 Niagara on the point—the best steam power our railroad had. We had this deluxe power on a 12-car local because, by now, most of the fast name trains were hauled by diesels.

The Hudson Division crew climbed down from the cab. The engineer talked to Walt, and the fireman told me the engine, No. 6004, was an easy steamer, and that he had marked the optimum settings of the steam valves that blew coal from the distribution plate into the firebox and of the water pump. These settings would give me a good base line for my job.

Beyond the whine of the turbogenerator and soft hissing of steam, there was an odd quiet to the scene. There were no men with noisy pneumatic grease guns, making that loud staccato racket while greasing the side-rod bearings. Most of our other passenger engines required such lubrication, but not the Niagaras, which had roller-bearing rods.

Walt tossed his grip up in the gangway and then was on his way around then engine for his inspection. I climbed up into the cab, put our grips in the seat boxes, and looked into the firebox.

The fire was as near to perfect as one could be. I blew out the water gauges and checked the water level in the tender. We had sufficient water to get to Schenectady. The coal was the best I had seen in a long while: beautiful, uniform pieces, shiny black, with very little fine coal.

I used the squirt hose to wash down the cab deck to minimize the dust and then cleaned the narrow windshields on the engineer's and fireman's sides. That done, I turned on the smoke consumer, a device that shot steam into the firebox to reduce the

black smoke when the stoker was used. It was a juggling act now to keep the fire ready for our departure without making too much smoke, for there could be consequences.

Many eyes were on us from the upstairs offices, watching for some poor unsuspecting fireman to cloud the city with dense black smoke. These eyes had "gray cards" to refer to in order to judge the density of any smoke. If the smoke was too bad, one was assured of a trip to the office. A fireman did not want the safety valve popping off either—wasting steam and water was frowned upon, too.

Also, one must not have the water level too high in the gauges, because we were faced with a very stiff uphill grade right out of Albany. If the water was too high and the engine worked too hard, foaming could happen in the boiler. Water could be carried through to the smokebox up front, wetting the spark netting there. If the netting got wet, it could plug with exhaust ash, cutting off the draft to the fire. Foaming could also cause water to carry over into the valves and cylinders; if this happened, one was in big trouble! Water in the cylinder could cause the cylinder head to blow off.

When I felt the slack run gently in and out, I knew a helper engine had been attached on the rear. The helper would push us to Tower 3, just over 3 miles out. Helpers on West Albany Hill were equipped with an extension of the coupler cut lever that enabled the fireman to separate his engine from the train without leaving the cab. He had to do this before we were moving fast enough to take the slack away from them. In other words, he had better get cut away in time, or he and his engineer would be in for a fast ride on the rear of our train! Up past Tower 3, the grade started to level off and we would begin to pick up speed.

I watched back on the fireman's side now, looking for our signal from the conductor to

I was elated to see that our train had a Niagara—the best of NYC's steam power.

Niagara 6021 on the Hudson Division shows what author Williams saw the day he fired sister 6004 west from Albany: a long, smooth boiler with smoke deflectors up front and roller-bearing side rods below.

ARNOLD HAAS





In April 1948, two years before fireman Williams' memorable trip on her, Niagara 6004 battles up West Albany Hill as an eastbound drops downgrade on the next track.

JIM SHAUGHNESSY

leave town. Soon I saw him give a hand signal. I told Walt we had the highball, and he released the engine brake and edged the throttle open. We could now feel the helper working. Walt turned on the sanders as we were starting right on a curve. Then he really went to work on the throttle.

Up the hill we went at a steady pace, everything looking good. Just past Tower 3 we felt the slack ease back as the helper cut off.

We were up to 79 mph going by Tower 8—then we would start down a sharp grade into Schenectady. Walt made a brake reduction, as we had a 60-mph speed restriction around the first curve and the brakes had to

be kept applied going down the grade until we stopped at the station.

After Walt received the highball at Schenectady, he had to work the engine hard in order to have speed enough to scoop water from the Scotia track pans on the other side

Two explosions rocked us from side to side. A wall of steam came from below the cab.

of the Mohawk River bridge. I got the stoker and water pump adjusted, then got up from my seat to open the tank petcocks, allowing us to see if we scooped enough water. I also opened the air supply valve to the water scoop. I stood on the swaying apron ahead of the tender and watched for Walt to give me the “Down” command. When it came, I pushed the scoop-actuating lever and down went the scoop. When we came to the signal indicating the end of the track pan, Walt hollered “Up!” and I pulled the valve handle back, closed the main air valve, then one by one I closed the tank try cocks. We had scooped enough water!

I decided that the fire needed just a very light shake of the grates by now, and there was a need for a little extra coal underneath the stoker distribution plate. This was done by holding the inverted shovel over the front of the plate and let the coal fall in that spot only. This all accomplished, we kept going toward Amsterdam.

After leaving Amsterdam, our next speed restriction was for the curve at Tribes Hill. Then it was on to Yosts, where we scooped water again.

Just west of Yosts was another 45-mph restriction for another curve. Next, coming west from St. Johnsville and approaching Little Falls, Walt had to again reduce to 45 mph for a curve, leaving brakes applied and also encountering an uphill grade in the process. This Walt accomplished with finesse and made the station stop on the mark. The Little Falls station and the curve were on the fireman's side, so I watched for a hand signal to proceed. When I got the signal, I hollered to Walt and away we went.

The whole weight of our train was still trailing downhill behind us, so the 6004 really had to work to achieve speed. We had accelerated to about 40 mph when two explosions occurred, rocking the locomotive from side to side. Immediately a wall of steam came from the vicinity of the ash pan below the cab. I shut off the stoker, turned on the blower, left the water pump on, and grabbed the shaker bar. Walt hollered not to open the fire door. I dumped the fire from the four front sections of the grates. Walt kept the engine working full throttle and even moved the reverse lever to the full ahead position. The steam pressure was dropping rapidly and so was the water in the glass. Walt was leaning way out of his window, trying to see ahead. My windshield was covered with water, steam, and ash. It seemed like an eternity, but finally the steam was low enough that the air pumps were not keeping the brakes off.

Walt was now holding the engine brake off, and still working the engine, trying to use up as much steam as possible to reduce pressure in the boiler. Although he didn't know exactly what was wrong, he took steps

to reduce the risk of a boiler explosion. I had finally dumped the last two grate sections in the back of the firebox. I disconnected the gangway chains so I could use them to block a set of wheels when we finally got stopped.

When we did come to a halt, Walt put the brake valve in full emergency. There was still too much steam blowing around the gangway for me to exit that way, so I opened the coal doors on the tender, climbed over the coal, and got down onto the ground from the rear of the tank. I had the chains, fusees, a flag, and torpedoes. I blocked the farthest driving wheel forward and then took off for a trackside telephone.

We were just about opposite the Remington Arms factory at North Frankfort, about 85 miles out of Albany and 10 miles east of Utica. I got to a phone and called the dispatcher, and told him we had had two explosions within the firebox, but were unaware of what caused them. I told him we would definitely need another engine. Then I said I would walk farther west and place torpedoes on the rail and come back to the phone.

By the time I got back, the brakeman had come forward, so I gave him my fusees and flag and returned to the engine. There I found Walt sitting on the ground on the north side of the tracks, away from all the steam. Together we went to the front of the locomotive, lifted the front coupler into position, and put the locking pin in place so it would be ready for the rescue engine.

After about an hour and a half, things had calmed down around the cab, and there was very little steam. There was, however, still water leaking out, but without any pressure. We climbed into the cab, stood way to the fireman's side, and opened the fire doors manually—just a bit. Nothing blew out at us, so I opened the door wide and latched it. We both got out our flashlights to look inside the firebox. It was still kind of murky in there, but we could see that most of the brick arch had collapsed down onto the grates. The site of the explosion looked to be where two of the large tubes that supported the arch were separated from the wall or the flue sheet, just above the slope of the throat sheet, or the front of the firebox. We closed the door, as there was nothing more we could do.

After a little over two hours had gone by, we heard torpedoes exploding from the west, so we knew a relief engine was close. It was dark by now, so Walt and I went to the front of our engine and lit a couple of fusees. Our brakeman, having been picked up from his flagging position ahead, was riding on the rear of the relief engine, a 3100-series 4-8-2 Mohawk, as it backed toward us. Two men from the Utica roundhouse were there to couple the engines, hook up air hoses, and cut out the doubleheading cock on our engine. They also looked into the firebox.



“Down!” A Niagara takes water at the Scotia track pans west of Schenectady. The Central refined scoop and tender-vent designs to enable water-scooping at 80 mph. **“Up!”**

D. B. RUSSELL



Had it not failed, Niagara 6004 would have duplicated this scene of No. 6001 departing Syracuse for Buffalo; instead, 6004 was set out at Utica and a Mohawk continued west.

CLASSIC TRAINS COLLECTION

When the air was pumped up, I unblocked the wheels of our crippled Niagara and went up to the relief locomotive to get its fire in shape. Walt got a signal from the conductor to try the air brakes. Everything worked fine, and we pulled up to the telephone to get an OK to proceed from the dispatcher.

At Utica, we set out the 6004 in the yard. The mechanics and relief crew from our engine got off, and we tried the air again after recoupling to our train. When that was done, we left Utica and continued west.

Although the Mohawk had no trouble handling the train, it had a top speed of only

70 mph, so we lost more time. Needless to say, our arrival at Syracuse was very tardy.

We never heard any more about the 6004; there were no questions or investigations. I never saw the engine again. At one time, I heard a rumor that the boiler from 4-8-4 No. 5500, the only Niagara with poppet valves, was going to be exchanged to the 6004.

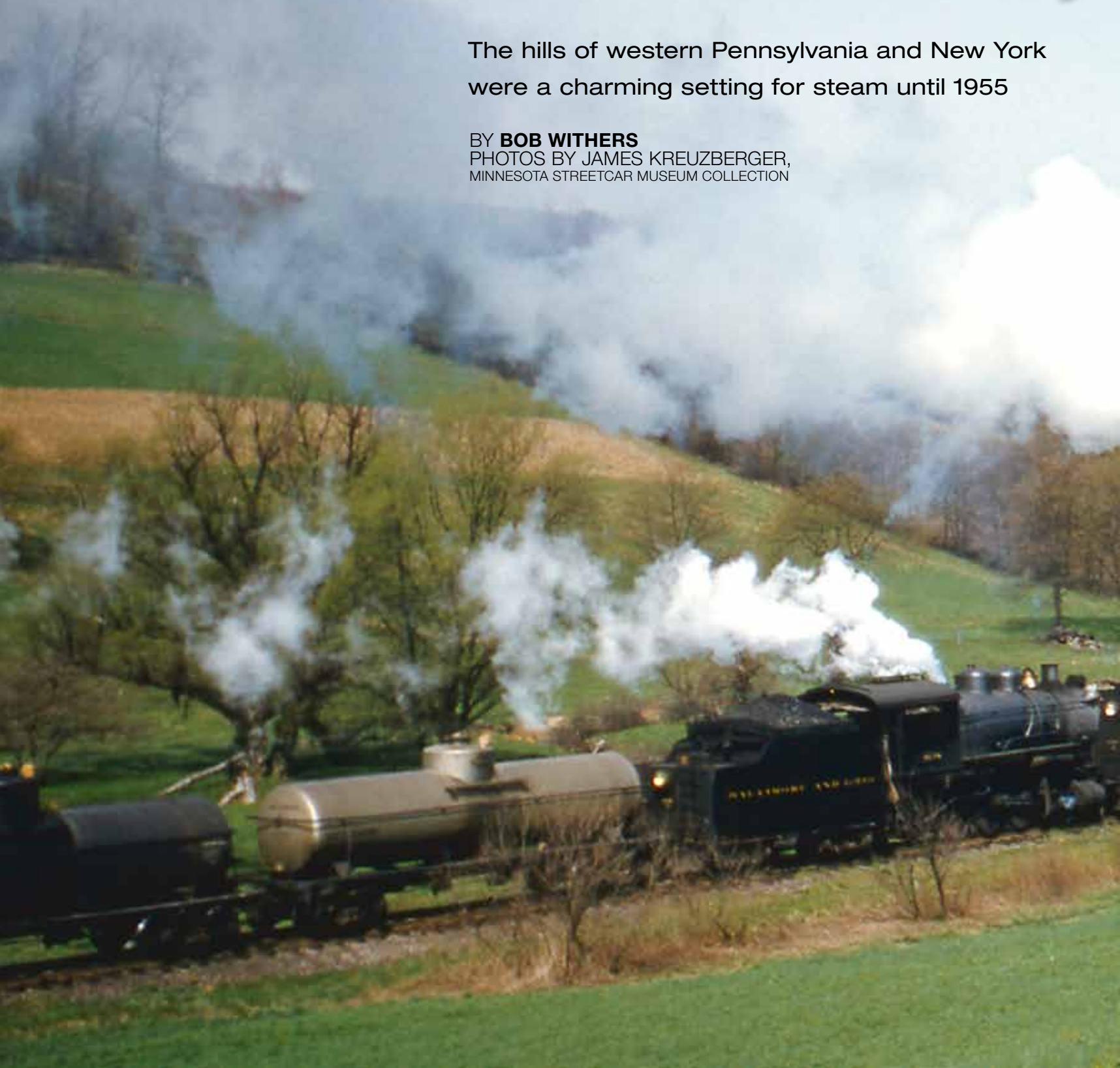
Whether this happened I do not know. One thing I do know—I am happy that we lived through the incident. One wonders what would have happened if Walt had chosen to shut the throttle off instead of working the engine until she stalled. His quick thinking may have prevented a boiler explosion. ■

B&O'S BUFFALO *Steam,*

The hills of western Pennsylvania and New York
were a charming setting for steam until 1955

BY **BOB WITHERS**

PHOTOS BY JAMES KREUZBERGER,
MINNESOTA STREETCAR MUSEUM COLLECTION



DIVISION

shafts, and stumps

The Baltimore & Ohio Railroad's acquisition of the Buffalo, Rochester & Pittsburgh Railway and the Buffalo & Susquehanna Railroad in 1932 represented B&O President Daniel Willard's dream of a nearly level route from New York to the Midwest.

Following World War I, the Interstate Commerce Commission proposed grouping

prosperous railroads into major systems that would absorb weaker lines to improve service and maintain competition. BR&P would have been assigned to B&O [See "Grouping the Railroads," Winter 2011 CLASSIC TRAINS]. But the Great Depression arrived and the consolidations never happened. So B&O developed its own consolidation plan.

By building an 80-mile connector between the B&S at Sinnemahoning, Pa., and the B&O-controlled Reading at Williamsport, Pa., Willard hoped to run his trains around the Pittsburgh and Cumberland divisions' mountains—but the Depression throttled that dream, too.

Then, in 1942, flooding destroyed a major piece of the ex-B&S between Sinnemahoning



E-60 Consolidations 3117 and 3138 steam through Carbon Center, Pa., with freight 85 in April 1955. They are heading up the old Pittsburgh & Western line to Mount Jewett, known to railroaders as "the stumps."



Class P-6a Pacific 5232 with Buffalo–Pittsburgh train 251 approaches Ashford, N.Y., the junction of the former BR&P lines to Buffalo and Rochester, in April 1955.



A view from above Foxburg, Pa., shows the two-level (rail on top, road below) ex-P&W bridge over the Allegheny River, with part of the switchback in the foreground.

and Burrows, Pa., forcing B&O to use the Erie Railroad to reach the isolated eastern segment. The connector, had it been built, shortly would have lost its *raison d'être*.

These clouds did have silver linings, however. BR&P, B&S, and the Pittsburgh & Western, which B&O already owned, ran through a lot of coal country, which contributed mightily to the carrier's bottom line.

But back to the beginning.

Backers built the Rochester & State Line Railroad between 1873 and 1878 from Rochester to Salamanca, N.Y., with an eye on those northwestern Pennsylvania coal fields. Until going belly-up in 1880, the R&SL hauled farm produce, lumber, and crude oil from an abundance of local wells—but little coal. The reconstituted Rochester & Pittsburgh added a branch from Ashford, N.Y., to Buffalo—giving the company access to Lake Erie and Lake Ontario—and extended its main line into the heart of the Keystone State's coal region.

Combining existing trackage with several smaller lines to form the BR&P in 1887, the company extended its track down to Butler, Pa., and a connection with the P&W. Construction continued through 1913, mostly involving more than a dozen coal branches.

Customers sank mine shafts by the dozens. An early list includes 73 mines on the



Pittsburgh–Buffalo train 252, consisting of a 4-6-2, a baggage-RPO, two full baggage cars, and a coach, crosses a bridge on the ex-BR&P at Carbon Center in February '55.

BR&P, and a 1957 B&O directory shows 46 active tipples on former BR&P, B&S, and P&W lines. For decades, mine runs gathered several hundred loads each day that road crews then forwarded to docks in Buffalo and Rochester—most of it bound for Canada—and connecting lines serving New England. Traffic volume mandated a second main track between Punxsutawney, Pa., and Ashford by 1903.

In 1929, B&O bought a controlling interest in BR&P and B&S—two Y-shaped railroads of 520 miles and 228 miles, respectively. The smaller road ran from Sagamore, Pa., up to Addison and Wellsville in south central New York. The ICC permitted B&O to operate BR&P and B&S as part of its system effective January 1, 1932. These two roads and most of the ex-P&W's Butler Branch eventually became B&O's Buffalo Division.

A RICH MIXTURE OF MOTIVE POWER

These three predecessors—and the companies from which they were formed—boasted a varied all-time steam roster. A 2-foot-gauge 0-4-0 handled a crosstie plant in



At Foxburg, 30 miles out of Butler on “the stumps,” E-60 3138 takes water before heading back with freight 86. Note how the edge of the turntable pit just clears the main track.



Here's 3138 again, northbound near Bruin on the former P&W. The narrow-gauge origins of the Butler–Foxburg–Mount Jewett “stumps” line is evident in this April 1955 photo.

Bradford, Pa. Road power ranged from 80 4-4-0s to 55 hefty 2-6-6-2s and 9 2-8-8-2s. In between, there were 327 Consolidations; 111 Moguls; 60 0-4-0, 0-6-0, and 0-8-0 switchers; 55 4-8-0s; 48 Mikados; 44 Ten-Wheelers; 22 Pacifics; 20 Atlantics; 16 Shays; 13 tank engines; 8 Decapods; a 2-4-0; and a 4-2-0.

The semi-mountainous terrain demanded enormous pulling and pushing capabilities—even the articulateds often ran in pairs. Those hills doubtless made the B&O glad

that of the 317 locomotives it inherited, the 64 articulateds were among them.

BR&P's Clarion Hill between Howard and Clarion Junction, Pa., with ruling grades of 1.5 percent southbound and 1.21 percent northbound, provided quite a challenge. The 2,211-foot-high summit, nearly as high as B&O's storied Sand Patch Grade, was located at Mount Jewett, Pa.

The northbound climb involved 20 miles on track operated jointly with the Erie, and



Tank cars for the area's dwindling oil traffic make up nearly half of Consolidation 3138's train, heading toward Foxburg near Carbon Center in April 1955.



In another view on the bucolic Northern Sub, a.k.a. "the stumps," E-60 3104 handles a short freight near Bruin. Alco's Brooks and Pittsburgh plants built the E-60's in 1904-08.

therein hangs a tale. In their earlier days, BR&P and Erie shared locomotive facilities at Clarion Junction. Policy required each company to provide a helper for the other on the basis of which engine was ready to go when a heavy northbound train came along. BR&P officers eventually realized their engines were doing most of the work; Erie crews had developed a way of finding something wrong with their locomotives when they were needed. BR&P canceled the agreement.

McMinn Summit sat atop another serious grade, and BR&P maintained a helper station between Dellwood and Lanes Mills south of Brockway, Pa. When a northbound drag approached, the dispatcher called the helper crew on a phone located next to the siding. The loud bell usually awakened the crew—but when it did not, he called the nearby McMinn farm and one of the McMinn children ran down to rouse the crew.

Heavy freights on the main lines and coal branches drew 2-6-6-2s, frequently double-headed, and easily recognizable by the huge air reservoirs atop their boilers. The 2-8-8-2s worked as pushers on the McMinn and Clarion hills. Mikados, also often doubleheaded,



powered lesser freights and pushed trains into Gainsville, N.Y. Double- and triple-headed Consolidations powered interdivisional trains between Punxsutawney, New Castle, Pa., and Pittsburgh's Glenwood Yard because of bridge restrictions over the Allegheny River near Mosgrove, Pa.; other Consolidations covered locals. Heavy yard/hump service was protected by Decapods—principally at Punxsutawney—while most other yard jobs were assigned 0-6-0s and 0-8-0s.

At least B&O was able to balance the heavy northbound coal with southbound ore heading toward steel plants south of the Buffalo Division.

NARROW GAUGE THROUGH "THE STUMPS"

The Buffalo Division's Northern Subdivision between Butler and Mount Jewett via Foxburg and Kane—the longest segment of the ex-P&W's Butler Branch—was another animal. B&O had purchased P&W to obtain a direct route to Chicago using its Pittsburgh–New Castle main line. But the sale also included P&W's narrow-gauge branch from Eidenau, Pa., through Butler to Mount Jewett, where it tied back into the BR&P.

Oil, collected from dozens of wells, provided the branch's early tonnage. But drillers needed wood, and P&W took on the charac-



Spiffed-up E-60's 3112 and 3138 pull hard near Carbon Center with a June 25, 1955, excursion from Youngstown, Ohio, to Foxburg. The 2-8-0s, which took over from a Pacific at Butler, will soon duck under the ex-BR&P line to Punxsutawney, visible at the right.



Buffalo Division denizens 3112 and 3138 head toward Foxburg at Chicora in April 1955. Diesels are just a few months away.



Eight-wheel switcher 792 and Pacific 5243 stand in the engine terminal at Riker Yard in Punxsutawney. The sturdy Brooks-built 0-8-0 began life on the BR&P.

teristics of a logging railroad to supply that need—a backwoods line with geared locomotives, light rail, timber trestles, horrendous grades, tight curves, and even a pair of switchbacks. Railroaders called the territory “the stumps.”

Helpers pushed trains out of Butler, across the North Oakland and Fairmount hills, out of Foxburg through the switchbacks, and on to North Clarion Junction. The switchbacks’ tail tracks limited cuts to eight cars—the lead engine and its cut went through first and

waited for the second engine with its cars to couple up before tackling the hills ahead.

Small class E-60 Consolidations performed this work after B&O transferred them from the flood-ravaged former B&S. Railfans called them “cute,” but they were the pride of old heads who didn’t take kindly to the term.

The company equipped Foxburg with a 65-foot “armstrong” turntable, which later grew by 5 feet and finally acquired a drive mechanism powered by air from the locomotive

being turned. The town also featured a double-deck bridge across the Allegheny River, with trains on top and vehicles on a single-lane road underneath. Motorists could watch the underbelly of a working steam locomotive above them—as long as no other cars showed up.

B&O converted the track to standard gauge by 1911, but once the oil boom went bust, the Northern Sub became a stepchild, of sorts. Today it’s gone, except for 21 miles between Butler and Bruin, Pa.

In November 1954, the Buffalo Division employed six Q-3 Mikados and one Q-4b Mikado, two P-5a Pacifics, and 43 E-60 Consolidations. The Mikes usually hauled freight, but they had steam lines and handled the passenger trains when necessary.

B&O began Buffalo Division dieselization in 1943 and completed it in late 1955, sending long funeral trains of steamers to their deaths in DuBois, Pa. But some former BR&P and B&S power survived long enough to show up elsewhere on the B&O. Ironically, the longest lasting of these were the ancient E-60’s, which were built by Alco’s Pittsburgh and Brooks works during 1904–08. They were slide-valve 2-8-0s with canted cylinders and 52-inch drivers, but their age didn’t keep them from spreading to other parts of the B&O. The 3114 was photographed in Grafton, W.Va., in 1947, as were the 3130 on the Monongah Division’s Ber-

ryburg Branch; the 3137 in the Buckhannon, W.Va., yard; the 3130 on the Buckhannon–Pickens mixed in 1954; and the 3112, leased to the Castleman River Railroad in Maryland in 1956. If the 3112 was still operating when the short line folded in 1959, she may have been the last B&O steam locomotive in regular service.

DIESELS, FREIGHT, AN 0-6-0, AND A PACIFIC'S HEADLIGHT

B&O inherited a flourishing passenger trade with the predecessor roads. In 1912, Alco-Brooks had built a set of 17 classy Pacifics with fine-trim stripes on their tenders and clean, round-corner box stripes around their numbers and cab windows that hauled the through sleepers, diners, cafe cars, parlor-observation cars, and coaches. Atlantics and Ten-Wheelers handled the locals.

But it all evaporated after World War II. E-60 Consols powered Galetton–Addison locals 78-79, which came off in November 1949, for their final two years because B&O had retired the last ex-B&S passenger engine, class A-9 Atlantic 1485, in December 1947. Only Pittsburgh–Buffalo day trains 251 and 252 remained after August 1953—protected by class P-5a Pacifics 5216, 5220, and 5221 and P-6a's 5230, 5231, 5232, 5236, and 5243. When Pacific 5232 backed her train into Pittsburgh's Smithfield Street Station on an appropriately gloomy Saturday, October 15, 1955, the Buffalo Division's regular passenger service died.

Interestingly, diesels threw a glancing punch to passenger steam in April 1955. Boiler-equipped GP9s 747 and 748 pulled the trains briefly, and SD7 760—formerly EMD demonstrator 991—made two round trips between Riker and Buffalo.

There were a few subsequent steam-powered fantrips on the Buffalo Division. One, out of Youngstown, Ohio, on June 25, 1955, was powered by a P-7 Pacific to New Castle and a P-6a to Butler. E-60's 3112 and 3138 took over for the trip to Foxburg, and went into retirement the next day.

In 1982, the Knox, Kane & Kinzua Railroad—later called Knox & Kane—began operating as a tourist line on the north end of the Northern Sub with a former Huntingdon & Broad Top 2-8-0 and a Chinese 2-8-2. That ended after a 2003 tornado ruined the well-known former Erie Kinzua Viaduct, the tourist line's popular destination; the operation folded up after a fire gutted the Kane enginehouse in 2008.

Only one locomotive from the Buffalo Division's predecessor companies exists. BR&P 0-6-0 152—built by Alco's Brooks plant in 1904—became B&O class D-44 No. 390 in 1932 and No. 1190 in 1950. In 1953, B&O sold her to the Ohio River Sand & Gravel Co. at New Martinsville, W.Va., where she operated for a while before being placed on display. In 1979, she went to the Mad



Pacific 5232 rolls high above Mahoning Creek with train 252's four heavyweight cars at Loop, Pa., on the former BR&P in April 1955. Next stop: Punxsutawney.



At Dayton, Pa., passengers board train 252's lone coach in October 1955, the month in which, with this train's discontinuance, B&O's Buffalo Division became freight-only.

River & NKP Museum in Bellevue, Ohio, which in 2008 sold her to Scott Symans, Roy Davis, and Terry Sprague in Dunkirk, N.Y., where the Brooks plant was located. Two years later, trucks hauled her to Dunkirk, where she awaits restoration.

At least one other piece of BR&P-related steam hardware exists. A private collector bought the B&O headlight from class P-17a Pacific 5147—a locomotive that started life as BR&P class WW Pacific 607—at a junk shop in Butler in 1962.

The Buffalo Division's value to the Baltimore & Ohio's bottom line is evidenced by the fact that two Genesee & Wyoming properties, the Buffalo & Pittsburgh and the Rochester & Southern railroads, which bought much of the trackage in 1988, still list coal as one of their top commodities. The extant 0-6-0, the Pacific's headlight, and the coal that filled the fireboxes of hundreds of their brothers are symbols of the steam heritage that helped make the regionals what they are today. ■

STEAM *photos*

STEAM WITHOUT GLORY: Back when steam locomotives were just another part of the American landscape, a Lehigh Valley 4-8-4 Pocono works through Easton, Pa., with a freight headed for northern New Jersey. The date is March 5, 1947, after a late-winter snow. Today this line along the Lehigh River is a major Norfolk Southern freight route, and the Poconos have been gone for six decades.

D. T. WALKER







An insider's view of
**SANTA FE
STEAM**

A veteran engineman looks back on the
various locomotive classes he fired and ran

BY JACK ELWOOD

Two examples of the Santa Fe's finest in steam—2-10-2 3927 and 2-10-4 5033—pull hard on a 110-car eastbound freight departing Belen, N.Mex. The 2-10-2 helper will cut off 40 miles ahead at Mountainair, N.Mex., summit of the 1.3 percent grade out of Belen.

STAN KISTLER

0-6-0



Six-wheel switcher 9105, built by the Santa Fe in 1904 as No. 2105, rests at Richmond, Calif., in 1946. Imagine a 128-mile L.A.–San Diego trip on this 51-inch-drivered engine!

STAN KISTLER

0-8-0



September 1940 finds 0-8-0 603 (built by Baldwin in 1901 as a 2-6-0; rebuilt at Topeka in 1928) crossing the PRR diamonds at 21st Street, Chicago, with a *Super Chief* consist.

LOUIS A. MARRE COLLECTION

2-8-0



Consolidation 1990 was a heavy road freight engine when built by Baldwin in 1907; 40 years later it works a local freight in Oakland.

FRED MATTHEWS

Having fond memories of the era of steam locomotives on the Santa Fe Railway, I would like to share my perspective of the way things were. My personal background, which includes firing and running steam locomotives from the beginning of my railroad career in 1939, allows me to reflect on many aspects of steam operations. Most of my involvement with steam occurred when I was working on the Los Angeles Division.

I would like to detail all types of Santa Fe steam locomotives with which I had experience, by differentiating classes, what they were like to fire and run, and their good and bad characteristics. Beyond the differences between classes, each individual locomotive had its idiosyncrasies. You had in your mind, or noted in your time book, just what it took to have a successful trip or tour of duty with each particular engine.

Santa Fe locomotive class designations were based on the road number of the first member of the class, which was often—but not always—an even “hundred.” For example, the 30 engines of the 3129 class of 2-8-2s were numbered 3129–3158.

I do not want to imply that the earlier times of railroading before my own did not also present interesting and challenging experiences to the engineers and firemen who preceded me. I was privileged to know and work with men who had handled steam locomotives for many years. Many of them learned the hard way, in trying times, with rudimentary equipment, that challenged them to get their trains over the road. They were innovators and paved the way for following generations to learn how to successfully run and fire the steam locomotive. It was truly an art form that not everyone

2-8-2



On June 14, 1952, with diesels reassigned to the San Joaquin Valley for the annual potato rush, 2-8-2 3243 climbs west toward Summit, Calif., with a local freight.

CHARD WALKER

could master. It took skill and knowledge to get maximum efficiency, requiring almost a magic touch. Some had it, others would never get it.

Just like people, steam locomotives had their good days and bad days. One trip everything would be perfect, then the next trip you were called for the same engine and she would tax all your experience to get her to steam or to run well. Many different mechanics worked on these engines, and they would have different ways of servicing and setting the valves that would affect the performance. Engineers and firemen drew on the experience they had gathered over time to try to correct some of the common troubles.

Although I was fortunate in experiencing only one or two road failures during my time in steam locomotive service, these were a fact of life in the steam era. This was particularly true during World War II, when engines might be kept running for 24 hours a day, with maintenance neglected because of the needs of the war effort.

Steam locomotives were creatures that needed “tender loving care” to function efficiently. When they didn’t get this in the shop or roundhouse, engine crews employed every trick that experience had taught them to keep them going. We liter-

2-10-2



The 3016 began life in 1904 as No. 980, one of Santa Fe’s first 2-10-2s. In 1911 the road rebuilt her and 19 sisters into 10 giant 2-10-10-2s, which reverted to 2-10-2s in 1915–17. As 3016, it kept the long “turtleback” tender it had when it was the rear half of a 2-10-10-2.

C. BARNARD, STAN KISTLER COLLECTION

ally used things like baling wire and wooden plugs for pipe repairs as the locomotive fleet aged and maintenance was reduced.

0-6-0 AND 0-8-0 SWITCHERS

The smallest locomotives I worked on during my career were 0-6-0 switch engines. Most of these were built in 1904 and carried a working boiler pressure of 180 psi. Their short wheelbases, without leading or trailing trucks, enabled them to negotiate sharp turnouts and curves characteristic of warehouse and industrial tracks. They were the predominant engines employed in the Coast Lines terminals of Los Angeles, San

Diego, and to a lesser degree San Bernardino, Barstow, and Bakersfield. They were also prevalent in Fresno, Stockton, Richmond, and San Francisco.

In an era when pay was based partly on a locomotive’s weight, jobs on switch engines often fell to those engineers and firemen who were low in seniority. My personal experience was that the 0-6-0s and 0-8-0s were good for the work they were assigned. Originally all were built with Johnson bar reverse gear, although most were later fitted with a power reverse. However, two switcher classes still had the older Johnson bar, a large, heavy lever that took much effort to

Fireman to engineer: a three-year trek

The process a fireman went through as he was promoted to engineer in the late steam era was a three-year progressive system. After one year of training, a fireman took his first examination. Over the years, I have lost the first-year question book, but as I recall, the questions pertained to proper firing practices, the use of the fuel-oil atomizer and water injectors, maintaining proper boiler water levels, proper combustion of oil, repair of broken pipes, and proper use of signals and safety practices.

Paraphrasing the Santa Fe booklet of instructions informing a new fireman of his duties, "... after being promoted to engineer the requirements are extensive, and safety requirements are very important in the operation of a steam locomotive. Constant diligence is a prerequisite. Boiler explosion is a threat if this is not done."

The second-year examination was an expanded version of the first year, with focus on how to repair mechanical breakdowns, driving-box brasses and wedges, how to jack up the locomotive and remove side rods, air-brake operations and piping, and more safety questions. Both first- and second-year examinations were in written and oral format, and had to be passed with a grade of 85 percent. The copy of my first-year exams, dated December 18, 1941, shows that I scored 94 percent on the written portion and 96 percent on the oral portion.

The third-year examination for final promotion was a tough one. It covered mechanical, air brakes, and operating rules. All segments were extensive and many hours were needed to cover all the questions. Most examiners were insistent that you knew the answers without doubt. Two attempts were allowed. If you failed on the second try, you would be fired.

During this three-year promotion period, you would study at every opportunity, getting together with others who would be in the same promotion-period class, setting up study sessions at one another's homes, and studying during layovers at terminals. Many of the friendships made at this time would last throughout your railroad career.

There was a tighter bond between crewmen in the steam era. On the job, the engineer and fireman needed to work almost as one to successfully operate a steam locomotive. Another factor was the great amount of time engineers and firemen would spend together on duty, up to 16 hours at a time per the federal hours-of-service rule in effect in that era. —*Jack Elwood*



The road to the right-hand side of a Santa Fe cab was a long, difficult one.

ROBERT HALE

When you opened the throttle, they were ready to go. They were essential on the switching lead making up trains, and also able to switch out long cuts of cars from inbound freight trains in the Los Angeles First Street yard. They could shove 65 cars up over the classification hump.

2-8-0s, 2-8-2s, AND EARLY 2-10-2s

Local freight engines came in three categories, all of which were restricted to a maximum speed of 35 mph. These were the 1900- and 1950-class 2-8-0 Consolidations, the 3100-class 2-8-2 Mikados, and the 900- and 1600-class 2-10-2s, a wheel arrangement widely known as the Santa Fe type because the railroad originated the design back in 1903.

The Consolidations were primarily assigned to local freight runs; they also were used in yard switching as necessary and also in helper service. They were powerful and easy to fire, but very rough riding. It was almost impossible to keep from being shaken to a pulp, and long exposures assured back, kidney, and prostate problems for the engine crews. When placing a bid for a certain job assignment, men took into account what kind of engine generally worked it. Engineers made sure never to exceed their 35 mph limit, as much for self-preservation as for deference to the rules.

The 3100- and 3129-class Mikados dated from 1913 and 1916; weighed 220,200 and 226,300 lbs., respectively; and shared 58-inch-diameter drivers. By my time, they were strictly local freight engines and known as "Little 3100s." The 3160 and 4000 classes were bigger, tipping the scales at about 260,000 lbs. and rolling on 63-inch drivers.

The 900 and 1600 classes were built, like nearly all 20th-century Santa Fe steam power, by the Baldwin Locomotive Works. These 2-10-2s were workhorses, used in local and through freight service, and much of the time in helper service in mountain territory. They rode and steamed reasonably well, and were generally good to run and fire. However, with 57-inch drivers, they were surely no speedsters.

3800-CLASS 2-10-2s

The freight workhorse of the mountain sections of the Santa Fe was the 3800-class 2-10-2, of which the road bought a total of 141 between 1919 and 1927. Freights on Cajon Pass would almost always have a 3800 as the train engine, often assisted by one or two other 2-10-2s. The main drivers were blind, with no flanges, to allow the engines to negotiate sharp curves and turnouts. Many numbers of this class were rebuilt during their working life several times, and many changes were made. The 3800s generally were powerful, with good firing and running characteristics.

move forward and backward. Imagine if you can how an engineer felt after 8 or more hours of back-and-forth switching work on a Johnson bar engine.

As a convenience, these engines had the independent brake valve (engine brake only) mounted on the right-hand cab window sill, so the engineer did not have to reach in and under the automatic brake valve to use it as he leaned out of the cab window, as was often necessary on switch jobs.

Upon going on duty on a yard job, your first order of business was to run your engine to the water plug and fill the tender before starting work. It was quite a sight to see, at large yards with many jobs going on duty at the same time, five or six locomotives waiting their turn at the water plugs.

Six-wheel switchers were assigned to San Diego yard operations. Sometimes heavy repairs or federal inspections were required that were not able to be done there, and the

engines had to be run to Los Angeles. Once I was called off the Los Angeles engineers' extra board to take an 0-6-0 down to San Diego, and then return with another one that was due for maintenance. A rough, long ride was assured on a locomotive without leading or trailing trucks for 128 miles at 20 mph. It was necessary to take water at several locations en route, and fuel oil at Oceanside. This was not a frequent occurrence, but it was kind of fun. It was always a daytime trip, leisurely rocking alongside the Pacific Ocean for miles on end aboard a little old engine out on the main line all by itself, far from its normal environment.

Larger, more powerful 0-8-0s were used on heavier assignments. These included the coach yard, switching passenger cars. These engines, in the 570-614 number series, had higher capacity air pumps to quickly charge the air brake system in a cut of cars. They were good, strong engines to run and fire.

4-6-2s

The Santa Fe began using Pacifics in passenger service in 1903, and by the time the last were acquired in 1924 it had 274 engines of nine classes. The newest and fastest were the 3400 class. As part of the general upgrading of passenger power beginning in the late 1930s, the 3400s got 79-inch drivers and other improvements that made them good for 100 mph, while other 4-6-2s were restricted to 75 mph.

Of special note is the 1226, the first and one of the longest-lived of its class. The 1226s were built in 1905–06 as four-cylinder compounds and rebuilt as simple engines in the 1920s. She was still being used in basic helper service in 1940 when I started firing.

4-8-2s AND 4-8-4s

The Santa Fe's first eight-coupled passenger locomotives were the 3700-class 4-8-2s. By the time I hired out, these 69-inch-driven engines had been eclipsed by the road's still-expanding fleet of 80-inch 4-8-4s. The Mountains were capable and easy to fire and run, but with only a two-wheel trailing truck, they did not ride well. It was a noticeable improvement when you had a 4-8-4.

The first of the larger 4-8-4 "Heavy Mountain" types, Nos. 3751–3764, arrived from Baldwin during 1927–29. I got to know them after a late-1930s rebuilding program gave them 80-inch drivers, roller bearings, cast engine beds, and other improvements. These engines were considerably larger and heavier than the 3700s. With the four-wheel truck under the cab, there was a much smoother ride, with less lateral motion. They were generally good steamers, which made them good to run. They had more cab room and good all-around visibility, and the cab valves were in close proximity.

The 11-member 3765 class, delivered in 1938, incorporated all the improved components given to the 3751s, and more. They were absolutely the best to run. They were good riders and steamers, had easy-to-see steam gauges and water glasses, and good cab seats. The throttle and brake valves were in a good location. The addition of smoke-stack extensions created yet more draft on the fire. While these were not pleasing to look at, they did the job. The 10 engines in the 3776 class were much the same as the 3765s. Per Santa Fe operating timetable No. 129, Los Angeles Coast Lines Division, effective November 10, 1946, there was a speed restriction of 90 mph for 3765 to 3785.

The unrestrained power of these magnificent machines was monumental. Their size is overwhelming from the moment you climbed up into the cab. Everything was solid, and you had the feeling that anything you wanted from this machine, she could easily do.

The 30 class 2900 4-8-4s were the last

4-6-2



No. 1226 was the first of Santa Fe's second batch of 4-6-2s, built as compounds in 1905. Simplified in 1925, it helps the eastbound *El Capitan* up Cajon Pass in the early 1940s.

HERB SULLIVAN

4-6-2



Pacific 3531 (built 1914 in Santa Fe's final group of compounds) is at Richmond, Calif., on August 18, 1940, near the end of its Bakersfield–Oakland run with the *Valley Flyer*.

R. E. SEARLE

4-6-2



Santa Fe's newest 4-6-2s were 50 rather ordinary 3400-class engines of 1919–24, which were rebuilt for high performance in the 1930s and '40s. No. 3439 digs in at Chillicothe, Ill.

STAN KISTLER COLLECTION

steam locomotives built for the Santa Fe. Delivered from Baldwin during 1943–44, they were numbered 2900–2929. Because of the limited availability of lightweight materials during World War II, these were the heaviest 4-8-4s ever built. They incorporated greater fuel oil and water capacity, differentiating them from the earlier 4-8-4s, but upon entering the engine cab you would not note any difference. The valves were all in the same locations, and there was no difference in firing, handling, or riding qualities. It was always a treat to get these big, new engines. When you had one on your train, you knew she would handle it with ease. Most of the time half the throttle would suffice. This was such a satisfying feeling for the engine crew, that you would hope that next trip you would have another of these magnificent locomotives. They were not generally used to San Diego, but were regulars to the east of Los Angeles, up Cajon Pass.

The 2900s were the pinnacle, the ultimate extension of the capabilities of the eight-coupled steam locomotive. It was appropriate that these magnificent machines were the last steam locomotives to be built for the Santa Fe.

ARTICULATEDS AND OTHERS

The Santa Fe acquired a number of articulated locomotives back in the 1910s, but all were scrapped or divided into conventional engines before my years of service. Unlike other railroads such as Southern Pacific and Union Pacific, which had very successful service with articulated locomotives, Santa Fe never embraced them. The mechanical department thought they were too difficult to maintain. Some of the old-time engineers I fired for had worked on the

4-8-2



Engine 3750 was the last of Santa Fe's 51 Mountain types, built during 1918–24. Their 69-inch drivers precluded high-speed running.

GERALD M. BEST

4-8-4



articulateds, but I never heard any stories about them. In retrospect, I wish I had asked about those locomotives. It would have been interesting to know if there were reasons in addition to the mechanical department's objections for the Santa Fe's complete rejection of articulateds.

Likewise, I had little or no experience with the Santa Fe's 4-6-4 and 2-10-4 engines, as these classes were used east of my territory and seldom ventured to the Coast Lines.

LAST OF SANTA FE STEAM

The curtain came down on Santa Fe steam in August 1957. The last stand of the great 4-8-4s and 2-10-4s took place in New Mexico, in helper service between Belen and Mountainair. These engines were only 13 years old and had many more years left in their service life. Some of us at the time were confounded at the decision to scrap

these engines, especially when I recalled that the first steam locomotive I worked on in Santa Fe service was 40 years old at the time. It was unprecedented for engines to be scrapped at such a young age.

In all my long engine service career, I will never forget the thrill and exhilaration that I experienced in Santa Fe steam locomotive passenger train service. No words can describe this feeling for those of us who were involved, the experience never forgotten of flying down the railroad at 100 miles an hour or more if you were running late, in all kinds of weather, night or day, knowing you had passengers depending on you to deliver them safely, and feeling the satisfaction upon arriving at the terminal on time.

I express my gratitude for having been a part of railroad history, still vivid in my memory. I can say with no hesitation that if all the steam locomotives that I've described came back at this time, I would be able to

"They were absolutely the best to run," says author Elwood of Santa Fe's final classes of 4-8-4s. No. 3782, built in 1941 as part of the 3776 class, sweeps through Frost, Calif., with the third section of the westbound *Grand Canyon* in late 1951.

ROBERT HALE

fire and run every one of them. The memory and the techniques remain with me. I loved those engines and made it my business to learn the operating methods conducive to their successful operation.

Of one fact I am certain, that America's early history with steam locomotives will never be duplicated by the diesel locomotives. With this endeavor, I have tried to give a first-hand account of the steam locomotive experience of many years ago, bearing in mind that there are not too many of us left anymore.

I was fortunate to live the railroad job that I loved, and remember fondly those experiences. ■

STEAM *photos*



LUCKY SHOT! We're a few miles west of Newport News, Va., along the Chesapeake & Ohio on a spring morning in 1951. Doing 70 mph and still accelerating, F-18 4-6-2 No. 481 on the westbound *Sportsman* passes T-1 2-10-4 No. 3005, also moving at a good clip with coal for tidewater.

DAVID W. SALTER



Experiencing 'REAL

Fondly remembered are a series of encounters with steam on the Denver & Rio Grande Western narrow-gauge lines in the early 1960s

BY DAVID BELL

I awoke curled up in the passenger seat of a Volkswagen Beetle in Ogden, Utah. It was barely sunrise this Labor Day 1962 weekend morning, but given my “bed-room,” I really couldn’t sleep anyway. Two days had brought my friend John LePrince and me from Los Angeles to Ogden via Goldfield, Austin, and Eureka, Nev.—not the most direct route. John, a fellow geology major from a small college in the Los Angeles area, and I drove northeast to chase a Union Pacific excursion from Ogden to Cheyenne, Wyo., with freshly renumbered 4-8-4 No. 8444. Not only did we visit “ghost railroads” of Nevada en route to Ogden, we were also headed for southwestern Colorado to visit more, and for a first look at the Denver & Rio Grande Western’s remaining narrow-gauge operations.

My friendship with John had revived a spark deep within me that had nearly expired several years before—that of a railfan. One of my earliest childhood memories was being lulled to sleep by the distinctive air-pump symphony of the cab-forward locomotives common in the Southern Pacific yard at Indio, Calif., in the late 1940s. I was 7 or 8 years old then, and would sneak over to the yard and depot (forbidden because it was on the opposite side of the tracks) for the sheer wonderment of it all. We lived less than a mile to the south, and it was nothing to pedal my bike or walk over there. In 1951 we moved to Escondido, Calif., at the end of a Santa Fe freight-only branch that connected with the Surf Line in Oceanside. Not too long after the move, and because of a lack of accessible (to me) railroading, I developed other interests, including girls. In 1959 I began college in Whittier, near Los Angeles, and that’s where the railfan friendship developed.

John was a true railfan, the first I encountered as far as I remember. He knew all

about railroads, especially many of the abandoned ones and especially the SP and Colorado narrow-gauge lines. We decided to make this trip, my first since starting college, on the kind of budget with which struggling college students are familiar.

Up to that point, my “railfanning” had been largely confined to brief encounters with Santa Fe’s *San Diegans*, even taking one from Pico Rivera, the nearest station to Whittier, to Oceanside now and then. So far on this odyssey, I had been introduced to the abandoned Tonopah & Goldfield, Nevada Central, and Eureka & Palisade, and soon I was to encounter the narrow-gauge history of Colorado.

1962 FIRST ENCOUNTER WITH THE SLIM GAUGE

After chasing and photographing the UP 8444 excursion until nightfall on the day I awoke in Ogden, we threw bedrolls down near the UP tracks a few miles west of Cheyenne. Following a morning visit to UP’s Cheyenne engine facilities, we began the trek south to Durango, Colo., heart of Denver & Rio Grande Western’s remaining narrow-gauge empire. It took the best part of a couple of days to get there, with a nighttime arrival at a campground just north of Ouray.

Next morning, John and I awoke in a grove of aspen with cliffs towering above us. Then it was south to Silverton and Durango over U.S. 550, the “Million Dollar Highway.” Silverton provided us with a real breakfast at the Grand Imperial Hotel. We were too

On my fourth visit to the D&RGW narrow gauge, in September 1964, I found a freight doubling up Cumbres Pass. Having brought the first portion up, Mikado 492 is just coming off the snowshed-covered wye at Cumbres to head back to Chama.



RAILROADING'





A day in early September 1962 finds Rio Grande 2-8-2 No. 480 shuffling back and forth as she assembles a train and spots cars at their proper locations. This is Farmington, N.Mex., westernmost point of the then-existing narrow-gauge lines. It was my first photographic encounter with steam working freight as well as my first visit to the narrow-gauge, and we didn't know how lucky we were.

early for the daily *Silverton* passenger train, but John found a caboose worth investigating and measuring for modeling purposes. While he was engrossed in that, the ringing of a large bell announced the first day of school, and I was mesmerized by the ingenuity of late-arriving kids of assorted ages materializing through fences and shinnying up drainpipes to access the venerable three-story stone structure.

We arrived in Durango shortly after noon, and I there encountered my first live narrow-gauge activity—all steam! To me, this was “Real Railroading”—i.e., steam railroading. There was a real roundhouse with two or three real steam locomotives and real trainmen doing real railroad things. And that was just the beginning. That night, we splurged on a hotel room at the Strater for \$3.50, which provided us with a room on the top floor and a bathtub. I know it was the top floor because the hotel was heated by steam and the steam pipe ended in our room as a vertical pipe extending nearly to the ceiling. The “safety” had the habit of pressure building sufficiently throughout the night to shoot the loosely-fitted valve into the air, which then would roll across the floor. That was OK; the floor tended to slope, and the ancient beds (for some reason on small rollers) rolled toward

the west wall all night. One of us would vacate the warm covers and put things back where they belonged.

The following day, John and I snooped around the yard and roundhouse (no fences then) and took a few photos as the *Silverton* was made up. We then followed the narrow-gauge line southwest to Farmington, N.Mex., before beginning our homeward journey to California and our senior year of college. At the time I didn't realize how lucky we were that day, but we encountered 2-8-2 No. 480 making up a freight in Farmington. I assumed this was a practically everyday occurrence. I used up what was left of my Kodachrome as the switching progressed, and we even chased it as far as Aztec before both a lack of film and the time of day forced us to turn westward.

But I had been bitten! I knew I was going to return whenever I could to record this marvelous railroad. Somewhere in my mind, I knew this was living history, yet I refused to accept that it would ever cease.

1963 TWO TRIPS, MIXED RESULTS

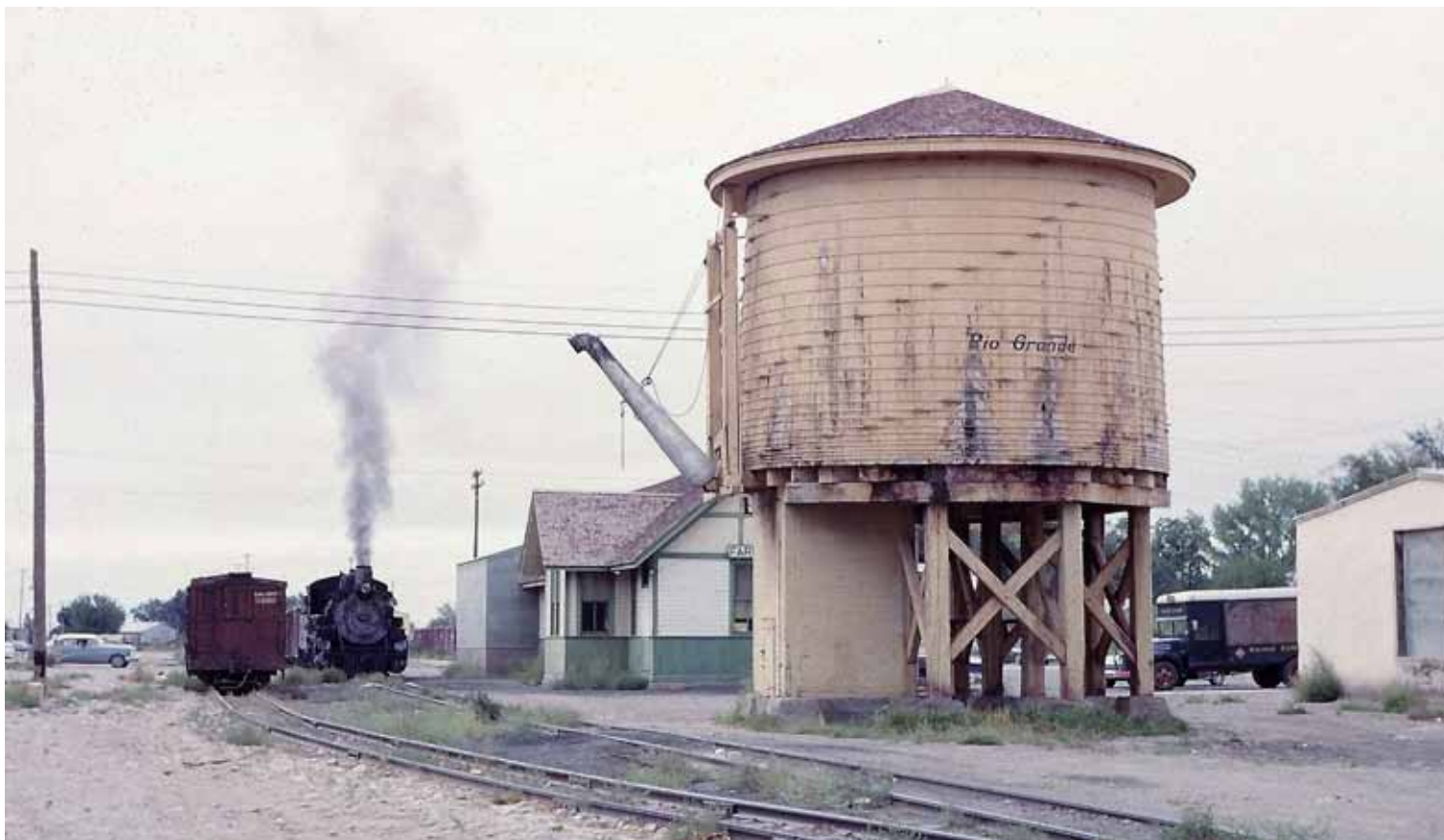
The following year, 1963, two trips to southwestern Colorado were made possible by vastly different circumstances. First was an early April geology field trip to the Grand

Canyon. I convinced my girlfriend and another couple that Durango would give us the necessary additional “geology” required for our papers to complete the class.

I was more surprised than my companions, I think, when we again discovered a freight being made up in Farmington, by 2-8-2 No. 491. Both the 490-series locomotives and the Farmington–Durango branch started life in standard-gauge dimensions, only to be converted after a few years to narrow gauge. After the freight was made up, we chased it up to Durango, but again time was short and we had to begin our return. As it turned out, that 1963 encounter was the last freight activity I ever saw on the Farmington branch.

Another lasting memory was lunch in Farmington, at a cafe I'd visited the previous September. It offered giant hamburgers, 10 inches in diameter, it seemed, for 35 cents! It was a project just to finish one. I warned my girlfriend of this as she ordered three (we were both used to smaller ones available at three to five for \$1 near our college), but in vain. At least, though, we all had cold hamburgers for dinner that evening as we drove westward into the sunset.

My second D&RGW narrow-gauge encounter in 1963 was after a Labor Day weekend series of excursions in conjunction

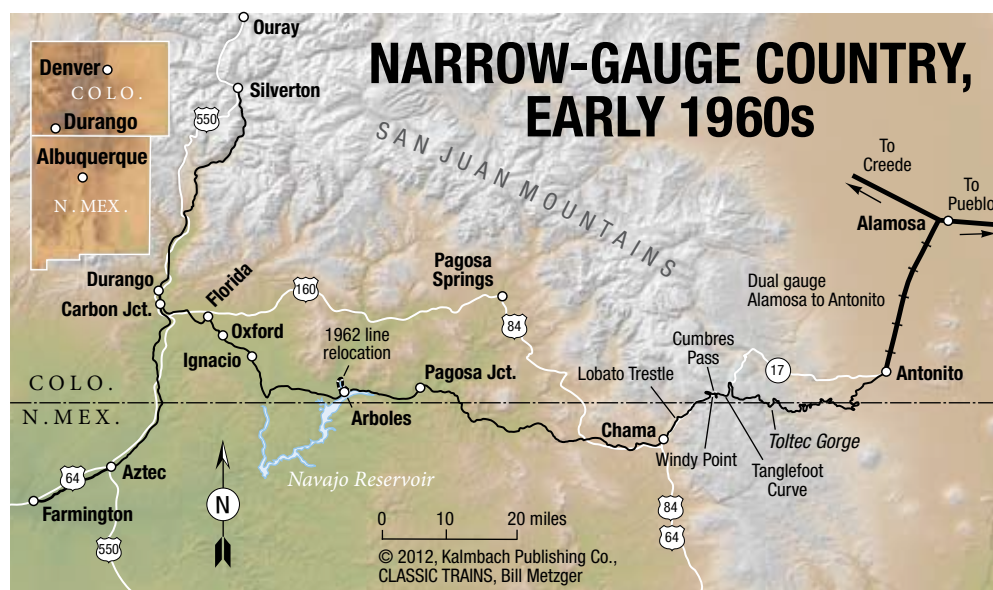


Farmington in 1962, continued: Engine 480 appears to waddle along the light rail, but she gets the job done. The 1925 Baldwin has turned on the wye to the east and is now bringing up the final cut of cars past the Farmington depot. Note another anachronism, the Railway Express truck parked at the right. When I returned the following spring, the venerable depot had been destroyed by fire.

with the National Railway Historical Society's annual convention, held in Denver. In action for NRHS were UP 8444; Colorado & Southern 2-8-0 No. 638 (one of two C&S Consolidations still operational—sister 641 was stationed up in Leadville, Colo., the last everyday U.S. Class 1 steam operation); Great Western Railway 2-10-0 No. 90; and Burlington Route 4-8-4 No. 5632. While I couldn't afford to ride any of those trips, I managed to chase and photograph all of them, and splurged by staying in a Denver facility called the Essex Hotel.

Following the convention, the NRHS sponsored what turned out to be the last passenger excursion on the D&RGW to go from Alamosa to Durango, with a return the following day. I managed to extricate myself from Denver and make it to Chama, N.Mex., in time for the return, catching the special a few miles west of Chama. On the drive down to Chama, I got my first look at Alamosa, eastern terminus of the narrow gauge, with its maze of three-rail (standard- and narrow-gauge) tracks. Narrow-gauge engines in all states of repair and disrepair were congregated at the roundhouse, for the first time giving rise to my feeling that perhaps this paradise would not last, after all.

Most people, including myself, spoke (and speak) of the narrow-gauge operations



as the "Colorado narrow gauge." In fact, most of the Farmington Branch was in New Mexico, and the Alamosa–Durango main line crossed the state line a dozen or so times. (Today, the two states help sponsor the Antonito–Chama Cumbres & Toltec Scenic tourist operation.)

My time was short, though, as—after

chasing the passenger extra to a point just beyond Cumbres Pass as it disappeared heading toward Toltec Gorge—I had to head home for the beginning of graduate school. On the way west, I stopped at Durango, where I found K-28 Mike 478 spotting gondolas at the coaling tower, and 473 on the turntable. Unfortunately, I never did



Luck was with me again on my second visit, in April 1963, when I found K-37 No. 491 in Farmington, here taking a drink before coupling onto her train and departing for Durango. The K-37's were built as standard-gauge 2-8-0s in 1908 and rebuilt to slim-gauge 2-8-2s in 1928. The Farmington branch was built as standard gauge for reasons that vanished; its isolation made it impractical, and it soon was converted to 3-foot gauge.



Rare elsewhere by April '63, but commonplace on the narrow gauge, a brakeman uses his strength and a club to slow, and then "tie down," a string of boxcars. This again is in Farmington, and the 491 has just shoved these cars down a siding. Meanwhile, my girlfriend and the couple with us wait in the car, wondering what I find so interesting.



Third-time charm: In September 1963, I finally make it to Chama, only to find that the NRHS special returning from Durango has yet to arrive. West of town I find it, with No. 484 whistling for the U.S. 84 crossing. The 480- and 490-series Mikes mainly worked freights between Farmington and Alamosa. Only rarely did these heavier 2-8-2s venture up the Silverton branch, usually on a work extra.

see a freight train during my visit.

This second trip of 1963 was sponsored somewhat as a graduation gift by my parents. I toted a spanking-new suitcase given to me by an aunt and uncle that just begged to be used, and two shiny new gasoline credit cards (my first) appeared in my student mailbox just before the June graduation. In those days, this was nothing unique, just standard practice for college graduates on the part of the oil companies, in an era way before any worry about identity theft. Thank you, Atlantic-Richfield and Texaco!

1964 A BLOCKBUSTER SEPTEMBER VISIT

The year 1964 turned out to be stellar for this steam fan. I discovered the McCloud River Railroad in northern California, which was experimenting with running an occasional excursion with its 2-6-2 No. 25 from Mount Shasta to McCloud. I also managed to see and photograph Nevada Northern 4-6-0 No. 40 on a Nevada State Centennial excursion, from Ely all the way north to the SP connection at Cobre. She is a beautiful 1910 Baldwin that 40 years later I actually got to operate under the Nevada Northern Railway Museum's rental program.

The best 1964 steam event for me, though, was a chance to return to Durango on the Tuesday after Labor Day. I arrived Monday night and slept in the back seat of my 1957 Ford sedan, a three-speed stick with overdrive, in a kind of sheltered wide spot on U.S. 160 just west of Durango and the Animas River. I couldn't even afford the nearby KOA Campground. Early Tuesday morning, I made my way to the Rio Grande roundhouse and found an engineman inside. I inquired if there might be anything in the works in the way of a freight to or from Farmington or Chama. After a little



Leaving Chama and stopping in Durango on my way back to southern California in September 1963, I encountered class K-28 No. 478 (one of D&RGW's 10 K-28's, all built by Alco in 1923) positioning a cut of drop-bottom gondolas at the coaling tower. The cars were dumped and the coal then hoisted by a bucket device into the tower. Two crewmen just in front of the locomotive guide the engineer.

consideration, he responded, "Well, they're making up a freight right now that's due to go east any time. That's about it."

Elated, I jumped back in my car and drove south to Carbon Junction, where the Farmington branch separated from the Alamosa line, to await developments. Time seemed to drag, which gave me an opportunity to feast on some Pepsi and deviled eggs (provided by my mother a couple of days earlier in Victorville, Calif.) stashed in a Coleman cooler in the back of my car. The "any time" departure turned out to be a couple of hours later, when 2-8-2 No. 487 came into view with a short freight. I chased it to a little beyond Ignacio, where 487 filled out the train to a more respectable size with lumber and assorted agricultural products.

Rather than continue the chase across the back country, I headed for Chama, which meant returning to U.S. 160 and following it to Pagosa Springs, where I would turn southeast on U.S. 84 to Chama. According to my map, there was a more direct route if I kept going east from Ignacio and more or less followed the railroad, but the road seemed iffy on the map from about Pagosa Junction eastward. I wasn't ready to be quite that adventurous. Besides, I wanted to see what Chama held for me.

That turned out to be nothing, at least in



On the same Durango visit, K-28 sister 473 rides the turntable in front of the roundhouse. In those days, the lack of fences enabled a bit of snooping, and the employees did not mind as long as visitors understood that this was a working railroad and were careful. K-28's 473, 476, and 478 rotated duty on the two seasonal sections of the *Silverton*. Of the three K classes in use, they were the lightest, but not by much.

the way of locomotives. Some interesting equipment was on hand, but there was no sign of train activity. By then it was raining, a typical early fall shower, but I still turned around and headed west, following the railroad to see if I could encounter the 487. Daylight turned to darkness well before I

heard even a remote sound of the train, so I headed back to Chama for the night, only to discover as I pulled in to the little town's only gas station that I'd been driving for some distance with a flat right-rear tire! It was smoking badly by then, so the experience cost me a new tire. Fortunately that



My fourth and most productive trip to the Rio Grande narrow gauge took place just after Labor Day in 1964. At Durango on Tuesday morning, September 8, a freight was being made up and would leave shortly, according to a trainman I encountered in the roundhouse. I made my way down to Carbon Junction to record the departure, but ended up waiting at least a couple of hours

for it to happen. Eventually, along came the 487, one of the road's 10 K-36's, with four cars and a caboose. *This* took 2 hours? However, by the time the train reached Chama, at least 30 more cars had been added to the consist. The rails visible above the train are the branch to Farmington, with Carbon Junction itself just out of the photo to the right.



Wednesday, September 9, 1964, in Chama: What a sight! And what sounds! Now *this* was "real railroading!" I'd heard the 484 and 492 arrive the night before with freight destined for Durango and Farmington. As the 484 is readied for work, crewmen swap

information and tell stories as they tend to the engine's needs. Soon 484 will proceed west by herself with the cars she and 492 brought in the night before. Later, the 487, with 492 assisting, will assault the 4 percent west approach to Cumbres Pass.



The grade and tonnage obliged Mikes 487 and 492 to take their train up the hill in two portions, a routine occurrence on Cumbres Pass. A good 15 minutes after it first came into view, the second run up to Cumbres is on the steepest part of the grade as it approaches Windy Point. In a minute or two it will pass directly beneath me. A malfunction of some sort took the caboose out of

service for this second run, which explains the gray maintenance-of-way car behind the rear locomotive. Once this cut reaches the summit, the two halves will be joined to proceed on to Alamosa. By the time this was done, it was dusk, so I headed back to the campground at Chama. But what a Wednesday of “real railroading” it had been!

was all that was amiss, but the incident put a big hole in my meager travel budget.

After a dinner at a place just west of town, I headed for the campground east of Chama on the Chama River, again “camping” in the back seat of my Ford. I could stretch out a bit diagonally if I slid the front seat as far forward as it would go. I had just dozed off, perhaps around 9 o’clock or so, when the unmistakable sound of a steam whistle announced an arrival from the east as it crossed Highway 17. I didn’t bother to do anything about this, other than to smile and lie back down.

On Wednesday morning, September 9, again early, I headed for the locomotive facilities and found not only No. 487 in steam but also Nos. 484 and 492. The latter two were responsible for all the whistling I’d heard the night before. All three were being serviced before their respective departures: 484 to continue west to Durango with the train that had arrived doubleheaded from Alamosa, and 487 and 492 to go east with two turns up to Cumbres before continuing as a single train on to Alamosa.

There were still puddles everywhere from the showers the night before, and it looked

as if we could expect more rain, but there was no way that would dampen my spirits. I exposed a lot of Kodachrome as engines and crews were readied, then I chased the 484 west as it departed first. That was the only bad news, as things turned out—my camera had suffered some kind of malfunction, and all those photos were overexposed. (In actuality, I’d screwed up reading the light meter of my new camera.) About all you could discern was that a cloud of smoke was emanating from something.

And it had been something! There was a slight grade westbound as the track approached the U.S. 84 crossing, and the wet weather caused a lot of slipping and smoke as the train made excruciatingly slow progress. After shooting at one other location (with the same camera results, alas), I returned to Chama and chased the first Cumbres turn. This was apparently normal procedure. Each locomotive was rated for 10 or so cars on the 4 percent grade up to Cumbres, so a train of this size required two efforts to get all the freight to the summit, at over 10,000 feet elevation. The 487 led the procession, and the 492 pushed on the rear. This eliminated the need to stop and run

the helper light across Lobato Trestle, whose weight restrictions precluded two engines proceeding in tandem.

The good news, revealed when I looked at the processed slides, was that my camera problem seemed to have corrected itself. The bad news, right then, was that there was roadwork on Highway 17 east of Chama, which was then a dirt road. As I attempted to make my way through the foot-high or so ridge of dirt marking the center of the road and pass the grader, I managed to snag a large rock with my muffler. I was a muddy mess after I extricated the offending piece of geology and made my way east shortly after the train had passed. I wasn’t even interested in looking at my rock “specimen.” Even though the delay had only been minutes, a surprising number of cars had backed up behind me. Could they all have been railfans?

About halfway to the summit, I stopped to climb down below the road to get some pictures, and who should I encounter but John LePrince, the friend with whom I had made my first visit two years earlier! (Why weren’t we traveling together? Well, John was with his fiancée, and somehow three



Heading west from Chama on Thursday, September 10, 1964, to begin my trip back to California, I encountered No. 493 on an eastbound near Carbon Junction. I turned around and gave chase. The next I saw of the train was at a lonely spur identified as Oxford.



In its eastward trek, No. 493 leads its train across the San Juan River on a recently built bridge, courtesy of the federal government owing to a line relocation necessitated by a new dam and reservoir. This created a veritable speedway for a few miles, because the rail on the relocation was heavier than that used elsewhere on the narrow-gauge.

really would have been a crowd, especially in that same Volkswagen I'd slept in two years earlier.) We exchanged notes and took off after the first Cumbres turn.

Then it was time to drive Indy-style, as much as a muddy mountain road and a sedan would allow, back to Chama to catch the start of the second turn. Apparently something had bad-ordered the caboose, so a maintenance-of-way combine of sorts was doing duty at the rear of the train. John, his fiancée, and I met up again at the engine-house, where the conductor offered us iced tea out of a five-gallon bottle.

If anything, the second turn was even more spectacular. John and I hiked from

Cumbres station up the hillside to the top of Windy Point. From there we had an incredible view as the locomotives pushed and pulled their train to the summit, passing beneath us perhaps 15 minutes after first coming into view. By the time the train was reassembled at the top and headed on its way toward Alamosa, it was dusk. I returned to the campground for another night, but there was no whistling that evening. But what a Wednesday it had been!

Next morning, with nothing going on in Chama, I headed back to Durango, but I did not quite get there because I encountered engine 493 with an eastbound freight just before it crossed U.S. 160 near the top of the

grade from Carbon Junction, not far from a spot with the improbable name of Florida.

The chase was on again. My intention was to follow it all the way to Chama and chance the unknown road that paralleled much of the track. I chose to get a bit ahead of the train at a place called Oxford, rather than top off the gas tank as I should have done. I really didn't think I had the time to do both, and I thought I had enough gas to make Chama, though it would be close. As it turned out, I would have had plenty of time for gas, because the train picked up cars and did some switching long before it reached Oxford, only about 15 miles but a good two hours after I first saw it.

Finally the train showed up and I kept pace, managing to get pretty good coverage, including the line relocation at Arboles necessitated by the construction of a dam and reservoir, a project that actually lengthened the narrow-gauge system by a few miles! The early fall color, as road and track followed the San Juan River eastward, was something to behold for this southern California boy who had only read about fall colors. The pavement ended just past Arboles, but the dirt road was pretty good. However, at Pagosa Junction, I had to make a decision. I had three choices: continue eastward, following the track on what amounted to a set of dirt ruts on which I might have to backtrack; head north to Pagosa Springs, where gas was available, on a road that was also unknown and climbed at least one pretty good grade; or backtrack to Durango on known routes. My mental coin landed on the third option, and I headed west, although the train seemed to be tugging at me all the way.

By the time I reached Durango, the car took just over 22 gallons of gas in a 23-gallon tank. But I had made it. Time and money dictated I begin the journey home, so I departed the narrow-gauge country.

MORE STEAM, BUT ELSEWHERE, THEN A SLIM-GAUGE REUNION

The year 1965 offered me no opportunity to visit the Rio Grande narrow gauge. I was too busy trying to find a job with my newly acquired master's degree in geology, preferably in teaching. A break occurred in August, and I moved to northern California to take a post at a community college. Thus it was not until 1966 that I again had a chance to visit southwestern Colorado, but I was thwarted with car trouble on the day of departure for a trip that would lead me to Chicago and the supposed last run of Burlington Route 2-8-2 No. 4960.

Instead of the three or four days I intended to spend in narrow-gauge country, I managed only one day. Moreover, a stop in Durango revealed that the freights that had been fairly frequent in 1964 now were reduced to just a few times the entire summer,



Nearing Juanita, 493's eastward train again crosses the San Juan River, about 3 miles east of Pagosa Junction. Here it was decision time for me, whether to continue the chase, go north to Pagosa Springs to replenish my car's fuel tank, or return west to Durango. Rather than attempt a dubious unknown, I chose the

third option, so it was good-bye to the train, and the narrow gauge, soon after this photo. Thus ended three days of a remarkable series of steam freights I would never encounter again. Hindsight is wonderful, for had I known the future, I would have chanced the unknown and continued the chase to Chama.

with a clean-up of sorts before the winter snows would close Cumbres Pass.

The good news of that trip, though, was not narrow-gauge-related, but rather visits to other steam spots: Sterling, Ill., where Northwestern Steel & Wire Co. still ran ex-Grand Trunk Western 0-8-0s; Amory, Miss., and Mississippian Railway's ex-Frisco 2-8-0s; the Reader Railroad in Arkansas; and the first UP 8444 trip west of Laramie since it began residing in Cheyenne.

The next two years, 1967 and '68, were no better, although my 1968 trip was notable. A new railfan friend, who had started teaching at the college the same year, accompanied me as we stopped at the Magma Arizona Railroad in Superior, Ariz., for its last two days of steam operation. This was just before a Rio Grande freight was scheduled to run from Durango to Alamosa. For reasons I now cannot recall, I was unable to stay in Durango following that venture, although my friend did, catching what for all practical purposes was the last narrow-gauge revenue freight. [The last D&RGW train of any sort on the Alamosa-Durango

line, a special, tied up on Friday, December 6, 1968—see "Last Train on the Narrow-Gauge" in Winter 2002 CLASSIC TRAINS.]

After that, the unthinkable occurred—all but the Silverton line and what became the Cumbres & Toltec Scenic was abandoned. The riders on those tourist lines do witness spectacular scenery, but freight was gone, and with it, to me, the last bastion of "real railroading." Having seen the real thing, I had no interest in revisiting the remaining tourist operations. During those 1960s visits, I learned what real railroading was: hard work and long hours, usually accomplished with pride, teamwork, and camaraderie. I have often wondered if the crews of those D&RGW narrow-gauge freights had a sense of the passing history, or whether it was "just a job," and one that usually involved longer hours and harder work than toiling on modern railroads.

Time has a way of changing things, of course. I can travel now without having to sleep in the back seat of my car, and I no longer find it appealing to just "camp" along a roadside somewhere. In 2006, a friend and

I managed to finally ride the *Silverton*, and it was spectacular—I was sorry I had waited so long to make that trip. Remarkably, the first locomotive I encountered on a freight in 1962, No. 480, was hauling our section of the *Silverton* that day.

Then in 2008, the same friend and I rode the C&TS from Chama to Antonito, springing for the parlor-car service, and I rode on the platform of that car as No. 487—which I first saw in 1963 as a helper on the last Durango-Alamosa passenger special, and again in 1964 on the point of a freight—made loud, beautiful music assaulting the 4 percent grade up Cumbres Pass. That day, the 487 had the train to herself. And I finally got to see the spectacular Toltec Gorge.

What now? Bank account willing, I fully intend to make more trips on the C&TS. Perhaps you "can't go home again," but this operation still gives me a chance to see the locomotives I remember from four decades earlier and experience a known railroad from a different perspective. Oh, and Highway 17 has long since been paved, which I guess is progress. ■

STEAM *photos*



END OF THE D&H LINE: Delaware & Hudson's 40 4-6-6-4 Challengers came from Alco between 1940 and 1946. No. 1539—the last of the class and indeed the last steam locomotive built for the D&H—passes through Oneonta, N.Y., in October 1951, bound for Binghamton with 63 cars.

EDWARD THEISINGER

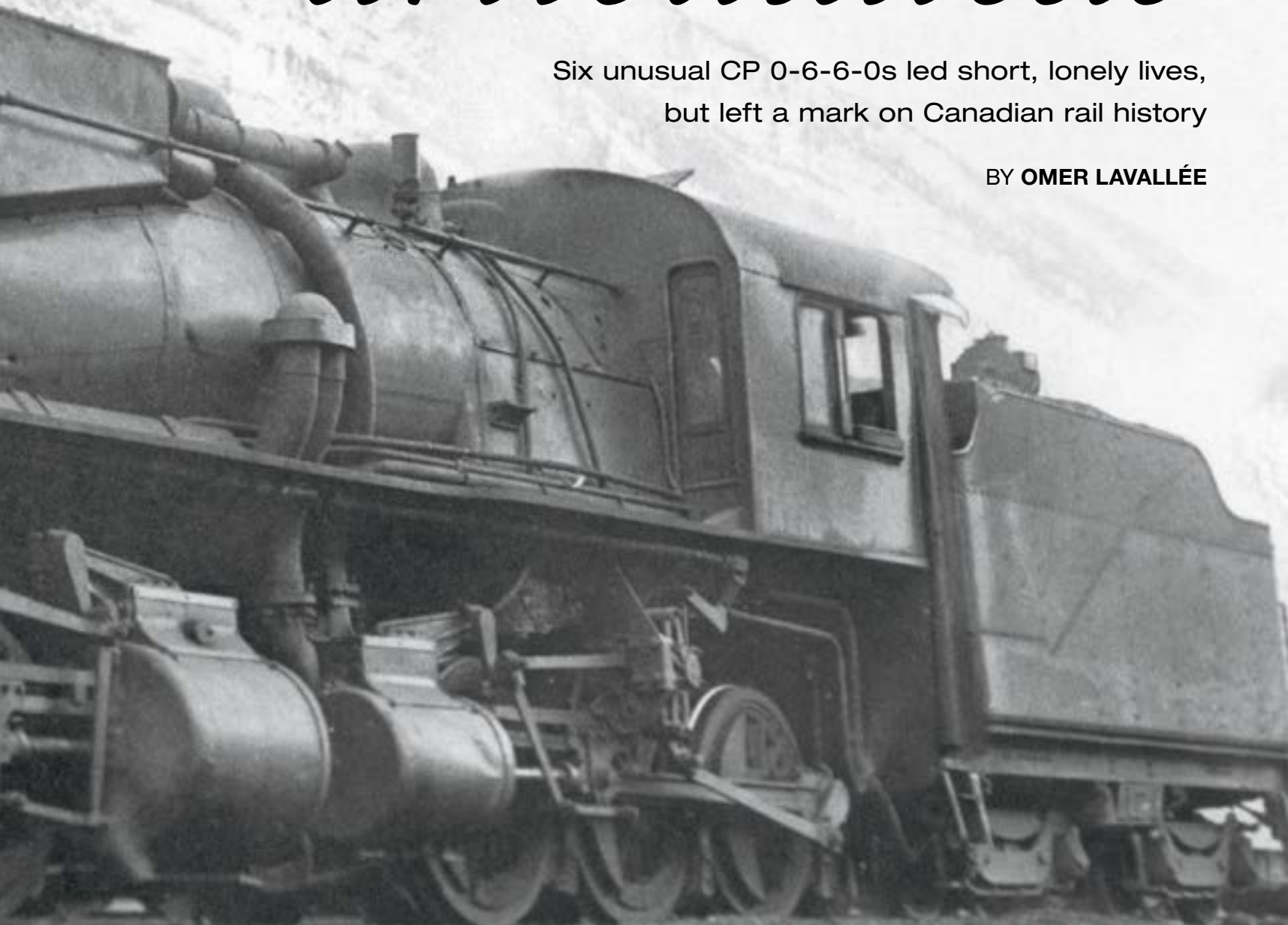




CANADA'S ONLY *articulateds*

Six unusual CP 0-6-6-0s led short, lonely lives,
but left a mark on Canadian rail history

BY OMER LAVALLÉE



A giant of its day, Canadian Pacific 0-6-6-0
No. 1950 stands at Field, B.C., ready for
another push east up Kicking Horse Pass.

CANADIAN PACIFIC ARCHIVES

Many railroads in the United States with lots of tonnage to haul or mountains to cross—or both—used large articulated steam locomotives. Yet Canadian carriers, even though they had substantially similar operating conditions, almost entirely shunned such power. While the explanation can be given in six words—“lack of comparable concentrated traffic volume”—such brevity hides an interesting story about the Canadian Pacific Railway’s brief use of articulated locomotives.

First, let’s look at geography and traffic. It’s true that Canada replicates, on an even more massive scale, the geography of the continental United States: rolling eastern mountain ranges and high, rocky western mountains separated by many hundreds of miles of plains. Moreover, Canada has frozen, tundra-like wastes and the primordial Laurentian Shield country of rocks, trees, and forests. Again like its neighbor, it has heavily used rail lines penetrating these areas.

However, Canada differs from the American experience in that sustained, year-round traffic of sufficient volume to have justified the use of specialized large power simply never existed in Canada’s steam age. It was not until the late 1960s, when high volume strip mining operations in Alberta and British Columbia began to respond to unprecedented export demands from Japan, that unit coal trains began to give Canadian lines tonnage volumes that had, long before in America, spawned massive locomotives such as Union Pacific’s Big Boys and Norfolk & Western’s Y6s.

No such heavy trains were seen in Canada in steam days. In those times, the major traffic volume challenge was the annual “grain rush,” when Canada’s railways responded to the need to speed as much as possible of its abundant prairie harvest to ports on the Atlantic and Pacific oceans, and even on Hudson Bay. However, this pressure period seldom exceeded 8 or 10 weeks’ duration. Another seasonal demand was the annual “winter port” season in eastern Canada, when the freezing over of the St. Lawrence River system closed down the port of Montreal from December to April. During this interval, CP’s export/import traffic was routed through the port of Saint John, New Brunswick, while Canadian National’s utilized Halifax, Nova Scotia.

To cope with these requirements, both of the major railways had fleets of 4-6-0s, 2-8-0s, and 2-8-2s that moved from the East to the prairies and back, like migratory birds, according to the season. Even though double- (and even triple-) heading in steam days was labor-intensive, it was more cost-effective to use smaller locomotives in this way. In the off seasons, they could be used across the broad range of regular services, whereas large specialized locomotives, too powerful



British-trained engineer Henry Hague Vaughan designed the CP 0-6-6-0s.

CANADIAN PACIFIC ARCHIVES

for normal requirements, would have had to be stored. CP’s class D10 4-6-0s—at 502 members the numerically largest class of steam locomotives ever used in Canada—were well known for following this pattern.

Canada’s few classes of heavy rigid-frame locomotives, such as CN’s larger 2-10-2s and CP’s 2-10-2s and 2-10-4s, were assigned and used to advantage on a year-round basis in mountain services. Even so, this power was smaller and less impressive than its American counterparts.

CP’S “BIG HILL”

Canada’s only articulated locomotives were developed in response to perceived needs in mountain territory that, in the end, were not fully borne out. During the three decades following its opening of Canada’s first transcontinental railway in 1886, CP concentrated on improving the original line. The first two of these decades were devoted to the replacement of wooden bridges with steel ones and installation of progressively heavier rail, with only minor attention given to improved alignment and grade.

However, in 1906, the first of these major projects was undertaken when work was begun to eradicate the most serious obstacle on the whole 2,990-mile transcontinental main line: the western slope of the Rocky Mountains just west of the border between Alberta and British Columbia. Here, eastbound trains in the last dozen miles approaching the 5,335-foot Continental Divide summit at Kicking Horse Pass faced a formidable obstacle: the 4 miles of 4.5-percent grade known as the “Big Hill.”

The Big Hill had been introduced into the transcontinental profile as a temporary, time-saving expedient in the rush to complete the line. Transcontinental main line specifications called for a maximum grade of

2.2 percent, but the Canadian government permitted the exception in order to hasten the work.

Despite predictions of many runaway train disasters, the Big Hill experienced only a couple of minor incidents. It achieved an enviable safety record, while providing such spectacles as three engines (head-end 4-6-0, mid-train and pusher 2-8-0s) on the daily six- or seven-car eastbound transcontinental *Atlantic Express*. Some freights, especially after 1900, needed four or even five 2-8-0s to move 30 or 40 cars over the same 4 miles.

The Big Hill was situated in the narrow Upper Canyon of the Kicking Horse River with very little room in which open-air doubling-back of the alignment could be developed to lengthen the distance and reduce the grade. The answer was to copy a track arrangement that existed on the transalpine St. Gotthard line in Switzerland. Built in the 1880s, that railway featured a characteristic subsequently emulated frequently in many parts of the world: spiral tunnels.

Although there are a number of locations on this continent at which such construction might have been used to advantage, CP’s two helical bores—Upper Spiral Tunnel and Lower Spiral Tunnel—are the only examples in North America. Opened to traffic in 1909, they provided 8 miles of 2.2-percent grade, compensated for curvature, to replace the Big Hill’s 4 miles of 4.5 percent. The tunnels’ completion coincided with the introduction of freight and passenger cars of steel construction and hence of greater capacity. Even though the grade, known after the realignment as Field Hill (for Field, B.C., at its base), had been eased to the system mainline maximum standard, a desire to move trains over this section at speeds comparable to less-demanding stretches of main line envisioned specialized pusher engines.

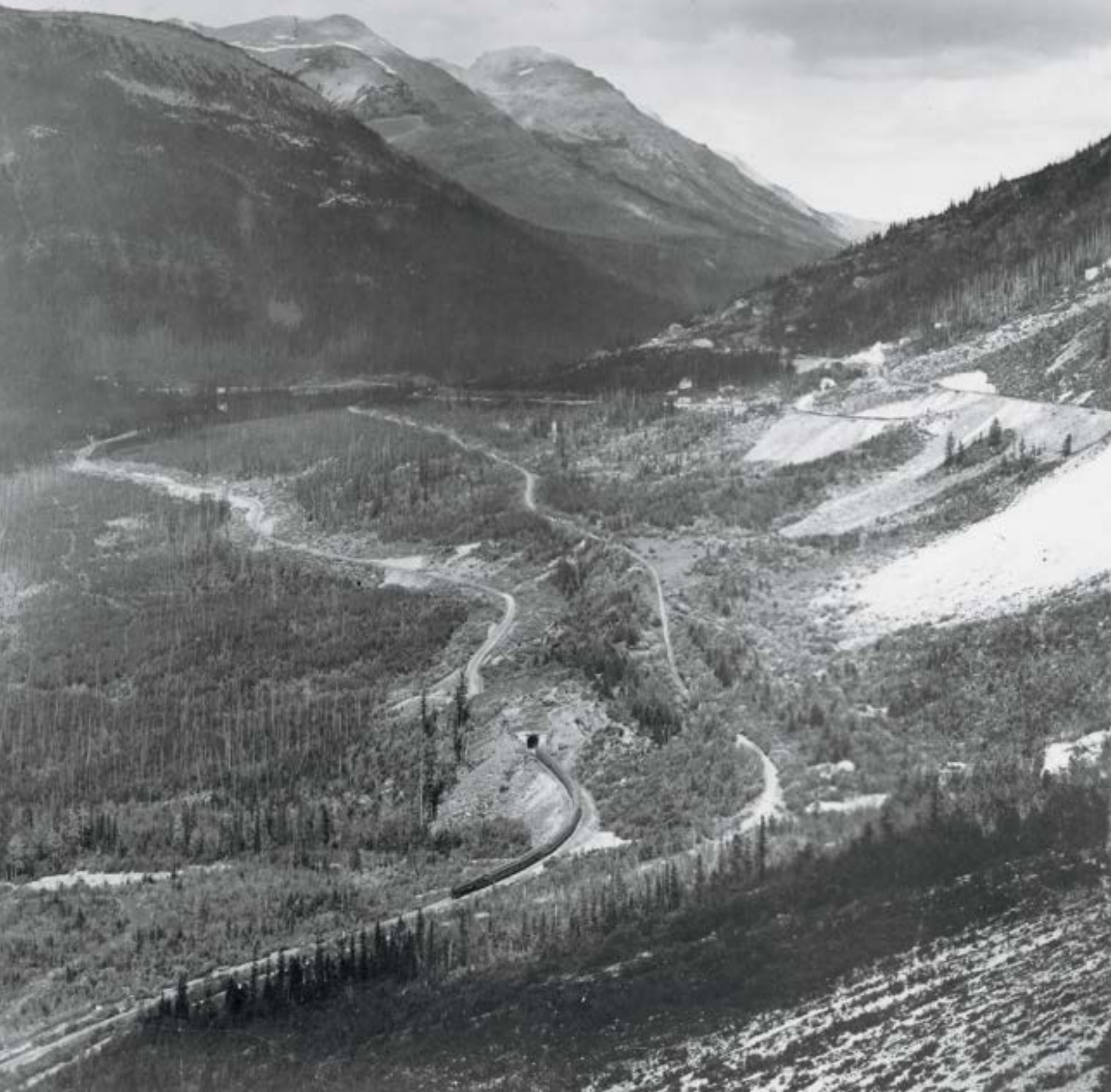
HENRY HAGUE VAUGHAN

Thus it was that in 1908, Canadian Pacific’s sixth mechanical chief, Henry Hague Vaughan (1868–1942), then holding the title of assistant to the vice president, set himself the task of designing a pusher locomotive to be used on Field Hill. Vaughan was a British-trained mechanical engineer who had served his apprenticeship with Nasmyth Wilson & Co. of Manchester, England. His North American career, begun in 1891, had been well-rounded in various positions from machinist to mechanical engineer with U.S. railroads and suppliers. In 1902, he became assistant superintendent of motive power for the Lake Shore & Michigan Southern at Cleveland, Ohio, the position he relinquished in December 1905 to come to the CP.

By far the most innovative of the 10 officers who headed CP’s mechanical department in the steam era, Vaughan, in his relatively short tenure of 11 years (1904–1915), saw the railway acquire about 1,500 new engines,

CP's 0-6-6-0s were built for the west slope of Kicking Horse Pass. Here, a westbound passenger train has traversed the fills at the right as it drops down the 1909 spiral tunnel alignment, which replaced the old 4.5-percent line in the center of the photo.

CLASSIC TRAINS COLLECTION





The CP R1's had short careers in remote territory a century ago, so photos of them are rare. Here's another view of R1a 1950 between assignments at Field when it was new.

CANADIAN PACIFIC ARCHIVES

representing 46 percent of CP's total all time steam locomotive complement of 3,257.

Perhaps Vaughan's major accomplishment was the general adoption of the superheater, CP becoming the first major railway outside continental Europe to do so on a large scale. In an address to the American Society of Mechanical Engineers, Vaughan stated that as of the end of 1906, CP had 197 locomotives equipped with superheaters, in contrast to only 15 on seven different U.S. carriers.

Previously, in 1901, CP had also pioneered with its application—the first outside Prussia, where the superheater was invented—of a Schmidt smokebox superheater to one of its otherwise standard 4-6-0s. Subsequently, Vaughan became the co-developer (with his chief draftsman, A. W. Horsey) of CP's own Vaughan-Horsey return-bend superheater, with which a majority of its locomotives were equipped.

CP'S FIRST 0-6-6-0

Returning to the Kicking Horse Pass requirements, Vaughan chose a Mallet compound configuration. The resulting locomotive, class R1a 0-6-6-0 No. 1950, which he designed, was built in CP's own Angus Shops in Montreal, being outshopped in October 1909. Vaughan, no slavish emulator of con-

temporaries, was critical of similar engines already in existence, and he made major design changes.

One idiosyncrasy in particular that bothered him on contemporary Mallets was the long projection of the forward engine unit ahead of the smokebox front. Another problem was posed by the expansion sleeves on the live-steam dry pipes, which had to be kept tight to feed steam to the forward, low-pressure cylinders. A third disadvantage was the distance this low-pressure steam had to travel, producing excessive condensation by the time the steam entered the cylinders and was put to use.

Vaughan was convinced that all these drawbacks could be eliminated by placing the cylinder pairs back-to-back (or "front-to-front") in the center of the locomotive, and this was the arrangement adopted for No. 1950. In fact, only one packed joint was required for pipes carrying steam under pressure. This was located directly over the pin connecting the movable front six-wheel unit with the fixed rear one. The only movement in this joint was a "swivel" one, extension and contraction being done away with entirely. Since the high- and low-pressure cylinders abutted, exhaust steam from former to latter had only a short distance to travel.

Push-me/pull-you 0-6-6-0?

When I first became interested in the study of CP steam locomotives, there was a popular anecdote among older and retired mechanical staff members about the face-to-face positioning of No. 1950's cylinders. According to this legend, an error had been made in designing the reverse gear on the locomotive. When the throttle was opened, both engine units started to work against one another, as each unit had been connected in "forward" gear with respect to its cylinders! The story went on to say that Henry Vaughan salvaged the gaffe by pointing out to official onlookers that, because the locomotive hadn't moved, it was proof that it had been designed so efficiently that each unit had the same tractive effort. In view of Vaughan's professionalism and thoroughness, this amusing story must be dismissed as fiction. —Omer Lavallée



Prototype 1950 wears flat gray and white striping for its builder's portrait. The boxy "reheater," unique to this engine, gave way to a more conventional superheater.

CANADIAN PACIFIC ARCHIVES

No. 1950's boiler was described as follows in the August 1909 issue of *The Railway & Marine World*:

"... the boiler consists of a feedwater heater, reheater, and steam generator, there being four flue sheets, the flues in the rear section being 109 in. long and 102 in. in the front section, the reheating compartment being 63 in. long. The two sections are connected by two equalizing pipes, one of which is below the normal water level and serves to maintain equal levels in the front and back sections. The other is located above the water line and allows the steam, which may form in the feed water heating section, to pass to the back section. The injectors discharge into a check valve which is located underneath the bell stand on the top of the boiler and connects with the front section..."

Coming at a time long after CP had thoroughly adopted the principle of superheating, it is surprising that, initially, the 0-6-6-0 used superheated (called "reheated") steam only in its low-pressure cylinders. Thus the path of the steam initially followed that of a conventional nonsuperheated compound locomotive: saturated steam was drawn from the boiler through the throttle and fed to the 22x26-inch high-pressure cylinders. However, instead of exhausting directly into the 32½ x 26-inch low-pressure cylinders as on a conventional compound locomotive, this exhaust was first passed through the reheater, thus drying it and raising its temperature be-



As a simple articulated, R1c 1955 had cylinders of equal diameter, although they were positioned face-to-face as on the five Mallets.

CANADIAN PACIFIC ARCHIVES

fore passing into those cylinders.

Tests conducted in fall 1909 on No. 1950, both on Field Hill as well as on the 1.75-percent Hochelaga Hill in Montreal near Angus Shops, showed satisfactory results. The locomotive developed a tractive effort of 57,400 pounds, and, while rated for 660-ton trains on Field Hill, could haul 700 tons under summer conditions. This was in contrast to a 424-ton rating and a 36,200-pound tractive effort for the existing class M4 2-8-0s normally assigned to that service.

Early in 1910, No. 1950 returned to Angus for modifications. The major ones were, first, giving it a conventional boiler with CP's own Vaughan-Horsey superheater, thus almost doubling the R1a's heating surface while

halving the number of tubes. The steam now passed through the superheater before going to the high-pressure cylinders. Second, the bushings were removed to increase the high- and low-pressure cylinder diameters to 23¼ and 34 inches, respectively.

FIVE MORE 0-6-6-0s

In this form, R1a 1950 was the prototype for four more 0-6-6-0s, Nos. 1951–1954, designated class R1b. The only significant modification made in the R1b's was the reduction in diameter of the high-pressure cylinders to 23 inches. These locomotives left Angus between April and September 1911.

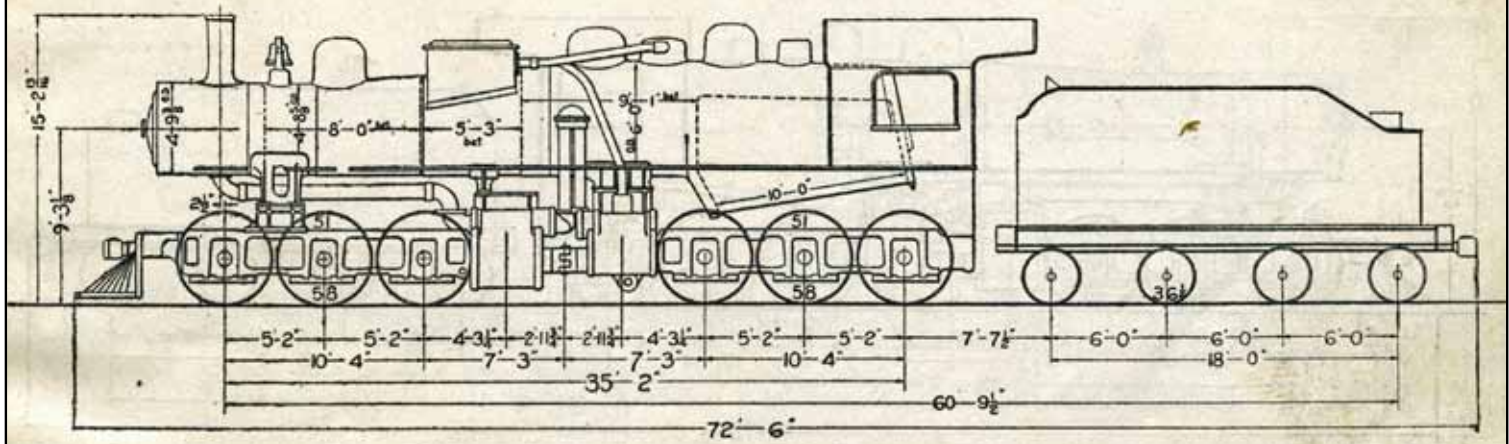
A sixth 0-6-6-0, outshopped in October 1911 as class R1c 1955, was a rather different

animal. Both sets of 20x26-inch cylinders were high pressure, making it a simple, not compound locomotive. The Pennsylvania Railroad was building a simple 2-8-8-2 simultaneously; though completed also in October 1911, that engine remained at the PRR shops for stationary testing until late November. Hence, CP 1955 was the first North American-style simple articulated to be placed in revenue service. The "North American" distinction is necessary because the many British-style Fairlie Patent-type single- and double-ended locomotives (some built under license by William Mason in the U.S.), introduced in the 1860s, were also simple articulated.

All six CP class R1 engines had the same

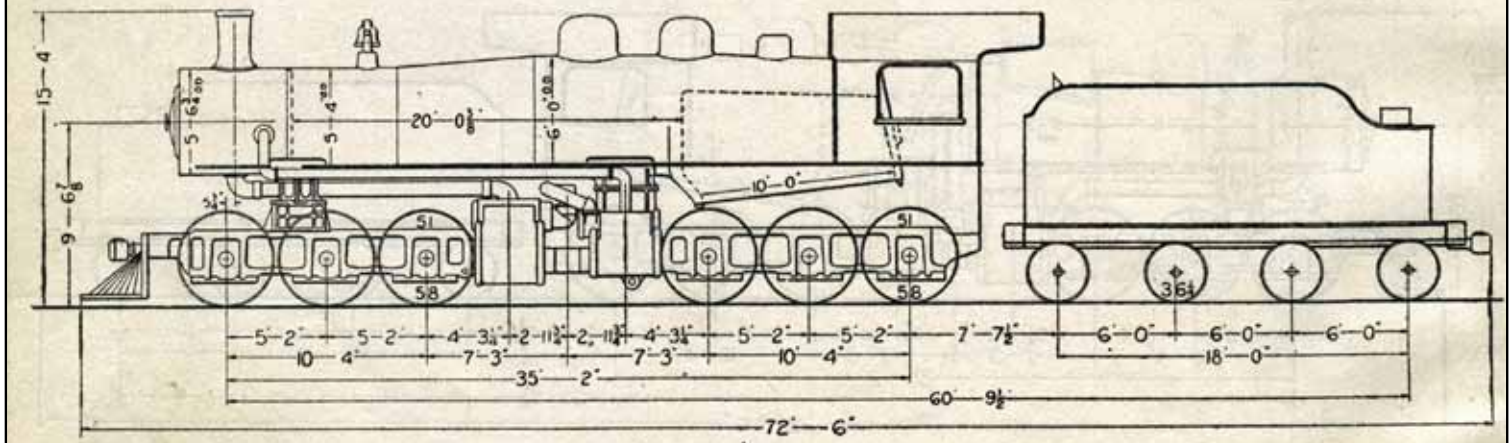
0-6-6-0 MALLET COMPOUND LOCOMOTIVE

CLASS R 1
SUB-CLASS R1a
CAPACITY 280%



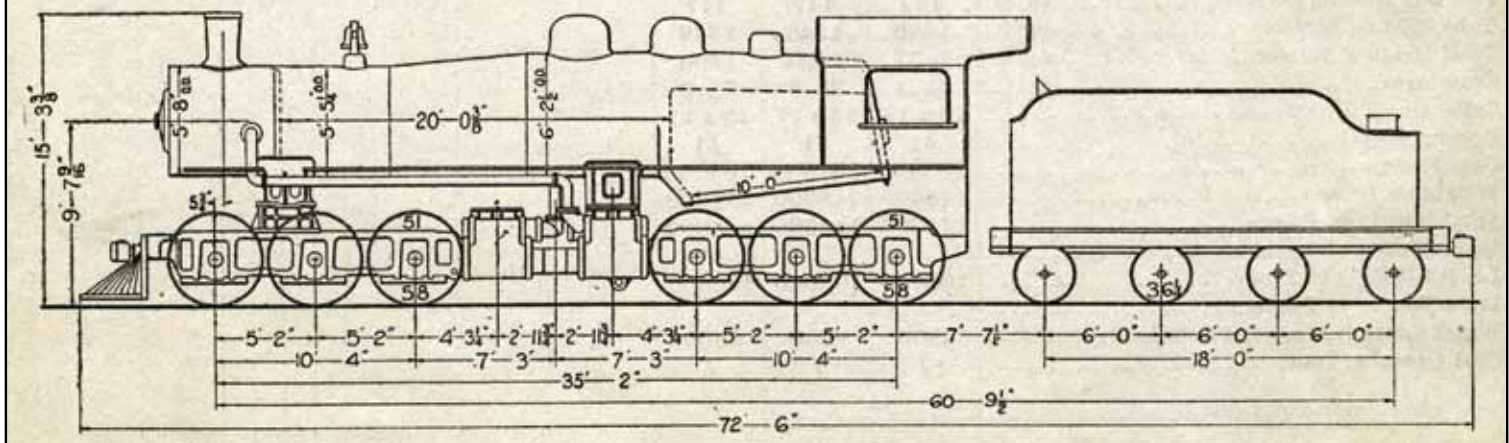
0-6-6-0 MALLET COMPOUND LOCOMOTIVE

CLASS R 1
SUB-CLASS R1b
CAPACITY 280%



0-6-6-0 ARTICULATED SIMPLE LOCOMOTIVE

CLASS R 1
SUB-CLASS R1c
CAPACITY 280%



Pages from a CP diagram book show how the classes of R1's compared. Overall length was a little more than half that of a UP Big Boy.

JAMES A. BROWN COLLECTION

tractive effort rating, 57,000 pounds, and weighed about 130 tons in working order; tenders weighed an additional 81 tons fully loaded. In 1912 and '13, as part of a general renumbering, the 0-6-6-0s took new numbers as follows: No. 1950 became 5750, Nos. 1951–1954 became 5751–5754, and No. 1955 became 5755.

At the outbreak of World War I in 1914, great pressure was put on CP's shop facilities by the conversion of much space to the manufacture of war materiel. Experimentation and production of new locomotives was curtailed. Henry Vaughan's passion lay in locomotive development. Since this activity would be dormant until the return of peace, George Bury, CP's vice president and a man remembered by many as one of strong will and arbitrary temperament, pressured Vaughan to devote more effort to administration and less to Angus Shops. Bury did so despite his personal feeling, as explained in a letter to Sir Thomas Shaughnessy, CP's chairman and president, in which Bury said Vaughan was "... a superior engineer and most capable designer ... [but] not an administrator or a shop man."

When Vaughan balked at his new role, Bury insisted, resulting in Vaughan's resignation. This was seen as a great loss to the company, and Bury was called upon to explain it in writing to Shaughnessy, which he did in these terms: "... that in view of ... my desire to have him give time to the system, he would retire from the service." As a face-saving gesture—more for CP than for Vaughan—Shaughnessy saw that Vaughan retained a nominal connection as a "consulting engineer." In the event, Vaughan devoted himself to war work.

Vaughan's place as head of the mechanical department was taken in April 1915 by William E. Woodhouse, who was given the title of chief mechanical engineer. He lacked the international engineering credentials, imagination, and genius of Vaughan. However, his 24 years with CP, which had seen him rise from a teenage fitter through locomotive foreman and superintendent of shops to an administrator in the mechanical department, made him a good choice as a wartime "caretaker" of this function.

It was in these circumstances that the six 0-6-6-0s began to become due for general overhauls in 1915–16. What then transpired, though technically under Woodhouse's administration, was said to be the result of a decision Vaughan had reached before his sudden departure. CP had now several years' experience with these engines, and the compound system that five of them used now was viewed as obsolete. Moreover, experience in operation had demonstrated that articulation was an unnecessary and costly complication, at a time when more and larger rigid-wheelbase road locomotives were badly needed to cope with rising traffic demands.

The ABCs of CP's 0-6-6-0s

Class	R1a	R1b	R1c
Original Nos.	1950	1951–1954	1955
1912 Nos.	5750	5751–5754	5755
Boiler pressure (psi)	200	200	200
Length of tubes btwn. tube sheets	9 ft. 1 in.	20 ft. 0 ³ / ₈ in.	20 ft. 0 ³ / ₈ in.
Superheating surface (square feet)	487	548	548
Firebox heating surface (sq. ft.)	180	180	185
Feedwater heating surface (sq. ft.)	1,233	-	-
Tube heating surface (sq. ft.)	1,374	2,589	2,764
Fire heating surface (sq. ft.)	2,787	2,769	2,746
Total all heating surfaces (sq. ft.)	3,274	3,417	3,497
Grate area (sq. ft.)	59	59	59
Cylinders (bore x stroke in inches)	23 ¹ / ₄ x26 & 34x26	23x26 & 34x26	20x26
Driving wheel diameter (inches)	58	58	58
Weight on drivers (lbs.)	262,000	259,000	262,000
Total weight of engine (lbs.)	262,000	259,000	262,000
Tender water capacity (Imp. gal.)	5,000	5,000	5,000
Tender coal capacity (tons)	12	12	12



After less than a decade, CP rebuilt the class R1 0-6-6-0s to R2 2-10-0s; as Decapods, they led long lives. R2a 5751, originally R1a 1951, rests in Montreal on July 27, 1956.

JAMES A. BROWN

REBUILT TO 2-10-0s

Whether its ultimate source was Vaughan or Woodhouse, in May 1916 the order was given to prepare drawings to rebuild the first 0-6-6-0, No. 5750, into a 2-10-0. These drawings were completed in 30 days—supporting the view that planning had begun before Vaughan's departure—and the locomotive entered Angus Shops in June. It emerged only three weeks later. In its new form, with 23½ x 32-inch cylinders but retaining 10 of its 12 58-inch drivers, it kept its road number but was reclassified R2a. The process also saw a 10 percent reduction in tractive effort to 51,800 pounds, with corresponding reductions in weight and heating surface.

The other 0-6-6-0s followed No. 5750 through this process between October 1916

and January 1917. Nos. 5751–5754 became class R2b, while No. 5755 was designated class R2c.

The new 2-10-0s met all expectations, but were retained in the East, ending their careers in the late 1950s as transfer and switching locomotives around Montreal and occasionally elsewhere, such as Saint John during the "winter port" season. In Montreal, their regular assignments included hauling long transfers from the harbor area to Outremont, and later, St. Luc yards, climbing the same Hochelaga grade upon which No. 1950 had first been tested in 1909. They were scrapped at Angus Shops between October 1956 and September 1960, more than four decades after Canada's brief fling with articulated steam locomotives. ■

STEAM *photos*

DOUBLE DEPARTURE: In a view from Mission Tower, just outside Los Angeles Union Passenger Terminal, on a foggy April 1946 morning, Union Pacific and Southern Pacific trains begin their runs. At left is UP 4-8-2 No. 7024 with train 24, the *Pacific Limited* for Chicago. At right, another Mountain type, SP 4352, double-heads with an unidentified 4-8-4 on train 51, the *San Joaquin Daylight* to Oakland.

H. L. KELSO





TURNING A TEN-WHEELER: The crew of Maine Central 4-6-0 No. 379 lean into their task on the “armstrong” turntable at Beecher Falls, Vt., in September 1948. The 1907 Baldwin has brought mixed train 378 up from Bartlett and is being readied to return south, with a side trip to Gilman.

PHILIP R. HASTINGS

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