Classic Trains
SPECIAL EDITION NO. 10

36 RAILROADS • EXCURSION STARS • RARE PHOTOS

Fantastic 4-8-4 Locomotives

SPECIAL COLLECTOR'S EDITION!

Special 2012

Fast, powerful, versatile giants from the zenith of steam

Stories from the cab

Majestic machines on the Santa Fe, N&W, CB&Q, Lackawanna, Northern Pacific, NYC, Rock Island, Canadian National, UP, SP, Milwaukee, AND MORE

£4.50
05
9 770898 894913
www.ClassicTrainsMag.com

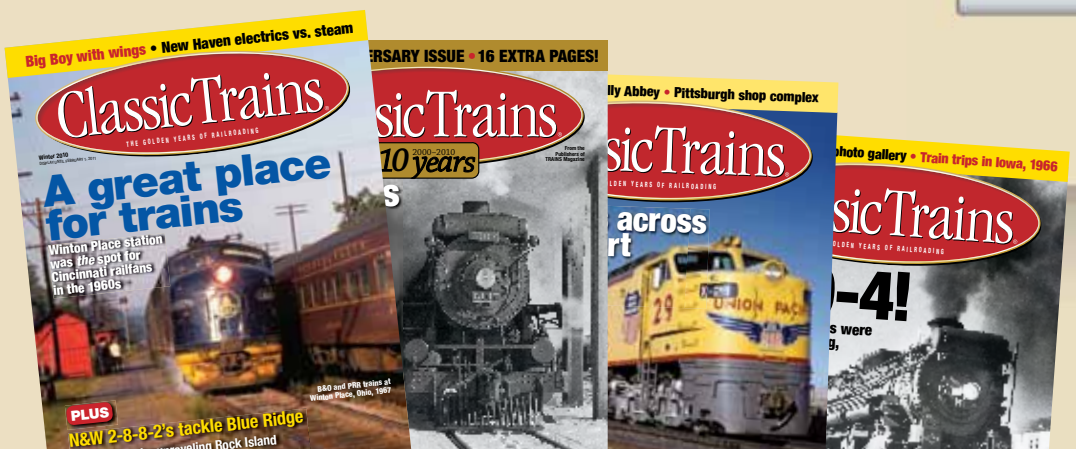
Fantastic 4-8-4 Locomotives • CLASSIC TRAINS SPECIAL EDITION NO. 10 • 2012

Get the most out of *Classic Trains!*

With a ***Classic Trains*** subscription you'll relive the golden years of railroading through historical narratives, personal recollections from railroaders and railfans, and spectacular images of steam locomotives, early diesels, and the great trains they pulled.

Plus, gain subscriber-only access to everything ClassicTrainsMag.com has to offer!

- 4 issues of *Classic Trains* magazine
- Photo of the Day Archive
- Bird's-Eye View Online
- Live railroading Web cams



Subscribe Today!
1-800-533-6644
www.ClassicTrainsMag.com

Monday-Friday, 8:30 a.m.-4:30 p.m. Central Time.
Outside the U.S. and Canada, call 262-796-8776, x661

P12432

A0BK8K

Fantastic 4-8-4 Locomotives

CLASSIC TRAINS SPECIAL EDITION NO. 10 • 2012

FANTASTIC 4-8-4 LOCOMOTIVES (ISBN 978-0-89024-862-1) is published by Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612.

Editorial
Phone: (262) 796-8776
E-mail: editor@classictrainsmag.com
Fax: (262) 798-6468

Display advertising sales
Phone: (888) 558-1544, ext. 625
E-mail: adsales@classictrainsmag.com
Fax: (262) 796-0126

Customer service
Phone: (800) 533-6644
Outside U.S. and Canada: (262) 796-8776, ext. 421
E-mail: customerservice@kalmbach.com
Fax: (262) 796-1615

Retail trade orders and inquiries
Phone: (800) 558-1544, press 3
Outside U.S. and Canada: (262) 796-8776, ext. 818

Visit our website
www.ClassicTrainsMag.com

Single copy prices (U.S. funds): $9.95 in U.S.; $11.95 in Canada and other foreign counties, payable in U.S. funds drawn on a U.S. bank. Canadian price includes GST. BN12271 3209RT Printed in the U.S.A.

When 4-8-4 adds up to 10

Welcome to FANTASTIC 4-8-4 LOCOMOTIVES, Special Edition No. 10 from CLASSIC TRAINS magazine. In our nine previous specials, dating back to 2003, we've covered a variety of topics: streamliners, the world of steam locomotives, first-generation diesels, the railroads' role in World War II, speed in railroading, and railroaders themselves. But we'd never devoted an entire special edition to a single locomotive type—until now.

As the most numerous of all the wheel arrangements introduced during steam's "Super-power" era, the 1,125-member 4-8-4 family seemed a natural for an issue-length tribute. To tell its story, we enlisted authorities on steam, history, and preservation. Bill Withuhn's introductory essay [pages 8–13] addresses the origin and significance of the type. On pages 74–79, John Hankey considers the various names besides Northern by which the 4-8-4 was known. Jim Wrinn reviews the 18 engines that have kept the 4-8-4 legacy alive by hauling excursion trains in the five decades since dieselization [pages 80–105].

To Neil Carlson fell the biggest task of all: describing and analyzing the more than five dozen 4-8-4 designs built for North American service between 1926 and 1950 [pages 16–57]. Even those 42 pages couldn't quite contain Neil's sprawling study; in addition to the specification tables found in each of the five parts, Neil developed graphs comparing the horsepower generated by the various designs. These, plus a glossary of terms, can be found on our website, www.ClassicTrainsMag.com.

The 4-8-4 has been called "the king of wheel arrangements." In assembling this tribute, we've found no reason why it might be dethroned. On a scale of 1 to 10, surely it's a solid 10.

Robert S. McGonigal

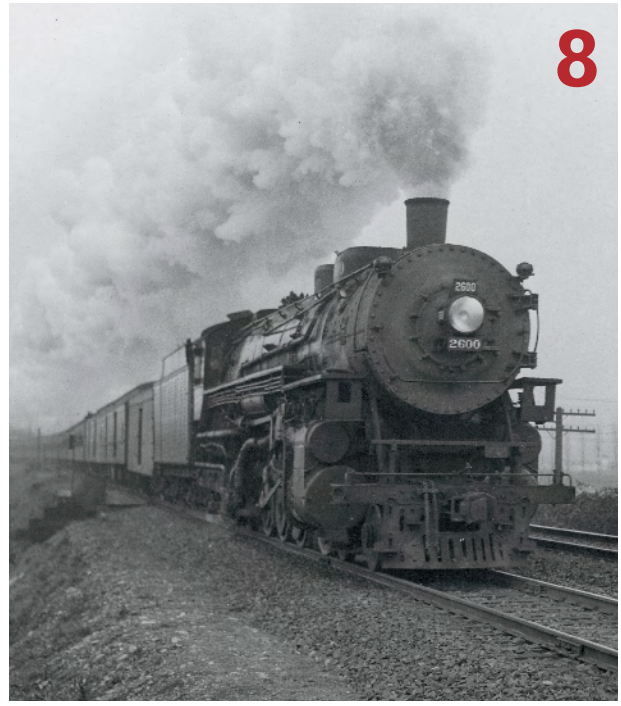
ROBERT HALE

Santa Fe 2915, a member of one of the most potent and celebrated of all 4-8-4 classes, rolls the third section of the *Grand Canyon* west at Frost, Calif., in December 1951.

Fantastic 4-8-4 Locomotives

Classic Trains SPECIAL EDITION NO. 10

CLASSIC TRAINS SPECIAL EDITION NO. 10 • 2012



On the cover: Fantrip celebrity Burlington Route No. 5632 hauls an NRHS convention excursion train on subsidiary Colorado & Southern north of Denver on September 2, 1963. *Tom Gildersleeve photo*


26


36


62


74
NORTHERN
TYPE


80

Contributors

NEIL CARLSON ["All About the 4-8-4," pages 14–57], who grew up in Buffalo, N.Y., in the 1950s, has had a lifetime fascination with steam power, reinforced by visits to the local Nickel Plate Road roundhouse as a teenager. When NKP dieselized in 1958, he refocused on Ontario, where Canadian National and Canadian Pacific both ran steam for another year and a half. Neil attended college in Ohio, and, after earning degrees in electrical engineering, he moved to California's Silicon Valley, where he worked for several high-tech firms. Now retired, he lives in Reno, Nev. Among Neil's six previous articles with us are articles on fast-freight articulateds [Steam Glory, 2004], the 2-8-4 type [Steam Glory 2, 2007], the 4-6-4 type [Fast Trains, 2009], and the 2-10-4 type [Fall 2010]. He's pictured on Fort Wayne Railroad Historical Society's NKP Berkshire No. 765 in 2007.

JOHN P. HANKEY [co-author, "A Northern Type by Any Other Name," pages 74–79] is a historian and museum consultant. He is a frequent contributor to railroad publications. This is his fourth article in a Classic Trains publication.

HOWARD G. HILL ["Man in a Hurry," pages 58–61] began his railroad career in 1914 at SP's Texas & New Orleans shops in Houston. In five years, he advanced from apprentice machinist to mechanical engineer, and thereafter he worked in the railway supply field. Hill was awarded the Legion of Merit and personally cited by Gen. George S. Patton Jr. for an "outstanding job" while serving as General Manager of the U.S. Military Railway during the final stages of the Sicilian Campaign in 1943. Hill designed U.S. War Department 0-6-0T's and 2-8-2's during World War II, and wrote about them in the December 1964 issue of Trains magazine. Including "Man in a Hurry," Hill had three other articles in Trains; in October 1968's "K4 vs. J-1 in 1931," he described riding the locomotives that pulled the *Broadway Limited* and *20th Century Limited*. His book *Riding the Limiteds' Locomotives* was published in 1972. Hill died in 1983.

TOM MAW ["First Trip on a Northern," pages 72–73] was born, raised, and still lives near Toronto. He hired on with CN in 1955 and worked as a yardman/trainman for 12 years. In 1967 he became a transportation analyst. He was promoted in 1971 to Trainmaster, moving on to Road Foreman of Engines, Assistant Superintendent, and then in January 1990 to Terminal Superintendent with responsibility for border operations for both the CN in Sarnia, Ont., and Grand Trunk Western in Port Huron, Mich. This included a carfloat operation over the St. Clair River, a rail tunnel under the river, and CN's largest flat switching yard. He retired in 1995 after the opening of CN's new Sarnia–Port Huron tunnel. This is his first article in a Classic Trains publication.

ROBERT S. McGONIGAL [co-author, "A Northern Type by Any Other Name," pages 74–79] has been Editor of Classic Trains since its launch in 2000. The first steam locomotive he ever saw, at age 4 or 5, was Reading T-1 No. 2100, on an Iron Horse Ramble at Jenkintown, Pa.—and it scared him half to death. Rob has gotten over his fear, but hasn't lost his sense of awe when in the presence of a live 4-8-4.

BILL WITHUHN ["A Locomotive for All Seasons," pages 8–13] is Curator Emeritus at the Smithsonian Institution. He got involved in hands-on steam repair, firing, and running in the mid-'60s. Recurring stints as assigned engineer have included a 2-8-0, a classic high-wheeled 4-4-2, three 4-6-2's, a 2-8-2, and Milwaukee Road 4-8-4 No. 261 (with which he's pictured)—13 different steam locomotives in all. "I'm just a journeyman," he insists. "I'm no match for the veterans who've done it every day—those are the guys I look up to." Bill is perhaps best known as chairman of the Engineering Standards Committee for Steam Locomotives, which for nearly two decades has worked with the National Board of Boiler Inspectors and FRA on steam inspection and repair standards. His 4-8-4 experiences include a ride over Sherman Hill on UP 8444 (as it was then) with Don Short at the throttle, five days with GS-4 4449 and Doyle McCormack on the *American Freedom Train*, and, of course, running the 261 at track speed on Conrail, BNSF, and the Twin Cities & Western with Steve Sandberg and Robert Franzen.

JIM WRINN ["Magic Numbers," pages 80–105] has been Editor of Trains magazine since 2004. He rode behind his first 4-8-4 in August 1976 when he joined a segment of the famous Atlanta–Alexandria, Va., excursion powered by No. 4449 on the Southern Railway. In 2005, he enjoyed a cab ride on the

4449 in Washington state as it doubleheaded with another 4-8-4, SP&S No. 700. As a follower of the Norfolk Southern steam program, he saw Norfolk & Western 611 on its first run in 1982 and its last in 1994. Jim's book about the Southern Railway-Norfolk Southern steam program, *Steam's Camelot*, was published in 2000. Among Jim's favorite 4-8-4 experiences is the August 2002 journey of Santa Fe 3751 in which he and legendary photographer Stan Kistler both happened to choose the same curve to photograph the engine near Parker, Ariz., on a blistering 100-degree day. "Just to find the same spot and enjoy the company of someone whose work I've admired for years, 'Mr. Santa Fe,' made the wait well worth it," Jim says. He's pictured with Southern 2-8-0 No. 542 at the North Carolina Transportation Museum at Spencer, where he has long been active.

A LOCOMOTIVE for all seasons

Powerful, efficient, versatile, and handsome, the 4-8-4 was the star of the final decades of American steam

BY **BILL WITHUHN**

"The standard modern American steam locomotive," author George Drury called it in his 1993 Kalmbach Publishing Co. book *Guide to North American Steam Locomotives*, and few would disagree. Many have compared the 4-8-4 in its significance for steam design in the 20th century as akin to the 4-4-0 in the 19th. Numerous examples of each type, in their time, displayed a balance of proportion and form that was especially pleasing. Moreover, the 4-4-0 and 4-8-4 proved exceptionally versatile, being widely used in both passenger and freight service.

Some 36 railroads in North America adopted the 4-8-4, with production spanning from 1926 to 1950. The Northern Pacific put the first ones into service, and the name "Northern" became attached to the type on the NP and many other roads. The NP's new engines helped change the way all railroads looked at their overall economics. Rather than focusing on the raw tonnage capacity of their locomotives, railroads began to look at *productivity*: the tonnage hauled in a given amount of *time*—in a year, in a week, in an hour.

In their first full year, the initial dozen NP class A 4-8-4's sharply reduced the number of engine changes needed on long-distance runs and eliminated doubleheading of passenger locomotives in two difficult districts (Jamestown, N. Dak.–Glendive, Mont., 323 miles; and Livingston, Mont.–Missoula over Bozeman Pass, 240 miles). NP's class A's, as a group, cut annual operating costs by $260,000 while pulling heavier trains faster. That's in 1927 dollars; the savings would be about $3.4 million today.

MORE THAN AN EXPANDED 4-8-2

The first 4-8-4, and many later, came from the American Locomotive Co. (Alco). Alfred Bruce, Alco's last chief steam designer, commented on a widespread view about the genesis of the 4-8-4: "This type was, of course, the logical successor to the 4-8-2 type" and "use

The 4-4-0 American type was the standard general-service road engine of the 19th century. Pennsylvania No. 274 dated from 1875.

PRR PHOTO

Northern Pacific 2600—the very first 4-8-4—gallops out of the mist with a 19-car passenger train somewhere between Seattle and Tacoma, Wash. From this engine flowed more than a thousand others, and an extraordinary chapter in railroad history.

WILLARD W. MARSH PHOTO

Canadian National was the first road to acquire 4-8-4's for dual (*i.e.*, freight and passenger) service. U-2-c 6150, from CN's third (1929) group, catches morning light at Montreal in November '57.

BOB KRONE PHOTO

Three men pull Timken 1111—the first locomotive built with roller bearings on all axles—at a trade show in Atlantic City. One track over is a PRR M1a, a 4-8-2 that was the equal of many 4-8-4's.

TIMKEN PHOTO

of four-wheel trailer trucks instead of two-wheel trucks was the result of pure arithmetic and little else . . ." Designers at rival Lima Locomotive Works, however, would have taken strong issue on both counts. Lima's 2-8-4 Berkshire type, introduced just a year before the first Northern, paved the way to the wide adoption of four-wheel trailing trucks and thus to the bigger fireboxes such trucks permitted. The practical problems were far more than "pure arithmetic." And in the context of the NP's design decisions, the first 4-8-4 was definitely *not* a "logical successor to the 4-8-2." In fact, the direct design predecessor of the first Northern was a heavy 4-6-2 Pacific.

In 1923, NP redesigned its Q-5 Pacific to create the heavier Q-6. NP managers were disappointed, for the new Pacifics proved too slow when their trains were longer than usual. Then another factor fundamentally altered the picture: strikes at NP-owned coal mines in Montana. The railroad owned deep mines at Chestnut and Red Lodge, which produced good grades of bituminous coal. Miners there organized themselves in the early 1920s, and strikes began in 1923. NP responded by building track toward new strip-mined pits at Colstrip, Mont., in Rosebud County. The coal there—a semi-bituminous variety, almost lignite—had not been tapped previously because the heating value was low: only about 8,000 Btu per pound, compared to 12,000 Btu/lb. for Red Lodge coal (and 12,000–15,000 Btu/lb. for coal used by railroads in the East). Moreover, the ash content of Rosebud was high. On all counts, this was poor stuff for locomotives, but NP management was determined to use it. The Colstrip mines began production in September 1924.

Engines used on branchline passenger trains and local freights could tolerate the Rosebud coal, since these locomotives seldom ran at maximum power and could empty their ashpans often. For larger engines on main lines, Rosebud proved inadequate in existing fireboxes. Ash was a particular issue: The ultimate limit on how far any coal-burner can go between servicing stops is its ashpan capacity. Thus, for important traffic, NP was still dependent on coal from troubled Red Lodge and Chestnut mines.

In late 1925, Northern Pacific design staff began working up specifications for a new passenger locomotive. The engine had to keep schedule up long grades without a helper, while pulling greater train weights than a Q-6 could handle. Mechanical engineers E. L. Grimm and E. R. Manor set up a task force to solve the problem of burning Rosebud in large engines. They briefly considered a theoretical 4-8-2, but analysis quickly showed it could not make enough steam burning Rosebud, since a large enough grate area could not be incorporated. The team settled on a grate of 115 square feet, an unprecedented size for an eight-drivered locomotive. Just enlarging the grate wasn't the only thing; the firebox also needed a big combustion chamber to allow full burning of such fuel. This was all too much for a two-wheel trailing truck to support, and thus was born the first 4-8-4—in a direct line from a class of heavy 4-6-2's.

An Alco-favored supplier provided the trailing truck: a four-wheel version of Commonwealth's "Delta" form. Unlike four-wheel, short-wheelbase trailing trucks tried before on a few non-NP engines, the rear truck of a class A had a long wheelbase. That allowed a generous ashpan, and the Delta three-point suspension avoided the tracking problems of early Lima 2-8-4's and 2-10-4's with their extended-frame rear trucks.

NP intended the 4-8-4 as an engine for passenger trains operating on sustained grades. The trade press proclaimed NP's success: longer runs without engine change, lower operating costs, better schedule-keeping, and a trailing-truck design that solved the practical problems of earlier long-wheelbase types. If a big engine could perform so successfully on such poor coal, what could a 4-8-4 do if designed for better coal? And what about fast freight?

FOLLOWING NP'S LEAD

After NP, the next railroads to reap the operating and economic benefits of the 4-8-4, all in 1927, were Lackawanna (five engines from Alco), Santa Fe (one from Baldwin, with many more later), and Canadian National/Grand Trunk Western (52 from Canadian builders and Alco). CN introduced the "dual service" concept for 4-8-4's, planning them specifically for both passenger and freight trains. After that, Alco and Baldwin enjoyed more orders. Lima, meanwhile, concentrated on producing its "Super-power" 2-8-4's and 2-10-4's for freight.

The 4-8-4 type was a boon to steam-era railroading, but one big change, wrought by an individual 4-8-4, is with us to this day: the widespread use of roller bearings. Next to the Westinghouse air brake, the roller bearing was the most fundamental improvement to railway technology in history.

In 1929–30, Alco designed a locomotive for a client that wasn't even a railroad. T. V. Buckwalter, vice president of Timken Roller Bearing Co. in Akron, Ohio, had proposed it. As the Great Depression caused automotive production to fall, Timken's mainstay orders for automobile wheel and transmission bearings plummeted too. Perhaps the railroad-supply market, which Timken had been trying to crack for years, could help the company survive. Roller bearings had been tried on locomotive trucks, but not on driving axles. Despite the advantages roller bearings offered, railroads were reluctant to specify them because of their huge first cost compared to plain bronze bearings.

One of the Central's stellar Niagaras dashes through Hammond, Ind., with an express from Chicago at sundown on October 16, 1949.

H. M. STANGE PHOTO, KRAMBLES-PETERSON ARCHIVE

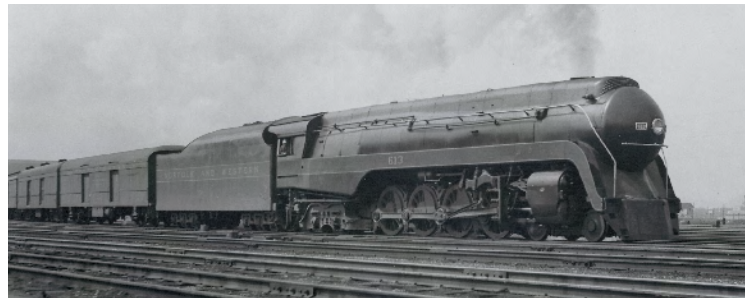
Alco persuaded Timken that the demonstrator locomotive should be a dual-service 4-8-4, so it could shine when pulling any kind of train. Paid for with $150,000 from Timken, numbered 1111, and informally christened the "Four Aces," the locomotive began a nationwide, 100,000-mile sales tour. For the first time in North America, a piece of railroad motive power had roller bearings on all axles. The name TIMKEN gleamed in silver leaf on its tender, and the pips of spade, heart, diamond, and club decorated its sand dome. The card-game markings symbolized the risk Timken was taking—that it could penetrate the locomotive market just as the Depression was gathering force. Needless to say, that historic gamble paid off.

THE TOP THREE: ATSF, N&W, NYC

The argument is perennial: which of the 4-8-4 designs was the "most powerful?" There are many claimants; few are well documented.

The largest and heaviest 4-8-4's were the 30 Santa Fe 2900-class engines delivered in 1943–44 by Baldwin. Oil-burners, the 2900's could make 4,600 drawbar horsepower according to road-test results. From available records, only two designs exceeded 5,000 h.p. at the tender's rear coupler in road tests, and unlike NP's A, both burned high-Btu, low-ash coal. One was New York Central's Niagara; Alco built 27 in 1945–46. The other was Norfolk & Western's class J, 14 of which N&W constructed at its Roanoke shops between 1941 and '50. The final three J's of 1950 were the last 4-8-4's built in North America.

NYC motive power chief Paul Kiefer had designed the road's superb 4-6-4 Hudsons. The Niagara was his final steam project. He and his staff collaborated with the Alco team led by Alfred Bruce. To get the largest boiler diameter they could (100 inches) within the NYC's tight clearances, there was no steam dome, an idea tried a few years earlier. To avoid drawing water into the drypipe, the pipe was placed high inside the boiler. Slots along the pipe's upper length provided for a plentiful intake of steam and reduced turbulence of flow. The rest of the design—combustion volume, steam passageways, running gear—was advanced in every detail. Performance was stellar:



Norfolk & Western 613, the final 4-8-4 built in North America, departs Cincinnati with the *Cavalier* for Norfolk, Va., in May 1952. Like NYC's Niagaras, N&W's J's could top 5,000 drawbar h.p.

BOB BORCHERDING PHOTO

The Santa Fe 2900's were the heaviest of all 4-8-4's. Built to haul mile-long freights or 90-mph passenger trains, No. 2925 has been relegated to helper service as it arrives at Mountainair, N.Mex., after assisting F3 diesels up from Belen on July 1, 1956.

JIM EHERNBERGER PHOTO

THE 4-8-4 FAMILY: 1,125 engines, 36 railroads

Railroad (quantity)	Class	Road Nos.	Builder, Year(s)	Notes
Atchison, Topeka & Santa Fe (65)	3751 3765 3776 2900	3751–3764 3765–3775 3776–3785 2900–2929	Baldwin, 1927-29 Baldwin, 1938 Baldwin, 1941 Baldwin, 1943-44	
Atlantic Coast Line (12)	R-1	1800–1811	Baldwin, 1938	
Canadian National (160)	U-2-a U-2-b U-2-c U-2-d U-2-e U-2-f U-2-g U-2-h U-4-a	6100–6119 6120–6139 6140–6159 6160–6164 6165–6179 6180–6189 6200–6234 6235–6264 6400–6404	Canadian, 1927 Montreal, 1927 Montreal, 1929 Montreal, 1936 Montreal, 1940 Canadian, 1940 Montreal, 1942-43 Montreal, 1943-44 Montreal, 1936	Streamlined
Canadian Pacific (2)	K1a	3100–3101	CPR, 1928	
Central of Georgia (8)	K	451-458	Lima, 1943	
Chesapeake & Ohio (12)	J-3 J-3a	600–606 610–614	Lima, 1935, '42 Lima, 1948	
Chicago & North Western (35)	H	3001–3035	Baldwin, 1929	24 H's rebuilt to class H-1 in 1946-49
Chicago, Burlington & Quincy (36)	O-5 O-5A	5600–5607 5608–5635	Baldwin, 1930 CB&Q, 1936-40	
Chicago, Milwaukee, St. Paul & Pacific (52)	S1 S1 S2 S3	9700 251 201–240 260–269	Baldwin, 1930 MILW, 1938 Baldwin, 1937-40 Alco, 1944	To MILW 250
Chicago, Rock Island & Pacific (85)	R-67B R-67B	5000–5064 5100–5119	Alco, 1929-30 Alco, 1944, '46	
Delaware & Hudson (15)	K-62	300–314	Alco, 1943	
Delaware, Lackawanna & Western (55)	Q-1 Q-2 Q-3 Q-4	1501–1505 1601–1620 1621–1630 1631–1650	Alco, 1927 Alco, 1929 Alco, 1932 Alco, 1934	
Denver & Rio Grande Western (19)	M-64 M-68	1700–1713 1800–1804	Baldwin, 1929 Baldwin, 1938	
Grand Trunk Western (43)	U-3-a U-3-b U-4-b	6300–6311 6312–6336 6405–6410	Alco, 1927 Alco, 1942-43 Lima, 1938	Streamlined
Great Northern (20)	S-1 S-2	2550–2555 2575–2588	Baldwin, 1929 Baldwin, 1930	
Lehigh Valley (37)	T-1 T-2 T-2B T-3	5100–5110 5200–5210 5211–5220 5125–5129	Baldwin, 1931, '32 Alco, 1931, '32 Alco, 1943 Baldwin, 1934, '35	
Missouri Pacific (40)	N-75 N-73	2101–2125 2201–2215	MP, 1940-42 Baldwin, 1943	
Nashville, Chattanooga & St. Louis (25)	J2-57 J3-57	565–569 570–589	Alco, 1930 Alco, 1942-43	
National of Mexico (32)	QR-1	3025–3056	Bald., Alco, 1946	
New York Central (28)	HS-1a S-1a, b S-2a	800 6000–6025 5500	Alco, 1931 Alco, 1945-46 Alco, 1946	Experimental Poppet valves
Norfolk & Western (14)	J J1 (to J) J	600–604 605–610 611–613	N&W, 1941-42 N&W, 1943 N&W, 1950	All J's built with streamlining, added to J1's later
Northern Pacific (49)	A A-1 A-2 A-3 A-4 A-5	2600–2611 2626 2650–2659 2660–2667 2670–2677 2680–2689	Alco, 1926 Alco, 1930 Baldwin, 1934 Baldwin, 1938 Baldwin, 1941 Baldwin, 1943	Ex-Timken 1111
Reading (30)	T-1	2100-2129	RDG, 1945-47	
Richmond, Fredericksburg & Potomac (27)	- -	551–555 601–622	Baldwin, 1937 Baldwin, 1938-45	
St. Louis-San Francisco (25)	-	4500–4524	Baldwin, 1942-43	
St. Louis Southwestern (20)	L1 L1	800–809 810–819	Baldwin, 1930 SSW, 1937, '43	11 to SP 4475–81, 4485–88
Soo Line (4)	O-20	5000–5003	Lima, 1938	
Southern Pacific (70)	GS-1 GS-2 GS-3 GS-4 GS-5 GS-6	4400–4409 4410–4415 4416–4429 4430–4457 4458–4459 4460–4469	Baldwin, 1930 Lima, 1936 Lima, 1937 Lima, 1941-42 Lima, 1942 Lima, 1943	Streamlined Streamlined Streamlined Streamlined Streamlined Semi-streamlined
Spokane, Portland & Seattle (3)	E-1	700–702	Baldwin, 1938	
Temiskaming & Northern Ontario (4)	-	1100–1103	Canadian, 1936-37	
Texas & New Orleans (4)	GS-1	700–703	Baldwin, 1930	
Toledo, Peoria & Western (6)	H-10	80–85	Alco, 1937	
Union Pacific (45)	FEF-1 FEF-2 FEF-3	800–819 820–834 835–844	Alco, 1937 Alco, 1939 Alco, 1944	
Wabash (25)	O-1	2900–2924	Baldwin, 1930-31	
Western Maryland (12)	J-1	1401–1412	Baldwin, 1947	
Western Pacific (6)	GS-64	481–486	Lima, 1943	Semi-streamlined

Counting Southern Pacific subsidiary Texas & New Orleans as a separate carrier, 36 North American railroads owned 4-8-4's, in fleets ranging in size from Canadian National's 160 to Canadian Pacific's 2. No other U.S. road topped Rock Island's total of 85 engines.

6,600 h.p. in the cylinders at 85 mph, with 5,050 drawbar h.p. at 60–65 mph. A single poppet-valve version produced about the same power, but with markedly less fuel and water consumption.

Norfolk & Western's own amazing engineering staff, led by Mechanical Engineer H. W. Reynolds, who had succeeded John A. Pilcher in late 1938, conceived the road's remarkable J class. The team that Pilcher and Reynolds had built pulled out all the stops. Every performance-determining parameter—grate area (108 square feet), combustion chamber length (102 inches), boiler diameter (also 102 inches), boiler pressure (300 psi), generous valves, improved draft at lower back pressure, and more—was stretched to practical limits. Notably, N&W staff worked out unusual driver counterbalancing, a balancing that depended on very stiff centering action by the lead and trailing trucks. Dramatically improved rotary balance allowed relatively low, 70-inch-diameter drivers, giving maximum drawbar power at 40–55 mph, speeds typical on much of N&W's uphill-downhill profile. Yet road tests proved a J could rocket up to 110 mph. The lower driver diameter also gave more room for increased boiler diameter. In its tests, running on best-quality, high-heat Pocahontas coal, a J could easily reach 5,100 drawbar h.p.

Depression, World War II, and dieselization conspired to keep 4-8-4 numbers relatively low. Individual orders for specific classes of 4-8-4's were generally around 10 or a dozen, or maybe 20, at a time. In the 1900–25 years, railroads customarily ordered as many as 50 engines at once and often owned 100 or more in each class. Canadian National bought by far the largest 4-8-4 fleet, 160 (plus 43 on subsidiary Grand Trunk Western). In the U.S., the Rock Island was tops with 85, followed by Southern Pacific with 70 (or 84, counting subsidiary Texas & New Orleans' 4 engines and 11 others that SP leased from Cotton Belt in the 1950s).

A LASTING LEGACY

Total 4-8-4 production amounted to 1,125 engines—just 3 percent of the steam locomotives in North America during the type's heyday. In that respect, it achieved nothing like the ubiquity of the 4-4-0, of which some 25,000 were built. But the 4-8-4 was by a large margin the most numerous of the principal Super-power era wheel arrangements, the others in the top five being the 2-8-4 (611 locomotives

"At a mile a minute, they're not even breathing hard." Milwaukee Road 261, one of several 4-8-4's maintained for excursion service five decades after the end of the steam era, bounds along the CSX main line with West Virginia's *New River Train* in October 1994.

HAROLD A. EDMONSON PHOTO

built), 2-10-4 (430), 4-6-4 (487), and 4-6-6-4 (252).

More railroads bought Northerns than any of the other modern types. Some 4-8-4 classes were strictly passenger haulers, others were for freight, while others were dual-service engines. As diesels bumped them from their original assignments, 4-8-4's designed for passenger service might end their days on freight trains. The three dozen 4-8-4 owners were spread from coast to coast and included carriers in Canada and Mexico. Indeed, the list of big roads (2,000 route-miles or more) that *didn't* have 4-8-4's is short: Boston & Maine, New Haven, Erie, Katy, Seaboard, Louisville & Nashville, Baltimore & Ohio, Illinois Central, Southern, and Pennsylvania.

Why no PRR 4-8-4? Pennsy had added thousands of new engines in the late 1910s and '20s and thus was flush with motive power when the Depression hit. Adding to the surplus was Pennsy's electrification of its eastern lines, completed in 1938. And, PRR already had an engine that was comparable to a 4-8-4: the M1a 4-8-2. The M1a was the equal of many 4-8-4's, given the high-Btu coal that PRR used on its main lines and the huge combustion volume of the M1a's firebox. PRR's substantial track structure permitted heavy axle loads not tolerable on many other railroads, so the M1a needed one less trailing axle to support its overall weight. There's another side to the PRR's "almost 4-8-4" story: But for Baldwin's advocacy of duplex drive, PRR's 52 class T1 4-4-4-4's of 1942–46 might have been 4-8-4's.

What is the legacy of the 4-8-4? The Northern set the stage for railroading in the rest of the 20th century, with the type's power at speed, its flexibility in handling any kind of train, and its role in bringing railroading into a more time-sensitive world. Also, 4-8-4's were the biggest, the most powerful, and/or the last steam engines delivered to many railroads, the final flowering of nearly a century and a half of locomotive development.

And who could then imagine that in the 21st century, five decades after diesels vanquished steam from regular service, that 4-8-4's would still thrill us as they roar past? Preserved engines like Milwaukee 261, Santa Fe 3751, Southern Pacific 4449, and Union Pacific 844 still occasionally romp along the high iron with excursion trains. At a mile-a-minute, they're not even breathing hard. Splendid fugitives from another era, cared for by people who know their meaning, they run. *They run!*

All about

More than a thousand engines. Three dozen owners throughout North America. Constructed by three builders and seven railroad companies. A quarter-century production period during which steam reached its zenith. These are the sprawling parameters of the 4-8-4 story. To tell it, we turned to Neil Carlson, an authority on modern steam locomotives who has written extensively about them. In the five

the 4-8-4

articles on the following pages, Neil first presents the early years of 4-8-4 development, then breaks the story down by builder, covering engines built by Alco, Baldwin, Lima, and the railroads' shops. This 42-page package, by far the most extensive study of a single wheel arrangement CLASSIC TRAINS has ever published, covers every 4-8-4 design on every railroad that owned the type. We hope you enjoy it!—*Robert S. McGonigal*

Chicago, Burlington & Quincy 5632, one of the most famous of the 1,125 North American 4-8-4's, roars through Lisle, Ill., in July 1959, returning to Chicago with an excursion train.

D. G. HOFFMAN PHOTO, ED DEROUIN COLLECTION

Early years

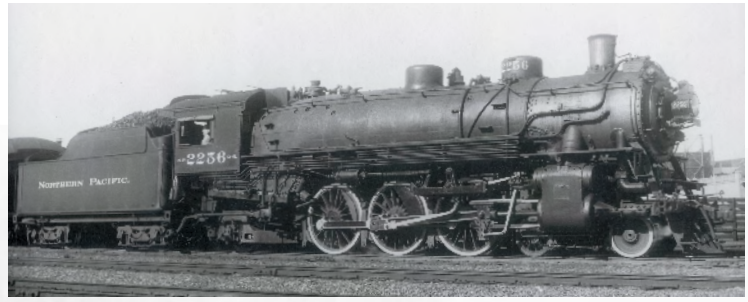
From scaled-up Pacific to Super-power standard

Originated as a specialized solution to a specific set of circumstances, the 4-8-4 evolved in a few short years into a general-purpose machine

BY NEIL CARLSON

The first 4-8-4 appeared in 1926. It was not created as part of the then-incipient Super-power steam movement, but rather to solve a specific operating problem on the Northern Pacific Railway.

By the mid-1920s, NP's class Q-6 Pacifics were increasingly unable to handle the new passenger trains with heavy steel cars. Train size for the road's flagship *North Coast Limited* had grown to 14 and 15 cars and doubleheading had become common. Management wanted a new locomotive to eliminate this. Management also wanted the engines to burn "Rosebud" coal, a poor grade of fuel similar to lignite that was available from on-line mines. Although Rosebud contained only about half the heat content of good quality eastern bituminous coal, it cost only about one-quarter as much. Any new engine would have to handle the bigger trains *and* burn Rosebud.



When Northern Pacific sought a replacement for its class Q-6 4-6-2 heavy passenger engines, it arrived at the first 4-8-4, which it designated class A. Note the overall similarity between Q-6 Pacific No. 2256 (above) and class A Northern No. 2606.

2256, H. F. HARVEY COLLECTION; 2606, R. F. COLLINS, LOUIS A. MARRE COLLECTION

Burning lignite efficiently requires both a large grate and a large furnace volume. Since it contains less heat energy than the same amount of bituminous coal, more of it must be burned in order to generate the same amount of heat—hence the need for a large grate area. Lignite also has a much higher percentage of volatiles (hydrocarbons) than bituminous coal. Therefore, when it is heated, the volatile component of this fuel is quickly driven off in the form of flammable gases. These gases mix with air and then burn in the volume of the firebox—above the grate. Lots of furnace volume is needed to allow the gas/air mixture to be completely burned before entering the boiler tubes and flues, at which point all combustion stops.

Through experimentation, NP determined that a grate area of 115 square feet was necessary if the new locomotive was to burn Rosebud. The engine might have been a big 4-8-2 if better coal had been used. The tractive effort of a 4-8-2 was adequate, however its single-axle trailing truck would not support the large firebox required. A two-axle trailing truck was needed. Thus, the 4-8-4 was born.

The American Locomotive Co. had been NP's preferred builder for years, and Alco collaborated with the railroad on the design of the new 4-8-4. The construction of these locomotives, designated class A by the NP, was entirely conventional. They had built-up frames, and the cylinders were cast in two halves, bolted together, and then bolted to the frame. Plain ("friction") bearings were used on all axles. The boiler pressure was initially set at 210 psi (although it was later raised to 225 and, eventually, 240 psi). The A's were equipped with a Franklin booster driving the rear axle of the trailing truck. The boiler was equipped with the then-new Type E superheater and an Elesco exhaust steam injector. Tube length was 21 feet, and the big combustion chamber's was 74½ inches. The chamber's length was important because it added to the furnace volume.

Alco delivered the first class A, No. 2600, in December 1926, followed by 11 more in 1927. As the originator of the wheel arrangement, NP at first called its new 4-8-4's the Northern Pacific type. The shortened form "Northern" soon became the standard name, although there were numerous exceptions [see pages 74–79].

As the A's went into service, NP conducted extensive dynamometer-car tests with them. The engines initially operated with too high a back pressure to suit the NP, which made a series of modifications to the valves and exhaust nozzle to reduce it. During testing, the A's developed about 3,000 drawbar horsepower (dbhp), well short of their calculated theoretical output of 3,500 dbhp. The difference is explained by the poor quality Rosebud coal. NP's subsequent, but larger, 4-8-4's exhibited the same characteristics.

The 2600's went into passenger service in North Dakota and Montana, replacing the doubleheaded 4-6-2's. In the 1930s and '40s, NP acquired an additional 37 bigger 4-8-4's (from Baldwin, not Alco—see pages 44–45) and as they went into service, the original engines moved to the Pacific Coast. Eventually, all were converted to oil-firing—a change that undoubtedly improved their performance.

Lackawanna was the second road to buy 4-8-4's. At far left, Q-1 passenger engine 1503 approaches Hoboken Terminal with the *Merchants Express* from Scranton. At left, Q-2 freight hog 1602 claws toward Pocono Summit with westbound tonnage.

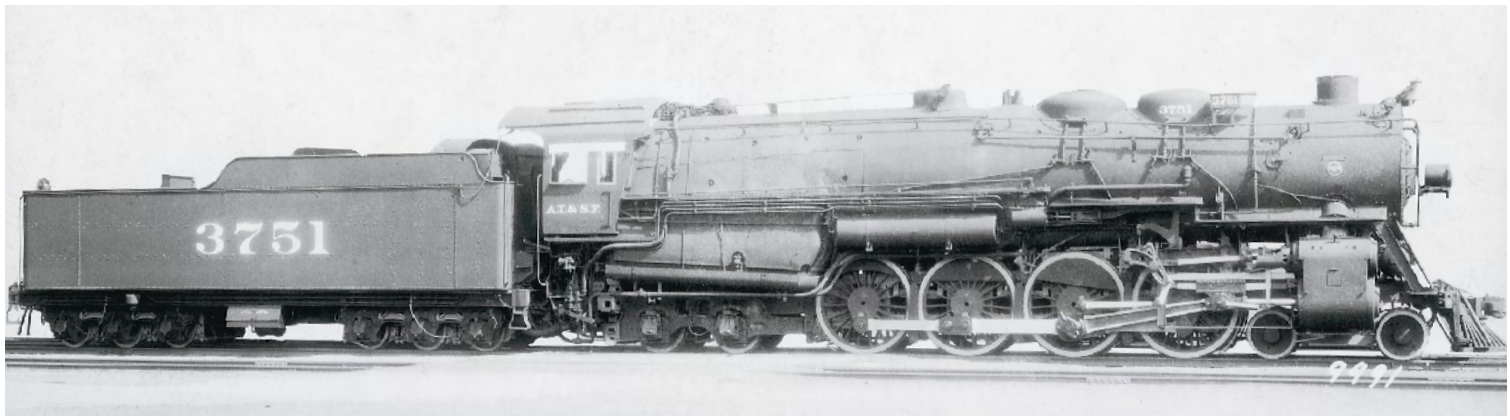
FAR LEFT, WAYNE BRUMBAUGH; LEFT, J. B. RESCHKE

THE FIRST WAVE: DL&W, CN/GTW, SANTA FE, CP

Because of the poor coal it burned, Northern Pacific's first 4-8-4 probably didn't qualify as a Super-power locomotive. Nevertheless, as a concept, the 4-8-4 design most certainly did. The NP class A was built at the same time that Lima Locomotive Works was demonstrating its new 2-8-4 Berkshire and Alco was building the first 4-6-4 Hudson for the New York Central. It wasn't a big projection to envision a Super-power 4-8-4—burning good fuel. The excitement of Super-power steam was in the air, and in short order, the Lackawanna, Santa Fe, Canadian National, Grand Trunk Western, and Canadian Pacific all set about acquiring new 4-8-4's.

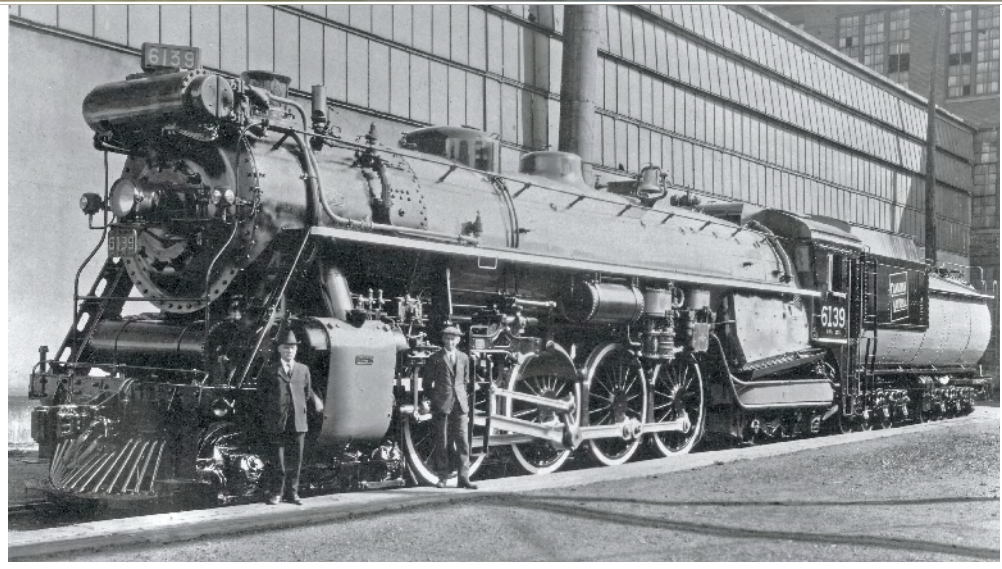
The Delaware, Lackawanna & Western faced tough competition in the New York City–Buffalo market. Even though it had the shortest route, it also had a difficult profile through the Pocono Mountains of northeastern Pennsylvania. DL&W had been using heavy 4-8-2's in this territory on its passenger trains and wanted a more powerful locomotive. As a good customer of Alco, Lackawanna's mechanical department was well aware of the NP class A under construction. As a consequence, together with Alco it embarked upon the development of its own new 4-8-4. Just months after the first Northern was delivered to the NP, Lackawanna took delivery of five engines in 1927—class Q-1 Nos. 1500–1504. They were similar in size to the NP engines, but they had 77-inch drivers and the old Type A superheater. The railroad named them Poconos after the mountains through which they ran. They were immediately put to work on DL&W's crack passenger trains such as the *Lackawanna Limited*, where they turned in a creditable performance.

Meanwhile, on the freight side, the Erie Railroad had modernized its operations in the late 1920s with 105 new 2-8-4's. Faced with this stiffer competition for East Coast–Midwest freight traffic, in 1929 the DL&W received a further 20 4-8-4's from Alco, class Q-2. Numbered 1600–1619, they had essentially the same boilers as the Q-1, but they were mounted on frames with 70-inch drivers that were better suited for freight service. Lackawanna used the new power to handle its hot trains to its connections in Buffalo. In 1932 and '34 the DL&W would go on to



Santa Fe tested the 4-8-4 waters in 1927 with one prototype before ordering 13 more 3751-class engines. Rebuilt, No. 3751 still runs.

CLASSIC TRAINS COLLECTION



Canadian National 6139 (left) exemplifies the 52 U-2 and U-3 engines CN and Grand Trunk Western received in 1927. The dual-service pioneers kicked off the continent's biggest 4-8-4 fleet. CN 6201 (above, built in 1942) hustles near Hyde Park, Ont., in '58.

LEFT, CANADIAN NATIONAL; ABOVE, HAROLD A. EDMONSON

receive another 30 Alco-built 4-8-4's [see pages 29–30].

Santa Fe Railway's first 4-8-4's were an outgrowth of its 3700-class 4-8-2's. Indeed, the number of the last 4-8-2 was 3750, and that of the first 4-8-4 was 3751. The design was the work of the railroad's mechanical department and, as was typical of the Santa Fe's approach to Super-power steam, it was on the conservative side. The railroad ordered one engine from Baldwin, supplier of nearly all modern Santa Fe steam power, in 1927. Like the 4-8-2's, No. 3751 was a passenger engine. After thorough testing of the prototype, Santa Fe ordered 13 more, which Baldwin delivered in 1928–29.

The 3751-class engines had everything that they needed to become star performers —with one key exception. They had big boilers with a more than an ample amount of heating surface, Type E superheaters, feedwater heaters, big grates, lots of furnace volume, and fireboxes stuffed full of thermic syphons. What was missing? They had the same boiler pressure—210 psi—as the 4-8-2's. This figure was later raised to 220 psi, but had it been 250 psi, the 3751's could have developed a good 10 percent more horsepower.

Santa Fe would eventually own a total of 65 Baldwin 4-8-4's [pages 45–47, with the subsequent engines being substantially larger than the original 3751 class. Furthermore, the company would rebuild and modernize all the early engines.

The Canadian National and Grand Trunk Western 4-8-4's, delivered in 1927, were cut from the same cloth, GTW being a subsidiary of CN. Reflecting the light track structure that characterized most CN lines, they were the first of the "lightweight" 4-8-4's , weighing less than 400,000 lbs. CN's 40-engine order was split evenly between Alco subsidiary Montreal Locomotive Works (class U-2-a Nos. 6100–6119) and the Canadian Locomotive Co. at Kingston, Ont. (U-2-b Nos. 6120–6139). The 12 GTW engines, class U-3-a Nos. 6300–6311, were built by Alco and were slightly larger than their CN cousins. Originally, the CN called them the Con-

Like CN, Canadian Pacific sampled the 4-8-4 early, building two for passenger service in 1928. But CP stuck with the 4-6-4 as its top varnish power, and K1a's 3101 (above, at Montreal West on September 6, 1954) and 3100 remained the loneliest of all 4-8-4's.

MIKE USENIA PHOTO

federation type, but this was later changed to Northern and a small metal plate was affixed to the cylinders of the CN and GTW engines proclaiming this.

The three 4-8-4's designed up to this point (for NP, Lackawanna, and Santa Fe) had been for passenger service. The CN/GTW engines were intended for dual service, handling both passenger and fast freight assignments. Adding to their versatility, the U-2's and U-3's were light enough so they could be used on many secondary lines as well as the main lines. CN and GTW together would acquire a total of 203 4-8-4's, the largest fleet by far in North America, with the final engines (U-2-h's for CN) coming in 1944. Over the years, changes were made in the valves and in some of the appliances, but the basic design remained the same. The CN and GTW 4-8-4's lived long lives, some lasting until the very end of mainline steam in North America in spring 1960.

Canadian Pacific built two 4-8-4's at its Angus Shops in Montreal in 1928. CP management was very much aware of the Superpower trends that were taking place in the industry, and the two class K1a's were as much of an experiment as anything else, intended to see how a large, modern locomotive would work on the CP. Nos. 3100–3101 were bigger than those of neighboring Canadian National, with an engine weight of 423,000 lbs. They also had a boiler pressure of 275 psi, which was high for the time.

It was a good design, and on other railroads it would have been a success—but not on the CP. Essentially, it was too big. In this era, railroads built locomotives sized for specific assignments. CP used 2-8-2's in freight service and 4-6-2's in passenger service. The new 4-8-4's would have had power to spare in either assignment, but the CP, as traditional as it was, was not about to change the order of its operations. Eventually, the two engines found a home on the overnight Montreal–Toronto passenger trains. These often ran as big as 20 cars and did lots of express and mail work at most stops as they covered the 350 miles during the night on an 8-hour, 15-minute schedule. When the trains were dieselized in the mid-1950s, the two K1a's were converted to oil-firing and sent west to Manitoba, where they ran out their last miles in freight service.

OIL-BURNERS: GN, COTTON BELT, AND SP

The 4-8-4 type also quickly moved into oil-burning territory. The topography of the West and Southwest, where oil-firing was most prevalent, was ideally suited for this wheel arrangement, and new oil-fired engines were delivered to the Great Northern, Cotton Belt, and Southern Pacific in 1929 and '30. Baldwin, which had more experience with oil-burners than any other builder, constructed all three designs.

GN received 6 locomotives in 1929 and another 14 in 1930. They were of two different classes, S-1 and S-2, but both were intended for passenger service. The S-1's, Nos. 2550–2555, were the largest 4-8-4's to date, tipping the scales at a hefty 472,000 lbs., and they were the only North American 4-8-4's ever to have Belpaire boilers, a GN hallmark. The S-2's (2575–2588) were much lighter, but they were also trendsetters, being the first to have 80-inch drivers. In service, the big S-1's handled trains between Seattle and Spokane, while the high-drivered S-2's worked between Spokane and Havre, Mont. These 20 engines allowed GN to cut the time of its premier train, the newly inaugurated *Empire Builder*, between the Twin Cities and Seattle by 7 hours.

The St. Louis Southwestern, or Cotton Belt, got 10 engines in 1930 for fast freight service. Nos. 800–809 replaced 2-8-0's on the road's hot merchandise and perishable trains between Tyler, Texas, and Pine Bluff, Ark. With their 70-inch drivers, they were a compact design that could still fit on the railroad's 90-foot turntables. As the Great Depression began to lift in the late 1930s, Cotton Belt again felt the need for new power, and the company turned out five new engines at its Pine Bluff shops in 1937 using Baldwin-supplied boilers, then repeated the feat during the war in 1943. With these 10 additional engines, SSW's 4-8-4 territory was extended all the way to St. Louis.

Southern Pacific took delivery of 14 class GS-1 engines from Baldwin in 1930. These were the natural result of company's need to expand upon its large fleet of 4-8-2's and develop a more powerful engine. GS stood for Golden State—yet another moniker for

Green and silver Great Northern S-2 2588 (above) spans the plains near Browning, Mont., with the westbound *Empire Builder* in 1941. S-1 2552 (right), from the first (1929) order for oil-fired 4-8-4's, shows off its Belpaire firebox, a common feature of GN power, at Hillyard, Wash., in 1939.
ABOVE, W. R. MCGEE; RIGHT, R. F. COLLINS, LOUIS A. MARRE COLL.

the 4-8-4. Of the 14 engines, 10 were assigned to trains between Oakland and Portland, while 4 went to SP subsidiary Texas & New Orleans. All were used in passenger service. The GS-1 sold SP management on the 4-8-4 type, and it would later become noteworthy as a bellwether design that led to an additional 74 locomotives—mechanically similar but dramatically different in appearance—for SP and two other railroads, but built by Lima [pages 50–53].

DESIGN MATURITY: IMPROVEMENTS TO THE 4-8-4

The Northern was a very good design right from its inception, and as the number delivered grew, the improvements made were rather modest. This was unlike other modern designs, on which it took some time to work out the best compromises among grate area, tube length, combustion chamber length, driver diameter, etc. The 4-8-4 was a big enough locomotive so that, proportionately, everything just seemed to fit.

The first 4-8-4's were capable of about 3,500 to 4,000 dbhp. Later and bigger examples pushed this figure to 4,500. Finally, a couple of superbly designed 4-8-4's reached the 5,000 mark. Several important factors were required to achieve these higher horsepower levels: a high boiler pressure, incorporation of the Type E superheater, a large combustion chamber, and thermic syphons in the firebox.

Before the Super-power era, 200 psi was considered a high boiler pressure. However, engineers soon realized that one of the factors for maximizing locomotive performance was increasing boiler pressure. Simply stated, high-pressure steam contains more heat energy than low-pressure steam. While some early 4-8-4's had boiler pressures as low as 210 psi, this was quickly understood to be a mistake. As the design matured, 250 psi became the minimum figure, and many designs pushed this higher, up to 300 psi in some cases. But, these higher pressures did not come without a price.

Locomotive boilers had to be able to hold these higher pressures, of course, and this meant the use of stronger materials such as nickel steel or silicon carbon steel. This was more expensive than plain carbon steel, but it permitted the construction of stronger boilers without an increase in weight. Unfortunately, after a period of use, some of the boilers built with these exotic steels began to fail from stress-related embrittlement. This occurred typically at stress points such as rivet locations. Several railroads encountered these problems, including the Milwaukee Road, Missouri Pacific, and Santa Fe. Depending upon when in the life of the locomotive this problem arose, it could mean either a new boiler, or an early retirement.

The alternative was just building a heavier locomotive. During World War II, the exotic, lighter-weight steels were in short supply, and several engines with higher-pressure boilers were built with carbon steel. To match the strength of the preferred material, carbon steel had to be thicker, which increased total weight. Two wartime classes, the Santa Fe 2900's and the Northern Pacific A-5's, were the heaviest 4-8-4's built.

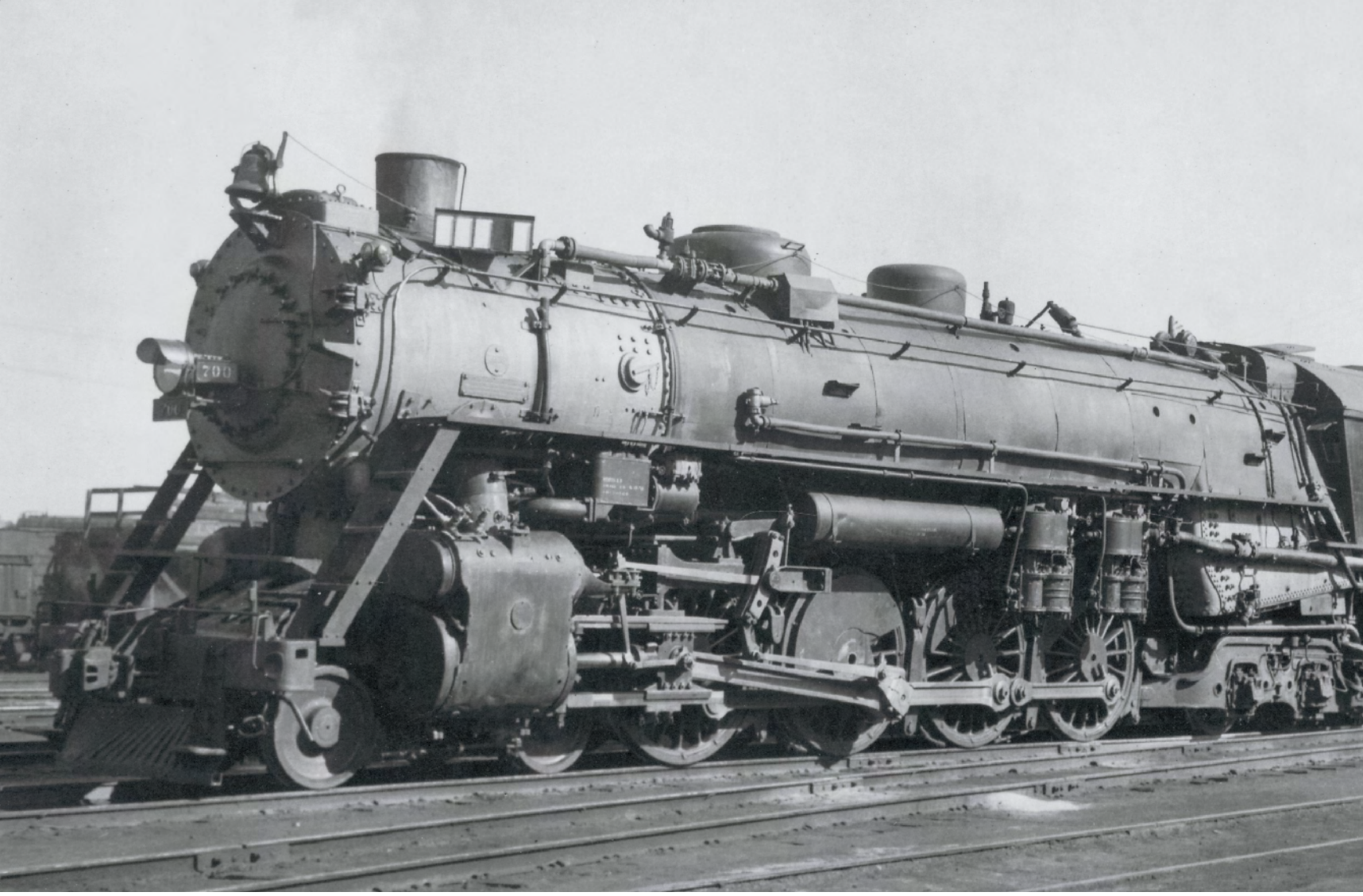
Use of the Type E superheater was vital. Compared to the older Type A, it could produce significantly higher steam temperatures. The Type E also permitted a flue and tube arrangement that provided 10 to 15 percent more indirect heating surface in the flues and tubes, as much as 30 percent more superheating surface—all in the same boiler space. As a consequence, more heat was absorbed by the boiler, and a more powerful boiler resulted. On a big 4-8-4, the increase could be as much as 400 to 500 h.p. Nevertheless, some modern locomotives were still built with the old Type A superheater. When this occurred, it was because of railroad preference, for after 1930 no builder would have proposed a new engine with the old superheater.

One of the compromises in a locomotive such as the 4-6-4 or 2-8-4 was the trade-off between tube length and combustion chamber length. The tube length adds heating surface, and the combustion chamber increases firebox furnace volume. A 4-8-4 was big enough for both a large combustion chamber and long tube lengths—an example of the natural balance inherent in the type. Just the same, in later years designers had pretty much figured out that a tube length of more than 19 or 20 feet was not necessary, and they put any extra length into the combustion chamber. A large combustion chamber proved to be critical when a locomotive needed to develop high horsepower. At high firing rates, this additional firebox volume was needed for the complete combustion of the fuel.

The combustion chamber had another beneficial effect. It increased the firebox direct heating surface. The heating surfaces of the firebox and combustion chamber absorb heat by radiation directly from the fire. It is a much more effective means of transferring heat to the boiler than the flues and tubes, which transfer heat indirectly by convection from the hot gases passing through them.

An exception to the above was with oil-fired locomotives. Baldwin believed that an oil fire was not as luminous as—or, put another way, less radiant than—a coal fire, and the builder typically added a bit more tube length on oil-burning engines. With a less luminous fire, the added heating surface of the combustion chamber would not be as effective in absorbing radiant heat.

Another item was the incorporation of firebox thermic syphons, which gave the boiler a boost. They first added more firebox heating surface, and they enhanced heat transfer. Water moving up through the syphons was lifted from the coolest part of the boiler—right at the bottom. Heat transfer is enhanced when the temperature differences between the heat source (the fire) and the material absorbing the heat (the water) are the greatest. Syphons absorbed a lot of heat. However, like many aspects of steam locomotive design, there was a negative trade-off. Syphons could be maintenance-intensive



Fourteen Baldwin GS-1 oil-burners of 1930—10 for Southern Pacific, 4 for subsidiary Texas & New Orleans—were the conventional-looking forerunners of the flamboyant fleet of streamlined *Daylight* engines constructed by Lima. T&NO 700 poses at El Paso in 1938.

FRED A. STINDT PHOTO

because of cinder cutting—in their exposed position within the firebox, syphons took a pummeling from swirling, partially combusted bits of coal. For this reason, some railroads preferred not to use syphons. But among the builders, Baldwin loved them, and they were commonplace on Baldwin-designed boilers.

Finally, another important appliance was a feedwater heater or exhaust steam injector. These devices recycled exhaust steam to heat the boiler feedwater. They increased boiler capacity by 8 to 10 percent and, with one exception, all 4-8-4's came so equipped.

One of the requirements of a modern steam locomotive was high availability. This meant faster terminal turnarounds and less shop time. Several railroads were able to regularly put 14,000 to 15,000 miles per month on their 4-8-4's. Two important technical advancements contributed to this: cast-steel engine beds and roller bearings.

In the early days, steam locomotives had steel-bar or wrought-steel frames that were bolted together. The cylinders were cast in two pieces and then were bolted to the frame. As locomotives grew in size, problems began to occur. A big engine generates tremendous forces with each piston thrust, and eventually these forces would begin to work the frame out of tram. When this happened, the misaligned frame accelerated the wear on the bearings and the reciprocating or sliding parts.

The cast-steel bed solved this problem. It was one huge casting that completely replaced a built-up frame. The first simple cast beds were produced in 1924, and they became increasingly sophisticated. By 1926, the cylinders were being cast with the frame. In 1929, integral air reservoirs had been included in the castings. By 1930, just about all new locomotives were built with cast-steel beds. The company that provided the bulk of these was Commonwealth Steel Castings in Granite City, Ill.

The widespread use of roller bearings can be traced to a 4-8-4 commissioned by the Timken Roller Bearing Co. The first locomotive equipped with roller bearings on all axles, built by Alco in 1930, it began a nationwide tour to demonstrate the benefits of the devices in railroad service. The tour met with some success. Generally, roller bearings were later adopted for engines in passenger service, but not necessarily for those in freight service. Roller bearings were costly, and the feeling prevailed that they could not be financially justified in lower-speed freight service. Several major railroads took this view. One, the SP, put rollers on just two locomotives, both 4-8-4's; others never equipped a single engine, passenger or freight. This mentality began to change later in the lifespan of the 4-8-4, and roads such as Norfolk & Western, Chesapeake & Ohio, and New York Central even took things a step further. In addition to the axles, they also specified roller bearings on side rods.

Four railroads tested poppet valves on their 4-8-4's: Santa Fe, Canadian National, Burlington Route, and NYC. The Santa Fe actually ran two experiments. One of its first 4-8-4's, No. 3764, was delivered with Caprotti poppet valves in 1929. The other appli-

Early 4-8-4's compared

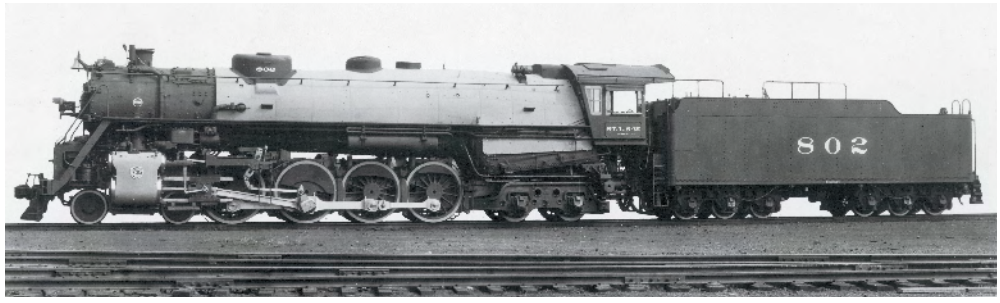
Railroad	NP	DL&W	CN	ATSF	CP	GN	GN	SSW	SP
Class	A	Q-1	U-2a	3751	K1a	S-1	S-2	L-1	GS-1
Road numbers	2600–11	1501–05	6100–19	3751	3100–01	2550–55	2575–88	800–09	4400–09
Builder, year	Alco, '26	Alco, '27	CLC, '27	BLW, '27	CPR, '28	BLW, '29	BLW, '30	BLW, '30	BLW, '30
Service	Psgr.	Psgr.	Dual svc.	Psgr.	Psgr.	Psgr.	Psgr.	Freight	Psgr.
Cylinders:									
bore x stroke (in.)	28 x 30	27 x 32	25½ x 30	30 x 30	25½ x 30	28 x 30	29 x 29	26 x 30	27 x 30
valve gear	Baker	Walsch.	Baker	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.
valve dia. (in.)	14	12	14	15	14	14	14	14	12
valve travel (in.)	9	9	9	9	7	7½	7½	7¾	7¼
Driver diameter (in.)	73	77	73	73	75	73	80	70	73½
Boiler:									
pressure (psi)	225	250	250	210	275	250	225	250	250
grate area (sq. ft.)	115	88.2	84.4	108	93.5	102	97.7	88.3	90.4
fuel	Rosebud	soft coal	soft coal	soft coal	soft coal	oil	oil	oil	oil
cmbstn. chmbr. (in.)	74½	66	48½	44	60	44	60	54	60
tube length (ft.-in.)	21-0	21-6	21-6	21-0	20-6	22-0	22-0	20-0	21-6
syphons	none	2	2	3	none	none	none	3	none
heating surfaces:									
evaporative (sq. ft.)	4,600	5,193	4,256	5,672	4,931	5,404	4,402	4,728	4,852
superheater (sq. ft.)	1,992E	1,324A	1,700E	2,250E	2,112E	2,444E	2,265E	2,060E	1,886E
Weights, working order:									
drivers (lbs.)	260,000	269,000	232,000	269,400	250,000	273,700	247,300	242,500	262,000
engine (lbs.)	426,000	421,000	378,000	421,900	423,000	472,120	420,900	422,500	442,300
tender (lbs.)	313,900	216,000	260,000	383,000	286,000	375,780	326,900	387,000	372,880
Rated tractive force	73,800B	64,500	67,700B	66,000	60,800	67,000	58,300	61,500	75,910B
Factor of adhesion	4.22	4.17	4.05	4.08	4.32	4.08	4.24	3.94	4.28
Tender capacity:									
fuel	24 tons	14 tons	20 tons	20 tons	20 tons	5,800 gal	5,800 gal	5,000 gal	4,692 gal
water (U.S. gal.)	15,000	12,000	11,300 Imp	15,000	12,000 Imp	22,000	17,000	15,000	16,152

E or A = type E or A superheater; B = tractive force including booster; Imp = Imperial gallons

cations, including the second on the Santa Fe, were made with Franklin poppet valves during the 1940s. In theory, poppet valves had two advantages over piston valves. First, they decoupled the timing of the valve events. With a piston valve, if the timing of one valve event is altered, the timing of all valve events is altered. For example, if the valve gear is set up so that cut-off (valve closure ending steam admission to the cylinders) occurs early, after 25 percent of the stroke, then release (valve opening to exhaust steam) will also occur early after just 50 to 60 percent of the stroke, the precise figure being dependent on the valve design.

With a poppet valve, release might always be delayed for as long as 90 percent of the stroke—regardless of when cut-off occurs. This obviously makes better use of the expansive properties of steam. The second advantage is that a poppet valve can provide a larger port opening for a longer period than is possible with a piston valve. This permits the freer admission and exhaust of steam. Just the same, even with all these potential advantages, the tests run on modern engines equipped with poppet valves were largely inconclusive. While the locomotives often did demonstrate somewhat better performance, in the end it was all academic. By this time, the diesel was on the scene and it made no difference how well poppet valves worked.

Unlike most other steam types, the 4-8-4 moved toward some measure of standardization at an early date. It actually started with the CN and GTW deliveries in 1927. While not really Alco or Montreal designs, these engines nevertheless formed the basis of another 192 almost identical locomotives delivered through 1944. By 1929, Alco had started to develop its own standard platforms. Eventually, the company had three standard 4-8-4 designs that it built for a variety of railroads. These were centered on the boiler, the locomotive's prime mover. A standard boiler could then be mounted to a frame with the right combination of cylinder dimensions and wheels for its intended assignment. Baldwin, Alco's principal rival, was less successful at this. Its work mostly reflected the reuse of common boiler components that were shared among numerous locomotives.



No. 802 was one of 10 fast-freight oil-burners Cotton Belt received from Baldwin in 1930; the road later built 10 more itself. Parent SP leased 11 of the 800's in the 1950s; No. 4476 (ex-SSW 804) is ready to depart San Francisco with a commute train on July 3, 1953.

802, COTTON BELT; 4476, ART THOMPSON, ALAN MILLER COLLECTION

Alco Standards and lightweights, FEF's and Niagaras

After building the first 4-8-4's, Schenectady achieved a measure of standardization for its small and mid-size engines, and produced two groups of legendary giants

BY NEIL CARLSON

Two firms—American Locomotive Co. (Alco) of Schenectady, N.Y., and Baldwin Locomotive Works of Eddystone, Pa., near Philadelphia—dominated 20th-century steam locomotive manufacturing. Alco built 356 4-8-4's, the first being the NP class A's of 1926–27, soon followed by engines for the Lackawanna and Grand Trunk Western [pages 16–21]. In 1929, Alco began producing 4-8-4's based on standard designs. Notable exceptions to this standardization were the FEF class for Union Pacific, and the New York Central Niagaras.

ROCK ISLAND'S BIG FLEET

Rock Island's 25 class R-67B engines of 1929 formed the basis for Alco's first standard design. The railroad purchased them because it wanted a locomotive that had the potential to reduce its Chicago–Pacific Coast manifest schedules (handled by connecting roads from New Mexico and Colorado onward). Intended for freight service, Nos. 5000–5024 were equipped with 69-inch drivers. However, the frame axle spacing was such that it would permit the substitution of 74-inch drivers at a later date.

Pleased with the performance of its new 4-8-4's, the Rock ordered 40 more, delivered in 1930. Initially, their operating territory was somewhat limited because of bridge restrictions and the engines' lack of Automatic Train Stop, which was required east of Silvis, Ill. However, over the years RI made a series of line improvements and applied ATS equipment to the engines, enabling them to operate all the way from Chicago to Denver or Tucumcari, N.Mex. With the expansion of RI's oil-burning territory, 35 engines were converted from coal-firing. During the late

Rock Island 5058 (left), from the road's first group of 4-8-4's in 1929–30, rolls a freight extra west near Lawrence, Kans., on January 29, 1952. Two years and one day earlier (above), 1944-built No. 5106 passes RI's Council Bluffs, Iowa, depot with an eastbound.

LEFT, ROBERT OLMSTED; ABOVE, JACK PFEIFER

Timken 1111 (above) is stopped with NP's *North Coast Limited* at Logan, Mont., on a windy, 22-below-zero day in January 1932, near the end of its roller-bearing sales tour. The celebrity became NP 2626; its last run was on an August 4, 1957, fantrip (right).

ABOVE, R. V. NIXON; RIGHT, HAL LEWIS

1930s and early '40s, RI modernized all 65 with 74-inch drivers and roller bearings.

To cope with World War II traffic, Rock Island acquired 20 more 4-8-4's, delivered in 1944 and '46 and numbered 5100–5119. Although they carried the same R-67B class designation as the earlier engines, these 4-8-4's were built to Alco's second standard design, discussed below. Ten were built as oil-burners to work the Kansas City–Tucumcari district. Unfortunately, the 1944–46 engines led short lives, for the Rock completed dieselization by the end of 1953. At 85, Rock Island's 4-8-4 fleet was the largest in the U.S. until Southern Pacific's acquisition of several Cotton Belt 800's brought its total to 85 as well.

TIMKEN'S 'FOUR ACES'

Not all 4-8-4's were built for railroads. In 1930, Alco produced one of its standard-design engines for the Timken Roller Bearing Co. Numbered 1111 and nicknamed "Four Aces," it was equipped with roller bearings on all engine and tender axles. Timken commissioned it as a demonstrator to show the railroads the benefits of roller bearings. In addition to rollers, No. 1111 had the unusual feature of being able to adjust its driver axle loading from 33 tons to 31 tons in order to permit operation on railroads with lighter physical plants. It toured 14 railroads throughout the U.S. However, while on the Northern Pacific, the engine suffered some firebox damage and NP eventually purchased it from Timken. With a smaller grate area than NP's other 4-8-4's, No. 2626, as NP numbered it, was ill-suited to burn Rosebud coal, and it wound up on the Pacific Coast after being converted to oil firing.

LV TRIES ONE FROM EACH

One railroad that Timken 1111 visited was the Lehigh Valley, and as it turned out, the visit was very opportune. Timken wanted to sell roller bearings, but on the LV, it was the 4-8-4 concept that took hold.

"The Valley" was one of four railroads competing between New York/New Jersey and Buffalo. By 1929, rivals Lackawanna, New York Central, and Erie had all improved their freight service by upgrading their motive power, while LV was still using 2-8-2's, 2-10-2's, and freight 4-6-2's. LV's management was impressed by the 1111. Consequently, even though the economy was ailing, the railroad ordered a sample 4-8-4 from both Alco and Baldwin with the understanding that additional orders would follow if the engines performed successfully. In the steam era, this was unusual. Most railroads had a favorite builder that built the bulk of each carrier's power. In this case, LV appeared to be setting up a competitive situation between the builders.

The sample 4-8-4's arrived in 1931; each was intended to meet performance specs prepared by the railroad. Alco's engine was built to its Rock Island standard design, and it became LV class T-2 No. 5200. The Baldwin, No. 5100, was just a bit smaller, and received the class designation T-1. Using a dynamometer car leased from Westinghouse Air Brake, LV put them through their paces. Both performed very well. They each handled bigger trains faster, significantly bettering the road's existing freight schedules—and they did it while using less fuel and water.

After the trials, instead of choosing one design, the Valley ordered an additional 10 engines from each builder, giving it a total of 22 4-8-4's. The road called them Wyomings—named after a river valley in Pennsylvania through which LV ran.

Pacifics normally handled LV's passenger trains. However, during holidays, or at the end of a term at Cornell University in Ithaca, N.Y., the trains grew to where doubleheading was necessary. To have engines that could fill in as passenger power during these times, LV in 1934 ordered from Baldwin five dual-service, 77-inch-drivered class T-3's.

World War II traffic prompted LV's final Wyoming order: 10 T-2B freight engines from Alco, based on the Alco T-2 of 1931. The Valley bought its first road diesels in 1945, and by the end of 1951 it had no more active steam locomotives.

Lehigh Valley had 21 Alco 4-8-4's and 16 Baldwins. Alco T-2B 5218 (above), built as a fast-freight engine in 1943, has been relegated to work-train duty at Hillside, N.J., in July 1950. Baldwin T-1 5107 (right) passes Geneva Junction, N.Y., in 1948.

ABOVE, JOHN DZIOBKO; RIGHT, R. OLLIS, H. K. VOLLRATH COLL.

MORE FOR THE LACKAWANNA

The neighboring Delaware, Lackawanna & Western already owned 25 4-8-4's by the time Lehigh Valley got its first ones, and DL&W increased its reliance on the type in the early '30s, receiving 30 more from Alco. Ten arrived in 1932, class Q-3, and 20 more in 1934, class Q-4. Unlike the earlier Poconos, which were custom designs, the new engines were built to Alco's Rock Island standard.

Both new groups employed the Type E superheater, making their boilers more powerful. Q-3's 1621–1630 were fast freighters with 70-inch drivers, while Q-4's 1631–1650 were dual-service, 74-inch-drivered engines. In the short period of seven years, DL&W had amassed a total of 55 4-8-4's. This was a large number for a road of less than 1,000 route-miles, and amounted to the biggest 4-8-4 roster in the East. Lackawanna was also quick to dieselize, which it accomplished in the early 1950s.

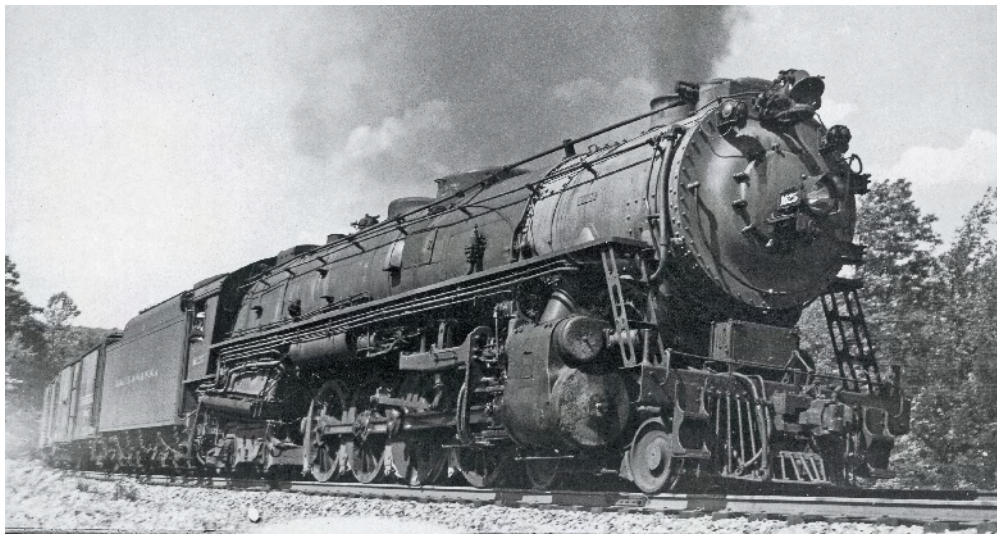
FOR D&H, A SECOND STANDARD

Alco developed its second standard design during World War II; 15 Delaware & Hudson engines of 1943 were the first examples. Just how this happened is lost to history. However, it's intriguing because this could be considered a new locomotive design, and the War Production Board generally did not permit this. The WPB insisted that locomotive production should be based on existing designs. Nevertheless, there were some exceptions, and this may have been one. But to add to the intrigue, recall that Lehigh Valley's T-2B's of 1943 were built to Alco's *first* standard design.

The D&H K-62's were bigger than Alco's prior Rock Island-based standard. The firebox was larger, the tubes shorter, and the com-

Distinctively styled Delaware & Hudson 303 curves along the shore of Lake Champlain south of Port Henry, N.Y., with a southbound freight sometime in the late 1940s.

H. W. PONTIN PHOTO



Lackawanna 1625 was one of 10 class Q-3 freight 4-8-4's built in 1932; 20 dual-service Q-4's [page 75] followed in '34. At 55 engines, DL&W had the East's biggest 4-8-4 fleet.

ROBERT A. LEMASSENA PHOTO

bustion chamber longer. These were all good features that resulted in a more advanced engine, and may explain why the WPB approved the design. On the other hand, they were built with the D&H's favored Type A superheater. So, when the Milwaukee Road and Rock Island came looking for additional 4-8-4's in 1944, because of WPB restrictions, they had to accept the Type A, too.

D&H 300–314 were handsome machines with many of the features that had given D&H power a British appearance over the years. They had recessed headlights, skirted running boards, hidden piping, smoke lifters, and capped stacks. They worked in freight and passenger service from Oneonta, N.Y., up to Rouses Point at the Canadian border. On passenger trains, they ran all the way to Montreal, and were regular visitors to Canadian Pacific's Glen roundhouse. Unfortunately, they also led short lives, for the D&H was fully dieselized by 1952.

MILWAUKEE ROAD

The Milwaukee Road also found itself short of power during the war; it wanted a heavy passenger engine. Its Baldwin S2 class 4-8-4's [pages 40–41], already on the roster, were too big for this assignment because of some tight station clearances, so a somewhat smaller locomotive was needed. The railroad turned to Alco for 10 D&H-based engines, MILW class S3, received in 1944. Since the WPB would not approve new locomotives for passenger service alone, they were considered dual-service engines. During and after the war, Nos. 260–269 performed a yeoman service in many capacities. Four were converted to oil-firing and sent to work on the Idaho Division between the railroad's two electrified districts. Some of the S3's lasted nearly to the end of MILW steam in 1955.

NC&StL'S LIGHTWEIGHTS

The first lightweights were the CN and GTW engines of 1927, but it did not take long for additional examples to appear. In 1930 Alco delivered five locomotives, each with an engine weight of just 381,000 lbs., to the Nashville, Chattanooga & St. Louis. The railroad's mechanical department had designed the 70-inch-drivered engines, desig-

Milwaukee Road No. 260, built in 1944 as the first of the railroad's 10 S3's, crosses the Fox River at Elgin, Ill., with eastbound reefers in 1948. The S3's were the Milwaukee's last new steam locomotives, a distinction held by 4-8-4's on many roads.

BARNEY L. STONE, KRAMBLES-PETERSON ARCHIVE

nated class J2 and numbered 565–569, for dual service on the Nashville–Chattanooga main line. The NC&StL was a key player in a passenger route composed of five railroads that offered through service from Chicago to Florida; the J2's were regular power for these trains. Reflecting the territory through which it operated, the "NC" called its 4-8-4's the Dixie type.

In 1941, as the war in Europe generated increased traffic, NC&StL ordered 10 more 4-8-4's from Alco. Classed J3, Nos. 570–579 were updated, slightly heavier versions of the J2's, with bigger tenders. The new Dixies had a semi-streamlined look that included running-board skirts with a yellow band that continued across the tender, and a conical smokebox front with a recessed headlight. The crews called them "Yellow Jackets."

By this time, new 110-foot turntables had enabled Dixie territory to be extended to Atlanta, and Alco built 10 more J3's in 1943. Although they carried the same nose cone as the earlier J3's, they lacked running-board skirts; yellow trim on the running boards and tenders earned Nos. 580–589 the nickname "Stripes." The Dixie era was done by 1952 when the NC dieselized.

LITTLE GUYS FOR TP&W, NdeM

Alco more or less adopted the NC&StL design as its own and built similar locomotives for two more railroads, Toledo Peoria & Western and Nacionales de México. The TP&W was a 268-mile bridge route across central Illinois connecting several western railroads with the Pennsylvania. TP&W's six 4-8-4's of 1937 were not truly copies of the NC&StL engines, but they did share some common dimensions. At 361,000 lbs., TP&W's were the lightest 4-8-4's built for service in North America (and the only ones with two-digit road numbers: 80–85). They were also the least sophisticated, with a Type A superheater and no feedwater heating device. They ran in relative obscurity until replaced by diesels in 1950.

The Nacionales de México took delivery of 32 4-8-4's, Nos. 3025–3056, in 1946. The order was equally split between Alco and Baldwin, but all the engines were built to Alco's NC&StL design. They were principally freight engines, operating out of Mexico City to Queretaro and Guadalajara. The QR-1's were the last 4-8-4's in regular service in North America, some lasting until late 1966.

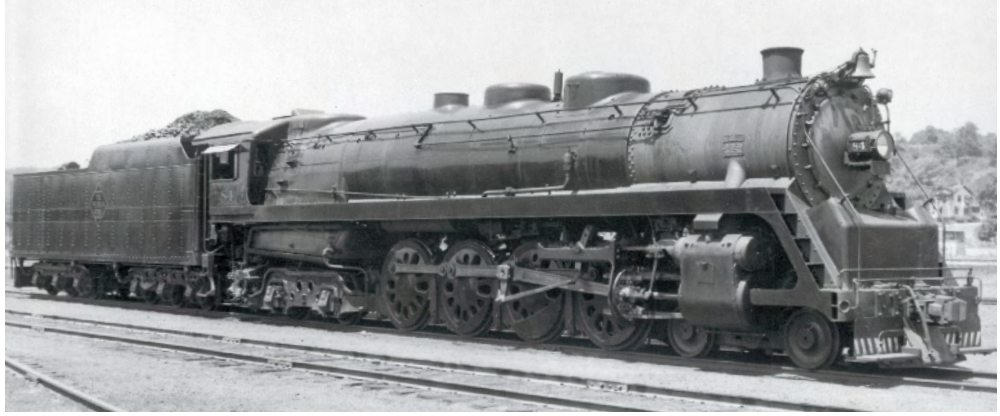
CN/GTW AND THE 'OTHER' T&NO

Two additional railroad-designed lightweights arrived in 1936. Canadian National received five streamlined 4-8-4's from Alco affiliate Montreal Locomotive Works. Designed with the aid of wind-tunnel tests, they had 77-inch drivers for Montreal–Toronto and Toronto–Sarnia, Ont., passenger service. As class U-4-a, they were a new design and were even a bit smaller than their older U-2 cousins. The class leader, No. 6400, achieved fame as the engine that powered the Royal Train on the CN when King George VI visited Canada in 1939. On the U.S. side of the border, Lima built six almost identical engines, class U-4-b, for the Grand Trunk Western in 1938. The last U-4-a ran in April 1959, one year before the end of CN steam.

The second of the two 1936 lightweight designs was a pair of engines built by Canadian Locomotive Co. for the Temiskaming & Northern Ontario—today's Ontario Northland. Numbered 1100–1101 and accessorized with smoke deflectors, running-board skirts, and a jazzy paint job, they powered T&NO's *Northland* between North Bay and Cochrane, Ont. Two more, 1102-1103, arrived the following year, also from CLC. The locomotives weighed just 371,320 lbs. and had 69-inch drivers. Tucked away in the north woods of Ontario, the T&NO foursome was perhaps the most obscure of all North American 4-8-4 fleets.

NC&StL J2 567 (above) commands a fast freight near Smyrna, Ga., on the Atlanta–Chattanooga line, in October 1947. Two J3's (left), "Yellow Jacket" 576 and "Stripe" 587, back toward Atlanta Union Station, where they will pick up trains for the north.

ABOVE, DAVID W. SALTER; LEFT, L. A. MCLEAN



The lightest of all domestic 4-8-4's, TP&W 80–85 were handsome, with green accents and tender stripes and a red "The Peoria Road" emblem. No. 84 is at East Peoria in 1938.

HAROLD K. VOLLRATH COLLECTION

GIANTS WEST: UNION PACIFIC

Alco's best known 4-8-4's were those it built for Union Pacific and New York Central. UP's class FEF ("Four-Eight-Four") locomotives were the result of the railroad's inspiration, while the Central's Niagaras were the product of the road's own in-house design department.

Before the arrival of its 4-8-4's, Union Pacific depended on a fleet of 50 4-8-2's to handle its mainline passenger trains. However, with the advent of increased train lengths and fast new services, it became evident that the 4-8-2's lacked the raw horsepower for the job. After a particularly embarrassing 4-8-2 engine failure on a train carrying the UP president's business car, management directed Vice President of Research and Mechanical Standards Otto Jabelmann to start design work on a replacement locomotive. Designers at first vacillated between a big 4-6-4 and a 4-8-4, but soon decided that the power of a 4-8-4 was needed. Jabelmann (YAH-bel-man) and his staff conceptualized the locomotive, and then designed it in close collaboration with Alco.

UP ultimately owned 45 4-8-4's in three classes. The first 20, FEF-1's 800–819, constructed in 1937, went into service between Omaha and Ogden/Salt Lake City. They immediately began setting records for performance and availability, regularly posting 14,000-mile months. Fifteen more, FEF-2's 820–834, arrived in 1939, and 4-8-4 operating territory was extended to Huntington, Ore. The final 10, FEF-3's 835–844, came in 1944, prompted by expectations of increased traffic as the principal war effort shifted to the Pacific Theater.

There were a few differences among the three classes, and each group was a little heavier than the last. The FEF-1's had 77-inch drivers and a Type A superheater. The second group had 80-inch drivers, a Type E superheater, a shorter tube length (19 feet) and a longer combustion chamber (90 inches). The

Alco-built No. 3025, first of the National Railways of Mexico's "Niagras," as NdeM called its 4-8-4's, departs Valle de Mexico with a northbound freight in May 1962. Built by Alco and Baldwin to an Alco lightweight design, some Niagras ran until '66.

TOM GILDERSLEEVE PHOTO

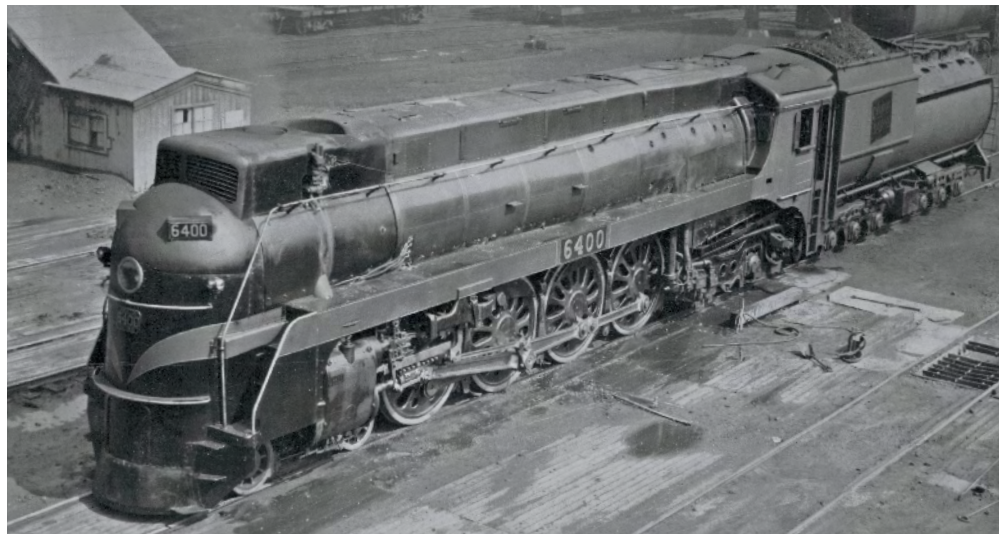
FEF-3's were almost identical, except they reverted to the Type A superheater because of cinder-clogging problems experienced in the flues of the Type E. All three classes had 100-inch outside diameter boilers and were designed for continuous operation at 100 mph. UP considered them all capable of developing about 4,000 h.p. at the drawbar and used them interchangeably. The FEF's were built as coal-burners, but a threat of a coal strike in 1946 resulted in all 45 being quickly converted to oil. After this change, the 800's became frequent visitors to Los Angeles. Also in the postwar era, some of the engines were painted in two versions of an attractive two-tone gray livery, and all received large smoke deflectors.

As diesels began to take over UP passenger assignments, the FEF's were shifted to freight service, where most of them ran out their last miles. A few made runs on regular-service trains as late as fall 1958.

GIANTS EAST: NYC

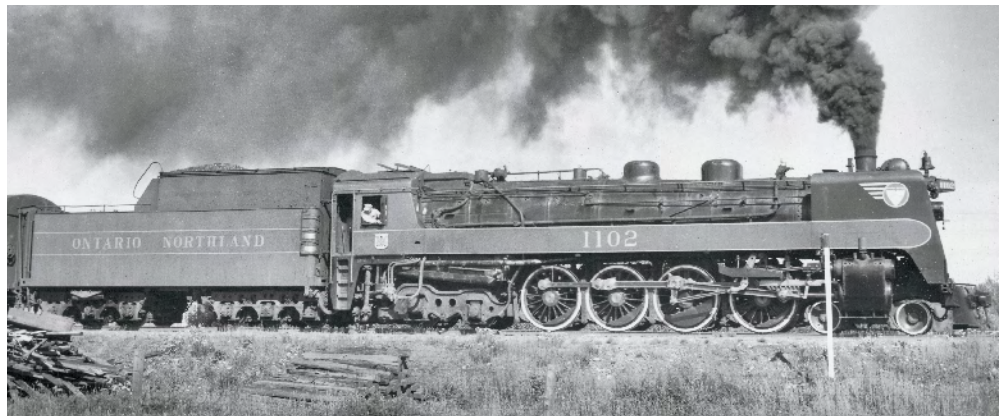
Unlike the Jablemann-Alco Union Pacific FEF's, the New York Central 4-8-4's of 1945–46, called Niagaras, were completely the work of the railroad's Chief Engineer of Motive Power, Paul Kiefer, and his staff.

The Central, like rival Pennsylvania, entered the 1940s without a 4-8-4, relying instead on an armada of 4-8-2's for fast



An overhead view at Toronto highlights the skyline casing of Canadian National 6400, the first U-4-a, built by Alco's Canadian affiliate Montreal Locomotive Works in 1936.

RAIL PHOTO SERVICE



Another Canadian lightweight, albeit without any Alco connections, was Temiskaming & Northern Ontario Nos. 1100–1103, designed by T&NO and built by Canadian Locomotive.

BEN F. CUTLER PHOTO

Alco 4-8-4's compared

	1st Alco standard design					2nd Alco standard design			Railroad designs			
Railroad	**CRI&P**	**Timken**	**LV**	**DL&W**	**LV**	**D&H**	**CMStP&P**	**CRI&P**	**UP**	**UP**	**NYC**	**T&NOnt**
Class	R-67B	-	T-2	Q-4	T-2B	K-62	S3	R-67B	FEF-1	FEF-2	S-1b	-
Road Numbers	5000–5065	1111	5200–5210	1631–1650	5211–5220	300–314	260–269	5100–5119	800–819	820–834	6001–6025	1100–1103
Year	1929–30	1930	1931	1934	1943	1943	1944	1944, '46	1937	1939	1946	1936–37*
Service	Freight	Dual svc.	Freight	Dual svc.	Freight	Dual svc.	Dual svc.	Freight	Psgr.	Psgr.	Psgr.	Psgr.
Cylinders:												
bore x stroke (in.)	26 x 32	27 x 30	26 x 32	28 x 32	26 x 32	24½ x 32	26 x 32	26 x 32	24½ x 32	24½ x 32	25½ x 32	22½ x 30
valve gear	Baker	Walsch.	Baker	Walsch.	Baker	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Baker	Walsch.
valve dia. (in.)	12	12	12	12	12	12	n.a.	12	12	12	14	n.a.
valve travel (in.)	8⅜	8½	8⅝	7½	8⅝	7½	n.a.	7⅝	7	7	8½	n.a.
Driver diameter (in.)	69	73	70	74	70	75	74	74	77	80	79	69
Boiler:												
pressure (psi)	250	250	255	250	255	285	250	270	300	300	275	275
grate area (sq. ft.)	88.3	88.3	88.3	88.2	88.3	96.2	96.2	96.3	100.2	100.2	100	70.3
fuel	soft coal	soft coal	soft coal	soft coal	soft coal	soft coal	soft coal	oil	soft coal	soft coal	soft coal	soft coal
cmbstn. chmbr. (in.)	54	54	54	66	54	84	84	84	72	90	92½	n.a.
tube length (ft.-in.)	21-6	21-6	21-6	21-6	21-6	20-0	20-0	20-0	20-6	19-0	19-0	20-0
syphons	4	3	4	2	4	none	none	4	none	none	none	n.a.
heating surfaces:												
evaporative (sq. ft.)	5,443	5,120	5,441	5,488	5,376	4,477	4,478	4,573	4,597	4,470	4,832	3,777
superheater (sq. ft.)	2,243E	2,157E	2,243E	2,180E	2,095E	1,473A	1,438A	1,438A	1,473A	1,900E	1,977E	1,665E
Weights, working order:												
drivers (lbs.)	265,500	264,000	268,000	274,000	274,500	270,000	259,300	280,000	270,000	270,000	275,000	218,210
engine (lbs.)	434,000	417,500	422,000	447,000	451,000	470,000	460,000	467,000	465,000	483,000	471,000	371,320
tender (lbs.)	299,200	294,000	358,800	313,000	389,000	367,300	364,100	372,000	366,500	406,500	420,000	281,500
Rated tractive force	79,100B	76,500B	85,060B	72,000	66,700	62,040	62,119	67,000	63,600	63,800	61,570	64,950B
Factor of adhesion	3.98	4.14	4.07	3.80	4.11	4.35	4.17	4.18	4.25	4.23	4.41	4.00
Tender capacity:												
fuel	20 tons	21 tons	28 tons	26 tons	30 tons	25 tons	20 tons	5,500 gal	25 tons	25 tons	46 tons	20 tons
water (U.S. gal.)	15,000	14,200	18,000	16,000	20,000	20,000	25,000	21,500	20,000	23,500	18,000	11,000 imp

E or A = type E or A superheater; B = tractive force including booster; imp = Imperial Gallons; n.a. = not available; * = built by Canadian Locomotive Co.; † = order split between Alco and Baldwin; ‡ = built by Montreal Locomotive Works

Nos. 809 and 823 (left), from UP's first and second groups of FEF's, respectively, pull out of Cheyenne with the *California Fast Mail* in 1940. Six years later, after conversion to oil and addition of smoke lifters, FEF-3 840 (below left) speeds the L.A.–Chicago *Transcon* near Green River, Wyo.

LEFT, R. H. KINDIG; BELOW LEFT, R. F. COLLINS, L. A. MARRE COLL.

freight and heavy passenger work. However, NYC had tried the 4-8-4 earlier in the form of a multipressure, three-cylinder, compound engine built by Alco in 1931. The middle cylinder worked at 850 psi, and the two outside cylinders used a mixture of exhaust from the middle cylinder and steam direct from the boiler at 250 psi. Inside the boiler and firebox was a closed-loop steam system that carried pressures up to 1,300 psi. Unsuccessful, Central's first 4-8-4 was not duplicated and led a short life.

New York Central's Niagara grew out of a desire to increase the boiler capacity of the road's heaviest passenger power, the class L-4 4-8-2's of 1942–43. However, Kiefer's people quickly realized that a larger firebox and boiler would require another axle to carry the added weight. They designed a big, but very compact, locomotive. NYC's main lines were constricted by tight clearances, and the new 4-8-4 pushed the loading gauge right to the limit. The allowable vertical clearance was just 15 feet 3 inches. The distance from

	Common design			
TP&W	NC&StL	NdeM	CN	CN
H-10	J3	QR-1	U-4-a	U-2-e
80–85	570–589	3025–3056	6400–6404	6165–6179
1937	1942–43	1946†	1936‡	1940‡
Freight	Dual svc.	Freight	Psgr.	Dual svc.
23½ x 30	25 x 30	25 x 30	24 x 30	25½ x 30
Walsch.	Walsch.	Walsch.	Baker	Baker
n.a.	n.a.	12	12	14
n.a.	n.a.	8	9	9
69	70	70	77	73
250	250	250	275	250
77.3	77.3	77.3	73.7	84.4
soft coal	soft coal	oil	soft coal	soft coal
n.a.	48	48	49	48
20-0	20-6	20-6	21-0	21-6
2	2	3	2	2
3,960	4,203	4,185	3,861	4,220
1,095A	1,721E	1,721E	1,530E	1,884E
204,000	228,000	241,000	236,000	240,800
361,000	399,000	387,000	379,800	402,700
324,300	285,000	245,000	284,200	284,250
51,023	57,000	57,000	52,000	67,100B
4.00	4.00	4.23	4.53	4.24
18 tons	16 tons	6,000 gal	20 tons	20 tons
18,000	15,000	15,000	11,700 imp	11,600 imp

NYC S-1b Niagara 6017 (above) represents the ultimate in North American 4-8-4 development as it rushes up the Hudson River valley near Poughkeepsie, N.Y., with the Chicago-bound *Pacemaker* on October 8, 1946. The Central's first 4-8-4, HS-1a No. 800 of 1931 (right), was a complex experiment that didn't pan out.

ABOVE, BILL PRICE; RIGHT, NYC

the rail to the tip of the stack measured 15 feet ¾ inches, a difference of just 1¼ inches! With the engine's 100-inch-diameter boiler there was no room for a steam dome; instead, it employed a European-style perforated dry pipe at the top of the steam space in the boiler. Twin sand domes hung low on each side of the boiler, the stack was just 7 inches high, and all the other usual items commonly found atop a boiler such as pop valves, turbogenerators, cab roof, etc., were moved or modified so as not to extend beyond the boiler top.

The tenders were of a unique centipede design. They held a whopping 46 tons of coal, but just 18,000 gallons of water. The engines were intended to run through from Harmon, N.Y., to Chicago without a change—a distance of 928 miles. Coal was loaded and the fire was cleaned en route just once, at Collinwood Yard in Cleveland. Water was taken at speed from strategically located track pans.

The first Niagara, class S-1a No. 6000, was delivered in March 1945. Twenty-five more of class S-1b followed, with deliveries stretching into early 1946. The Niagara was the second-to-last newly designed 4-8-4 in North America, and it was very close to the end of steam locomotive production at Alco. Indeed, the gigantic tenders were built by Lima, as Alco was converting its tender shop to diesel production.

No. 6000 was delivered with 75-inch drivers, but the axle spacing of the frame was such that it could also take 79-inch drivers, the size used on the Hudsons. This change was soon made, and the 26 subsequent Niagaras rolled out of Alco on 79-inch wheels. The boiler as delivered had a pressure of 275 psi and was designed to operate at 290 psi. When the 75-inch drivers were swapped for 79-inchers, it had been intended to raise the pressure to 290 psi in order to maintain a tractive effort of 62,330 lbs. However, this was not done, and the boiler pressure for all engines remained at 275. The last engine of the series came equipped with Franklin poppet valves. It was class S-2a No. 5500.

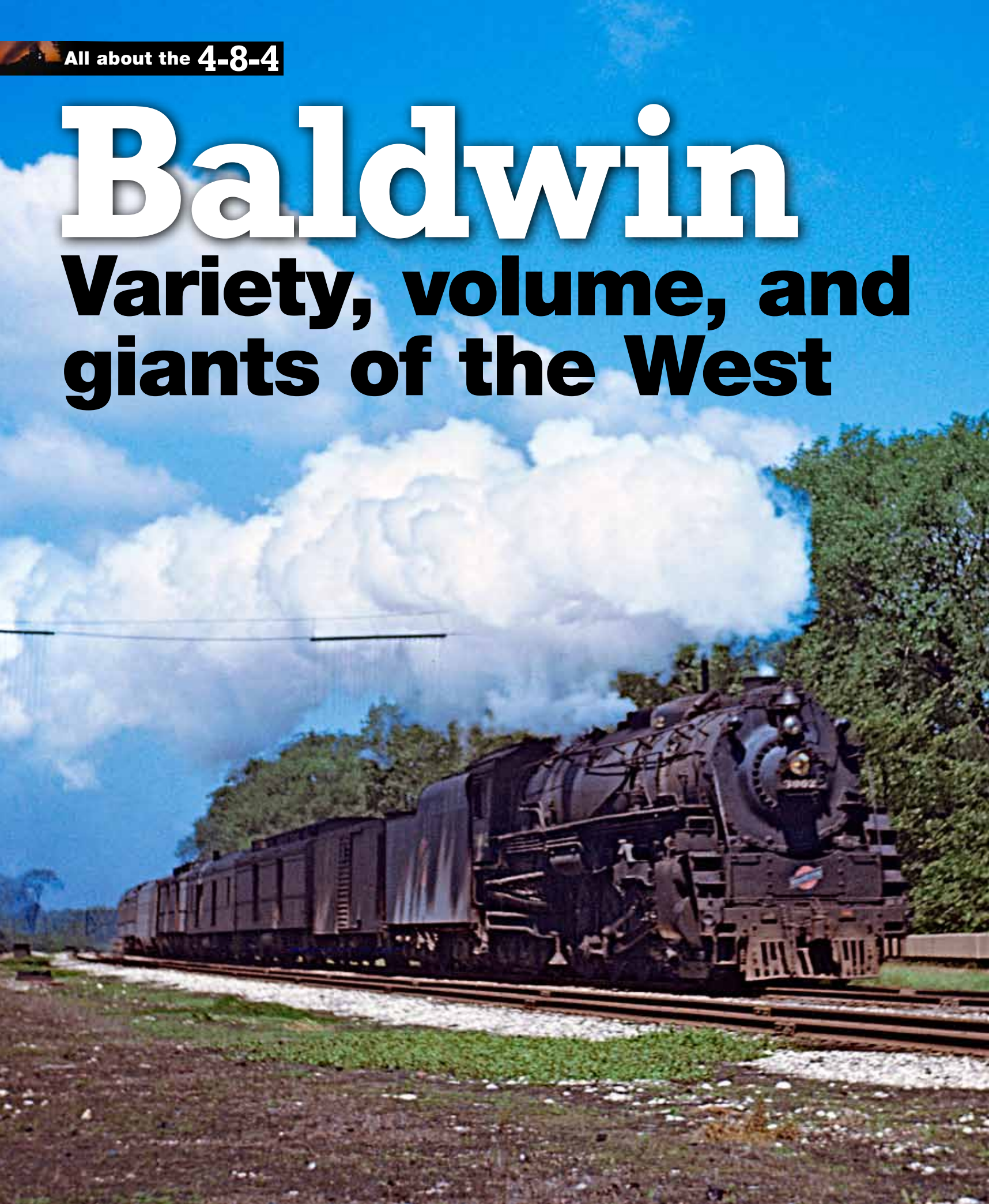
Normally a railroad would be expected to put a new design through a series of trials shortly after delivery to get a feel for its capabilities. However, NYC didn't do any serious testing of the Niagaras for a year and a half. More than 60 years later, the reason for this is unknown. We can speculate that, since the railroad had already decided on dieselization, it was felt that testing steam locomotives would serve no useful purpose. Just the same, in October and November 1946, several S-1's and the S-2a were put under the microscope during a series of road tests with a dynamometer car. The S-1's showed they were capable of developing 5,000 h.p. at the drawbar. This was in line with expectations.

What was a bit of surprise, however, is that the S-2a with poppet valves performed only slightly better than the piston valve-equipped S-1's. One reason for this is that the S-1's had been designed with excellent valve events. They had piston valves with a long travel of 8½ inches and a 14-inch diameter. With these specs it would have been possible to provide wide and long port openings for both steam admission and exhaust, even at high speeds.

NYC 4-8-4's lived rather short lives. The 5500, with its poppet valves, was an oddball in the fleet and was set aside in 1951. As the Central dieselized its eastern lines, it moved the Niagaras to Big Four routes in Ohio and Indiana. The trust agreement for the engines expired in August 1955, and a year later all were gone.

Baldwin

Variety, volume, and giants of the West



Customization characterized the Philadelphia builder's 4-8-4 production, which included the great NP and Santa Fe fleets

BY NEIL CARLSON

Baldwin Locomotive Works, established in Philadelphia in 1831, built 399 4-8-4's, 43 more than Alco. It also produced a greater variety of designs for many more railroads. And, whereas Alco attempted to introduce some standardization into its production, Baldwin was all over the map. It might use a firebox from one engine, a smokebox from another, and then put them together to form a new boiler. The result was, with one exception purchased by three railroads, a custom design for each customer. In addition, although many Alco 4-8-4's were of small or moderate size, Baldwin built some truly large engines.

'RAIL CRUNCHERS' FOR C&NW

The first Baldwin 4-8-4's were the Santa Fe 3751-class engines of 1927–29 and the Great Northern, Cotton Belt, and Southern Pacific Lines oil-burners of 1929–30 [see pages 16–25]. This section picks up in October 1929, when Baldwin delivered the first "rail crunchers" to the Chicago & North Western. By far the biggest engines on the C&NW, the class H's weighed an astounding 498,000 lbs. and were the first 4-8-4's with 100-inch-diameter boilers. Despite being one of the earliest 4-8-4 designs, the H's rank fourth among all 4-8-4's in terms of both total weight and tractive effort.

The dual-service behemoths went to work on the 488-mile Chicago–Omaha route. Although C&NW was Union Pacific's principal eastern partner for forwarding freight and passengers between Chicago and the West Coast, three other roads vied for this traffic, and North Western needed the 4-8-4's to remain competitive. The H's replaced Mikados on hot freights, and they eliminated doubleheading of Pacifics on premier passenger trains. Eventually, they got up to Milwaukee and even ventured as far as Altoona, Wis.

In 1939, North Western began upgrading the H's with Boxpok drivers, lightweight rods, and roller bearings on all axles. These improvements made a good engine better, but more were to come. After World War II, even though it had acquired FT freight diesels, C&NW embarked on a program to rebuild the entire class. Starting in April 1946, H's were cycled through the 40th Street shops in Chicago for new one-piece cast engine beds (which dispensed with the crack-prone "banjo" frame above the rear truck), multiple-bearing crossheads, welded fireboxes, and freer steam passages. The rebuilds were designated class H-1.

The H-1's performed very well and cost substantially less than the H's to operate, one of the key objectives of the program. Nevertheless, it was not enough to hold off the diesel. The project ended in 1949 after 24 engines as the railroad moved toward complete dieselization. By the end of 1954, C&NW's 4-8-4 era was over.

RIO GRANDE'S ROCKIES CLIMBERS

Denver & Rio Grande Western owned 19 Baldwin 4-8-4's. Class M-64 Nos. 1700–1713 were delivered in 1929, and five bigger M-68's, Nos. 1800–1804, arrived in 1937. Both classes were considered passenger power. With one of the toughest mainline operating profiles of any railroad, D&RGW had skipped the usual order of things. Instead of using Pacifics on passenger trains, it went directly to 4-8-2's at an early date; 4-8-4's were next in the line of progression. Out of respect for the mountainous terrain, the M-64's were equipped with 70-inch drivers; they handled the *Scenic Limited* and other top trains between Denver and Salt Lake City via the Royal Gorge and Tennessee Pass.

Completion of the Moffat Tunnel and Dotsero Cutoff expanded M-64 territory and prompted the Rio

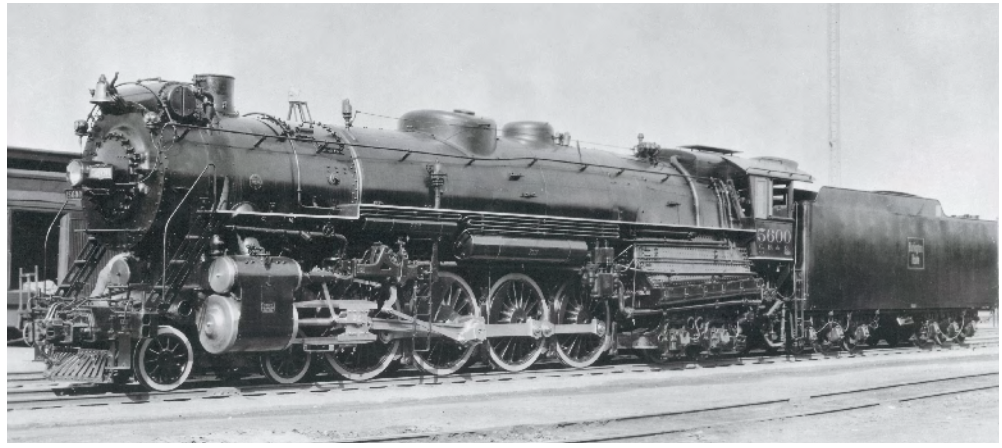
North Western class H No. 3002 (left) is eastbound with a passenger train at River Forest, Ill., on June 4, 1945. Engine 3016 (above), one of the H-1 rebuilds, heads a westbound freight at Boone, Iowa, in August 1949.

LEFT, V. O. HARKNESS; ABOVE, RAY MUELLER


1801
1801
1801

In a fine June 1941 display of standard-era railroading (above), Rio Grande M-64 No. 1707 accelerates the westbound *Scenic Limited* out of Salida, Colo. Brand-new M-68 1801 (left) departs Denver with the same train three years earlier, in March '38.

ABOVE, DAN PETERSON; LEFT, RICHARD H. KINDIG



Handsome Burlington O-5 5600, fresh out of Baldwin in 1930 (before solid pilots, vestibule cabs, and other alterations to Q 4-8-4's), looks ready for a limited, not a freight train.

CLARENCE J. ROOT PHOTO

In Lafayette, Ind., Wabash freight Extra 2924 West crosses the Big Four-Nickel Plate line at Lafayette Junction in August 1941. Soon the big O-1 will be rolling fast for Decatur, Ill.

DONALD C. BURKHARDT PHOTO

Grande to acquire the M-68's. These were big engines, outweighing their earlier brethren by 60,000 lbs. They were handsome too, with 73-inch drivers and all-weather cabs. The M-68's shared many specifications with the Milwaukee Road S2, built in 1937 [following page], to the extent that the two could be considered a common design—Baldwin's only one for a 4-8-4. They performed well during the war years. However, the rugged Rio Grande was a prime candidate for the diesel, and its big standard-gauge engines died early. The beautiful 4-8-4's were gone by the end of 1954.

BURLINGTON BUYS AND BUILDS

In 1930, Baldwin delivered eight large 4-8-4's, class O-5, to the Chicago, Burlington & Quincy, which put them on fast freights between Galesburg, Ill., and Denver. Pleased with the performance of Nos. 5600–5607, management requisitioned three more 4-8-4's in 1936. However, these were built in the company's West Burlington (Iowa) Shops using Baldwin-supplied boilers. The new engines, class O-5A, were a little heavier—473,700 lbs. vs. 461,500 lbs. for the O-5's—and, instead of an Elesco feedwater heater, they had a Worthington Type S.

Two additional orders from West Burlington in 1938 and '40 resulted in a fleet of 36 Northerns. With more engines available, some began to be used in passenger service, and their territory was extended to Minneapolis and other parts of the system. Several were converted to oil-firing and designated class O-5B. Burlington's Northerns worked in regular service as late as 1958, and one, No. 5632, became an excursion engine that wasn't retired until 1964.

POWER FOR 'WABASHING'

The Wabash was a bridge route with a main line that connected western railroads in Kansas City and St. Louis to a number of eastern lines as it worked its way to Toledo and Detroit. One of the key attributes of this routing was that it avoided Chicago, and the road developed a reputation as a fast-freight line. Indeed, the term "Wabashing" meant moving something fast. In 1930 the railroad received 25 Baldwin 4-8-2's, followed just months later by 25 very similar Baldwin 4-8-4's, with the 4-8-4 deliveries stretching into 1931. All these engines were for fast-freight service.

The initial territory for Wabash's class O-1 4-8-4's, Nos. 2900–2924, was between Decatur, Ill., and Detroit, but later they could be found operating over much of the system. The 70-inch-drivered O-1's ranked as mid-sized 4-8-4's and were ideal for freight service. As it turned out, they were also the last new steam engines acquired by the railroad. The Wabash dieselized its mainline operations early, and the 4-8-4's became casualties. All were off the roster by early 1956.

RF&P's Generals, like No. 554 (top left, at Acca Yard, Richmond), were used mostly in freight service. Engine 602 (top right, at Potomac Yard, Alexandria) represents the first and second groups of Governors, which had Vanderbilt tenders. The third and final batch of Governors had rectangular tanks, as on No. 614, stopped at Alexandria with the southbound *Silver Comet* on May 8, 1941.

TOP LEFT, BRUCE D. FALES; TOP RIGHT, C. W. WITBECK; ABOVE, CHARLES WALES

GENERALS AND GOVERNORS

In 1934, Baldwin delivered engines to both the Lehigh Valley [see page xx] and the Northern Pacific (discussed below). Afterward, Baldwin endured a two-year hiatus in 4-8-4 production, during which it slipped into bankruptcy. It was not until 1937, as the economy was starting to show some signs of life, that railroads came knocking at Baldwin's door inquiring about new power.

Richmond, Fredericksburg & Potomac was the ultimate bridge route. Just 113 miles long, it joined the Pennsylvania and Baltimore & Ohio in Alexandria, Va., with the Atlantic Coast Line and Seaboard Air Line in Richmond. It was a fast, well-engineered, double-track railroad. Motive power consisted primarily of big Pacifics and a handful of Mountains handling both freight and passenger traffic. But, as the Great Depression eased, management thought it was time to update the line's motive power. Baldwin had been RF&P's favored supplier for years, and in 1937 it built six modern 4-8-4's for the road. Nos. 551–555 were decent-size locomotives, with 77-inch drivers and weighing 466,060 lbs. They had been intended as dual-service engines, but as it turned out, they had some clearance and weight issues that prevented their operation into Washington Union Station. Consequently, they wound up in freight service between Acca Yard in Richmond and Potomac Yard in Alexandria. Each was named for a Civil War general, and the class became known as Generals.

A year later, six additional engines arrived from Baldwin, Nos. 601–606. Like the Generals, they had 77-inch drivers, but their smaller size and lighter weight allowed them to reach Washington Union Station. They came with Vanderbilt tenders and, surprisingly, Type A superheaters. They were named after Virginia governors, and of course were called Governors.

RF&P was a major player in handling New York–Florida passenger trains, and the Governors were assigned to these important runs. World War II only intensified this traffic, and RF&P went back to Baldwin twice for more 4-8-4's. In 1942 it received another six Governors identical to the first batch. A final 10 Governors, with rectangular tenders, arrived in 1945, bringing RF&P's 4-8-4 total to 27.

RF&P was a "spit-and-polish" operation whose engines had elaborate lettering and trim, and they were meticulously maintained. When the ACL and SAL dieselized, their power began running through to Washington without an engine change at Richmond. This left the RF&P 4-8-4's without employment, and the last one ran on January 4, 1954. Then, amazingly, 10 of them got a reprieve when Chesapeake & Ohio leased them from July 1955 through April 1956 to help cope with a traffic surge. After that, they sat in Richmond for a while before being retired in 1959.

MILWAUKEE'S S1 AND S2

The other railroad that came knocking on Baldwin's door in 1937 was the Chicago, Milwaukee, St. Paul & Pacific, which ordered 30 4-8-4's. However, these were not the Milwaukee's first Northerns. In 1930, the road received 14 4-6-4's and one 4-8-4, all from Baldwin and all built to in-house MILW designs. The single 4-8-4, designated class S1, No. 9700, was an experiment to validate the

Milwaukee S2 No. 222 (above) leads Chicago-bound tonnage near Rondout, Ill., in September 1948. MILW's first 4-8-4, S1 No. 9700 (right), poses at Milwaukee on April 21, 1934, freshly converted to oil fuel.

ABOVE, C. H. KERRIGAN; RIGHT, MILWAUKEE ROAD

4-8-4 concept on the Milwaukee, which had a lot of wide-open territory where such a locomotive could really stretch its legs. The S1 went into through-passenger service on the 914-mile line between Minneapolis and Harlowton, Mont., and performed according to expectations. In 1934, it was converted to oil and sent west to cover the territory in Idaho and Washington between the railroad's two electrified divisions. In 1938, it got a mate. The company's West Milwaukee Shops built a duplicate S1, No. 251, that was also sent to the Northwest.

The 1937 engines, class S2 Nos. 201–230, replaced heavy 2-8-2's in Chicago–Omaha and Chicago–Minneapolis freight service. These were large, modern locomotives, with cast-steel beds, roller bearings on all axles, a 285-psi boiler pressure, 74-inch drivers, Type E superheaters, a firebox full of syphons, vestibule cabs, welded tenders, and an engine weight of more than 490,000 lbs. Baldwin used their basic design in two subsequent orders, for Rio Grande and MoPac. They acquitted themselves well as they improved schedules and cut operating costs, and the Milwaukee went back to Baldwin for 10 more in 1940. Additionally, during World War II, the company bought 10 smaller, dual-service Alcos, class S3 [pages 26–35]. They were all fine engines, but the Milwaukee had obtained its first road passenger and freight diesels just before and during the war, and these purchases were accelerated after V-J Day. Dieselization was completed in 1955.

ACL: BIGGEST IN THE SOUTH

In 1938, Atlantic Coast Line owned 345 4-6-2's. Its level profile permitted their use not only on passenger trains but also, extensively, on freight. Indeed, the railroad owned only 37 Mikados. ACL, like rival Seaboard Air Line, did a lot of business bringing people from the Northeast to Florida. In the late 1930s, this traffic was increasing, obliging Coast Line to doublehead Pacifics on its passenger trains. Meanwhile, the parallel Seaboard was using modernized 4-8-2's in the same service, and ACL management decided it was time for new passenger power.

Baldwin delivered a dozen 4-8-4's in 1938, class R-1 Nos. 1800–1811, intended for fast, heavy passenger service. They were one of five 4-8-4 designs fitted with 80-inch drivers, tipped the scales at 460,000 lbs, and pulled capacious 16-wheel tenders. But, they also came with the older-style Type A superheaters. The R-1's were the only modern steam power on the ACL, and they were the biggest steam locomotives in the South. Together with the Baldwin 4-8-4's recently delivered to the RF&P, both railroads had locomotives that were the horsepower equivalent of a

Beautifully turned-out Atlantic Coast Line R-1 No. 1807 makes stately progress out of Richmond with the second section of the *Florida Special*'s East Coast section in March 1939. The silver, gray, and black 4-8-4 will take the train all the way to Jacksonville.
WILEY M. BRYAN PHOTO

Pennsy GG1 electric locomotive, which handled the Florida trains between New York and Washington. When the PRR brought a heavy Florida train into Washington Union Station, the RF&P could couple on a 4-8-4 and take the train to Richmond, where an ACL R-1 would take over and forward the entire train to Jacksonville with no doubleheading or need to adjust tonnage. Florida East Coast 4-8-2's handled the train the remaining miles to Miami.

The R-1's performed well, but they did experience one serious problem—a tendency toward high-speed wheel slips. This was traced to having too much additional counterweight applied to the driving wheels in order to balance the reciprocating weight of the pistons and main rods. This additional weight is called "overbalance" because it is added after the wheels and side rods have already been statically balanced. The overbalance reduces the jigging motion induced in the locomotive by the reciprocating weights. Unfortunately, it also unbalances the wheels in a rotational sense. Adding overbalance was normal practice, and in this instance Baldwin and ACL followed the Association of American Railroads recommendation for the amount of weight used.

Nevertheless, it was too much. This extra counterweight left the driving wheels sufficiently unbalanced so that at high speeds the centrifugal force it created could lift the drivers off the rail, allowing them to slip when the counterweight was rotating upward, and it created hammer blows (called dynamic augment) to the rail when rotating downward. Reducing the amount of overbalance resolved the problem, and afterward the engines were permitted speeds up to 90 mph.

Dieselization came early to the southeastern railroads. The Seaboard began buying passenger road diesels in 1938, and ACL soon followed. As the diesels arrived, the R-1's were shifted to freight service, but all were off the roster by 1953.

FRISCO'S FAST 4500'S

In summer 1941, the St. Louis-San Francisco decided that new motive power was required to meet the traffic demands during the build-up to World War II. The railroad had tested Electro-Motive's FT demonstrator during its tour the previous year, but had decided that a four-unit diesel with 5,400 h.p. was too big, given the operating style of the railroad. Frisco preferred to limit its trains to moderate tonnage and move them fast. Management thought a better choice would be new steam locomotives, and the mechanical staff began discussions with Baldwin about the design of a new 4-8-4.

The road ordered 15 engines, which were delivered as Nos. 4500–4514 in fall 1942. Three were oil-burners for use in passenger service; the remaining 12 were coal-fired. They were big engines, weighing 474,000 lbs. Mounted on 74-inch drivers, they also were handsome machines. However, they also displayed the Frisco's conservatism. They had relatively small grates of just 88 square feet. Boiler pressure was 250 psi. They were equipped with Coffin feedwater heaters that were mounted in the right water leg of the tender. Additionally, they had Coffin Type C-S superheaters. The C-S looked similar to the Superheater Co.'s Type A. However, whereas a Type A had a double-pass loop inside one 5-inch-diameter flue, the Type C-S consisted of just a single-pass loop, with two such single-pass units placed in each 5-inch flue. The C-S superheater also had the throttle on the saturated steam side of the superheater header. For the Frisco engines, this wound up being an "old- fashioned" dome throttle—the only 4-8-4's so equipped. It's a mystery why the Frisco specified this. Perhaps the Coffin Co. had a good salesman.

The arrival of the 4-8-4's occurred at a critical time. In the Atlantic, German submarines had stopped the ocean transportation of gasoline and other petroleum products from the Gulf of Mexico up the East Coast, and these shipments were now moving by rail. The 4500's played a key role in handling this traffic from Oklahoma and Texas to the St. Louis gateway. By 1943, the railroad needed still more power and Baldwin delivered another 10 4-8-4's. An important difference was that Nos. 4515–4524 came with Franklin trailing-truck boosters, which increased their starting tractive effort to 80,800 lbs. It was a successful enough application that the earlier 15 engines were also equipped with boosters.

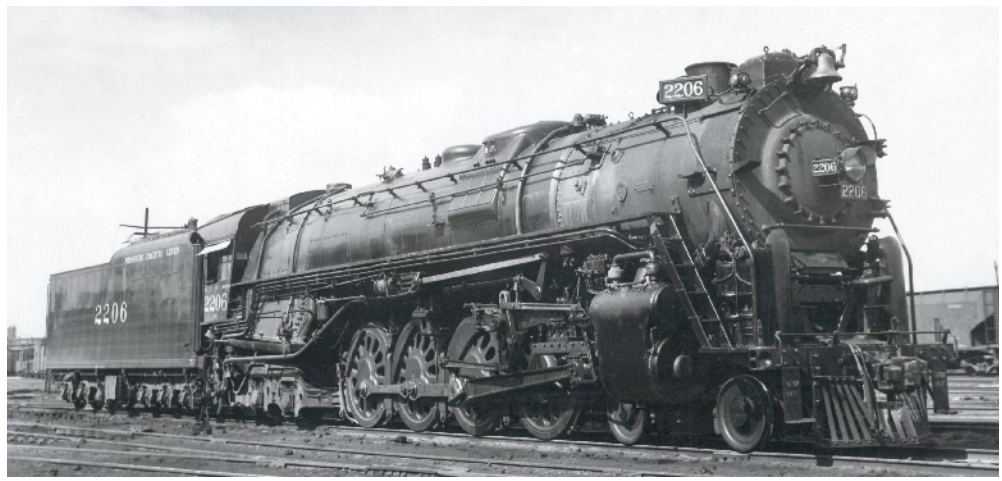
Frisco received its first passenger diesels in 1947 and first freight diesels in 1948. It announced a plan for complete dieselization in summer '48. The beautiful 4500's were without employment by the end of 1950.

MILW/D&RGW FOR MOPAC

Missouri Pacific's first 4-8-4's were 25 engines the company shops rebuilt from 2-8-4's during 1940–42 [pages 54–57]. As war traffic continued to increase, the road went to Baldwin for additional 4-8-4's in 1943. The

Frisco locomotive 4501 is dirty but still striking in its blue and cream paint job, with the name of the road's *Meteor* passenger train emblazoned on the tender, as it approaches St. Louis Union Station.

BEN F. CUTLER PHOTO



Wartime production restrictions led Missouri Pacific in 1943 to order copies of the Rio Grande's M-68 4-8-4. MoPac N-73 No. 2206 is a near twin to D&RGW 1801 [page 38].

BRUCE R. MEYER COLLECTION

War Production Board generally restricted locomotive construction to existing designs. The Rio Grande was a major interchange partner with MP, and management was familiar with D&RGW's capable M-68's of 1938, which in turn had been based on the Milwaukee S2. MoPac believed that copies of these engines would do the job, and ordered 15 from Baldwin. The MoPac N-73 represented the third application of what might be considered Baldwin's only standard design.

MoPac Nos. 2201–2215, class N-73, arrived in mid-1943. They were a bit heavier than the Rio Grande engines, outweighing them by some 17,000 lbs., and they did not have the vestibule cabs. They came with cast-steel beds and roller bearings on all axles. MP used them in both freight and passenger service out of St. Louis to Kansas City and Poplar Bluff, Mo.

MoPac received its first road freight diesels less than five months after the arrival of the N-73's. Dieselization continued, and by 1950 the big 4-8-4's were being bumped to other territories as diesels took over their chores on the main line. They were last used on the Arkansas Division, in mid-1954.

WM'S AMAZING ANACHRONISMS

Baldwin's final 4-8-4's were a dozen delivered to the Western Maryland in 1947. They were the last 4-8-4's designed, the last steam locomotives to join the WM roster, and the second-to-last 4-8-4's produced by a commercial builder. Classified J-1 and numbered 1401–1412, they were huge engines with immense boilers and a weight of 506,500 lbs., making them the third-heaviest 4-8-4's. But perhaps the most amazing thing about them is that they were built at all.

WM was one of the participants in the Alphabet Route, a consortium of eight railroads that collectively provided a fast freight route from the Midwest to the East Coast. (The route's name came from the many

The great girth of the boilers on Western Maryland's 4-8-4's is apparent in this view of No. 1401 making time with a hotshot at Cumberland Narrows, Md., in 1952. The low-drivered Potomacs were ideally suited for their duties, but led unfortunately short lives.

BOB MILNER PHOTO

different letters in the reporting marks of the cooperating railroads.) After World War II, freight service to the East had become more competitive as the big guys such as the NYC, Pennsy, and B&O began picking up the pace. As a consequence, one of WM's connections, the Reading Company, had recently placed modern 4-8-4's in service [page 57]. WM had gained some experience with the Reading engines, which operated in pool service over a portion of the WM between Hagerstown, Md., and Rutherford, Pa. On this same piece of railroad, WM was operating big, but slow, 2-8-0's. To remain competitive, management felt new power was needed.

By 1947, almost all railroads had decided that dieselization was the answer. Instead, WM, for which coal was an important traffic source, went to Baldwin for more coal-burning steam. In a vivid illustration of Baldwin's customized approach, the builder created a design for an order of just 12 engines, even as it was transitioning from steam to diesel production. Nevertheless, the J-1's performed well and became popular with the crews on runs between Cumberland, Md., and Rutherford. For this final 4-8-4 design, WM coined the final 4-8-4 name: Potomac type.

As it happened, WM also bought its first freight diesels in 1947. The 4-8-4's were withdrawn from service in 1954, having worked for just seven years.

NP: BEYOND THE CLASS A

Baldwin had two key customers who designed their own engines: Northern Pacific and Santa Fe. However, they were Baldwin customers for different reasons. The NP, which had originated the 4-8-4 type with an order to Alco, went out for bids when shopping for new power, and Baldwin was the low bidder. The Santa Fe, on the other hand, had established a technical relationship with the builder over many years. And even though Santa Fe designed its own locomotives, its mechanical department still valued Baldwin as a consultant. Furthermore, the road was pleased with the quality of Baldwin's products, and bought nearly all its 20th century steam power from the Philadelphia builder.

During the early 1930s, NP realized it was losing express business to the competing Great Northern and Milwaukee Road. NP had limited its premier passenger trains to 10 cars, while the competition was handling 14 to 15 cars, including many express and baggage cars. To respond to this situation, NP management decided they needed more than the 12 Alco 4-8-4's of 1926–27 then in service, and directed the mechanical department to begin designing a new engine. It would need to be quite a bit larger than the original class A's, and, overall, it bore little resemblance to them. Weight increased from 426,000 lbs. to 489,400. The boiler's outside diameter went from 94 inches to 99½; height rose from 15 feet 10½ inches to 17-2; and driver diameter grew from 73 inches to 77. The new engines had semi-Vanderbilt tenders vs. the rectangular tenders on the originals. Changes were also made in many boiler appliances, and the engines had enormous smokestacks. Finally, learning from Timken's "Four Aces," which had taken up permanent residence on the NP as No. 2626, the sole member of the A-1 class, designers specified roller bearings on all axles.

Baldwin delivered the engines, class A-2 Nos. 2650–2659, during fall 1934 and early '35. During early dynamometer car tests, performance was disappointing. The engines had been designed with limited cut-off and were slow at starting a train, an issue for many locomotives with limited cut-off. The problem was eventually solved by tinkering with the valve design to increase the maximum cut-off from 69 percent to 79 percent.

In 1938, NP ordered eight more engines built to essentially the A-2 design but classified A-3. Again, Baldwin was the low bidder. The locomotives, Nos. 2660–2667, looked a bit different from the A-2, perhaps because they did have the same large stack. But internally they were the same engine. With the addition of the A-3's, NP also started using 4-8-4's in fast-freight service, again to stay competitive with the GN and Milwaukee.

NP class A-3 No. 2666 (above) helps the *North Coast Limited* up Bozeman Pass. Bumped from the *NCL* by diesels, A-5 2588 (right) leaves Glendive, Mont., with the eastbound *Mainstreeter* on September 6, 1956.

ABOVE, R. V. NIXON; RIGHT, H. F. STEWART, STAN KISTLER COLL.

Three additional engines were added to NP's A-3 order by the Spokane, Portland & Seattle. SP&S was jointly owned by NP and GN, and its line along the Columbia River provided its owners with a direct route to Portland, Ore. Numbered 700–702, the SP&S class E-1's were built as oil-burners; otherwise they were a stock NP A-3. However, since they burned good fuel, they had the potential of being the most powerful of any of the NP-designed 4-8-4's.

Northern Pacific went back to Baldwin twice more for additional 4-8-4's. The first eight, class A-4 Nos. 2670–2677, arrived in 1941. These were bigger than any of the prior Northerns, and they possessed solid pilots with retractable couplers, all-weather cabs, and centipede tenders. Nevertheless, their design was traceable right back to the A-2.

Baldwin delivered a final 10 in 1943. Even though the railroad classified them as A-5, there were almost identical to the A-4. One difference was their weight. Because of wartime restrictions, heavier steel was substituted for the boiler and other parts, resulting in an engine weight of 508,500 lbs. Among 4-8-4's, only the Santa Fe 2900's outweighed the NP A-5's.

Even though they had great potential, NP's Baldwin 4-8-4's were held back by the poor-quality Rosebud coal that had led to the design of the original Northern types back in 1926. None of the NP engines turned in performances equal to the 4-8-4's of the New York Central or Norfolk & Western. Indeed, the best the NP Northerns achieved was not quite 4,000 drawbar horsepower. They probably could have developed an additional 1,000 h.p. burning good coal. But did this really matter? On the NP, it really made no difference. In its later 4-8-4's, NP had a fleet of 36 engines that were the equivalent of those on many other railroads. They could capably handle their assignments.

Of course, not even the best of fuels could have saved the NP Northerns from the fate suffered by 4-8-4's on all roads. Their last runs were in 1957.

SANTA FE'S 4-8-4 WAY

By 1936, the Santa Fe's 14 class 3751 4-8-4's [pages 19–20] had settled into a routine operating in a pool between La Junta, Colo., and Winslow, Ariz. This was the toughest part of the railroad's principal passenger-train route, with the 3 percent grades of Raton Pass and the stiff climb west out of Belen, N.Mex. Management had been satisfied with their performance. However, Union Pacific's introduction of new trains had stiffened the competition for Chicago–California passengers. Santa Fe's premier new train, the *Super Chief*, had been dieselized, and the 3751-class 4-8-4's were being converted to oil-firing in order to reduce the number of service stops and to extend their operating territory all the way to Los Angeles. Nevertheless, to remain competitive, the Santa Fe realized that it needed additional power, and in 1936 the board of directors approved the purchase of 11 new 4-8-4's.

They arrived from Baldwin in spring 1938

Santa Fe 3760 (above) shows the effects of the late-1930s rebuilding of the 3751-class 4-8-4's; pictured at Los Angeles on August 21, 1956, it had been stored for two years. Engine 3782 (right) of the 3776 class crosses the Arroyo Seco Parkway as it climbs from L.A. to Pasadena with the *Chief*; it's 1946, but 3782 still wears its wartime headlight visor.

ABOVE, STAN KISTLER; RIGHT, WENDELL H. KINNEY

as the new 3765 class. Dramatically different from the earlier 3751's, they were the biggest 4-8-4's delivered to date. They weighed 499,900 lbs., rolled on 80-inch drivers, and had 300 psi nickel-steel boilers. Roller bearings were used on all axles, and the boiler's outside diameter was 102 inches, the largest yet for any 4-8-4. Additionally, the 3765's were limited cut-off engines, with a maximum cut-off of 60 percent instead of the normal 80 to 85 percent for a full-stroke engine. All were oil-burners and set up for 100-mph operation. They joined the 3751's in the expanded La Junta–Los Angeles locomotive pool, a 1,236-mile district with the same locomotive running all the way through.

The 3751-class engines had originally been authorized for operation up to 90 mph, but it became obvious that their 73-inch driving wheels had not been balanced for this speed. In 1938, management set out to remedy this by authorizing the Albuquerque shops to rebuild all 14 engines. They received new cast-steel beds with 80-inch drivers and a new smokebox to accommodate the longer wheelbase. Boiler pressure was raised to 230 psi, steam passages were enlarged, roller bearings were applied to all axles, and some changes were made to the boiler appliances. When the 3751's went back into the engine pool, they were truly good for 90 mph.

Santa Fe ordered 10 additional 4-8-4's in 1940, and they arrived in summer 1941 as the 3776 class. With a couple of detail changes, they were essentially copies of the three-year-old 3765-class engines. The most visible changes were their 16-wheel tenders, and two of them were equipped with Timken lightweight rods and roller-bearing crank pins. With 35 powerful, fast engines now available, Santa Fe's five daily transcontinental passenger trains could be handled by 4-8-4's, and the locomotive pool was extended to Wellington, Kans., a distance of 1,542 miles from Los Angeles. Later, some runs were even stretched to Kansas City—at 1,776 miles, this was the longest steam run in North America, and probably the world.

During World War II, Santa Fe ordered another 30 4-8-4's from Baldwin. Again, these were essentially additional copies of the 3765 and 3776 classes. However, wartime material restrictions made necessary the use of carbon steel for the boilers instead of the nickel steel with which the previous classes had been built. To maintain the same strength for a 300 psi boiler, the boiler plating had to be thicker and therefore heavier. The resulting weight of 510,150 lbs. earned the new 2900-class engines the title of heaviest Northerns ever built. Unlike the railroad's earlier 4-8-4's, the 2900's went into freight service, working on the Pecos Division between Argentine, Kans., and Clovis, N.Mex., although the multi-talented giants later could be found on 90-mph passenger trains as well.

Santa Fe was an early purchaser of diesels, and by the end of 1945 it had 488 units on the roster, with many more to come. At first, the road's modern 2-10-4's and 4-8-4's remained active, being moved around the system to replace older steam as diesels invaded their territory. However, by 1954 the remaining engines had been concentrated at a few key locations where they could be fired up for use during seasonal traffic peaks. The last 4-8-4's made their final revenue runs in summer 1957, working as helpers out of Belen, N.Mex.

Baldwins compared

Railroad	C&NW	D&RGW	CB&Q
Class	H	M-64	0-5
Road Numbers	3001–3035	1700–1713	5600–07
Year	1929	1929	1930
Service	Dual svc.	Passenger	Dual svc.
Cylinders:			
bore x stroke (in.)	27 x 32	27 x 30	28 x 30
valve gear	Bak/Walsch	Walsch.	Baker
valve dia. (in.)	14	14	14
valve travel (in.)	8	7	9
Driver diameter (in.)	76	70	74
Boiler:			
pressure (psi)	275	240	240
grate area (sq. ft.)	100	88	105½
fuel	soft coal	soft coal	soft coal
cmbstn. chmbr. (in.)	60	42	60
tube length (ft.- in.)	21-0	22-0	21-0
syphons	3	2	none
heating surfaces:			
evaporative (sq. ft.)	5,314	4,917	5,311
superheater (sq. ft.)	2,357E	2,229E	2,403E
Weights, working order:			
drivers (lbs.)	288,000	264,900	274,000
engine (lbs.)	498,000	418,150	461,000
tender (lbs.)	320,000	278,600	350,500
Rated tractive force	84,200B	63,700	80,700B
Factor of adhesion	4.42	4.16	4.03
Tender capacity:			
fuel	20 tons	20 tons	24 tons
water (U.S. gal.)	18,000	14,000	18,000

E or A = type E or A superheater; B = tractive force including booster; na = not available

								Common design			Railroad designs		
	Wabash	LV	LV	RF&P	RF&P	ACL	SLSF	CMStP&P	D&RGW	MP	NP	ATSF	WM
	0-1	T-1	T-3	-	-	R-1	-	S2	M-68	N-73	A-2	2900	J-1
	2900–2924	5100–5110	5125–5129	551–555	601–606	1800–1811	4503–4514	201–230	1800–1804	2201–2215	2650–2659	2900–2929	1401–1412
	1930	1931–32	1934–35	1937	1938	1938	1942	1938	1938	1943	1934	1943–44	1947
	Freight	Freight	Dual svc.	Dual svc.	Dual svc.	Psgr.	Freight	Psgr.	Psgr.	Freight	Psgr.	Psgr.	Freight
	27 x 32	27 x 30	27 x 30	27 x 30	27 x 30	27 x 30	28 x 31	26 x 32	26 x 30	26 x 30	28 x 31	28 x 32	26½ x 32
	Bak/Walsch	Walsch.	Baker	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.
	12	12	12	12	n.a.	12	14	14	n.a.	14	14	15	14
	9 or 8	7½	8½	7½	n.a.	7½	8	7½	n.a.	7	7½	7⅝	8
	70	70	77	77	77	80	74	74	73	73	77	80	69
	250	250	275	275	260	275	250	285	285	285	260	300	255
	96.2	88	96.5	96.3	86.5	97.75	88	106	106	106	115	108	106.7
	soft coal	soft coal	soft coal	soft coal	soft coal	soft coal	soft coal	soft coal	soft coal	soft coal	Rosebud	oil	soft coal
	50	48	48	77	78	72	77	72	72	72	90½	64	60
	21-0	21-6	21-6	21-0	20-0	21-0	21-0	20-0	21-0	21-0	19-6	21-0	21-0
	2	4	4	3	3	3	3	3	3	3	none	1	3
	5,184	5,422	5,439	5,374	4,289	4,766	4,749	5,509	5,506	5,306	4,964	5,311	4,974
	2,369E	2,256E	2,056E	2,093E	1,325A	1,497A	1,508A	2,336E	2,336E	2,200E	2,174E	2,366E	2,170E
	274,100	270,000	272,200	277,245	260,486	263,127	280,000	282,320	279,172	280,000	279,800	295,000	290,000
	454,090	408,000	435,000	466,040	406,810	460,270	462,500	490,450	479,360	496,000	489,400	510,710	506,500
	296,510	366,200	389,000	376,900	282,000	435,500	275,400	397,000	394,000	359,000	387,600	464,700	421,500
	70,814	84,760B	66,500	82,700B	62,800	63,900	69,800	70,800	67,200	67,200	69,800	66,000	70,600
	3.87	4.02	4.09	4.18	4.15	4.12	4.0	3.00	4.2	4.17	4.0	4.46	4.1
	18 tons	28 tons	30 tons	22 tons	17 tons	27 tons	24 tons	25 tons	26 tons	20 tons	27 tons	7,000 gals	30 tons
	15,000	18,000	20,000	22,000	15,500	24,000	18,000	20,000	20,000	19,350	20,000	24,500	22,000

Lima

From the smallest builder, the fewest 4-8-4's

SP's legendary *Daylight* locomotives, plus copies for two smaller roads, accounted for three-quarters of the Ohio builder's total

BY NEIL CARLSON

Lima Locomotive Works, smallest of the U.S. builders, produced just 96 4-8-4's. Chesapeake & Ohio got 12, Grand Trunk Western 6, and Soo Line 4. The remainder comprised an interesting family of 74 engines built for Southern Pacific, Western Pacific and Central of Georgia.

The C&O engines came in three stages: five class J-3's (Nos. 600–604, named *Thomas Jefferson, Patrick Henry, Benjamin Harrison, James Madison*, and *Edmund Rudolph*) in 1935, two more J-3's in 1942 (605–606, *Thom-*

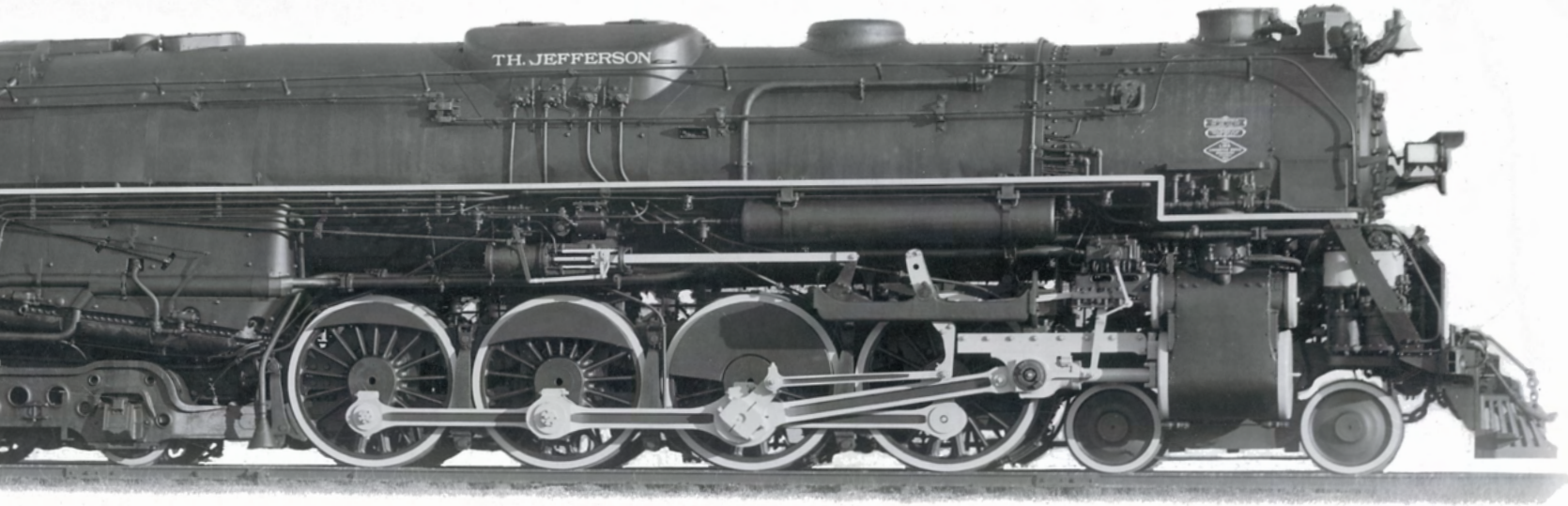
Two-year-old Greenbrier 610 crosses tidewater at Hampton, Va., with the Newport News section of C&O's *George Washington* in 1950.
BILL TAUB PHOTO

as Nelson Jr. and *James Madison*), and a final five of class J-3a in 1948 (610–614, no names). All were used in mountain passenger service in Virginia and West Virginia until the early 1950s, although at least two worked freights during a 1955 traffic surge. The first batch of Greenbriers, as C&O called the type, originally carried their headlights centered on the smokebox front in the classic manner, but this was later changed to the low position employed by the second and third groups from the start. The final five had lightweight, roller-bearing siderods and were the last 4-8-4's produced by a commercial builder.

Soo Line took delivery of its four in 1938, Nos. 5000-5003. Assigned to the Wisconsin Central portion of the Soo, on which they handled through freights between Chicago and Minneapolis, they were the system's only modern steam power. They were big enough —by Soo standards—that when the railroad dieselized the main line, they were too heavy to be used elsewhere. As a consequence, they were without jobs by 1954.

Also in 1938, Lima built Grand Trunk Western Nos. 6405–6410. These class U-4-b's were almost identical copies of five streamlined U-4-a's that Montreal Locomotive Works had built two years before for GTW parent Canadian National [pages 31–33].

C&O's first five 4-8-4's of 1935, handsome machines named for Virginia statesmen, shared many design traits with the road's Lima-built 2-10-4's delivered in 1930.
CLASSIC TRAINS COLLECTION



Soo Line 5001 is in the shadow of its own exhaust as it rolls a Chicago–Minneapolis time freight north through Antioch, Ill., in 1945.
V. O. HARKNESS PHOTO

GTW U-4-b No. 6407, on the point of a freight train at Pontiac, Mich., in November 1958, shows the effects of 20 years of service.
STAN KISTLER PHOTO

SP'S DAZZLING *DAYLIGHTS*

The 4-8-4's for which Lima is most well known are the 60 GS-series engines that went to Southern Pacific. In the mid-1930s, as the economy began to improve, SP initiated a program to upgrade its passenger service with streamlined lightweight equipment. Its most important train was to be the *Daylight*, a day train running down the coast between San Francisco and Los Angeles. It was to operate on an approximate 10-hour schedule over the 470 miles. The Coast Line was not a particularly fast route, and there were two significant summits to climb along the way. To maintain the required average speed of 47 mph over the route's roller-coaster profile, a big 4-8-4 was required. The engine needed enough power to not only maintain speed on the grades, but it also had to accelerate quickly to track speed when conditions permitted.

Although Baldwin had built SP's first 4-8-4's [pages 21–24], Lima was the low bidder for this order. Basically streamlined versions of the Baldwin GS-1's of 1930, the new GS-2's arrived in 1936. They wore a striking red, orange, black, and silver color scheme that matched the train. A skyline casing, all-weather cab, running-board skirting, and conical nose completed the streamlined look.

In service, the train matched its publicity and was an economic success. As a consequence, SP expanded its *Daylight* services to more routes. More engines were needed, and these arrived in 1937 in the form of 14 class GS-3's. They were based on the GS-1 and

SP GS-4 4439 (above) displays the striking *Daylight* livery as it powers train 99 near Santa Margarita, Calif. GS-2 4415 (right), from the first batch of streamlined GS's, heads "Overnite Merchandise" 374 from San Francisco at Glendale, Calif. War baby GS-6 4468 (below right) appears set for train 19, the Portland–Oakland *Klamath*.

GS-4, LINN H. WESTCOTT; GS-2, HERB SULLIVAN; GS-6, J. SCHMIDT, KRAMBLES-PETERSON COLLECTION

GS-2, but with a few changes. Driver diameter was 80 inches instead of 73½, and boiler pressure was raised to 280 psi. To accommodate the bigger drivers, the boiler was lengthened by 20 inches through use of an 80-inch combustion chamber rather than the prior 60-inch type. However, the other boiler specs remained the same. The cylinder diameter was reduced from 27 to 26 inches to keep the starting tractive effort about the same as on the earlier engines.

The GS-3 was another successful engine, and SP returned to Lima in 1941 and '42 for 30 more 4-8-4's, classes GS-4 (28 engines) and GS-5 (2). This time the boiler pressure was raised to 300 psi and the cylinder dimensions were changed to 25½ x 32 inches—again to keep the starting tractive effort in bounds. Other specs were the same as on earlier GS's, although the 4's and 5's had twin headlight housings (oscillating warning light above, standard headlight below). The only difference between a GS-4 and a GS-5 was roller bearings; the 5's had been so equipped as an experiment and wound up being the

Lima 4-8-4's compared

		Designs based on SP GS-1						
Railroad	**Soo**	**SP**	**SP**	**SP**	**SP**	**WP**	**CofG**	**C&O**
Class	0-20	GS-2	GS-3	GS-4	GS-6	GS-64	K	J-3
Road Numbers	5000–03	4410–15	4416–29	4430–57	4460–69	481–86	451–58	610–14
Year	1938	1936	1937	1941	1943	1943	1943	1948
Service	Freight	Psgr.	Psgr.	Psgr.	Dual svc.	Dual svc.	Dual svc.	Psgr.
Cylinders:								
bore x stroke (in.)	26 x 32	27 x 30	26 x 30	25½ x 32	27 x 30	27 x 30	27 x 30	27½ x 30
valve gear	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Baker
valve dia. (in.)	12	12	12	12	12	12	12	14
valve travel (in.)	7½	7¼	7¼	7¼	7¼	7¼	7¼	8
Driver diameter (in.)	75	73½	80	80	73½	73½	73½	74
Boiler:								
pressure (psi)	270	250	280	300	260	260	250	255
grate area (sq. ft.)	88.3	90.4	90.4	90.4	90.2	90.2	90.2	100
fuel	soft coal	oil	oil	oil	oil	oil	soft coal	soft coal
cmbstn. chmbr. (in.)	54	60	80	80	60	60	60	66
tube length (ft.-in.)	21-6	21-6	21-6	21-6	21-6	21-6	21-6	20-0
syphons	none	none	none	none	none	4	2	none
heating surfaces:								
evaporative (sq. ft.)	5,142	4,852	4,887	4,887	4,852	4,922	4,705	4,821
superheater (sq. ft.)	2,120E	2,086E	2,086E	2,086E	2,086E	2,086E	2,059E	2,058E
Weights, working order:								
drivers (lbs.)	263,000	266,500	267,300	275,700	283,200	280,950	260,000	285,200
engine (lbs.)	445,500	448,400	460,000	475,000	468,400	466,100	447,200	482,200
tender (lbs.)	317,600	372,880	358,880	390,750	395,100	397,700	246,640	386,130
Rated tractive force	66,000	74,710B	75,000B	78,650B	75,500B	64,200	63,200	81,035B
Factor of adhesion	3.99	4.28	4.25	4.25	4.38	4.38	4.11	4.29
Tender capacity:								
fuel	24 tons	6,275 gal	6,010 gal	6,000 gal	5,880 gal	6,000 gal	21 tons	25 tons
water (U.S. gal.)	17,500	22,000	22,000	23,000	23,300	23,300	13,000	21,500

E or A = type E or A superheater; B = tractive force including booster

only SP steam locomotives with rollers.

In 1943, SP believed it would need more 4-8-4's to handle the anticipated traffic increase once the principal war effort turned to the Pacific Theater. However, passenger engines with 80-inch drivers were not going to be approved by the War Production Board. So, the SP essentially requested 16 more 73½-inch-drivered GS-2's, although the new engines would be classified GS-6. Considered dual-service engines, the GS-6's lacked the running-board skirts, *Daylight* colors, and oscillating lights of their predecessors. The GS-6's were not confined to freight work, but even after wartime restrictions were lifted they never did receive the full *Daylight* look. Indeed, as the steam era waned, many earlier GS's lost their skirts and colorful paint jobs before regular steam activity ended in 1957.

GS-6 COPIES

However, SP did not receive all 16 GS-6's it ordered. Neighboring Western Pacific was also in need of new power, and the War Production Board diverted 6 of the GS-6's to the WP. And there was another wartime wrinkle. Central of Georgia had requested eight new Baldwin 4-8-4's, but the WPB again intervened and directed Lima to add these 8 engines to its production run of SP and WP 4-8-4's, for a total of 24.

The SP GS-6 and WP's class GS-64 were almost identical. Both were oil-burners, and the GS-64's even carried SP-style train-indicator boxes, which WP did not use. The two key differences were that the WP engines lacked boosters and they had firebox thermic syphons. WP also added smoke deflectors to its 4-8-4's in 1946 and '48. Although they also hauled freight trains, WP 481–486 were primarily passenger engines, and they operated over the entire main line from Oakland to Salt Lake City. Early in their careers they could be seen on the point of the *Exposition Flyer* before that train was replaced by the diesel-powered *California Zephyr* in March 1949. The last GS-64 ran in January 1953.

The differences with the Central of Georgia engines were more substantial. The CofG class K's were coal-burners, one of the few cases where a locomotive that had been designed as an oil-burner was reconfigured for coal. Like the WP engines, CofG 451–458 had firebox syphons. (The addition of the syphons made both the WP and CofG engines more powerful than the SP GS-6.) But, unlike the others, they lacked booster engines, skyline casings, conical noses, and had smallish, four-axle tenders to allow them to fit on the 85-foot turntable at Albany, Ga. Location of the air pumps on the pilot deck instead of on the fireman's side of the boiler further set them apart from the SP and WP engines. Nevertheless, "under the hood" there was a GS-6.

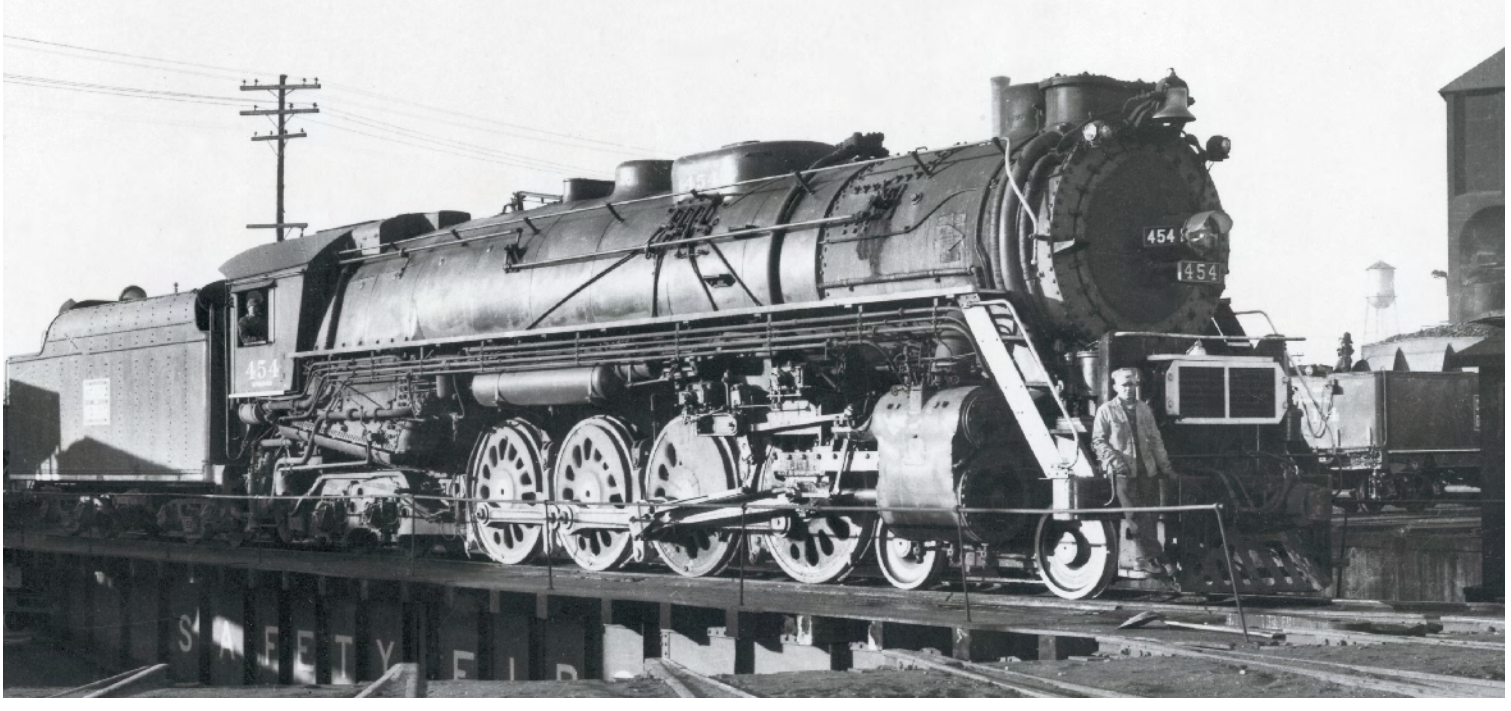
The CofG 4-8-4's were known as "Big Apples." They worked in freight and passenger service on the Macon and Columbus divisions, where they were often seen on top Florida trains such as the *Dixie Flagler* and *Seminole*. The CofG became fully dieselized in 1953, and retired its 4-8-4's the same year.

So, did Lima have any original 4-8-4 designs of its own? As we have seen, the Southern Pacific GS series and related engines were mostly based on the work of Baldwin and SP designers. The engines Lima built for the Chesapeake & Ohio and Grand Trunk Western were railroad-designed. This leaves just the four Soo Line engines as the only pure-blood Lima 4-8-4's.

Normally pulled by a 4-6-0, WP's *Feather River Express* (above) is easy work for GS-64 No. 481 on August 16, 1947, a mile west of Altamont, Calif. The CofG class K's (like No. 454, right, at Columbus, Ga., in 1949) shared specs with the SP GS-6 and WP GS-64, but looked quite different.

ABOVE, JOHN C. ILLMAN; RIGHT, R. C. THOMASON COLLECTION


WESTERN PACIFIC
481


454
454

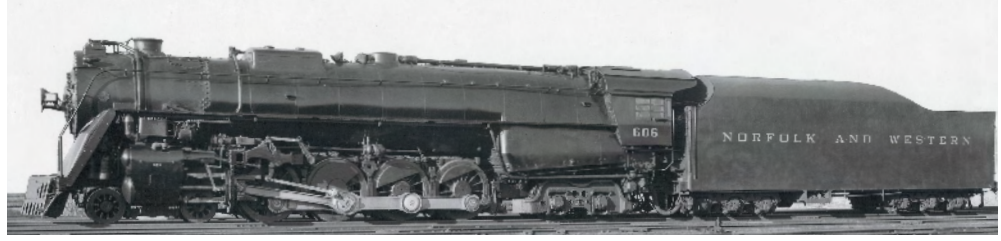
All about the 4-8-4

Homegrown

Three railroads designed and built their own

August 20, 1942: MoPac marks the completion of the final Sedalia-built 4-8-4 with a victory-themed ceremony at the shops.

MISSOURI PACIFIC, JOE COLLIAS COLLECTION



N&W 612 (top), the next-to-last U.S. 4-8-4, rolls the westbound *Powhatan Arrow* down Blue Ridge grade toward Roanoke, Va. N&W 606 (above) represents the six 4-8-4's built during the war without streamlining and other J features, all of which were added later.

TOP, J. SCHMIDT, KRAMBLES-PETERSON ARCHIVE; ABOVE, NORFOLK & WESTERN

Missouri Pacific, Norfolk & Western, and Reading Company created some memorable machines

BY NEIL CARLSON

Railroad shops built a total of 110 4-8-4's. This ran the gamut from simply making copies of commercially supplied engines already on the roster to designing and building totally new ones. Both Cotton Belt [see page 21] and Burlington Route [page 39] used Baldwin-supplied boilers to construct copies of engines they had received earlier from the Philadelphia firm. Milwaukee Road also built a copy of a Baldwin [page 41]. Canadian Pacific built two engines of its own design in 1928 [page 21], but they were its only 4-8-4's. The work of Missouri Pacific, Norfolk & Western, and Reading was much more significant, being entirely homegrown efforts. In particular, the N&W engines are widely considered to be the finest 4-8-4's ever built.

MISSOURI PACIFIC 2100'S

Missouri Pacific got 25 2-8-4 Berkshires, class BK-63, from Lima in 1930 and assigned them to redball freight service. This occurred at a time when western freight schedules were becoming more competitive, since the Burlington, Wabash, and Rock Island all had new 4-8-4's. The MP Berkshires had 63-inch drivers, which limited their speed, putting the road at a disadvantage. However, with traffic plummeting in the early stages of the Great Depression, MP had neither the resources nor the incentive to remedy the situation.

By the end of the decade, as traffic levels began to improve, MoPac looked at several proposals to convert its Berkshires into fast-freight Northerns. In 1940 the road sent two BK-63's to its Sedalia, Mo., shops for rebuilding into 4-8-4's. This entailed a lot more than changing the pilot truck. Although the smokebox, first boiler course, and firebox were retained, new second and third courses were inserted. The new third boiler course contained a 60-inch combustion chamber, a feature the 2-8-4's had lacked. The Berkshires' tube length of 21 feet 6 inches was retained, as was the general tube and flue arrangement of the Type E superheater. Many appliances were reused, including the Worthington BL feedwater heater. The rebuilt, lengthened boiler was mounted on a new cast-steel bed with 75-inch drivers—a full foot higher than the Berkshires' wheels.

After testing that showed the new engines, Nos. 2101 and 2102, were more than capable

of outperforming the 2-8-4's, MoPac expanded the program to include the entire group of 25 Berkshires. The final conversion, No. 2125, left Sedalia in August 1942. As 2-8-4's, the engines had run west from St. Louis to Kansas City and Osawatomie, Kans.; in rebuilt form, they also ranged south to Texarkana, Ark. Although considered freight engines, the 4-8-4's were also used in passenger service during World War II. The war also saw MP buy an additional 15 4-8-4's, built by Baldwin to a Rio Grande design [pages 42–43].

After the war, as MoPac was beginning to dieselize in earnest, the Sedalia 4-8-4's began to suffer from cracking at the boiler seams. Their boilers had been fabricated with nickel steel, and the material was behaving similarly on other railroads' engines. At first, MP sent problem engines back to Sedalia for new boiler courses, but as the problems grew worse and dieselization increased, the company began pulling the 4-8-4's out of service. The last was withdrawn in 1952.

NORFOLK & WESTERN CLASS J

Beginning in 1884 and continuing to 1953 when steam locomotive production ended, Norfolk & Western's Roanoke Shops constructed 447 engines. This was quite an achievement for a 2,200-mile railroad like the N&W. Apart from the commercial builders, only the Pennsylvania Railroad's shops in Altoona had a greater output. Roanoke was not merely prolific, for N&W engineers developed three of the finest locomotive designs in America: the class Y5 2-8-8-2 Mallet of 1930 (later refined to the Y6b), the class A fast-freight 2-6-6-4 of 1936, and the superb class J streamlined 4-8-4 of 1941.

The first five J's arrived just as America entered World War II. At 494,000 lbs., they were big engines. They had roller bearings on all axles and lightweight side rods, also with roller bearings. The outside diameter of the boiler at its maximum was a stout 102 inches. Their size was accentuated by a skyline casing and other streamlined elements designed by N&W's Frank Noel.

As delivered, the J's boiler pressure was 275 psi; however, the boilers were designed to accommodate 300 psi, and the operating pressure was later raised to this figure. At 300 psi, the J's rated tractive effort was 80,000 lbs. This was the highest of any 4-8-4 without use of a booster, and it resulted in a factor of adhesion of just 3.6—the lowest of any 4-8-4. Nevertheless, the J's were not slippery. They had 70-inch drivers—quite low for a passenger engine—but they fit N&W's profile to a tee. Much of the railroad ran through mountainous terrain with few opportunities for fast running. Just the same, on the coastal plains heading toward Norfolk, the J's could really fly. N&W calculated that the locomotives were capable of developing more than 5,000 drawbar horsepower.

The new engines, Nos. 600–604, went to work on the main line between Norfolk and Cincinnati, where they replaced USRA heavy 4-8-2's on premier passenger trains. One J could run through on the entire 677-mile distance with water and coal replenished en route. It wasn't long before the J's began achieving 15,000 service miles per month.

The big naval base at Norfolk generated lots of wartime passenger traffic, and the War Production Board gave the N&W permission to build six more J's in 1943. Because of wartime material restrictions, the engines were not streamlined or equipped with Timken lightweight side rods, resulting in a classification of J1. N&W subsequently applied these features to Nos. 605–610 and dropped the "1" from their designation.

After the war, N&W launched the *Powhatan Arrow*, a daytime Norfolk–Cincinnati streamliner. For power, Roanoke Shops provided three more J's in 1950—the very last 4-8-4's built for service in North America. For a time, the 14 J's protected 84 percent of N&W's passenger train-miles.

The J's turned in remarkable performances month in and month out on their home road, but an off-line test stint showed what they could do when given room to run. From December 4, 1944, through January 3, 1945, the Pennsylvania, which had majority ownership of the N&W, borrowed engine 610 for a series of test runs. The Pennsy had recently developed its own new passenger locomotive—the class T1 4-4-4-4—and wanted to compare it to the J.

The T1 was a duplex design with two sets of four driving wheels, each set powered by a pair of cylinders, in a rigid frame. It was a Baldwin concept intended to compete with the 4-8-4. A duplex's four cylinders could be much smaller than a 4-8-4's two, and, with the lower piston thrusts, side rods could be lighter and the rotating parts more easily balanced. The T1's had powerful boilers and could maintain 100 mph with heavy trains. However, the T1 was notoriously slippery. Because its drivers were not all coupled together, as on a 4-8-4, one set often held the rail while the other spun wildly.

The J was too big to operate on PRR's eastern lines, so the tests were conducted between Crestline, Ohio, and Chicago. Flat and straight, this was the fastest track on the Pennsy, which put the 610 to work on regularly scheduled trains. The J was able to handle all its assignments, and once topped 110 mph with 15 cars. Several reports written by

Reading T-1 2123 is in the clear with a coal drag at Robesonia, Pa., 12 miles west of Reading, Pa., on the Harrisburg main line, as sister 2118 roars by with a manifest freight.
JOHN PICKETT PHOTO

Railroad shops

Railroad	MP	N&W	RDG
Class	N-75	J	T-1
Road numbers	2101–25	600–613	2100–29
Year	1940–42	1941–50	1945–47
Service	Freight	Passenger	Freight
Cylinders:			
bore x stroke (in.)	28 x 30	27 x 32	27 x 32
valve gear	Walsch.	Baker	Walsch.
valve dia. (in.)	14	14	13
valve travel (in.)	not avail.	8½	7½
Driver diameter (in.)	75	70	70
Boiler:			
pressure (psi)	250	300	240
grate area (sq. ft.)	88.3	107.7	94.5
fuel	soft coal	soft coal	soft/hard
cmbstn. chmbr. (in.)	63	103	45½
tube length (ft.-in.)	21-6	19-2½	20-0
syphons	3	none	4
heating surfaces:			
evaporative (sq. ft.)	4,837	5,271	4,920
superheater (sq. ft.)	1,953E	2,177E	1,214A
Weights, working order:			
on drivers (lbs.)	279,360	288,000	278,200
engine (lbs.)	445,950	494,000	441,300
tender (lbs.)	323,880	378,000	367,700
Rated tractive force	66,400	80,000	79,100B
Factor of adhesion	4.19	3.60	4.09
Tender capacity:			
fuel	20 tons	35 tons	26 tons
water (U.S. gal.)	17,250	20,000	19,000

E or A = type E or A superheater; B = tractive force including booster

observers testified to the locomotive's abilities, but the reports also sounded a cautionary note. The concern was over valve speed, which, because of the J's 70-inch drivers, was very high. The verdict: With a bigger driver, the J would be a great locomotive on this piece of the PRR; as-is, it would be a fine engine in the mountains—had clearance and weight restrictions permitted its operation there. After a month, the J returned home, and the PRR ordered 50 more T1's.

Dieselization came late to the coal-hauling N&W, but it did finally arrive. The J's remained the road's primary passenger power until summer 1958. With brakeman's doghouses fitted to their tenders, some worked on freight trains before all J's were retired by November 1959.

READING COMPANY'S T-1

Beginning in 1945, the Reading Company built 30 4-8-4's at the company shops in Reading, Pa. The 1,400-mile carrier was one of the railroads that formed the Alphabet Route, but its best freight power—low-driv-ered 2-8-2's and 2-10-2's—was straight out of the drag era. The Reading urgently needed a fast-freight locomotive. Rather than order new ones from a commercial builder, the road looked to its stock of obsolete power and to its own shops, whose locomotive-building heritage extended back to 1845.

The starting point was the company's class I-10 Consolidations built in 1923. These 2-8-0's had immense boilers, and, while they had more than enough tractive effort, they lacked the horsepower required for a fast freight work. Reading Shops began the conversion process by adding a new smokebox and a new first course to the I-10 boiler. Four thermic syphons were added to the firebox and combustion chamber, but otherwise the rest of the boiler was untouched. With the new course, the tube length of the boiler was increased from 15 feet 6 inches to 20 feet. However, the I-10 tube/flue arrangement and Type A superheater were retained. Boiler pressure was raised 20 pounds to 240 psi. The updated boiler was mounted a new bed consisting of an integrally cast frame and cylinders. New 70-inch Boxpok drivers were added, and 10 of the engines received Timken roller bearings on all axles.

Like all RDG power, the I-10 had a Wooten firebox with a large grate for burning anthracite. However, since the firebox had been mounted above the 2-8-0's rear driving wheels, it was relatively shallow. This was a good configuration for anthracite, but not for the bituminous coal the 4-8-4's would be fed, because it shortchanged furnace volume. Anthracite is a high-Btu fuel composed mostly of fixed carbon, and burns slowly right on the grate. Bituminous coal has a significant volatile content, and requires adequate furnace volume for good combustion. Had the firebox been designed for a 4-8-4, it would have been 12 to 18 inches deeper.

The T-1's were at once sleek and old-fashioned in appearance. The entire boiler, including the smokebox, was jacketed, the running boards were skirted, and the big welded tenders carried READING in large letters. But the engines also possessed age-old Reading traits like an above-center headlight and arched cab windows. In service the T-1's handled freights over much of the Reading system, from the Western Maryland connection at Hagerstown, Md., to New York-area points on the Jersey Central, and from Philadelphia into coal country. As diesels took over road-freight assignments, they were downgraded to helper service, transfers, and mine runs. For several months in 1956, nine were leased to the Pennsylvania, which used them north of Harrisburg, Pa. The Reading's last regular use of the T-1's was in early 1957, but three of them enjoyed a spectacular curtain call on the railroad's Iron Horse Rambles excursion series of 1959–64.

Man in a Hurry

Life in the cab when an N&W J broke the century mark

BY **COL. HOWARD G. HILL, USAR (RET.)**

Riding at 100 mph in the cab of a steam locomotive is an experience which comes to few men. I am one of the lucky ones. The occasion was a railfan trip which originated and terminated in Washington, D.C., on October 18, 1959, under the sponsorship of the Washington Chapter of the National Railway Historical Society. The last of the famous Norfolk & Western Railway class J 4-8-4 streamlined steam locomotives, No. 611, was assigned to haul the train from Petersburg, Va., to Norfolk and return. This was the swan song of steam locomotive operation into Norfolk, and glory be, how she did sing. Through the courtesy of C. E. Pond, general superintendent of motive power of the N&W, I was granted permission to ride in the cab of the 611 from Petersburg to Norfolk.

Baldwin built the first class J locomotives for the N&W about 1880. They were trim little eight-wheelers with 16 x 24-inch cylinders and 62-inch-diameter driving wheels. They weighed 39,500 lbs. on driving wheels and exerted a starting tractive effort of 11,792 lbs. With a factor of adhesion (weight on drivers divided by starting tractive force) of approximately 3.35, they must have been slippery if the hogger crowded the pistons a bit in starting. As was customary in those days, the J's were used in both passenger and freight service as needed.

The second group of class J locomotives on the N&W were beautiful little high-wheeled Atlantic passenger engines. They were numbered 600 to 606 inclusive and were built by Baldwin in 1903 and 1904. They had 19 x 28-inch cylinders and 79-inch-diameter driving wheels. They weighed 85,340 pounds on driving wheels and exerted a starting tractive effort of 21,750 pounds. Their factor of adhesion of 3.92 was a little closer to what is accepted as good practice than that of their predecessors. They had one of the early applications of piston valves located above the cylinders and operated by Stephenson valve gear. One of their assignments was to haul the *Cannon Ball*, a fast train which operated between Richmond and Norfolk via Petersburg on a daily round trip.

The third and final group of class J steam locomotives on N&W was designed by the engineers of the N&W motive power department and was built at the company's Roanoke Shops from 1941 onward. Because of the shortage of materials during the war, some of them

The man himself: N&W engineer Aubrey C. "Buddy" Phelps has his hand on the throttle of class J No. 611 during an October 18, 1959, excursion to Norfolk, Va., that included some fast running.

ORIGINAL PHOTO, HOWARD G. HILL; ILLUSTRATION WORK, DREW HALVERSON

were built without streamlining. Later they were streamlined to a pleasing design of clean lines which gave the impression of power, speed, and simplicity. The impression of speed was not an illusion. One engineer is reported to have pulled the throttle wide open on one of these J's during preliminary trials to test the strength of the rods and stretched her out to 110 mph. At that speed the driving wheels were turning over at 528 rpm, and she was running 1 mile in 32.73 seconds. When these locomotives were in regular passenger-train service they were reported to have cruised regularly at 85 to 90 mph on the long tangent east of Poe, Va., and they frequently hit 100 mph for a few miles if the train was behind the advertised.

These J's were among the heaviest and most powerful 4-8-4's ever built. They had 27 x 32-inch cylinders and 70-inch-diameter driving wheels. Tractive effort was 80,000 lbs. and weight on driving wheels was 288,000 lbs., giving a factor of adhesion of 3.60. Boiler pressure was 300 psi.

I was at the Petersburg station when the 611 came rolling slowly out of the west after running light from Roanoke. The NRHS special arrived from the north about 10:30 a.m. via the Atlantic Coast Line connection. Diesels were cut off, and the 611 was coupled to the train. Brakes were tested and preparations made for the dash to Norfolk as Passenger Extra 611 East. Aubrey C. (Buddy) Phelps was the lucky man who was running the 611 on this trip. He was a Norfolk Division engineer with about 21 years in engine service, runnng between Crewe, his home terminal, and Lamberts Point, where the big yards and coal piers are located, about a mile beyond the new Norfolk passenger station. Buddy told me later that he would gladly have waived his pay if necessary in order to run the 611 on this memorable run. The fireman was Omar H. Estes of Petersburg.

The highball from the conductor was the signal for action. Buddy moved the independent brake valve handle to the release position, and the engine and tender brakes kicked off with the familiar musical sigh from the exhaust at the distributing valve. He cracked the throttle and threw a couple of hatfuls of steam in her face. In a few seconds the 611 had the slack stretched and started slowly to move the 14-car string of varnish with its 800 passengers through the curve and onto the N&W eastward main track of the city line. Buddy handled the throttle, reverse lever, and sander valve skillfully, and the 611 held the rails without even a slight slip of her drivers.

At Poe, 3.83 miles east of Petersburg, we entered the eastward main track of the double-track Petersburg Belt Line, which bypasses downtown and is straight as an arrow for the next 51 miles. Buddy stopped the train to unload photographers (and me) for a run-by, backed up on the Belt Line until he was out of sight around the curve, and then came at us with the throttle wide open and dense clouds of black smoke billowing up into the clear blue sky. I got my share of still photos and movies, and when the passengers were back on the train I once again "climbed into the cab with my cameras in my hand." (What would the immortal Casey Jones have thought of this beautiful big engine? He would have been right at home in her cab and would have got her best performance out of her.)

We had another Casey Jones at the throttle that day in the person of Buddy Phelps. As soon as he got the highball, he cracked the throttle and started for Norfolk. We were on the high iron on a slightly undulating profile with a short ruling grade of .64 per cent ascending eastbound between Waverly and Wakefield. Buddy steadily increased the speed until the telegraph poles began to look like the slats in a picket fence. We were running 80 mph. Buddy "fanned them" to reduce speed to 45 mph through Waverly in compliance with a town ordinance, but was soon running at 85 approaching Wakefield. On a slight descending grade just east of Ivor we hit 95, and as we crossed Blackwater River east of Zuni the 611 leaped ahead until the speedometer in the cab indicated 100 mph.

In September 1957, two years before author Hill's ride in her cab, N&W 611 dashes through Blue Ridge, Va., with the 15-car *Tennessean*, which she'll hand over to the Southern at Lynchburg.

ORIGINAL PHOTO, J. J. YOUNG JR.; ILLUSTRATION WORK, DREW HALVERSON

At that point, I braced myself on the left side of the cab and shot the accompanying photograph [previous page] of Buddy just as he eased off to about half throttle—truly a picture of A Man in a Hurry. The significant feature of this photo is its portrayal of Phelps as master of the machine. Throughout the entire run he sat there calm, unruffled, relaxed, and at the same time completely alert, watching every detail of the operation and performance of the 611. His keen mind was tuned in on every sound, every movement of this marvelous machine. He proved himself to be a throttle artist of top rank. Throughout the run, his attitude was one of complete confidence and competence.

Our speed dropped to 95 as we approached the end of the long tangent at Kilby. Buddy fanned them to reduce speed to 75 through the curve into Suffolk, and to 40 over the Atlantic & Danville and Atlantic Coast Line at-grade crossings in Suffolk. Leaving Suffolk, the throttle was wide open again and the stack barked a staccato symphony which quickly became a steady roar. We soon hit 90 mph for about 20 miles through the Dismal Swamp. Before long, we reached the end of the racetrack and speed was reduced to 30 mph over drawbridge 7, to 15 mph over drawbridge 5 and through the yards until we stopped at Lovett Avenue, Norfolk. There the 611 was cut off to run light to Lamberts Point roundhouse for servicing while the train was moved to the old Norfolk passenger station by a diesel switcher.

The 611 was the last steam locomotive to pull a train out of Norfolk. I am sure that the hearts of many passengers were as heavy as mine as we looked through the car windows to watch the 611 as she rolled slowly around the curve to the right onto the westward main track shortly after 3:15 p.m.

We stopped at Yadkin, Milepost 10, for a photo run-by and at

Suffolk, Milepost 26, to give the townspeople an opportunity to look over the 611 and to get some pictures. Leaving Suffolk, Buddy beat the stack off the old girl, and we ran non-stop to Petersburg. We cruised at 90 mph most of the way, but just west of Windsor, Milepost 38, there was about 5 miles of .33 per cent descending grade westbound and by the time we reached Zuni, Milepost 44, the 611 again was blasting along at 100 mph. From back in the train, this speed was not as thrilling as it had been when I was in 611's cab.

The beautiful performance was interrupted by the 45-mph speed restriction through Waverly, but we were soon running 90 mph again until we approached the end of double track at Poe. Our arrival at Petersburg marked the end of a perfect day.

Six days later the 611 ran again on what was her last run, hauling a rail safari from Roanoke to Williamson, W.Va., and return. There was no opportunity for fast running on that trip because of the heavy grades on the Radford and Pocahontas divisions, but I was able to ride in her cab on the return trip from Williamson to Bluefield. Extreme curvature on this division necessitated a 45-mph limit, with 30 mph on many of the curves. As we started the climb up the new reduced Elkhorn Grade, I leaned out of the gangway to listen to every exhaust—the most beautiful stack music in the world. I had climbed the old Elkhorn Grade many times in the cabs of Y3 Mallets and K2a Mountains, but the 611's performance was the best of all.

After arrival at Roanoke passenger station about 10 p.m., I rushed up to the head end as the 611 was cut off. She moved slowly ahead into the darkness of the shop area, around a curve behind a building, and into oblivion. Later that night as I lay in bed at the hotel, thinking of the events of the day, I heard her melodious chime whistle as it sounded for one of the road crossings as she moved from the shop area to Shaffers Crossing roundhouse, where she was placed in storage. Surely that was her swan song.

100 mph? Maybe not…

"Man in a Hurry" by Col. Howard G. Hill first appeared in the December 1964 issue of TRAINS magazine. The words are reproduced here as a vivid, first-hand description of life in a 4-8-4 cab during a high-speed run.

However, a letter to the editor in February 1965 TRAINS casts doubt on certain aspects of Hill's account. The letter was from none other than E. L. "Tommy" Thompson, one of the most respected "train timers" in North America:

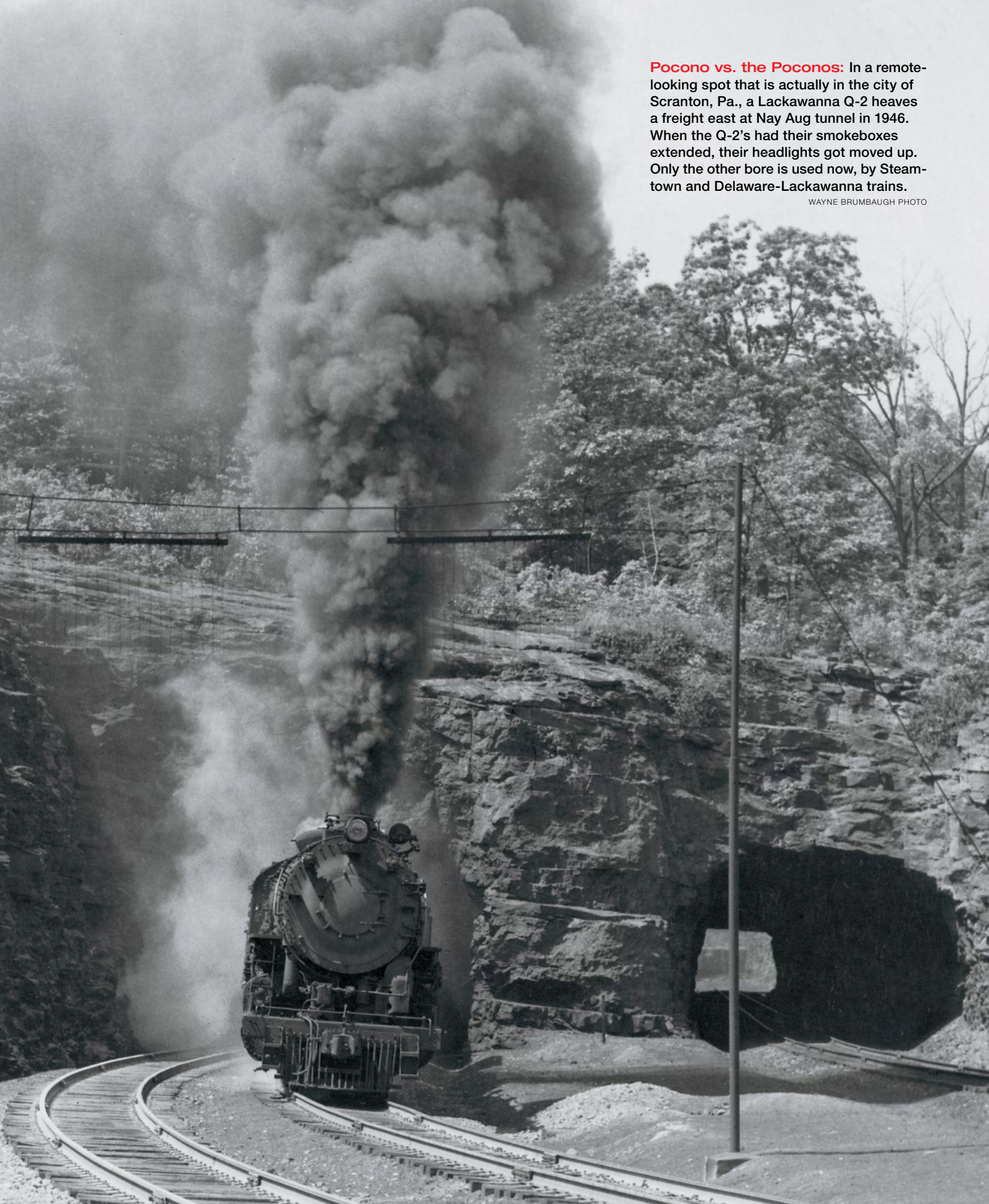
> "When I started reading 'Man in a Hurry,' I quickly remembered that I had ridden that train, so I dug out the schedule performance.
>
> "It sounds wonderful to say that the train made 100 in both directions, but my figures disprove this. As a matter of fact, my notes show that those in the engine said that they were running 90, although 41 seconds [88 mph] was about the best timed mile [that I observed]. It seems even more unlikely that coming back, the speed ever got anywhere near the three-figure mark. There is no evidence of any 90 mph going down in the Dismal Swamp (Juniper-Gilmerton area).
>
> "I don't want to throw cold water on an otherwise fine article (with a marvelous picture of an engineer at speed), but it would appear that the speedometer was way fast (although my notes indicate otherwise) or that the writer's imagination has got the best of the facts."

No further comment from Hill, Thompson, or the editors can be found, and all now are long since deceased. At the time of the run, N&W had a systemwide limit for the J's of 78 mph. It is highly unlikely that 611 hit 100 mph on October 18, 1959. And, although neither Hill nor anyone else could know it, her trip six days later was not her swan song [see pages 84–85].—*R.S.M.*

4-8-4 PHOTO GALLERY

Wabash twins: No. 2914 and a sister blast upgrade through Chicago Ridge, Ill., with a St. Louis-bound Wabash Railroad freight in March 1950. The semaphores protect the diamonds where the Wabash crosses the Indiana Harbor Belt; the interchange track curves off to the right. Wabash's 25 Baldwin 4-8-4's shared many traits with 25 Baldwin 4-8-2's delivered a few months before them.

BOB MILNER PHOTO



Pocono vs. the Poconos: In a remote-looking spot that is actually in the city of Scranton, Pa., a Lackawanna Q-2 heaves a freight east at Nay Aug tunnel in 1946. When the Q-2's had their smokeboxes extended, their headlights got moved up. Only the other bore is used now, by Steamtown and Delaware-Lackawanna trains.

WAYNE BRUMBAUGH PHOTO

One of each: All three classes of Union Pacific 4-8-4's are represented in this October 29, 1958, lineup at Grand Island, Nebr. From left, we have FEF-1 No. 805, FEF-2 No. 833 (now displayed in Ogden, Utah), and FEF-3 No. 835. UP had dieselized its Nebraska main line and retired this coal dock, but, in a 1958 traffic surge, reactivated the oil-fired 800's for Council Bluffs–North Platte freight work.

STAN KISTLER PHOTO

O-5A on the run: Bell swinging and white exhaust billowing, Burlington Route 5623 makes a glorious sight in command of a westbound freight at Oneida, Ill., on a perfect fall day in October 1954. The road's own West Burlington, Iowa, shops built the 28 O-5A's, using many Baldwin-supplied components, during 1936–1940.

BOB MILNER PHOTO

Helper service: Many 4-8-4's ended their careers doing work that was well below their station. In this April 12, 1956, scene, Reading T-1 No. 2119, built in the company shops only a decade before to expedite time-sensitive merchandise trains, is the pusher on a diesel-powered freight climbing toward Locust Summit, Pa.

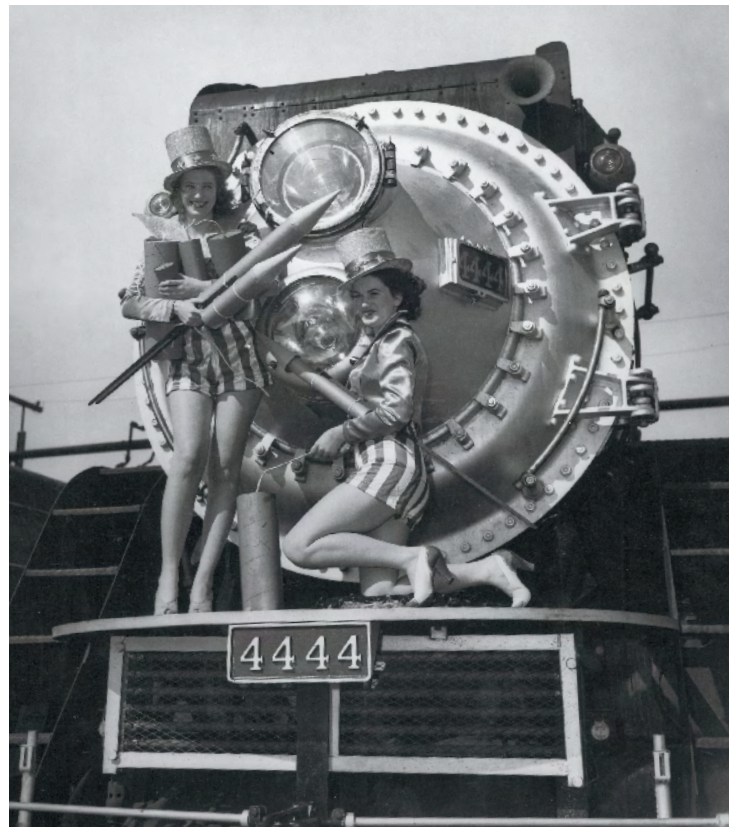
AL CHIONE COLLECTION

Rubdown for a Niagara: In a dramatic study of man and machine, a hostler polishes the manganese-vanadium side rods of New York Central No. 6000—the first Niagara. NYC's 26 S-1's, plus one poppet-valve S-2a, rank among the greatest of all 4-8-4 families.

CLASSIC TRAINS COLLECTION

Santa on his J: Whether he's using it for transportation or bringing it as a Christmas present, Santa Claus is onto a winner in the form of Norfolk & Western class J No. 607 at Roanoke, Va.

CLASSIC TRAINS COLLECTION



4444 for the 4th: Two gals, several fireworks, and GS-4 No. 4444 mark the July 4, 1941, inaugural of Southern Pacific's *San Joaquin Daylight*, which in fact initially was hauled by Pacifics.

CLASSIC TRAINS COLLECTION

An H-1 of an engine: Machinist Agnor Olson (left) and boilermaker James Sandy got the honor of christening Chicago & North Western's first rebuilt 4-8-4, H-1 No. 3004, at 40th Street Shops, Chicago, on April 1, 1946.

C&NW PHOTO


2671
2671
2671
PACIFIC

Northern on the *North Coast*: A-4 No. 2671 is midway between St. Paul and Minneapolis with the pride of the Northern Pacific, train 1, the *North Coast Limited*, in 1945. The 4-8-4 will work through to Livingston, Mont.—at 1,009 miles, one of the longest of all steam locomotive runs.

NORTHERN PACIFIC PHOTO

Other-worldly: A twin sealed-beam headlight and raised stack extension give Santa Fe 2905 an alien appearance as it helps F units climb Cajon Pass with the eastbound *Grand Canyon* near Devore, Calif., on December 2, 1951. The road took full advantage of the range of its oil-burning 4-8-4's by running them the 1,776 miles between Kansas City and Los Angeles without change—a record haul for U.S. steam power.

ROBERT HALE PHOTO

On the Rock: The big herald on the tank of Rock Island locomotive 5114 leaves no doubt as to the 1946 Alco's owner. Riding the elevated trackage through Joliet, Ill., the engine, from RI's final batch of 4-8-4's, has just crossed the Santa Fe-GM&O diamonds with a Chicago-bound time freight in 1951.

WALLACE W. ABBEY PHOTO

USSR steam stars: The world's largest 4-8-4 fleet—251 class P36 passenger locomotives, built during 1949–56—strode the 5-foot-gauge rails of the Soviet Union. Light by U.S. standards, the 72-inch-drivered, roller-bearing-equipped engines saw regular use until about 1974. In February 1994, preserved P36's 0218 and 0050 head up a photographers' charter train at Stanishevka, Ukraine.

HAROLD A. EDMONSON PHOTO

Crossing the Great Karoo: South African Railways' 3-foot 6-inch network was home to 140 sophisticated 4-8-4's, 90 of which were built with immense condensing tenders in order to conserve water on desert runs. Built in Britain and Germany in 1953, the class 25's and 25NC's were being phased out when No. 3483 headed a freight between Kimberley and DeAar in April '88.

HAROLD A. EDMONSON PHOTO

PRR Down Under: South Australian Railways' dozen class 520's, homebuilt in 1943–47, borrowed the styling of the Pennsylvania's T1 4-4-4-4 of 1942. The 520's worked SAR's 5-foot 3-inch-gauge lines until late 1966; two survive, including the class leader, pictured on a 1993 fantrip.

BILL HOUGH PHOTO

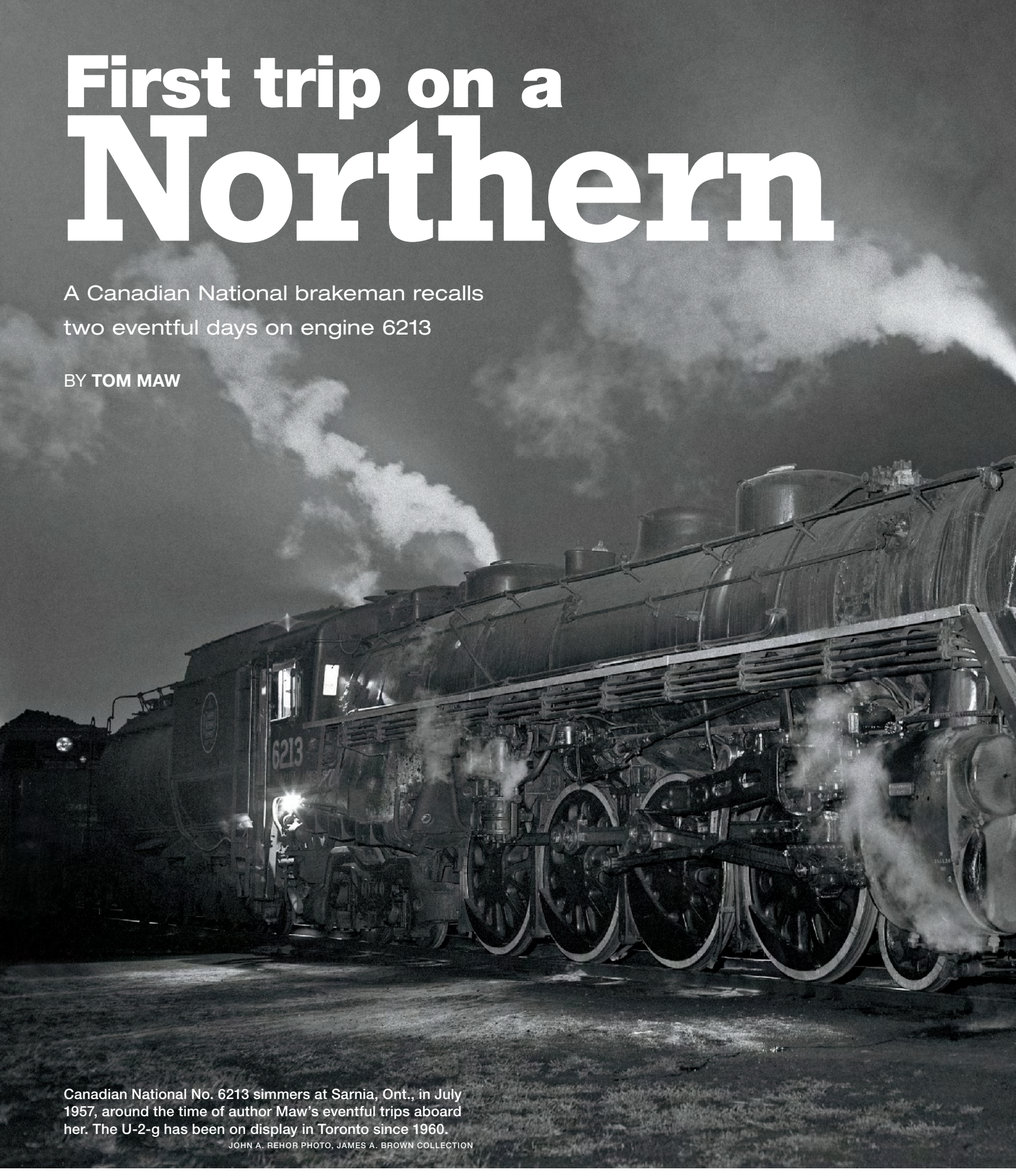
Spanish beauty: Like the Soviet P36, Spain's 10 4-8-4's were designed and built domestically. The 5-foot 6-inch-gauge oil-burners worked top passenger trains from 1955 until the early 1970s. Lanky No. 242F2007, doubleheading behind a 4-8-2 on a Madrid express, stands at Burgos in November 1966.

HAROLD A. EDMONSON PHOTO

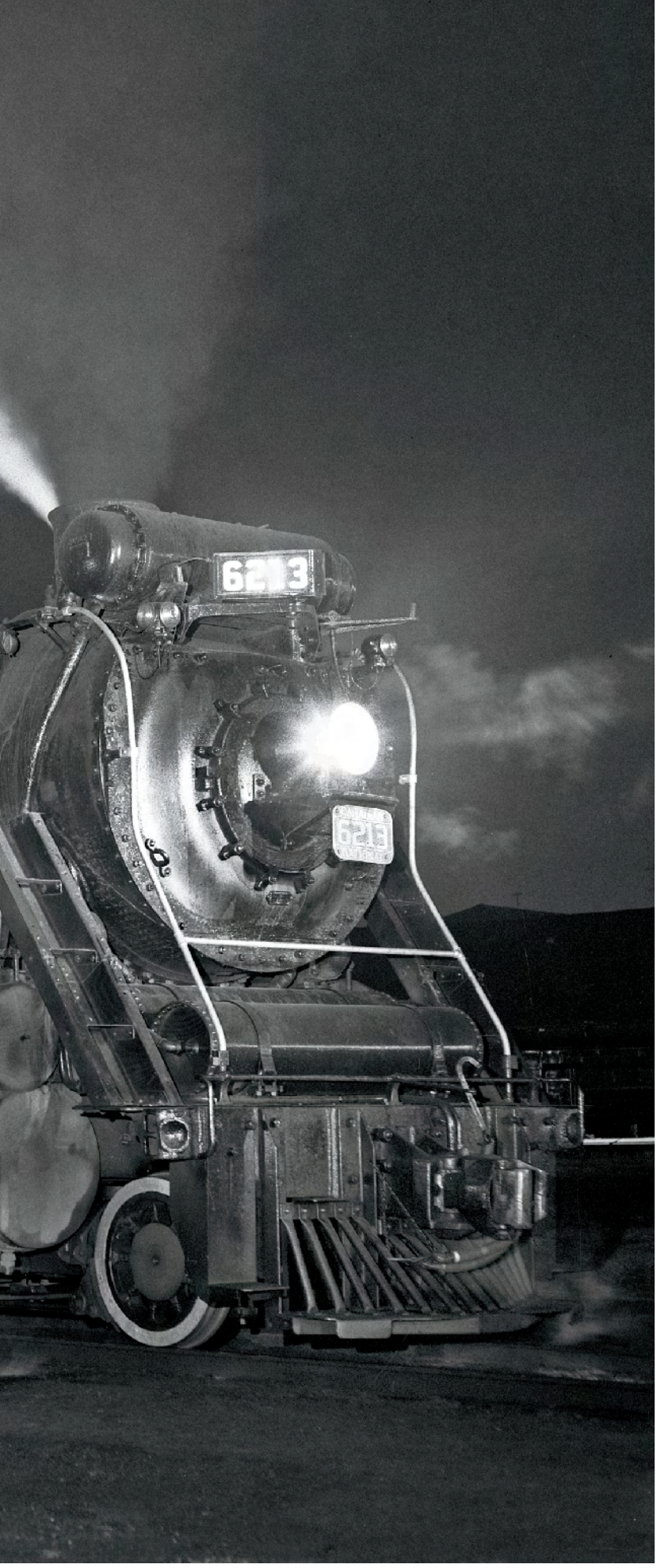
First trip on a Northern

A Canadian National brakeman recalls two eventful days on engine 6213

BY **TOM MAW**



Canadian National No. 6213 simmers at Sarnia, Ont., in July 1957, around the time of author Maw's eventful trips aboard her. The U-2-g has been on display in Toronto since 1960.
JOHN A. REHOR PHOTO, JAMES A. BROWN COLLECTION



To set the stage for this trip of a lifetime, a little history is in order. I hired on with the Canadian National in Toronto as a yardman in September 1955. In 1957, with very little experience on the main line, I was called as head-end brakeman on a freight extra north to Gravenhurst, a trip of about 110 miles. Operating authority was by train orders, your employee's timetable, and a good watch. Our power was No. 6213, a class U-2-g Northern built by Montreal Locomotive Works in 1942. It was my first trip on such a big engine. Climbing up into the cab of this monster was exciting, and I could not wait to get on the road.

On departing Toronto's Bathurst Street Yard, we proceeded up the Newmarket Subdivision, which has a fair uphill grade. On my seat behind the fireman, I could feel the power of the engine surging right up through my body—a feeling hard to describe but never forgotten.

We worked our way north, setting off and lifting cars at several locations. It took us nearly 12 hours to reach Washago, about 13 miles shy of Gravenhurst. I looked at my timetable and noted a northbound passenger train was due shortly.

With little experience with this situation, and feeling quite worried, I expressed my concern to the engineer. I suggested we let the passenger train pass us. He told me not to worry, as we had time to make it to Gravenhurst. I told him again how concerned I was.

Finally we departed Washago. The time just seemed to fly by, and I half expected to feel the crash of the passenger train running into us.

To ensure we cleared the main track as soon as possible at Gravenhurst, I climbed out on the little walkway that ran down the side of the engine so I could run ahead and get the switch without stopping the train. I dropped off the pilot and ran as fast as I could to the switch. I was shocked to find it was a spring switch, equipped with a lock. This creates a very time-consuming process to unlock and open the switch, particularly with the 6213 bearing down on me.

I just managed to get the switch over as the engine arrived, but I was afraid to put the handle down and secure the switch, as there was a chance the points might open and cause a derailment. I hung onto the handle until the caboose cleared, and no sooner closed the switch when the passenger train sailed past at about 40 mph. My conductor and I later had quite a discussion on why that train did not slow down, since it should have been warned of our presence by the burning fusee that had been thrown off our caboose.

After our required rest, which included about 5 hours' sleep in the caboose, we were ordered home. However, we were delayed getting the 6213 off the shop track, as a hotbox had been found on the pilot truck. Was this defect an omen of things to come?

With the hot bearing attended to, we started down the shop track. The entire crew was in the engine cab, with me standing in the doorway. Suddenly there was a loud *bang*, and the next thing I knew I was lying on the ground with the conductor on top of me. One of the water glasses had broken, filling the cab with hot water and steam. The fireman quickly put a stop to this by closing a valve, and there was no serious damage. This was another first for me—and the last, I hoped.

After switching in the yard for a few hours to make up our train, we departed Gravenhurst. Soon the fireman and I dozed off (yes, when you're tired enough, it is possible to fall asleep on a moving steam engine!). A funny noise startled me, and I awoke to find the engineer laughing and pointing at the fireman. Part of the cab floor was on fire, soon to give the fireman the hot foot of his life! I yelled and grabbed him as he almost jumped right out of the cab.

The coal stoker, which spreads the coal into the firebox by moving from side to side, had jammed on the fireman's side and hot coals had overflowed and started the fire. The rest of the trip was very hard work as we had to shovel coal into this hungry beast and use a long rake to spread the coal around the firebox.

We finished the trip without further incident. I was glad it was over, but now it's a treasured memory.

by any other name

Pocono, Greenbrier, Golden State . . . the many names by which the 4-8-4 was known reflected corporate aspirations, regional pride, and recognition that the type was something special

BY **JOHN P. HANKEY**
AND **ROBERT S. McGONIGAL**

Railroaders have always named things.

From the dawn of the industry, they gave evocative names to the locomotives they imported or created. The custom of naming vehicles—especially ships—was centuries old. It must have seemed perfectly ordinary for the first real locomotive operated in America—an English 0-4-0 imported by the Delaware & Hudson Canal Co. in 1829—to have arrived already named: the *Stourbridge Lion*.

Other early locomotives had easy-to-fathom names. "John Bull" was a common, if slightly derogatory, name used for England. It is little surprise that the Camden & Amboy's British-built locomotive *Stevens* (named after an early New Jersey railroad promoter) soon became known as the "John Bull." The name eventually gained official status, and the *John Bull* is today on exhibit at the Smithsonian Institution in Washington, D.C.

The Baltimore & Ohio is a fine example of the penchant for naming locomotives. Some early engines were named for Greek and Roman gods, perhaps because locomotives seemed to embody the strength, speed, and superhuman powers ascribed to classical deities. The B&O had an *Atlas*, a *Mercury*, and a *Vulcan*. It also named locomotives after animals with presumably worthy attributes—*Elephant*, *Stag*, *Reindeer*, and *Buffalo*.

It wasn't long before entire classes of locomotives acquired

DL&W Pocono 1640 is in the midst of its namesake mountains as it heads the mostly heavyweight consist of No. 21, a Saturday-only summer train between Hoboken and Scranton, Pa., in 1948.

OPPOSITE PAGE (GTW 6325), ROBERT S. MCGONIGAL; ABOVE, JOHN R. CANFIELD

names. The first, about 1835, were the "Grasshoppers," 0-4-0's with distinctive vertical main rods that suggested an insect-like quality of motion. Next were the "Crabs," compact 0-4-0's with squat vertical boilers and low-slung horizontal cylinders that must have resembled the sideways skittering of Chesapeake Bay blue crabs.

By 1850, B&O and its partner in locomotive design and construction, Ross Winans, had perfected the design of the "Camel" engines —crudely built but effective 0-8-0's that defined the original concept of "drag" locomotion. The cab's location atop the boiler gave these engines a humped profile not unlike like that of a camel.

In the last few decades of the 19th century, the names of locomotive types became a bit more generic. The 4-6-0 Ten-Wheeler was a good example: It had 10 wheels. The first 2-8-0, built in 1866 for the Lehigh Valley, was named *Consolidation* to mark the merger of two railroads into the LV; later, all 2-8-0's were known as Consolidations.

And what does all that have to do with naming 4-8-4's? Maybe more than we think. A combination of applied science, technological iteration, and just plain tinkering came to define an American tradition of locomotive building. We needed only 15 years —from 1830, when Peter Cooper's demonstration locomotive for the B&O first ran—to develop rugged, powerful, reasonably well-adapted

Sometime in 1950, Lehigh Valley 5204 climbs out of the Wyoming Valley, after which the road named its 4-8-4's, at Gracedale, Pa.

S. BOTSKO PHOTO

C&O Greenbrier 604 (above) hauls westbound mail at Alleghany, Va., 15 miles from the Greenbrier River, in October 1951. NYC Niagara 6014 (above left) is a long way from the Niagara River as it stops at Crestline, Ohio, in May 1954. WM Potomac 1411 (left) crosses its namesake river near Cumberland, Md., in March '52.

POTOMAC, ED THEISINGER; NIAGARA, JOHN DZIOBKO; GREENBRIER, BILL PRICE

4-4-0's, which, because of their ubiquity on this continent, came to be known as the American Standard, or simply American, type.

It took another 15-year span, from the late 1920s through the early 1940s, to turn the 4-8-4 into little more than a heat exchange machine, which is close to the ultimate compliment for a steam locomotive: a machine that converts the latent heat present in a fuel into useful work (in this case, moving trailing tonnage along a main track at the least possible cost and greatest possible speed).

Let's consider the proposition that the 4-8-4 represents a high point of modern American steam locomotive development. For a variety of reasons the 4-8-4 represented a technologically optimal form. Once the bugs got worked out and the general proportions established, there just wasn't much more to do with eight driving wheels. We just couldn't agree on what to call them.

The first 4-8-4's, built by Alco in 1926–27, went to the Northern Pacific. The general convention then was that the name of the first railroad to adopt a new wheel arrangement became attached to all engines of that wheel arrangement. The publicity men at Alco and NP seem to have assumed they could dub the new type Northern Pacific, soon shortened to Northern.

There was plenty of precedent for this. The Missouri Pacific claimed "naming rights" based on its 1903 order from Alco for the first domestic class of 4-6-2's. (Slightly earlier versions had gone to New Zealand—across the Pacific Ocean). However, Missouri Pacific's rails ended some 800 miles shy of its western namesake.

There isn't much evidence that early 20th century locomotive men had much of a sense of irony (or humor of any sort, for that matter). But it's interesting to note that the Santa Fe—which actually *did* reach the Pacific Coast—had the largest fleet of 4-4-2 Atlantic-type locomotives. And the Pennsylvania Railroad (always firmly attached to the Atlantic Coast) rostered by far the largest fleet of Pacifics.

A little deeper into the century, the Boston & Albany (and Lima Locomotive Works) named the 2-8-4 after the Berkshire Hills, which the locomotives were built to conquer. No one (except the Milwaukee Road, briefly) seemed to dispute the New York Central's right in 1927 to designate the 4-6-4 the Hudson type, after the famous river that made up such a vivid part of the Water Level Route. The Santa Fe Railway originated the 2-10-2 type, and the name stuck.

Early Mallet articulated types didn't get names. B&O received the

A rare 1941 photo shows GS-3 4420, from SP's second group of streamlined Golden States, on the *Morning Daylight* at San Miguel.

DAN POPE COLLECTION

first, 0-6-6-0 No. 2400, which came to be known informally as "Old Maud." It was the same for the 2-6-6-2's, 2-8-8-0's, and others in the first wave of articulateds. Surely these low-speed behemoths were not given names because of a lack of appreciation for what they could do. Their immense power changed the scale and complexion of much of the industry and made drag freight a truly paying proposition.

But those early Mallets tended to be ugly, usually labored in relative obscurity, and in general weren't the kinds of motive power the builders' salesmen or railroad p.r. folks understood as worthy of a catchy group name. For the most part, they were just "Malleys," an American corruption of the name of the Swiss locomotive designer who perfected the concept: Anatole Mallet, pronounced mal-LAY. Indeed, "Malley" lingered on some roads as a name for any type of articulated, be it compound or single expansion.

There were exceptions. Two years after receiving the first 4-8-4's, NP took delivery of the first 2-8-8-4, which it dubbed the Yellowstone type. Union Pacific, pioneer of the 4-6-6-4 wheel arrangement in 1936, named it the Challenger and, for the most part, other railroads that owned the type accepted the designation. As it had when it originated the 4-8-2 Mountain type three decades before, Chesapeake & Ohio seized a similar opportunity to name the 2-6-6-6 type the Allegheny.

The ultimate articulated (and, some would persuasively argue, the ultimate steam locomotive) was Union Pacific's 4-8-8-4 Big Boy. Sort of a "double 4-8-4," they were fast, powerful, and efficient—just about everything an operating officer could ask for. That is, an operating officer with heavy rail, broad curves, long turntables, big roundhouses, stout bridges, and massive tonnages to roll across long distances. The name originated when an anonymous Alco employee chalked the words BIG BOY on the unpainted smokebox of the first one as it was being built. Wisely, UP—the only railroad in the world to operate 4-8-8-4's—adopted the moniker as official.

Unlike the giant articulateds, the 4-8-4 could run on just about anybody's main track. It was the logical conclusion of an engineering evolution stretching back to pioneering antecedents like Winans' Camels and Matthias Baldwin's "Eight Wheel Connected" locomotives of the 1840s and '50s. Eight-coupled engines of

GN President John M. Budd spoke at the 1964 dedication of No. 2584, the last GN 4-8-4, at Havre, Mont., where it's still displayed.

CLASSIC TRAINS COLLECTION

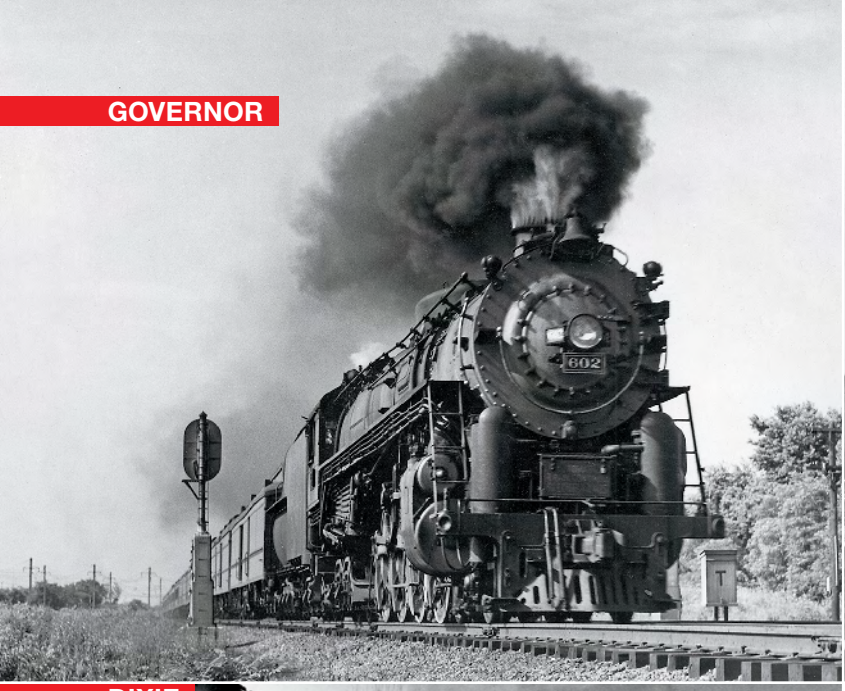
one sort or another in fact represent one of the most durable and versatile threads in locomotive development.

But the question remains: Why didn't the term "Northern" stick? Why did the 4-8-4 have more names than any other wheel arrangement? Of course, at this point no one will ever know with certainty, but we can speculate.

The technology itself may have been a factor. The first 4-8-4's were pretty ordinary machines. The initial classes represented incremental improvements over their immediate predecessors. The early 4-8-4's solved a few obvious problems and represented a comfortable "next step"—but not a great leap—in locomotive development.

And we have to understand a conservative, comfortable next step as it would have been perceived in 1927. With the 2-8-4 of 1925, the men at Lima were proposing revolutionary change with a completely different kind of eight-coupled machine. They almost literally were re-imagining modern steam locomotion and offering a distinct—some would say radical—break with long-held assumptions.

Alco was partnering with different railroads to push the limits of what modern locomotives could do. Designs like the 4-10-2 and 4-12-2 were at the edge of what conventional railroad track structure could handle, and not many railroads could run engines with those wheelbases or dynamic forces. Diesel-electric locomotives were a decade



RF&P 555, *General J. E. Johnston* (top right), wheels a fast freight upgrade at Massaponax, Va.; 602, *Governor Thomas Jefferson* (top left), handles 18 cars of varnish near Four Mile Run. NC&StL called all its 4-8-4's Dixies, but crews knew them as "Stripes" (middle) or, for those with running-board skirts, "Yellow Jackets." CofG "Big Apple" 452 (above) rolls watermelons at Lorane, Ga.

GENERAL, J. B. MORDACAI; GOVERNOR, C. W. WITBECK; DIXIE, J. N. KELLY JR.; BIG APPLE, H. M. COMER

from real production—but the seeds had been planted, and their potential was being discussed in the trade press and corporate offices.

There is another angle to this line of reasoning. Eight-coupled locomotives were already so common, and had been around for so long, that almost any new twist would have been understood as merely part of railroading's DNA. Machines with those general characteristics sort of belonged to everybody. There just wasn't enough novel to support the claim that the entire class of locomotives should be known as Northerns. And what, really, did "Northern" connote?

That is the crux of the second point, and this one is more cultural. In the 1920s and '30s, the shared memory of the Civil War was still alive. Indeed, feelings of regionalism seemed to be growing stronger. Radio magnified, rather than minimized, local cultural distinctions. The Depression years of the 1930s further restrained the kind of national homogenization we experience today.

For whatever reason, railroaders in certain parts of the country simply resisted being told that the big new engines they were spending precious capital to purchase must be called Northerns. In some places that was, no doubt, an echo of the Civil War and an expression of pride in southern heritage.

More important, decisions as to what to call a new class of locomotive were made by individual railroaders according to what they understood as their time, place, and culture. Often, railroads didn't decide what to call their 4-8-4's—railroaders did, probably based on many conversations, a shared sense of opportunity, and no little amount of pride. They may not have participated in a major breakthrough in locomotive design, and they may not have worked for major carriers. But they could run these ultimate eight-coupled engines just like the industry leaders, and give them names that meant something locally. On many roads, the 4-8-4 was the biggest, most advanced engine in the roundhouse, and it deserved a special name.

Railroads were quick to assert their 4-8-4 naming rights. The year after NP's Northerns hit the rails, the type's second buyer, the Delaware, Lackawanna & Western, chose to call its 4-8-4's Poconos, after the Pocono Mountain region. Both a scenic asset and an operational hindrance on its New York–Buffalo main line, this area of northeastern Pennsylvania was the heart of the Lackawanna.

Canadian National was another early 4-8-4 adopter, buying the type for itself and subsidiary Grand Trunk Western in 1927. From CN's perspective, NP was a "southern" (not to mention foreign) railroad and so, perhaps, an unsuitable inspiration for a Canadian loco-

motive name. In any case, CN affixed signs bearing the word CONFEDERATION to the running board of its first 4-8-4, delivered at the 60th anniversary of Canada's confederation structure of government. However, perhaps mindful of its role as the national railway of "the true north, strong and free," CN (and GTW) soon did an about-face, mounting small plates lettered NORTHERN TYPE on the cylinder jackets of its 4-8-4's [photo, page 74].

Santa Fe also joined the 4-8-4 club in 1927, with a single engine. No. 3751 was apparently considered a beefed-up version of an existing design, for the railroad numbered it directly above the last of its 3700-series 4-8-2's, and initially referred to it as a Heavy Mountain type. However, when fleet production began, Santa Fe dropped the name in favor of "3751 Class."

It is hard to imagine the Great Northern Railway accepting the term "Northern" for engines developed by its arch competitor—and it didn't. Instead, GN chose (initially, anyway) to refer to its 4-8-4's by the name of the train they were intended to pull, the *Empire Builder*.

Like the Lackawanna, the Lehigh Valley found inspiration in the Pennsylvania landscape through which it operated. LV called its 4-8-4's Wyomings, after the picturesque Wyoming Valley in the heart of the anthracite region. It was a fitting way to acknowledge a pride of place, a historic transportation corridor, and one of the most rugged and scenic landscapes in the Northeast.

Although Southern Pacific reached up to Portland, Ore., the sprawling system was decidedly not northern in its orientation. Traffic to, from, and within California was SP's bread and butter, and the road honored this by dubbing its 4-8-4's Golden States. In keeping with SP's practice of basing engine classifications on type names (2-8-0 Consolidations were in class C, 4-6-2 Pacifics were P, 4-8-2 Mountains were Mt, and so on), the Golden States were class GS. (The GS's were designed as passenger engines. To gain War Production Board approval for an additional order in 1943, SP redefined their designation to stand for General Service.)

In the South, where the 4-8-4 was relatively rare, the cultural aspects took on a somewhat different dimension. There has never been a time—at least, not since about 1820—when the term Northern was particularly well regarded there. You may imagine how the idea of a locomotive type bearing that name would have been received in the former Confederacy.

It was rejected. The Nashville, Chattanooga & St. Louis, whose territory was substantially Confederate during the Civil War, was the first southern road to receive 4-8-4's. They arrived in 1930, just 65 years after Appomattox. The NC&StL called itself The Dixie Line, and its top trains were the *Dixie Limited* and *Dixie Flyer*. Could the first 4-8-4's in the South be called anything but Dixies?

Chesapeake & Ohio in 1935 was part of the Cleveland, Ohio-based Van Swearingen empire, but its heart still lay in Richmond, Va., the former capital of the Confederacy. C&O called its 4-8-4's the Greenbrier type, a plug for the railroad-owned luxury hotel in White Sulphur Springs, W.Va., which itself was named for the Greenbrier River, which a C&O line followed. Chessie also named the first 7 of its eventual 12 Greenbriers after prominent Virginians; class engine 600 bore the lettering TH. JEFFERSON on its sand dome.

Likewise, Northern would never do for the Richmond, Fredericksburg & Potomac. RF&P had two classes of 4-8-4's and, unusually, called the classes by two different names: General (5 engines) and Governor (22). As on the C&O, each individual engine carried the name of a notable Virginian, in this case on the cab. No. 551, the first of the General class, was *General Robert E. Lee* (a Confederate, of course, as were the other four Generals), while No. 601, the first Governor, was *Governor Patrick Henry*. After No. 612, *Governor Claude A. Swanson*, the final 10 Governor engines were named after Virginia statesmen who served the commonwealth in various capacities: No. 613 was *John Marshall* (congressman and influential Chief Justice of the United States); 614 was *George Washington*.

Atlantic Coast Line, RF&P's principal southern connection, had a dozen big 4-8-4's. Although ACL didn't coin a name for them, it didn't call them Northerns, either. Like several other roads, ACL referred to them by their class designation (R-1) or number series (1800's). Likewise, Norfolk & Western's streamined 4-8-4's were simply J's.

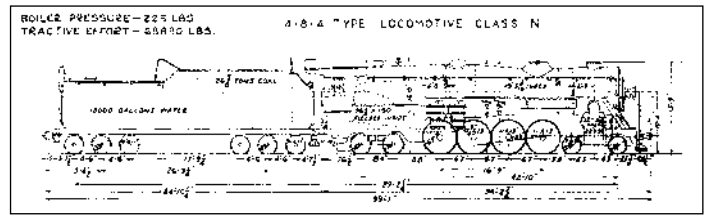
Central of Georgia was the only other southern road with 4-8-4's. Even in 1943, when the nation was united against external enemies and the road had redesignated its Mikados as the MacArthur type, CofG could not bring itself to call its eight new 4-8-4's Northerns. However, the new engines' deep green paint job inspired crews on the west end of the railroad to call them Big Apples, a handle that stuck.

With its Hudson (4-6-4) and Mohawk (4-8-2) types, New York Central established a pattern of naming wheel arrangements after major rivers that its main line followed. The short Niagara River was not a significant presence along the NYC, but its famous falls have long been a symbol of colossal power, which perhaps is what the road had in mind when it chose a name for its 4-8-4's, built by Alco in 1945–46. Among the most potent steam locomotives of all time, NYC's Niagaras lived up to their name.

Curiously, Nacionales de Mexico also adopted the name—albeit spelled "Niagra"—for its Alco-designed 4-8-4's, delivered in 1946. A tip of the hat to NYC's new Alcos? Perhaps, although the lightweight Mexican engines needed more than just another "a" to be on par with NYC's Niagaras, which outweighed them by 84,000 lbs.

Western Maryland became the last railroad to join the 4-8-4 club when it received a dozen from Baldwin in 1947. Like C&O and NYC, the road found inspiration in an on-line river, calling its engines the Potomac type. After the WM 1400's, there would be no new 4-8-4 designs in North America, and no additional evocative names coined for the type.

The Norfolk type?



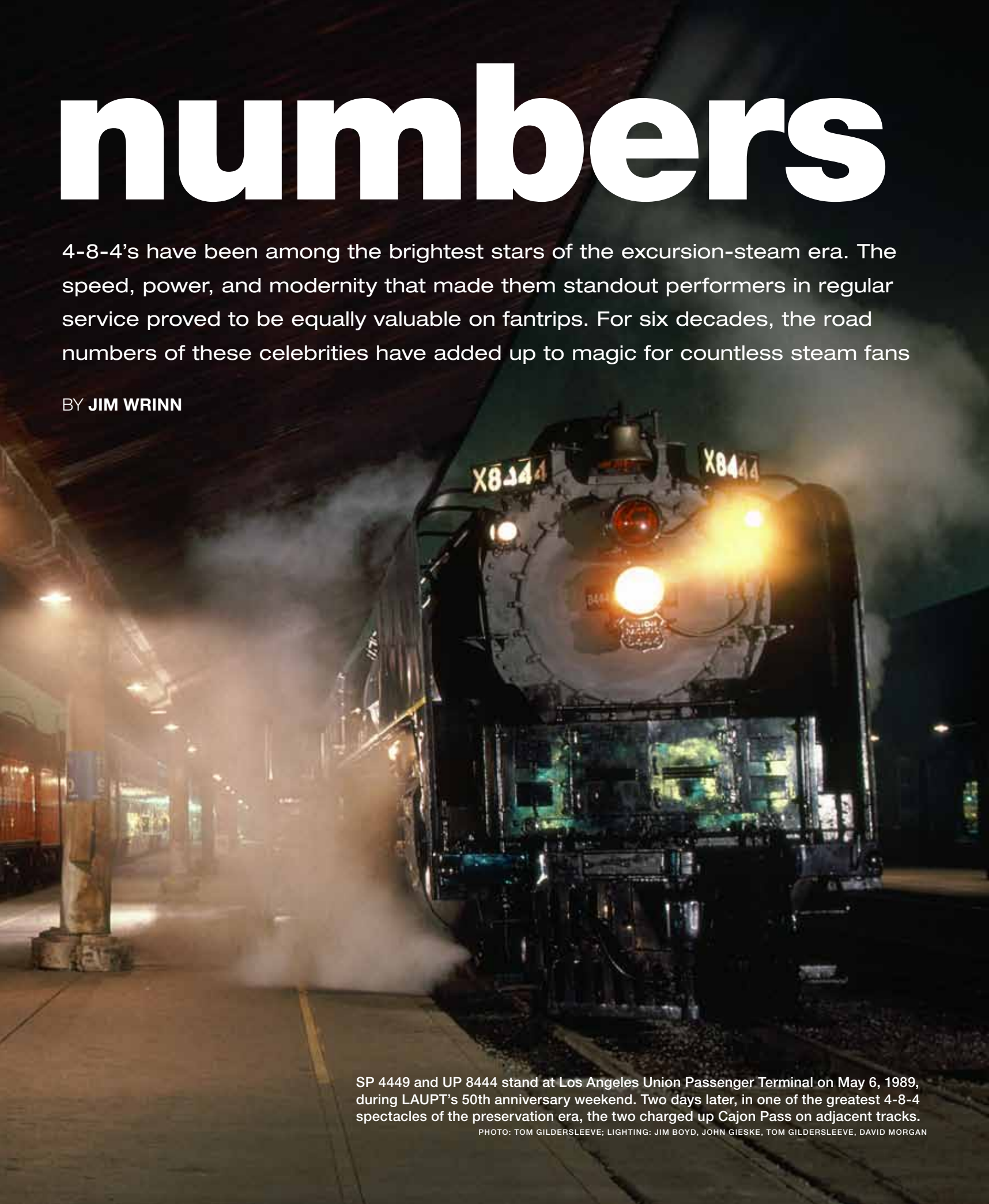
Norfolk & Western had been impressed with Lima's A-1 Berkshire of 1925 and decided it wanted a fast freight engine of its own. With two classes of successful 4-8-2's already on the road—and before Northern Pacific's pioneering 4-8-4's—Roanoke's engineers proposed an eight-coupled locomotive with a 100.1-square-foot grate. This was too much for a two-wheel trailing truck, so the new design was a 4-8-4, which N&W designated class N. In addition to being the first 4-8-4, the N might have been the strangest, for it was to have 63-inch drivers—6 inches lower than the smallest drivers on any North American 4-8-4. However, designers determined a smaller grate would be sufficient, and only a two-wheel trailing truck was needed. The result was the K3 4-8-2, which, though a good steamer, was plagued with machinery troubles. One wonders, though, had the class N been built, if Norfolk might have become the standard name for the 4-8-4 type.—*Ed King*

Magic

numbers

4-8-4's have been among the brightest stars of the excursion-steam era. The speed, power, and modernity that made them standout performers in regular service proved to be equally valuable on fantrips. For six decades, the road numbers of these celebrities have added up to magic for countless steam fans

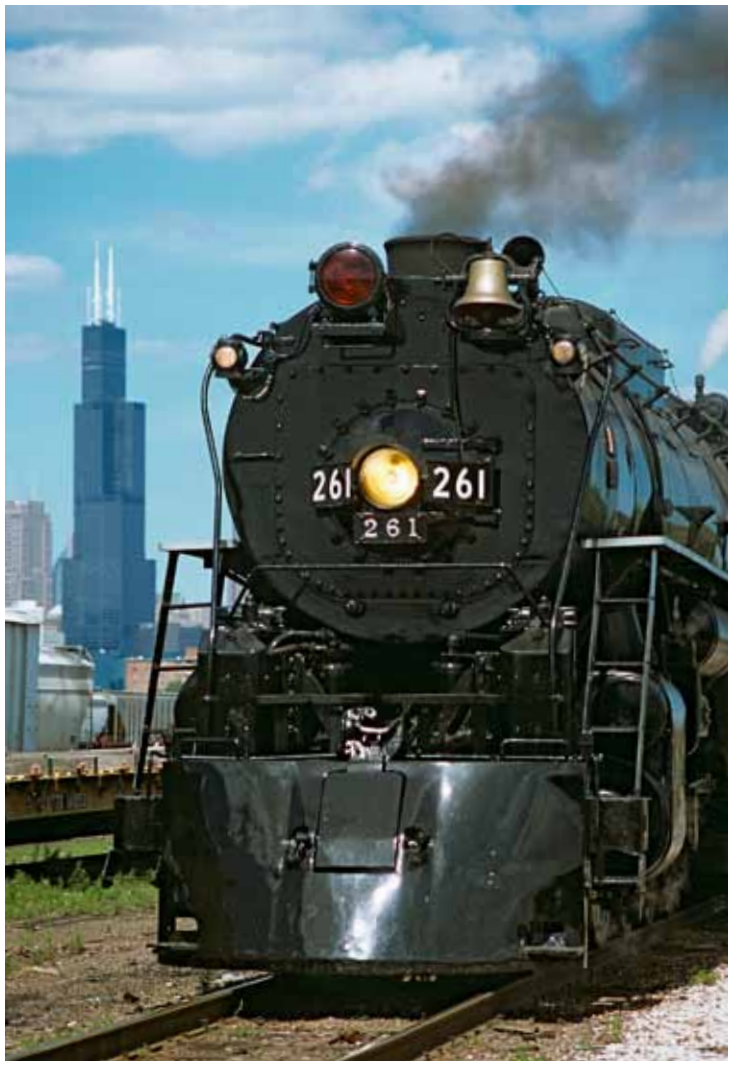
BY **JIM WRINN**



SP 4449 and UP 8444 stand at Los Angeles Union Passenger Terminal on May 6, 1989, during LAUPT's 50th anniversary weekend. Two days later, in one of the greatest 4-8-4 spectacles of the preservation era, the two charged up Cajon Pass on adjacent tracks.

PHOTO: TOM GILDERSLEEVE; LIGHTING: JIM BOYD, JOHN GIESKE, TOM GILDERSLEEVE, DAVID MORGAN

MILWAUKEE ROAD 261



Chicago, July 2004. HAROLD A. EDMONSON

At the end of steam operations on the Milwaukee Road, the railroad donated 4-8-4 No. 261 to the new National Railroad Museum in Green Bay, Wis., where the S3 was on display until 1991. That was when the for-profit group North Star Rail, headed by Steve Sandberg, whose grandfather had been an MILW engineer, leased the engine for excursions, and took her to Minneapolis for rebuilding, a task made easier by the 261's having only 10 years of service on her. Two years later, on September 18, 1993, the engine debuted in excursion service on Wisconsin Central, beginning a record of operating for the public at least once a year—a string unbroken for 15 years. Though based in the Upper Midwest, No. 261 has roamed far and wide. In her second year of excursion duty, she pinch-hit for Nickel Plate Road 2-8-4 No. 765 on the *New River Train* excursions in West Virginia, pulling 30-car consists with ease; she also traveled to Pennsylvania to participate in the July 1995 grand opening of the Steamtown National Historic Site, where she stayed—and ran—for a year. Just prior to her Keystone State safari, she starred in a documentary movie for the historic site, portraying a Lackawanna 4-8-4. Over the years, the engine's for-profit owners morphed into a non-profit foundation called Friends of the 261. Back in the Midwest, the locomotive roamed on BNSF Railway tracks as part of an employee appreciation special in 1998 that reached parts of North Dakota and Montana. Starting in 2004, the engine began operating Minneapolis-Milwaukee-Chicago over former MILW rails on through trips or on excursions based out of Milwaukee. In fall 2008, with her tube time near an end, the 261 pulled one last trip out of Minneapolis, traveling to La Crosse, Wis., and back. After that, the engine went back to Minneapolis for overhaul, pending a new lease agreement with the museum. Instead, after much wrangling, the museum agreed to sell the engine to the Friends. No. 261's overhaul is continuing in 2011 with the expectation that she will resume her remarkable excursion career in 2012 or '13.

Dinner train to Sturtevant, Wis., leaving Milwaukee, June 23, 2006. ROBERT S. MCGONIGAL

Photo freight at Tobyhanna, Pa., February 1996. ALAN M. MILLER

NORFOLK & WESTERN 611

None other than W. Graham Claytor Jr., then a lawyer in Washington, D.C., was instrumental in saving Norfolk & Western J class No. 611 at the end of steam operations in the 1950s. Claytor appealed directly to N&W President Stuart Saunders to keep the 4-8-4 running. Saunders resisted, but the dogged Claytor won a victory when Saunders promised not to scrap the engine. From 1959 to 1981, the J was on display at Wasena Park in Roanoke, Va. The June 1982 merger of Southern Railway, which had run steam excursions since 1966 (and of which Claytor was president 1967–77), and N&W, whose boss Bob Claytor was Graham's brother and another dyed-in-the-wool steam fan, led to the J's return to steam. After an overhaul in Southern's steam shop at Irondale, Ala., near Birmingham, she rolled north on the former SR in August 1982 for a triumphant return to her home city, running out the last miles from Lynchburg, Va., on the old N&W main line. Over the next dozen years, the J racked up miles from Florida to Chicago and Kansas City, impressing crowds with power (25-car trains, no problem), speed (79 mph, where she could, until a 40-mph limit was imposed after a 1986 derailment), and an amazing ability to adapt: In mountainous western North Carolina, with the help of one Geep, she could wrestle an excursion consist up the twisting 13-mile, 2.5-percent grade known as the Loops, or singlehandedly tackle the steepest main line in the land, 3-mile, 4.7-percent Saluda grade, with 4 or 5 cars. The end came for Norfolk Southern steam in 1994 after a minor collision between a freight and the empty passenger consist reawakened fears of a catastrophic derailment, 611's tube time came to an end, and both Claytors and other supporters were deceased or no longer in management. The J retraced the path from Birmingham to Roanoke she'd taken on her maiden voyage in 1982, arriving back home on Pearl Harbor Day. Today, she's the centerpiece exhibit of the Virginia Museum of Transportation in Roanoke.

Greenville, S.C.–Toccoa, Ga., trip southbound at Clemson, S.C., November 12, 1994. JIM WRINN

Cresting the grade, Saluda, N.C., May 30, 1993. JIM WRINN

Eastbound from Chicago at Fort Wayne, Ind., August 6, 1994. ROBERT S. MCGONIGAL


CHESAPEAKE & OHIO
614

Left: Eastbound on coal train at Cotton Hill, W.Va., January 1985. HAROLD A. EDMONSON. Above: Westbound east of Port Jervis, N.Y., October 27, 1996. MATT VAN HATTEM

C&O 614's excursion career was born like a phoenix, literally arising from the ashes of a 1979 Kentucky roundhouse fire that heavily damaged a fellow 4-8-4, Reading 2101, which had been powering the *Chessie Steam Special* [see page 94]. The Chessie System opened its B&O Railroad Museum collection to excursion entrepreneur Ross Rowland, who selected the Greenbrier from the museum roster as his new favorite, moved her to the Hagerstown, Md., roundhouse for restoration, and put the thoroughly modern 4-8-4 back in steam. In 1980 and '81, No. 614 pulled *Chessie Safety Express* excursions on Chessie, and also made an extended tour on Chessie's merger partner, Family Lines (Seaboard Coast Line Industries), spending much of the winter of 1980–81 like a good northeastern snowbird by living it up in Florida. Her next assignment was perhaps the strangest of any given to the 4-8-4's in the afterlife: For a month, in January 1985, she pulled loaded coal trains and empty hoppers on the old C&O main line between Huntington, W.Va., and Hinton, W.Va., through the New River Gorge. The stated purpose was to collect data for a new-generation steam locomotive, and instrumentation was rigged up between the "614-T" (as she was designated for the duration of the tests) and a tool car; but the project was never completed. The Greenbrier pulled excursions on New Jersey Transit from Hoboken to Port Jervis, N.Y., in fall 1996, '97, and '98, dazzling crowds with fast running and spirited runbys at its destination. No. 614 went into storage on the Reading & Northern at Port Clinton, Pa., until 2010 when, at the suggestion of R&N engineer Chris Bost, she was moved south, first to be in a special exhibit with N&W 611, and then in spring 2011, to join a display at the Chesapeake & Ohio Historical Society's headquarters in Clifton Forge, Va., back on home rails.

Cincinnati Union Terminal, November 2, 1980. HAROLD A. EDMONSON

SPOKANE, PORTLAND & SEATTLE
700

Above: Eastbound at Glade, Wash., April 21, 2001; HAROLD A. EDMONSON. Right: Prosser, Wash., October 19, 1990; ALAN M. MILLER

When Southern Pacific 4449 [page 98] departed Portland, Ore., to pull the *American Freedom Train* in 1975, she left behind a fellow park-display 4-8-4, SP&S 700. Soon, 15-year-old Chris McLarney, inspired by 4449's rebirth, turned his attention to the 700. He and other volunteers got her moved to a stall adjacent to 4449's in an SP roundhouse in Portland and began restoration work. Their efforts bore fruit in 1990, when the oil-burning Northern steamed for the first time. Over the years, No. 700 has operated extensively around the Pacific Northwest on BNSF Railway and regional railroads. She returned to home rails in 2001 with a trip to Spokane, Wash., and made her longest journey from home in 2002 with an excursion over Montana Rail Link. In 2005, the only surviving NP-design 4-8-4 doubleheaded with 4449 on a National Railway Historical Society trip to Wishram, Wash. Now, along with 4449, No. 700 is headed for a new building in Portland at the Oregon Railroad Heritage Center. Seeing the 700 in a good home is a goal of her caretakers, the Pacific Railroad Preservation Association. The days when she rolls down former SP&S tracks along the Columbia River are akin to heaven for lovers of mainline steam.


700
700
700

COTTON BELT 819

Cotton Belt 819's story is about hometown pride. Built in Cotton Belt's Pine Bluff, Ark., shops as the road's last new steam engine, she was put on display in a park there in 1955, but by the late 1970s was rusty, covered in graffiti, and stripped of parts. A local move in 1983 brought her back to the Cotton Belt shops, and a completely overhauled locomotive debuted in 1986. The Cotton Belt Rail Historical Society oversaw the restoration, and later that year she traveled to Little Rock to mark the Arkansas sesquicentennial. One of the 819's biggest outings was to St. Louis in 1990 for the National Railway Historical Society convention, where she appeared with three other big steam locomotives. But after that, the climate for excursions changed, and that hurt the 819. In 1995, the group asked for a trip over Southern Pacific, into which Cotton Belt had merged in 1992. SP said no, and the group settled for an open house and whistle blow. SP's 1996 merger into Union Pacific, which restricts steam operations to its own engines, did not help. And since then, new federal boiler laws have driven up the cost of restoration. Today, 819 is safe inside the Arkansas Railroad Museum in the Pine Bluff Shops where she was born.

Near Malden, Mo., June 1990. HAROLD A. EDMONSON

Winona, Texas, November 6, 1988. HAROLD A. EDMONSON

UNION PACIFIC 844

Westbound east of Dale Junction, Wyo., September 1, 1963. TOM GILDERSLEEVE

Of all the excursion 4-8-4's, only one holds the claim "never retired." UP's last-built steam locomotive slipped seamlessly from regular service to excursion duties, without ever leaving the UP roster. Since November 1960, she has been UP's public relations flagship, running off more than 300,000 miles between Chicago, the Pacific Northwest, and southern California from her home in Cheyenne, Wyo. From 1962 to 1989, a GP30 on the roster bumped the FEF-3's number to 8444, but she was still the same big, powerful 4-8-4, looking most at home with a matching yellow consist on Sherman Hill. During 1987–91, she roamed in UP's famous "greyhound" passenger livery. As UP grew with mergers, 844's territory grew, and she has made appearances on former Missouri Pacific, Chicago & North Western, Western Pacific, and Southern Pacific lines across the West and Midwest. Of all those post-merger outings, though, her June 1997 trek from Denver to Salt Lake City on the soon-to-be-closed ex-Rio Grande line via the Royal Gorge and Tennessee Pass ranks as one of the great excursions of all time. A boiler-tube failure while on display at California State Railroad Museum's Railfair '99 resulted in a major rebuild starting in 2001 and ending in 2004 that gave the big engine an all-new firebox, boiler braces, tubesheets, and another new life—good enough to reach her centennial in 2044 under steam!

En route to Sacramento, Calif., with 4-6-6-4 3985, Echo Canyon, Utah, April 24, 1981. J. DAVID INGLES

Eastbound on freight, Pine Bluffs, Wyo., July 28, 1989. PAUL F. DELUCA

READING
2100 2101 2102 2124

2124 and 2100 on Iron Horse Ramble photo runby at Port Clinton, Pa., September 23, 1961. BOB KRONE

This is a tale of four sisters whose lives took drastically different turns. One had a career that quickly soared and then ended for good; another strayed far; a third remained active in her home region; and a fourth gained national fame and then literally got burned. Between October 1959 and October '64, the Reading Co. operated 50 "Iron Horse Ramble" steam excursions; T-1's 2100, 2102, and 2124 powered these, with 2124 going to the Steamtown collection at the end of 1963, never to run again; she's now on display at the National Park Service site in Scranton, Pa. No. 2100 went to a scrapper in 1965 but was never cut up; in 1987 she was purchased for restoration in Hagerstown, Md., changed hands many times, and ended up owned by Canadian shortline entrepreneur Tom Payne, who moved her to St. Thomas, Ont., and converted her to oil-firing before another group took her to Tacoma, Wash., for a tourist railroad that lasted barely a year; No. 2100 remains stored in Washington. No. 2102 pulled excursions for private owners between the late 1960s and late 1970s, with one amazing stint dressed as Delaware & Hudson 4-8-4 No. 302 for that railroad's sesquicentennial in 1973. Andy Mueller, owner of regional railroad Reading & Northern, bought her in 1985 and ran her on fantrips both on and beyond the R&N until 1993; she's stored at R&N headquarters in Port Clinton, Pa., on home rails. No. 2101 went from scrapyard queen to national celebrity in 1975 when she became American Freedom Train No. 1, leading the U.S. bicentennial exhibition in the East and Midwest where clearances restricted use of AFT's primary engine, SP 4449. Afterward, 2101 pulled *Chessie Steam Special* trips for Baltimore & Ohio's 150th birthday in 1977–78, but a March 1979 roundhouse fire in Silver Grove, Ky., damaged her, ending her wanderings; she was cosmetically restored as AFT No. 1 and moved to the B&O Railroad Museum in 1980.

2101 as AFT No. 1 on American Freedom Train north of Kankakee, Ill., July 27, 1975. J. DAVID INGLES

2101 on Chessie Steam Special. HERBERT HEISS

2102 en route to Philadelphia at Birdsboro, Pa., December 3, 1988. SCOTT A. HARTLEY

2102 as D&H 302 at Starrucca, Pa, May 1973. TOM NEMETH

SANTA FE 3751

Westbound at Frost, Calif., December 30, 1991. TOM GILDERSLEEVE

Santa Fe's (and Baldwin's) first 4-8-4 was on display near the ATSF depot in San Bernardino, Calif., from 1958 until 1985, when the San Bernardino Railroad Historical Society began restoration work that would lead to mainline operations. The inaugural excursion took place in December 1991, when the iconic engine, two FP45's, and 15 passenger cars covered famed Cajon Pass and Tehachapi Loop on a multi-day trip from Los Angeles to Bakersfield and back. The following year, under Santa Fe sponsorship, the 3751 ran an employee appreciation special over the entire length of the main line from Los Angeles to Chicago, an 18-day outing. After the BNSF Railway merger, the locomotive returned to the

Westbound from San Bernardino, Calif., along Interstate 10, April 17, 2011. STEVE CRISE

Photo special on Grand Canyon Railway, August 2002. STEVE CRISE

former Santa Fe main line in 2002 with a trip to Arizona, where she also operated on Grand Canyon Railway tracks to South Rim as part of the National Railway Historical Society's annual convention. In recent years, the 3751 has pulled excursions from Los Angeles to San Diego, the destination of her last run in 1954. She has also steamed to various display venues around L.A. as the focus of educational outreach programs that involve area schoolchildren in history and technology. Planning is under way for the engine to return to Arizona in 2012. When not on the road, No. 3751 is stored at Amtrak's shop in Los Angeles, not publicly accessible but visible from Amtrak and Metrolink trains passing on the Redondo Junction flyover.

SOUTHERN PACIFIC 4449

En route to New Orleans, at Worden, Ore., May 6, 1984. ALAN M. MILLER

After Southern Pacific donated her to the city of Portland, Ore., in 1958, the 4449 became a park engine. She retained the Spartan appearance she'd had when retired: black, with running-board skirts removed. But one man, Jack M. Holst, had faith that the engine that had powered the *Daylight*, "the most beautiful train in the world," might someday run again. He kept the locomotive oiled for the day, years in the future, when she would return to steam. The opportunity came in 1975, when entrepreneur Ross Rowland selected the 4449 as the primary power for the *American Freedom Train*. Restoration was swift, and included re-application of all streamlined trim, plus a red, white, and blue livery to match the train. The engine's two-year stint at the point of the AFT saw her run from Chicago to the West Coast and back east again as far as Miami, Fla. Of course, the desire to ride behind the 4449 was strong, and with Southern Railway's excursion program going full blast, SR borrowed the engine for a

At Train Festival, Owosso, Mich., July 24, 2009. ROBERT S. MCGONIGAL

En route to Alexandria, Va., at Seneca, S.C., August 28, 1976. JOHN DZIOBKO

memorable two-day Atlanta–Alexandria, Va., trip during which 4449 often rolled the 23-car train at 80 mph. The engine returned to Portland from Florida on an Amtrak-sponsored transcontinental excursion. It wasn't long, though, before 4449's keepers, led by Doyle McCormack, repainted her in *Daylight* garb and had her back on the main line. Notable in her excursion career are multi-week sojourns to a world's fair in New Orleans in 1984 and to Train Festival in Michigan in 2009. She's trekked south to Sacramento for festivals at the California State Railroad Museum in 1981, '91, and '99. Today, the most colorful of all active 4-8-4's is most often found on the point of excursions on BNSF main lines and Portland & Western regional rail lines in and around Portland, solo or in the company of stablemate SP&S 700. Both 4-8-4's are set to move from their longtime home at the former SP Brooklyn roundhouse to a new Oregon Railroad Heritage Center, ironically near Oaks Park, where they were originally displayed.

BURLINGTON ROUTE 5632

Passenger-oriented Burlington Route did a brisk business running steam excursions both before and after dropping its last regular-service fires in January 1959. Some 21 different engines of various types handled the fantrips, but after late 1958 there were just two: O-1A 2-8-2 4960 and O-5B 4-8-4 5632. While excursions with 4960 were concentrated in Illinois, 5632 wandered as far as Colorado. Notable trips included turns on CB&Q's Eola–Mt. Morris, Ill., mixed train (with coaches added for the fans), plus two 1964 excursions for which she was painted completely in gold: one in May to mark the centennial of the Q's Chicago suburban service, and again in October for the 50th anniversary of Kansas City Union Station. A November 1, 1964, trip from K.C. to Bevier, Mo., turned out to be her last, and a 1965 overhaul was canceled as Lou Menk took over from steam-friendly Harry Murphy as the road's CEO. Afterward, steam preservationist Dick Jensen bought the 5632 and moved her to the Chicago & Western Indiana roundhouse in Chicago. Alas, his plan to reactivate the O-5B never materialized. C&WI evicted Jensen in 1969, giving him 48 hours to vacate; the 5632 stayed put, and the railroad sent her to a scrapper. The 5632's sad ending ranks as one of the greatest losses of big steam in the preservation era.

Westbound between Big Rock and Hinckley, Ill., on the Eola–Mount Morris mixed, summer 1962. MELVERN FINZER

Painted gold for suburban-service anniversary, Aurora, Ill., May 24, 1964. MARTY BERNARD


CANADIAN NATIONAL
6167 6218
6167
6167
YARD LIMIT

Left: 6167 near Port Hope, Ont., May 13, 1962. Above: 6218 at Stratford shops, Ont., November 26, 1963. BOTH: JAMES A. BROWN

Canadian National had been dieselized for just three months when the Upper Canada Railway Society and CN management decided that excursions with a still-serviceable 4-8-4 would do no harm. Thus, on July 10, 1960, No. 6167 pulled a fantrip to Niagara Falls and back, the first of some 50 excursions the engine would handle, adding about 12,000 miles onto a million-mile career, and carrying about 40,000 riders. While 6167's excursion career was short, it was just the beginning of a series of engines that would continue to polish CN rails. The road even made the transitions smooth: On the weekend of September 26–27, 1964, No. 6167 and sister 6218 (recently overhauled at Stratford, Ont., as the final job for the "Big Shop") doubleheaded on trips, marking the end of excursions for one engine and the beginning of them for the other. Needing new boiler tubes, 6167 was removed from service after the September 27 trip, stored in Toronto, and finally donated in October 1967 to Guelph, Ont., where she remains on display. No. 6218 operated on Central Vermont and Grand Trunk Western in the United States as well as on CN proper until 1971, when she needed an overhaul estimated to cost $200,000. Instead of doing the work, CN pulled 4-8-2 No. 6060 off display in Jasper, Alta., and launched the excursion career of yet another locomotive. No. 6218 was moved to Fort Erie, Ont., where she is on display.

GRAND TRUNK WESTERN
6322 6323 6325

6322 departing Chicago for South Bend, April 30, 1961. TOM GILDERSLEEVE

6323, Flushing, Mich., September 17, 1961. TOM GILDERSLEEVE

6325 on Ohio Central photo special at Dennison, Ohio, January 24, 2004. HAROLD A. EDMONSON

CN subsidiary Grand Trunk Western gave steam a grand official send-off on March 27, 1960, when two U-3-b's handled the first and second sections of Detroit–Durand locals 21 and 56. GTW kept one of the 4-8-4's, No. 6322, serviceable, using her on excursions until April 1961. Sister 6323 got into the act too, working at least six fantrips between August 1960 and Labor Day '61. She also occasionally handled scheduled trains, and her September 20, 1961, turn on 21 and 56 was the last run of a GTW 4-8-4 for 40 years. Another U-3-b, 6325, was a deteriorating display in Battle Creek, Mich., until shortline entrepreneur Jerry Joe Jacobsen bought her for his personal fleet of steam locomotives. In 1993 he moved No. 6325 to the Ohio Central shop at Morgan Run, Ohio. Work began in 1998, and in September 2001, the engine moved again under her own power. She looked right at home pulling a string of matching coaches on Ohio Central's former Pennsylvania Railroad Panhandle main line. But this was to be a short-lived revival. After a couple of years pulling photo charters and excursions, the Northern developed running-gear problems. Following a festival in July 2004, Ohio Central curtailed its steam excursions because of liability concerns, and 6325 has not run since. Jacobsen sold Ohio Central to shortline holding company Genesee & Wyoming in 2008 and then launched plans to build the Age of Steam museum in Sugar Creek, Ohio, where 6325 will be displayed in a new, 18-stall roundhouse.

To advertise in the Marketplace call Mike Yuhas:
1-888-558-1544, ext. 625

Where the 4-8-4's are

57 survive, from 17 railroads. Here's where they're located, as of October 2011

Original owning railroad (quantity surviving)	Road No.	Location
Atchison, Topeka & Santa Fe (9)	3751	San Bernardino Railroad Historical Society, Los Angeles, Calif.
	3759	Locomotive Park, Kingman, Ariz.
	3768	Great Plains Transportation Museum, Wichita, Kans.
	2903	Illinois Railway Museum, Union, Ill.
	2912	Pueblo Union Station, Pueblo, Colo.
	2913	Riverview Park, Fort Madison, Iowa
	2921	Beard Brook Park, Modesto, Calif.
	2925	California State Railroad Museum, Sacramento, Calif.
	2926	New Mexico Steam Locomotive & Railroad Historical Society, Albuquerque, N.Mex
Canadian National (6)	6153	Canadian Railway Museum, Delson, Que.
	6167	Adjacent to VIA Rail station, Guelph, Ont.
	6200	Canada Science & Technology Museum, Ottawa, Ont.
	6213	Roundhouse Park, Toronto, Ont.
	6218	Fort Erie Railroad Museum, Fort Erie, Ont.
	6400	Canada Science & Technology Museum, Ottawa, Ont.
Canadian Pacific (2)	3100	Canada Science & Technology Museum, Ottawa, Ont.
	3101	Display at IPSCO Steel, Regina, Sask.
Chesapeake & Ohio (1)	614	Chesapeake & Ohio Historical Society, Clifton Forge, Va.
Chicago, Burlington & Quincy (4)	5614	Patee Park, St. Joseph, Mo.
	5629	Colorado Railroad Museum, Golden, Colo.
	5631	Rotary Park, Sheridan, Wyo.
	5633	Douglas Railroad Interpretive Center, Douglas, Wyo.
Chicago, Milwaukee St. Paul & Pacific (2)	261	Friends of the 261, Minneapolis, Minn.
	265	Illinois Railway Museum, Union, Ill.
Grand Trunk Western (2)	6323	Illinois Railway Museum, Union, Ill.
	6325	Age of Steam Roundhouse, Sugarcreek, Ohio
Great Northern (1)	2584	Amtrak/BNSF Railway depot, Havre, Mont.
Nacionales de Mexico (12)	3027	Guadalajara, Jalisco
	3028	Stored at New Hope & Ivyland Railroad, New Hope, Pa.
	3030	Zacatecas, Zacatecas
	3031	Huehuetoca, Mexico
	3033	Pachuca, Hidalgo
	3034	Puebla, Puebla
	3035	Aguascalientes, Aguascalientes
	3036	Leon, Guanajuato
	3038	Mexico, Mexico, D.F.
	3039	Monterrey, Nuevo Leon
	3040	Oriental, Puebla
	3056	Tequisquiapan, Queretaro
Nashville, Chattanooga & St. Louis (1)	576	Centennial Park, Nashville, Tenn.
Norfolk & Western (1)	611	Virginia Museum of Transportation, Roanoke, Va.
Reading (4)	2100	Stored, Richland, Wash.
	2101	B&O Railroad Museum, Baltimore, Md.
	2102	Reading & Northern Railroad, Port Clinton, Pa.
	2124	Steamtown National Historic Site, Scranton, Pa.
St. Louis Southwestern (1)	819	Arkansas Railroad Museum, Pine Bluff, Ark.
St. Louis-San Francisco (4)	4500	Route 66 Village, Tulsa, Okla.
	4501	Museum of the American Railroad, Dallas, Texas
	4516	Missouri State Fairgrounds, Sedalia, Mo.
	4524	Grant Beach Park, Springfield, Mo.
Southern Pacific (2)	4449	Union Pacific roundhouse, Portland, Ore.
	4460	Museum of Transportation, St. Louis, Mo.
Spokane, Portland & Seattle (1)	700	Union Pacific roundhouse, Portland, Ore.
Union Pacific (4)	814	Rock Island Depot Museum, Council Bluffs, Iowa
	833	Utah State Railroad Museum, Ogden, Utah
	838	Union Pacific Railroad, Cheyenne, Nebr.
	844	Union Pacific Railroad, Cheyenne, Nebr.

Frisco 4500, restored to its original passenger paint scheme in 2010, was moved to Route 66 Village in Tulsa, Okla., in June 2011, where it forms a striking display beside the historic highway.

MIKE CONDREN PHOTO

4-8-4s Under Full Steam

15% off 4-8-4 DVDs!

Go to "4-8-4 Steam" on our website • Use Code 484SALE • Thru Feb. 6, 2012

SundayRiverProductions.com 866-544-7771