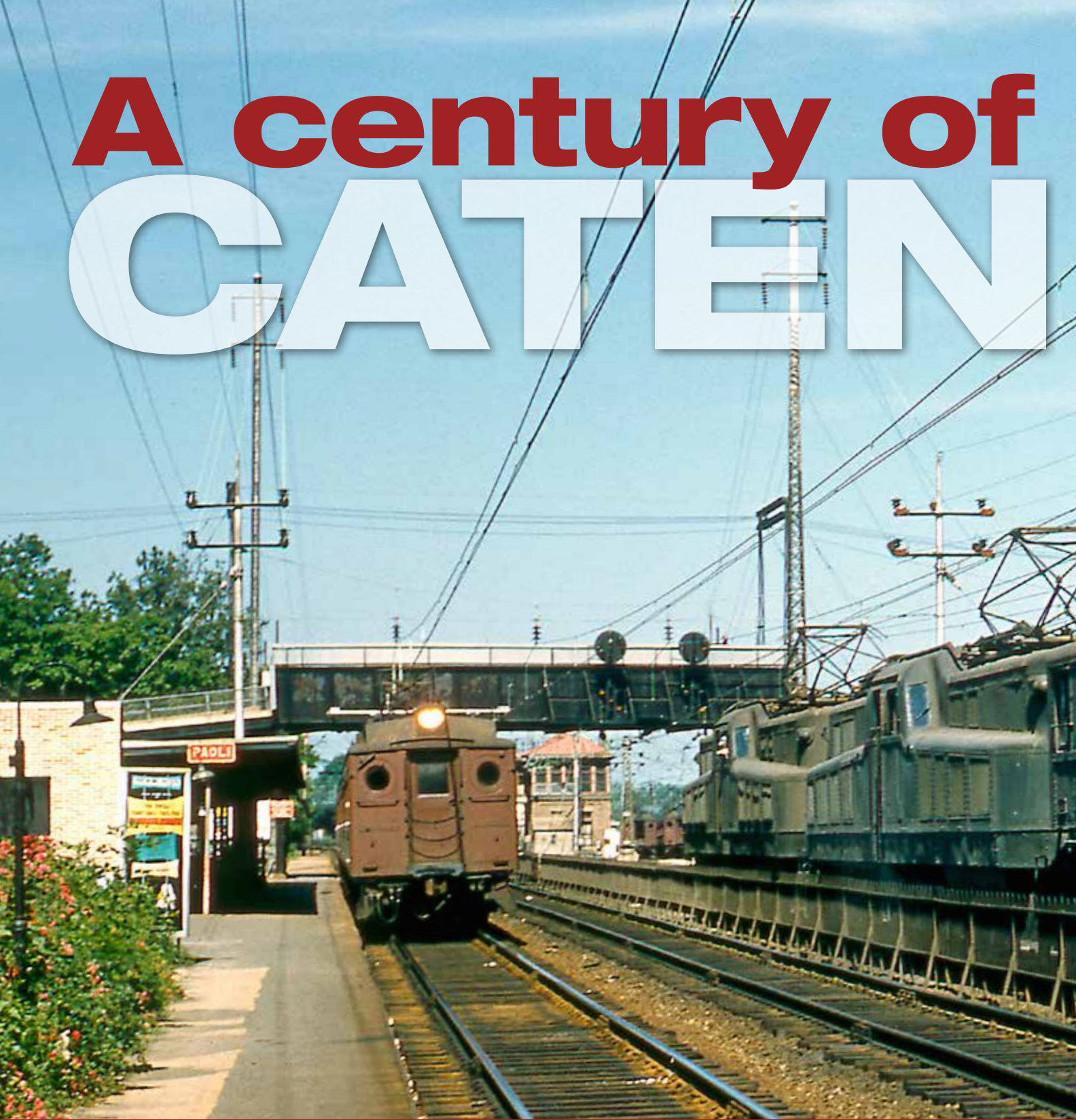
A century of CATEN



The Main Line west of Philadelphia — the first segment of the Pennsylvania Railroad's empire under wire — has been a grand stage for electric traction since 1915

By Frank Tatnall • Photos by the author

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PRR's Main Line was a rich blend of electrically powered commuter, intercity passenger, and heavy freight traffic. At Paoli (main photo), an MP54 MU train waits to depart for Philadelphia as three P5a motors grind upgrade with an ore train in June 1960. Shiny new MP54s (above left) pose at Narberth in 1915; a century later in May 2015 (above right), SEPTA Silverliner V cars continue the catenary tradition at Berwyn.

Left, PRR; right, Robert S. McGonigal

One hundred years ago, North America's greatest electrified railroad network was born. In 1915 the Pennsylvania Railroad erected catenary over the 20 miles between Philadelphia and Paoli, Pa., to improve commuter operations. By 1938, that first installation had grown to encompass 656 miles of PRR lines, powering all classes of traffic.

The Pennsylvania was not the first U.S. road to electrify a significant length of main line (the New Haven was the pioneer, in 1907), and PRR's electric lines were not quite the most far-flung (Milwaukee Road, with 663 route-miles, held that title). But PRR's system was by far the most extensive, encompassing at its peak nearly 3,000 miles of track, worked by more than 280 passenger, freight, and switching locomotives and hundreds of multiple-unit commuter cars. Much of this electric empire has been dismantled, but those first 20 miles survive as a key element in the most important group of rail passenger routes on the continent.

Paoli is a bustling town that anchors the west end of the upscale suburban area known to Philadelphians as the "Main Line." The town traces its history to an inn opened in 1769 as a way station on the original Lancaster Turnpike, and in turn the inn derived its name from an otherwise obscure 18th century Corsican patriot named Pasquale di Paoli.

American growth was westward, and when neighboring New York State completed the Erie Canal in 1825, Pennsylvania, to be competitive for traffic to and from "the West," decided to create its own cross-state transportation corridor. Officially known as the Main Line of Public Works, this 395-mile system from Philadelphia to Pittsburgh included two long sections of canal and, spanning the geographic obstacles between river valleys, two segments of railroad. At the east end, the 82-mile Philadelphia & Columbia Railroad was the surveyors' answer to the dilemma of crossing territory inhospitable to canals.

Paoli sits atop a long grade that until 1850 included the Belmont inclined plane, which hoisted railroad cars out of the Schuylkill River valley in Philadelphia. Through rail service on the P&C began April 1, 1834, hauled either by horses or locomotives, though some isolated operations had started in 1832. The P&C was a toll road open to all comers who had their own equipment, but in 1844 the authorities banned all horse-drawn traffic and, by default, steam became the sole motive power.

Before long, the P&C portion of the Main Line of Public Works had become the commercial spine of a rural area just west of Philadelphia. Merchants and villagers eventually adopted the name "Main Line" to identify and unify the series of small towns and settlements out to Paoli. Over the years, sections of farmland were developed into desirable residential properties for people working in Philadelphia — especially those with the means to commute. While some passenger accommodations had been provided almost since the railroad's incep-

An October 4, 1963, view toward center city Philadelphia from the suburban platforms of 30th Street Station captures three trains, all equipped with brand-new Budd Silverliners.

At Overbrook, a porthole window at the rear of an inbound MP54 train on Track 1 frames Penn Central Silverliners on Track 2 in 1970. By crossing under the City Avenue bridge, the trains have just entered Philadelphia. The circa 1860 depot has long been the Main Line's oldest.

With Overbrook tower presiding at the left, grimy PC E44s 4418 and 4412 drift through the station with an eastbound piggyback train on April 8, 1975. The 66-unit E44 fleet, built by GE during 1960–63, was the backbone of PRR, PC, and Conrail electric freight operations.

tion, this growing population began clamoring for efficient rail service to and from the big city.

Organized in 1846 to build west from Harrisburg, the state capital, the Pennsylvania Railroad purchased the entire Public Works transportation system in 1857, including the Philadelphia & Columbia. Passenger-carrying was just becoming a major factor for the expanding PRR system, but not so much in what today is termed short-haul services. Even after the Civil War, most rail travelers around Philadelphia still rode on longer-distance trains. In fact, the average customer rode for about 46 miles, so it took a while for the concept of "local" passenger operations to catch on.

Commuter rail service in the late 19th century virtually began on Philadelphia's Main Line, but it's unclear when the term "Paoli Local" came into common use. By the end of the century, PRR was running frequent Philadelphia–Paoli local service, with some trains operating all the way to Downingtown or West Chester. Not only did the trains carry a respectable volume of business people into the city and home again, but many city residents used the railroad in summer to escape the heat of that pre-air-conditioning era. The PRR even built a hotel in Bryn Mawr, 10 miles "up the hill" from Philadelphia, which catered to people looking for a nearby resort atmosphere. The railroad also was behind much of the Main Line's residential development, and many of its executives owned substantial estates along the line, such as A. J. Cassatt's Cheswold in Haverford.

From third rail to catenary

Baltimore & Ohio became the first U.S. steam railroad to apply electric traction to its core operations in 1895, when steeple-cab motors began hauling steam locomotives and their trains through the new Howard Street Tunnel in Baltimore. A decade later, the Pennsylvania began installing low-voltage, direct-current third-rail systems on subsidiaries Long

An eastbound MP54 train departs Narberth in 1957. Note the 60-cent price of a round-trip to Philadelphia, the heavily superelevated curve, and the old station on the outbound side, since demolished.

Just west of Ardmore station, pinstriped GG1 4854 hurries a westbound passenger train past the site of the Autocar truck plant, which was torn down not long before this September 1958 photo.

Island Rail Road, West Jersey & Seashore, and Hudson & Manhattan; all were worked with multiple-unit suburban or transit-style cars. PRR also used third-rail D.C. in 1910 for Pennsylvania Station in New York City and its associated yards, tunnels, and 5½ miles of main line to Manhattan Transfer, N.J., just east of Newark, where electric locomotives turned over their trains to steam.

The next step for PRR was to electrify its commuter lines out of Philadelphia. After studies by the consulting firm Gibbs & Hill, with particular attention to the New Haven's pioneering 11,000-volt, alternating-current overhead catenary system in New York and Connecticut, it was determined that A.C. would be more efficient than D.C. for high-density operations over longer distances. PRR management decided the line to Paoli was the leading electrification candidate, since it carried a heavy passenger-train volume and was one of the major

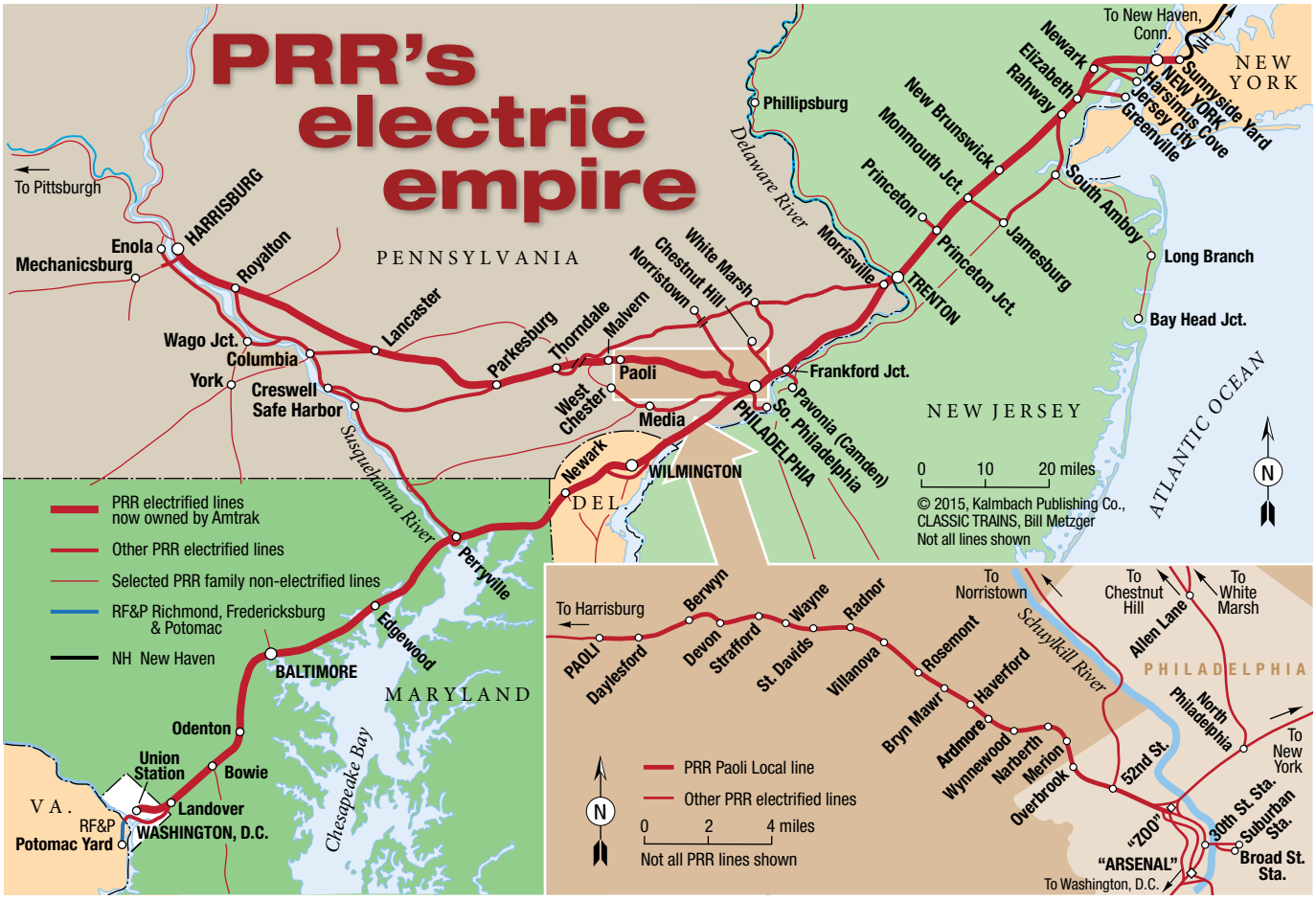
Motors 4843 and 4826, two of PRR's 139 versatile GG1s, head Transamerica piggyback trailers east at Merion in August 1961. Track 3, the westbound freight track, is white with sand dust from trains climbing the hill.

Observation car *Tower View* brings up the rear of PRR's eastbound *Broadway Limited* at Haverford on the morning of April 25, 1959. The stone building on the westbound side dates from just after an 1871 line relocation and once contained living quarters for the station agent.

causes of the severe congestion at Broad Street Station, Pennsy's major Philadelphia terminal. The station's huge trainshed covered 16 tracks, but the terminal was stub-end, which made the switching of steam-powered trains time-consuming. On March 12, 1913, PRR's board authorized electrification from Broad Street to Paoli.

The 17 Main Line communities, from Overbrook to Paoli, sat astride a busy railroad, as commuter trains shared the four tracks with 50 daily long-haul passenger trains plus numerous local and through freights, all steam-powered, of course. Westbound movements had to contend with a nearly continuous grade from West Philadelphia to Paoli, making for a lot of smoke and noise for neighbors along the line. In the 14.4 miles from Overbrook to Paoli, trains climbed more than 300 feet in elevation, with a maximum grade of nearly 1 percent between Overbrook and Narberth.

Electrification promised improved — and cleaner — local service, plus a substantial reduction in operating costs. An added benefit was shorter running times, since electric trains could accelerate faster from stations than could steam locomotives. Ultimately, the congestion at Broad Street was alleviated not only by the expanded electric operations but by the 1930 opening of the below-ground Suburban Station adjacent to the old terminal. Suburban Station, designed exclusively for electric commuter trains, was part of a PRR improvement program that also included the construction of



CATENARY CHRONOLOGY

1915 Philadelphia–Paoli, Pa.
1918 Philadelphia–Chestnut Hill, Pa.
1924 Allen Lane–White Marsh, Pa.
1928 Philadelphia–West Chester, Pa.
Philadelphia–Wilmington, Del.
1930 Philadelphia–Trenton, N.J.
Philadelphia–Norristown, Pa.
1931 New York–Manhattan Transfer, N.J.
1932 Jersey City–New Brunswick, N.J.
1933 New Brunswick–Trenton
1935 Wilmington–Washington, D.C., and Alexandria, Va.
Greenville, South Amboy, and Harsimus Cove branches
1938 Paoli–Harrisburg, Pa.
Morrisville–Enola, Pa.
Creswell, Pa.–Perryville, Md.
Lancaster–Columbia, Pa.
Shocks Mills–Royalton, Pa.
South Amboy–Monmouth Jct., N.J.
Frankford Jct., Pa.–Pavonia, N.J.
Delaware Extension (Phila.)

30th Street Station in 1930–33, culminating in the closure of Broad Street in 1952.

The two-year, $4 million Paoli electrification project, carried out mostly by PRR forces, covered the entire 20 miles of (mostly) four-track line west from Broad Street. Tubular steel poles erected 300 feet apart supported the catenary structure, which consisted of cross-mounted wires securing the messenger, auxiliary, and contact wires hung above each track. The road installed substations at West Philadelphia, Bryn Mawr, and Paoli, and built a large car-storage yard and maintenance shop at Paoli. All remaining grade crossings were closed. Position-light signals on steel bridges over the tracks replaced semaphores on lineside masts. (A modified position-light design became standard across the PRR.) The railroad contracted with Philadelphia Electric Co. to purchase 25-cycle, single-phase A.C. power, to be stepped down to 11,000 volts at the substations from the 44,000-volt transmission lines mounted on the same poles.

The next task was to provide rolling stock to carry the commuters, a decision having been made to employ self-propelled multiple-unit (MU) cars rather than locomotive-hauled trains. Bidirectional MUs would allow quick turnarounds at terminal points, as opposed to locomotives that had to be turned and shifted from one end of the trains to the other. Since 1911, PRR's Altoona shops, as well as suppliers including Pressed Steel Car and American Car & Foundry, had been building a fleet of 54-foot (not including vestibules) steel coaches. These cars were designed to be converted to electric operation simply by adding a power truck with two traction motors, engineer's control stands, headlights and other accessories, and a pantograph to collect power from the overhead wires.

In preparation for the start of electrified service, Altoona in early 1915 began converting 82 coaches into class MP54, the new designation for an electrically operated coach. The catenary to Paoli was energized on September 4, 1915, and numerous test runs made over the next few days.

With hundreds of spectators watching, revenue service on the electrified Paoli Local began at 5:55 a.m. on Saturday, September 11, 1915, when a three-car

Inbound former Reading "Blueliners" (three in SEPTA colors) pass Bryn Mawr tower in August 1986. The 1931-vintage "Blues," which outlasted the PRR MP54s, will run through the center city tunnel, terminating at North Broad Street on the ex-Reading side of SEPTA's rail system.

In the PRR era, MUs worked the locals, and electrics led nearly all through passenger trains, but steam and, later, diesels handled some freights. Westbound Alco FAs pass MP54s at Rosemont in June 1960.

Two 2,400 h.p. Baldwin transfer units, PRR class BS24, lean against the cabin car of an import ore train out of South Philadelphia at Radnor in mid-1960. They'll push as far as Paoli, then run light east.

MP54 train departed Paoli. The electrics made just one round trip that day, but within a month all 66 weekday Paoli trains were being operated with MUs. The change was enthusiastically welcomed both by riders and lineside residents.

Expanding the empire

The Pennsylvania's management considered the Paoli project — and the soon-to-follow wiring of the shorter Chestnut Hill Branch commuter line — to be more than simply an effort to relieve the congestion at Broad Street. It also would serve as a test of A.C. technology in moving trains more efficiently under actual operating conditions. PRR at the time was considering electrifying its main line over the Allegheny Mountains between Altoona and Johnstown, Pa. Although the Pennsy and its successors would flirt with the idea for decades, catenary never did go up over the mountains, but the template the PRR established on the Main Line in 1915 produced spectacular results on its eastern lines.

Over the next 23 years, PRR extended 11,000-volt electrification to all its important routes east of Harrisburg. The initial extensions were for suburban traffic centered on Philadelphia and New York. Then in 1928, the company announced plans to electrify the main line between New York and Wilmington, Del., for all types of traffic. Soon this ambitious plan was extended to Washington, D.C., and the big freight yard in Alexandria, Va., and ultimately to lines to Harrisburg and Enola, Pa. Much of this work was accomplished during the Great Depression, when the price of labor and materials was at rock bottom. But it still required great faith by the railroad's leaders, notably President W. W. Atterbury, to invest in major infrastructure improvements during a period of economic uncertainly and declining traffic. By 1945 the PRR's electrified trackage, including yards, totaled an astounding 2,789 miles.

Without electrification, PRR would have found it impossible to handle the passenger and freight traffic that flooded onto its lines during World War II. Certainly Amtrak's present Northeast Cor-

Afternoon sun highlights the gold leaf on the station sign at St. Davids as Paoli-bound MP54s pull in during the rush hour on August 31, 1961.

Conrail SD40-2s 6448/6437 and SD40 6241 have no use for the curving catenary west of Radnor as they climb west with MAIL-9 on November 15, 1979. Time is short for CR's electrics, and for freight on the Main Line.

F40PH diesels lead Amtrak 441, the Washington section of the *Broadway Limited*, at Strafford on April 20, 1980. For a time, 441 followed the New York section west to Harrisburg, where the trains were combined; beginning April 27 they were joined at 30th Street, Philadelphia. The ornate station was built in 1876 for use at Wayne, then moved west to Strafford in 1887.

On January 8, 1977, a Budd Silverliner II and a St. Louis Silverliner III skim through Devon on an Amtrak Harrisburg–Philadelphia schedule. Unlike today's Keystone Service, trains from the state capital in this era used leased commuter MUs and ran into Philly's Suburban Station.

ridor service could not exist without electrification.

Although the Pennsylvania wired hundreds of miles of main and branch lines along the New York–Washington axis during the 1920s and early '30s, Paoli remained the west end of catenary until 1938. For a few years beginning in 1933, electric locomotives hauled long-distance passenger trains to Paoli, where the motors were cut off and replaced by steam. This ended soon after January 15, 1938, when GG1 No. 4859 headed the first electrically powered passenger train through to Harrisburg.

Because of Paoli's location atop a ridge, both westbound and eastbound heavy freights often required pusher locomotives. The westbound helpers were based at the 46th Street engine terminal in Philadelphia, while eastbound trains got their helpers at Thorndale, 15 miles west of Paoli. This practice continued after electrics began hauling freights.

Eventually PRR's fleet of "red cars," as the Tuscan-red MP54s came to be known, encompassed more than 475 units in coach, coach-baggage, baggage-mail, and full baggage configurations. PRR used the MP54s not only on its six Philadelphia commuter lines — all of which were electrified by 1930 — but on routes in the New York area (including PRR's Long Island Rail Road, which had its own, larger, fleet of third-rail MP54s), Washington–Baltimore, and on some longer-distance secondary trains including Philadelphia–New York and Philadelphia–Harrisburg. Oddly, only 80 of Pennsy's MP54s were built new as MUs, in 1926–27.

Silverliners and SEPTA

After carrying the stress loads of World War II, the Pennsylvania became concerned about the cost of maintaining its weary MP54 fleet. In 1950–51, Altoona converted another batch of 50 coaches to electric MUs, in the 400 series. In contrast to earlier MP54s, the cars featured modernized interiors, recessed lighting, aluminum window sashes (but no air conditioning), roller bearings on all axles, and four traction motors.

A few years later, PRR officials contacted the Philadelphia-based Budd Company about supplying a new generation of MU cars. Budd had built a prototype stainless-steel lightweight coach for long-distance service, dubbed the "Pioneer III," but it had attracted no buyers. In June 1958 Budd delivered six state-of-the-art, air-conditioned cars based on the Pioneer III; PRR classified them MP85. The cash-strapped road did not repeat the order, but five of those six served until their retirement in 1990, well into the era of the current operator, Southeastern Pennsylvania Transportation Authority, which in 1983 took over

from the 7-year-old Conrail direct operation of the former PRR and Reading Company commuter services. (Today SEPTA operates 13 electrified commuter rail routes out of Philadelphia: 6 former Pennsy, 6 former Reading, and a new line opened in 1985 to the airport.)

Five years after the Pioneers came, and with considerable financial and technical assistance from the publicly funded Passenger Service Improvement Corp., PRR took delivery from Budd of 38 new stainless-steel MUs. Similar to the Pioneers, the 1963 cars (plus 17 others acquired for use on the Reading) were dubbed "Silverliners." Then in 1967, PRR received 20 similar cars from St. Louis Car Co. The Budds later were officially designated as "Silverliner II" cars while the St. Louis cars became "Silverliner III." SEPTA retroactively labeled the five remaining Pioneers as "Silverliner I."

SEPTA later acquired two more editions of Silverliners. First came 232 GE Silverliner IVs, delivered in 1974–75 to PRR successor Penn Central and to the Reading. Starting in 2010, SEPTA began receiving 120 Silverliner V cars from Hyundai-Rotem's new plant in South Philadelphia. The last MP54s were retired in 1981, and the final runs of the Silverliner IIs and IIIs occurred in June 2012. In a tribute to their durability, some of the MP54s had seen nearly 70 years of service as steam and then electric coaches, and many of the Silverliner IIs put in almost 50 years on the road.

PRR/PC multiple-unit cars have dominated the Paoli Local, but a variety of other equipment has been used as well. This included a few GG1-hauled trains of non-powered coaches and, under SEPTA, several 1931-vintage ex-Reading "Blueliners" as well as, beginning in 1987, push-pull trains of Bombardier coaches powered by AEM7 electric locomotives. This cross-use of equipment was made much easier in 1984 when SEPTA opened a new tunnel in center city Philadelphia. The tunnel enabled trains to run from former Reading points to former PRR points and vice versa, and routes from one side were combined with those from the other to form through services. SEPTA combined the Paoli Local with the former Reading Lansdale/Doylestown line under the label "R5," though the agency has since dropped the R-series nomenclature.

Lasting electric legacy

Although the rolling stock has changed over the past century, local passenger service on the Main Line is much the same in character as in 1915. Other changes have been more profound. The 1968 Penn Central merger saw PRR red give way to New York Central-inspired green on MP54s and station signs. PC's collapse led to Conrail in 1976, and some of the ex-PRR electric locomotives got blue paint. In the Conrail creation, Amtrak took title to the former PRR New York–Washington and Philadelphia–Harrisburg main lines. This resulted in Conrail's rerouting of freight traffic off the Main Line and onto a parallel ex-Reading routing and abandoning all electric freight operations in 1981. PRR's once-extensive fleet of medium- and long-haul passenger trains on the Main Line has dwindled to Amtrak's New York–Pittsburgh *Pennsylvanian* and several New York–Harrisburg trains. Even though the freights and limiteds are gone, Amtrak has retained all four tracks between Overbrook and Paoli.

September 2015 marks the 100th anniversary of the memorable day when a Paoli Local first ran under electric power. The Pennsylvania Railroad infrastructure is to a large extent still in place, though Amtrak plans to install new, taller catenary poles that also will carry high-voltage transmission lines from the Safe Harbor (Pa.) hydroelectric plant on

Veteran MP54s and a two-year-old Budd-built Pioneer III populate the yard outside the Paoli car shop in October 1960. PRR built or bought more than 475 of the "red cars."

Two Pioneer III cars move west from the Paoli yard on June 19, 1960. They're heading for a switchback out of view to the left, then will use the track at lower right to duck under the main line and head east into the station, where they will start their trip into Philadelphia.

Amtrak GG1 4919 passes Paoli tower with train 40, the eastbound *Broadway Limited*, New York section, on April 20, 1980, a week before the end of GG1 usage west of Philadelphia. Note the tower's new brickwork and windows, repairs made after a 1974 freight derailment.

Steam returned to the Main Line for probably the final time on May 18, 1986, when PRR 4-4-2 7002 and 4-4-0 1223 powered an excursion from Strasburg, Pa., to 30th Street and back. At Paoli, the special waits while Harrisburg-bound Metroliner cars make their station stop.

the Susquehanna River. The last two staffed towers, at Overbrook and Paoli, vestiges of the late 19th century, will be closed when remote control of the line is assumed by the Amtrak operations center in Wilmington, Del. But given its many notable features — the pioneering electrification, active interlocking towers, stone-arch bridges, 1930s-vintage signal system, and classic station buildings — the Main Line between Philadelphia and Paoli has been considered eligible for listing on the National Register of Historic Places.

Today, most SEPTA commuter trains extend well beyond Paoli, to Malvern or Thorndale, in a service officially called the "Paoli/Thorndale Line." The 1915-era yard and shops at Paoli were replaced in 1995 by new facilities east of Overbrook and at Frazer, 2½ miles west of Malvern. But, as one might expect in the history-conscious Philadelphia area, many folks along the Main Line still refer to their hometown train as the "Paoli Local," even though they may not recognize it as the genesis of the Pennsylvania Railroad's mighty electric empire.