MARYLAND TRANSPORTATION TRANSFORMED, 1800-1900

During the nineteenth century, Maryland's transportation network experienced tremendous change (Figure 4). The primary themes in the transformation of travel in the state, including the development of private toll roads or turnpikes, the construction of the National Road, the Chesapeake and Ohio Canal, the Chesapeake and Delaware Canal, and the Baltimore and Ohio Railroad, and the ultimate demand for better county roads, have been well covered by numerous historians, including St. George Leakin Sioussat, Joseph Durrenberger, Charles Leviness, Sherry Olson, Ralph Gray, Herbert Harwood, and William Hollifield (Durrenberger 1931; Gray 1985; Harwood 1979; Hollifield 1978; Leviness 1958; Olson 1980; Sioussat 1899). The following discussion is a concise summary of such themes and their relation to events and trends which affected or shaped bridge building in Maryland.

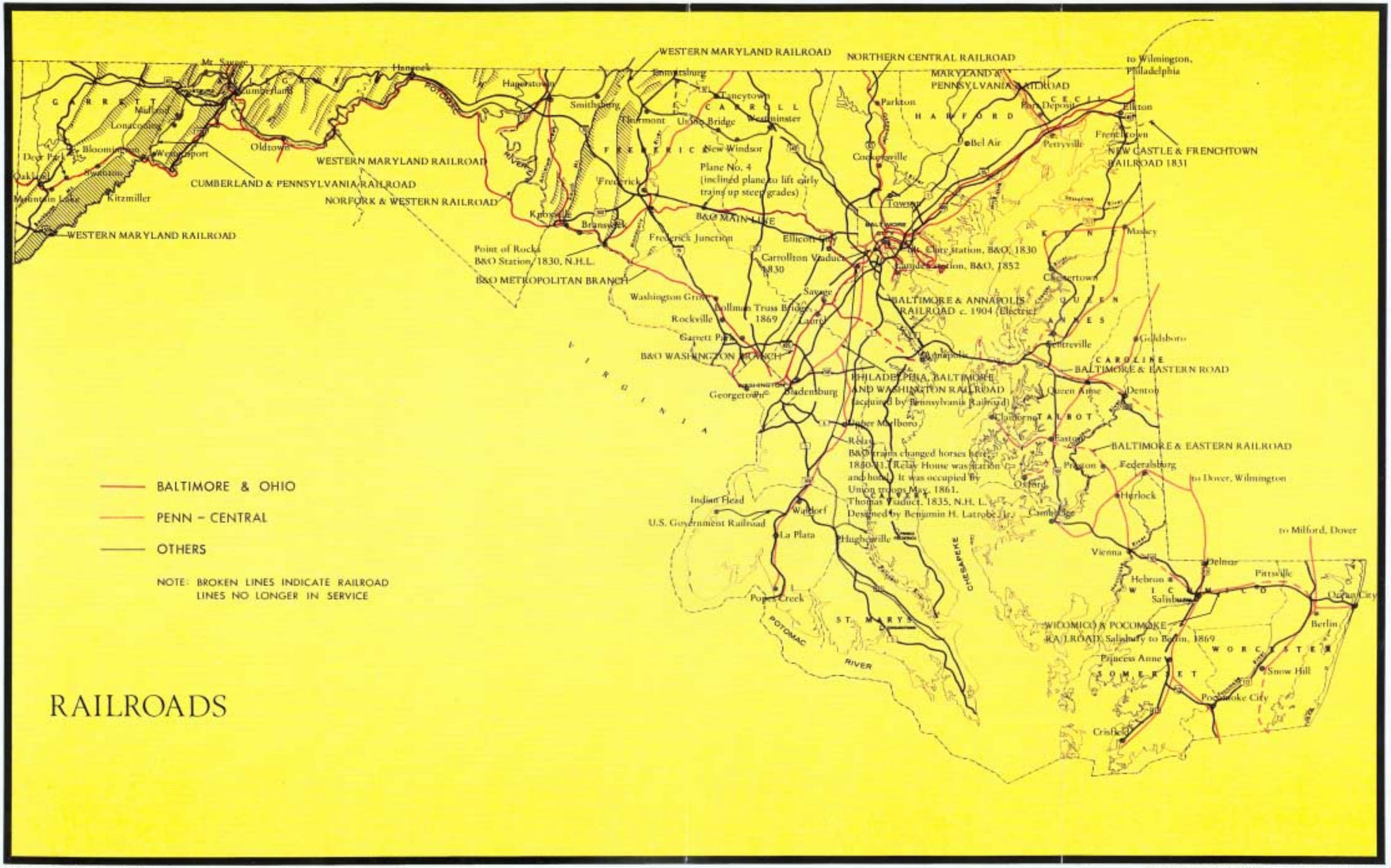

FIGURE 4: Maryland Railroads

SOURCE: *The State of Maryland Historic Atlas* 1973

Turnpikes and Turnpike Bridges

The 1787 legislation allowing Baltimore County to build improved roads, or turnpikes, to York, Frederick, Reisterstown, Westminster, and Hanover failed to produce complete highways to those destinations. Baltimore County nevertheless spent considerable sums improving portions of the old routes and was ultimately reimbursed by the General Assembly, which sought ways to attract private capital to the projects (Hollifield 1978:2). Turnpiking a road in the early national era meant straightening, rebedding, and resurfacing an old dirt route with various combinations of broken stone or gravel, or laying out by exact survey an entirely new route to take advantage of the terrain. With the scientific innovations in methods of stone surfacing and road drainage developed by British engineers Thomas Telford and James McAdam coming into American use during the first three decades of the nineteenth century, state boards of public works and private turnpike companies increasingly hired trained civil engineers to survey roads and build bridges along them (Lay 1992:110-111).

Between 1796 and 1801, five separate turnpike companies were chartered, none of which successfully completed a road (Sioussat 1899:145). During the legislative session of 1804-1805, however, the Assembly created three highly important turnpike companies: the Baltimore and Frederick Town Turnpike Company, which built the first improved link to the West (Frederick Road) through Ellicott City, New Market, Frederick, Middletown, and Boonsboro; the Baltimore and Reisterstown Turnpike Company, which with its two northern branches tapped the rich farm country of south-central Pennsylvania; and the Baltimore and York Town Turnpike Company, which connected Pennsylvania roads crossing the Susquehanna (Durrenberger 1931:66).

These companies overcame numerous challenges of topography and construction in order to build their roads. Reaching toward western Maryland, the Frederick Turnpike was gradually extended (in part, via roads financed and built by the state's banks under agreement with the General Assembly) to meet the National Road at Cumberland. Another branch of the pike led to Harper's Ferry and the Shenandoah Valley of Virginia. Treasury Secretary Albert Gallatin's famous 1808 study on internal improvements, and Governor Goldsborough's 1818 "Executive Communication on the Subject of Turnpike Roads" offered progress reports on the various turnpikes chartered by the Maryland legislature (Gallatin 1968:60-67; Goldsborough 1818). By 1807, the Baltimore and Reisterstown pike had been surveyed and was completed for ten miles of its length at a cost of $10,000 per mile. The Baltimore and Frederick Turnpike had built some 37 miles of its 62-mile total, while a restrictive clause delayed construction of the turnpike to York until after 1807 (Durrenberger 1931:66-67).

Goldsborough's 1818 report was based on questionnaires sent to each turnpike company (Goldsborough 1818). By that year, having witnessed the

advantages of private capitalization of improved roads, the Maryland legislature had authorized a number of other turnpikes, including the Falls Pike (Falls Road), the first improved Baltimore and Washington Turnpike (chartered 1813 to follow approximately the route of today's Baltimore-Washington Boulevard or Route 1 through the old port of Bladensburg to Washington), the Baltimore and Havre de Grace Turnpike (an 1813 precursor to present Old Philadelphia Road), and the New Castle and Frenchtown Turnpike (also chartered 1813 to carry goods over one of the old portage routes between the Chesapeake Bay and the Delaware River) (Durrenberger 1931; Holmes 1962). Other private toll roads, such as the Westminster, Taneytown and Emmitsburg Turnpike, and the Belair Turnpike (predecessor of Belair Road), were deliberately laid out to draw the commerce of the Susquehanna Valley away from Philadelphia and toward Baltimore (Durrenberger 1931).

The Goldsborough report documented use of both simple timber beam and stone arch bridges on the early turnpikes of Maryland. On the Baltimore and Reisterstown Turnpike, completed on January 8, 1810, with twelve tollgates, "many bridges" had been built by the company "of solid materials, at a very great expense," but no special bridge tolls were charged. The Baltimore and York Turnpike, finished in 1811, included five one-span stone arch bridges and two two-span stone arch bridges, on which a total of over $15,000 had been spent. On the Frederick pike "four considerable bridges" had been erected (over Gwynns Falls, the Patapsco, the Monocacy, and Catoctin Creek). The turnpike company's $56,000 four-span Monocacy Bridge (the so-called "Jug Bridge," a stone structure southeast of Frederick which stood until 1942) was built in the expectation that the company would defray the cost by tolls. When this was not authorized, no more money was available for turnpiking or improving the old Frederick road (Goldsborough 1818).

In the early nineteenth century, the companies' clear preference for stone arch bridges at important Piedmont and Appalachian Plateau crossings reflected a growing popular demand in those areas for sturdy structures able to withstand the pressures of frequent wagon traffic as well as the force of water, ice, and flood debris along streams and rivers with moderate or high slopes. The bridges' general durability has been demonstrated; the oldest known bridges extant in Maryland are the Parkton Stone Arch Bridge over the Little Gunpowder, built in 1809 in northern Baltimore County along a piked route (Meyer 1981:5-6), and Washington County's notable collection of stone arches, all probably erected between 1819 and 1863 although some undated examples may possibly predate the Parkton arch (Mish and Cottingham 1977). Numerous stonemasons in Maryland developed skill in the layout and building of such spans, and noted engineers such as the Shrivers and Latrobes worked for the turnpike firms (Durrenberger 1931).

In the Tidewater or Coastal Plain region, where drops in elevation were not so large, few stone bridges appear to have been constructed (no major turnpikes

except the New Castle and Frenchtown pike were built in the Delmarva peninsula) (Holmes 1962). On major rivers like the Susquehanna and Potomac, however, the earliest substantial spans were often long covered wooden bridges, supported on only a few piers in order to avoid obstructing heavy water flow (American Society of Civil Engineers 1976:7-14). A lengthy obstacle to the nation's earliest east-west turnpikes, the Susquehanna especially challenged the talents of the country's foremost timber bridge builders. In Maryland between 1815 and 1825, both Theodore Burr, inventor of the Burr arch type of covered bridge, and Lewis Wernwag, expert bridge constructor and designer of the famous "Colossus" bridge over the Schuylkill at Philadelphia, built long-span covered bridges at Conowingo and Port Deposit (Maryland Historical Trust 1970-1993). No longer extant, these bridges nevertheless mark the period of craftsman tradition in Maryland bridge building, as do the many stone arches erected by masons James Lloyd, Silas Harry, and John Weaver in western Maryland (Mish and Cottingham 1977).

Baltimore's preeminence as a destination of turnpikes built between 1810 and 1840 attested to that city's extraordinary growth after the Revolution. By about 1825, Baltimore was the third largest city in the United States and the terminus of seven turnpikes (Durrenberger 1931:69). Within the city, a variety of wooden bridges built under the City Commissioners' aegis (including an early drawbridge at Light Street) provided the beginnings of an urban infrastructure for the transport of freight and goods (Olson 1980). Even so, competition with such expanding port cities as Philadelphia, New York, Pittsburgh, and New Orleans kept Baltimore entrepreneurs alert to the possibility of new connections with the Midwest, where farms were rapidly replacing the old trans-Appalachian wilderness of the colonial era. Four major nineteenth century engineering projects in Maryland—the National Road, the Chesapeake and Ohio Canal, the Chesapeake and Delaware Canal, and the Baltimore and Ohio Railroad—emerged from the public effort to strengthen Baltimore's marketing position in the years prior to the Civil War (Livingood 1947; Rubin 1961). Each project directly affected the bridge building history of the state in the period before the introduction of automobiles and trucks.

The National Road

Some of Maryland's most significant bridges are located along the route of the National Road, a nationally significant improved turnpike constructed in the early nineteenth century from Cumberland to Uniontown, Pennsylvania, as the first federally built highway in the United States. In 1806, Congress authorized construction of a road "from Cumberland or a point on the northern bank of the river Potomac, in the State of Maryland, between Cumberland and the place where the main road leading from Gwynn's to Winchester, in Virginia, crosses the river, to the State of Ohio" (Sioussat 1899:183). By statute, Maryland, Pennsylvania, and Virginia granted permission for the so-called "U.S. Road" (also to be known as the Cumberland Road as well as National Road), and between 1811 and 1818 the road was built under the supervision of topographical engineers from the U.S. Army (Kanarek 1976; Sioussat 1899:184-185).

From 1818 to the early 1830s, linked to central and eastern Maryland via turnpikes from Cumberland through Hagerstown and Frederick, the National Road was maintained under Federal administration (Kanarek 1976:11-17). The unprecedented nature of the road's sixty-foot right-of-way was a perennial problem for nearby residents who built fences and even houses on the land allotted for the road. Repair of the National Road was a still worse challenge, as narrow iron wagon wheel rims and dragged sawlogs tore up the roadway surface. In 1823, U.S. Army engineer David Shriver, Jr., observed that "the road has suffered so much, that its original form is lost, and the sum in hand is not sufficient to stop the progress of ruin on it" (Kanarek 1976:13). Between 1832 and 1835, the U.S. War Department expended over $900,000 on National Road repairs, which included laying a new McAdam (or macadam) surface on the road (Kanarek 1976:14-17).

Semicircular stone masonry arches and culverts were the preferred bridges constructed along the route of the National Road. Where streams and rivers were encountered at an angle to the roadway, the so-called "S-bridges" were built, with a shape that allowed the bridge to be erected perpendicular to the bank (Ierley 1990:105). A significant, extant Maryland stone arch bridge, the Casselman River Bridge at Little Crossings, was built in 1813 by contractors Kerns and Bryson to a design by David Shriver to carry the National Road over the Casselman River near Grantsville, Garrett County (Little Crossings Historical Committee 1964). At least one original National Road stone arch culvert has also been located in the same area (Ware 1991:234).

Indicating the faith Maryland authorities placed in stone arch turnpike bridges, an 1834 dispute between Maryland and the U.S. Army engineers concerning the proper type of bridge for the National Road crossing of Will's Creek near Cumberland was resolved in favor of a stone span, over the objections of Captain Richard Delafield, who wanted a less expensive wooden superstructure on stone abutments and wingwalls. Bridge and culvert maintenance on the road

remained a regular, indeed chronic concern after the Maryland part of the National Road was taken over by the state in 1835 (Kanarek 1976:11-17).

By 1878, when the General Assembly turned over ownership of the National Road to Allegany and Garrett counties (Maryland General Assembly 1878:256-258), competition from the Baltimore and Ohio and other railroads had reduced commercial through traffic on the decayed road to a trickle. The Maryland Geological Survey's 1899 report on highways sadly noted that the National Road through Maryland was too narrow, muddy, and virtually impassable at points, and that bridge parapets on the Casselman River arch were disintegrating (Johnson 1899:214-215, 234-235). Renewal of the road as U.S. 40 awaited the coming of auto and truck traffic during the twentieth century (Allen 1991:38-43).

Maryland's Canals: C&O and C&D

Like the National Road, the earliest professionally engineered lock canals in Maryland represented public attempts to capture western and southern trade. Canal construction involved creating artificial, commercial water routes, often alongside a major river which would provide a water supply for operation of locks and basins. Existing roads had to be carried over or under canals, which themselves were sometimes required to cross roads or rivers on aqueducts. Bridge building, particularly stone masonry, was given impetus by the chartering of canal companies in Maryland.

Between 1824 and 1850, the Chesapeake and Ohio (C&O) Canal was constructed from the vicinity of Georgetown, near Washington, D.C., to Cumberland, Maryland, although its promoters hoped to extend it over the mountains to Ohio. Though economically outranked by the Baltimore and Ohio (B&O) Railroad, the canal operated well into the second decade of the twentieth century as a means of transporting goods and crops from western Maryland to the coastal and Atlantic trade. The Chesapeake and Delaware (C&D) Canal, completed in 1829 to link the Chesapeake and Delaware bays and widened to become a "ship canal" in the early twentieth century, currently remains in operation (Gray 1985).

Both canals necessitated bridges, but the types built evidently varied considerably. On the line of the C&O, from Georgetown west through the vicinity of Cumberland, the canal was spanned by dressed stone masonry arch bridges, and was occasionally carried (as at Monocacy River) by stone aqueducts (Sanderlin 1964) (Surviving examples of such structures, sometimes built of distinctive red Seneca sandstone, as well as various small bridges associated with lock complexes, have been documented and recorded by an ongoing project of the Historic American Engineering Record of the National Park Service [Sanderlin 1964]). The C&D, by contrast, was spanned by several covered timber bridges

and also included several early movable bridges (pivot or swing type). The fairly low profile of the C&D Canal obviated the need for major aqueducts. During the twentieth century, however, vertical lift bridges would be erected over the C&O at Williamsport (a railroad span) and over the C&D at Chesapeake City (to carry a highway) (Gray 1985).

The B&O Railroad and Maryland's Bridges

The C&O Canal's great rival during the nineteenth century was the Baltimore and Ohio Railroad. The B&O line transformed the Maryland landscape between 1830 and 1900 and ushered in momentous changes in bridge building technology (see Figure 4). The B&O made stone viaducts and then metal truss bridges acceptable to the general public by demonstrating that they would work if properly engineered. As the acknowledged innovator among early American railroad companies, the B&O was likewise a training ground for American civil engineers; such distinguished engineers as Benjamin H. Latrobe, Jonathan Knight, William G. McNeill, Caspar Weaver, Stephen H. Long, Wendel Bollman, and John E. Greiner began as railroad engineers and played significant roles in Maryland's bridge history. Although the spans built by the B&O and other railroads in the state generally were not intended for highway travel, the heavy loads they regularly carried proved the viability of such bridge types as the high masonry arch, the Long truss, the Bollman truss, the plate girder, and the timber trestle (Harwood 1979).

The history of the Baltimore and Ohio Railroad has been chronicled in detail by Herbert H. Harwood, Jr., in his *Impossible Challenge* (Harwood 1979). Technological historian Robert Vogel summarized the "firsts" of the B&O: "first practical railroad in America; the first to use an American locomotive; the first to cross the Alleghenies" (Vogel 1964:84). The B&O main line as fully articulated between 1829 and 1860 ran west from Mount Clare Station in Baltimore along the Patapsco valley through Ellicott City and Sykesville to Point of Rocks, Brunswick, and Harper's Ferry, and along the Potomac Valley to reach Cumberland and points beyond (Harwood 1979:14-34). Its success assured from an early date, the B&O throughout the nineteenth century built spur lines and access tracks to prominent mills, factories, mines and quarries, and lumber stands in the Piedmont and Appalachian Plateau counties of Maryland (Harwood 1979:206-396).

The initial stretch (the old main line) of the railroad west of Baltimore became the location of several imposing stone arch bridges, after the directors and engineers led by Jonathan Knight determined that most of the first bridges immediately west of the city should be of masonry (Harwood 1979:15-16). (Colonel Stephen H. Long entered a dissent to this decision, and later constructed the only major timber bridge—the Jackson Bridge, a covered wooden "Long truss" of his design—on the first division of the B&O, to carry the Washington and

Baltimore pike over the tracks [Harwood 1979:15-16]). Notable among these stone arch bridges is the nationally significant, extant Carrollton Viaduct, a two-span granite structure 312 feet long and including an 80-foot main arch over Gwynns Falls. Built in 1829-1830, the Carrollton Viaduct is the oldest surviving railroad bridge in the United States (Schodek 1987:77-78). Other extant or partially extant stone arches on the B&O's first division include some small spans near Baltimore, the remains of the Patterson Viaduct, at Ilchester on the Patapsco, and part of the Oliver Viaduct at Ellicott City (Harwood 1979:398).

Between 1833 and 1835, as the B&O constructed its Washington Branch south of the old main line, the well-known Thomas Viaduct was erected over the Patapsco near Elkridge. This structure, like the Carrollton Viaduct a major engineering landmark, is the oldest multiple arch railroad viaduct in the United States and possibly the best-known historic bridge in Maryland. Designed by Benjamin H. Latrobe and built in 1835, the Thomas Viaduct is 612 feet in length and consists of eight 58-foot arches built on a curvature that was itself revolutionary for its time (Harwood 1979:206-207). Still in service, "Latrobe's Folly" stands today as a physical legacy of the rise of the civil engineering profession in bridge building, as reflected in early nineteenth century Maryland railroading practice.

The Baltimore and Ohio Railroad prior to 1900 was carried on a variety of technologically innovative bridge structures in addition to the solid stone arches and imposing viaducts of its first division. Between 1840 and 1850, at Elysville (later Daniels) on the Patapsco and Harper's Ferry, covered wooden truss bridges of Latrobe's design, in which some cast iron was utilized in joints and wrought iron for certain tensile members, marked the key transitional phase from wood to iron in bridge building (Harwood 1979:48). Lewis Wernwag, who had built long-span timber bridges over the Susquehanna, was brought in by Latrobe to construct spans at Harper's Ferry. By 1849, when Latrobe's annual chief engineer's report noted that new bridges with "a superstructure of iron upon stone abutments" would be erected at Savage and Bladensburg, the railroad was following the lead of prominent bridge engineer Squire Whipple, designer of a series of small iron truss bridges over the Erie Canal in the early 1840s. Latrobe's "new bridges" of 1849 were of another new design, the Bollman truss, pioneered by the B&O's own master of road Wendel Bollman of Baltimore, who had formerly served the railroad as foreman of bridges (Vogel 1964).

The Bollman truss, discussed in further detail below in the section entitled "Metal Truss Bridges," was structurally a combination truss and suspension bridge, in which a system of lines of trussing carried individual panel loads to the ends of the frame by members acting independently of one another. Patented in 1851, with a renewal of rights in 1866, Bollman's design was utilized extensively along the B&O line (as a through truss in some cases and a deck truss in others) and was marketed throughout the United States and South America by Bollman's Baltimore-based bridge companies, W. Bollman and Company and the Patapsco

Bridge Company, between 1855 and the 1870s. Appropriately, Savage, Maryland, where one of the first two Bollman truss bridges was built in 1850, is the location of the last known surviving Bollman truss. Although not the original span at the site, the bridge has been restored by Howard County and designated a National Civil Engineering Landmark and a National Historic Landmark (Vogel 1964).

The Bollman trusses on the B&O heralded the widespread use of metal truss bridges in Maryland for highways as well as railroads. As technology progressed and mathematical understanding of truss analysis became more refined, Bollman's unusual design was largely superseded by less complex, easier to market Pratt and Warren metal truss bridges (see "Metal Truss Bridges," below). On the B&O and many other Maryland railroads, the late nineteenth century witnessed adoption of Pratt and Warren designs as well as use of highly adaptable, simple structure types such as the metal plate girder (the earliest known example of this type in the United States was a 54-foot prefabricated single-track deck girder erected by the Baltimore and Susquehanna Railroad at Bolton Station in 1847), and the wooden timber trestle, although reliable masonry arch bridges and viaducts were still being built throughout the century (DeLony 1993:43; Harwood 1979; Tyrrell 1911:195). Trusses as well as timber beam bridges supported on timber piles were used by railroads active on the Eastern Shore between 1860 and 1900 (Hayman 1979).

Bollman's companies were among the earliest to actively market truss bridges as easy to erect; the historic span at Savage still bears numerical imprints intended to guide work crews in the proper placement of the members. After the Civil War, however, a full complement of prominent metal truss bridge building firms became interested in selling trusses to railroads and county commissioners. Baltimore-based companies known to have built trusses in Maryland included Bollman's two firms, the Baltimore Bridge Company, led by Charles and Benjamin Latrobe and Charles Shaler Smith, and the H.A. Ramsay firm (Howard 1873:216-218). Firms located outside of the state but marketing in Maryland between 1865 and 1900 were the King Bridge Company and the Wrought Iron Bridge Company, both of Canton, Ohio; the Pittsburg Bridge Company; the Penn Iron Bridge Company; Nelson and Buchanan (who also acted as agents for Pittsburg Bridge Company); the Roanoke Iron and Bridge Company; and the York Bridge Company (primarily active after 1900) (Maryland Historical Trust 1970-1993).

Pioneered by the Baltimore and Ohio, railroad construction in Maryland during the nineteenth century included many important freight and passenger lines, such as the Northern Central and the Western Maryland Railway (Gunnarson 1990). An array of railroads also served the Delmarva peninsula, connecting Tidewater farms and towns and linking them to markets in Baltimore and Philadelphia (Hayman 1979).

The Road Network and the 1899 Report on Highways

Although major improved turnpikes, canals, and railroads dominated Maryland's commercial and industrial transportation in the nineteenth century, a highway network was also gradually developing. The state's basic system of county roads, and private roads built to access farms or factory sites, slowly expanded during the 1800-1900 period, under the patronage of the General Assembly and county officials. After the pioneering private toll road legislation of 1804-1805, many other turnpike laws were enacted, most of which resulted in actual construction of pikes. Historian Joseph Durrenberger observed that Maryland, to a greater degree than Pennsylvania, New York, or New Jersey, did not summarily abandon its turnpikes to decay, and in 1899 had a greater proportion of turnpike mileage in actual operation than did the other Mid-Atlantic states (Durrenberger 1931:161).

In 1818, the county courts were authorized to regularly appoint three-person panels of viewers to inspect potential or proposed road and bridge locations and "examine whether the public convenience requires it" (Sioussat 1899:154). The 1818 law was expanded in greater detail in the 1853 code, which, with subsequent revisions and amendments of 1856, 1860, 1874, and 1888, governed county administration of public roads and bridges until the end of the century (Sioussat 1899:154). The legislature also maintained its protective interest in the encouragement of private access roads; the right to construct such roads was specifically extended to quarry operators and mine owners (1833) and to millers, factory owners, limekiln operators, and distillery owners seeking railroad access (1836) (Maryland General Assembly 1836:n.p., Chapter 255). By an 1835 law, plans for private roads had to be submitted to the county levy courts (Maryland General Assembly 1835:n.p., Chapter 253).

State maps and county atlases published in Maryland between 1865 and 1900 depicted a full road network, with numerous overland routes clearly shown even in remote or mountainous regions (Hopkins 1877, 1878a, 1878b, 1878c, 1879). While a well-interlaced array of roads certainly existed near Baltimore and in the western Tidewater counties, unfortunately, many of the roads so depicted were largely unimproved dirt routes, dusty in dry weather, impassable due to mud in rainy times, and either neglected or filled with deep wagon wheel ruts from too much travel (Johnson 1899). By the 1890s, however, with bicycling a popular pastime and automotive traffic on the horizon, voices were raised for road reform. The 1894 statement of the Maryland Road League offered a pragmatic analysis of the counties' predicament:

> The Commissioners are already authorized by statute, in their discretion, to commit the roads and bridges to experts, but unanimously refuse to do so, probably for the reason, among others, that they do not feel warranted in incurring the resulting expense. It

> is likewise not worth while to recommend that they should be compelled to employ engineers (they probably would not consent to it in the first place); while, if such a law were forced upon them, lack of funds would probably compel them to employ inefficient men, and no good would be attained [Maryland Road League 1894:8-9].

The league recommended that the state create an "engineering department" and place its services at the command of each county, which they hoped would eventually set up a county engineer's office of its own. Although many counties were slow to professionalize their road and bridge functions, these recommendations gathered force during the 1890s and finally took shape in the Maryland Geological Survey's supervision of state road-building (1899-1908), the 1901 founding of the Baltimore County engineer's office, and the creation of the Maryland State Roads Commission in 1908 (Maryland Road League 1894). It is noteworthy that Baltimore City had employed professional civil engineers as early as 1880 and had begun a separate roads engineer office by 1898 (Olson 1980).

Fittingly, the nineteenth century era in Maryland transportation history closed with publication and widespread discussion of the 1899 *Report on the Highways of Maryland*, issued by the Maryland Geological Survey under authority of an 1898 act of the General Assembly. The report included a full survey of Maryland's roads by county, and for the first time in Maryland history scientifically analyzed the relation of topography, climate, and geology to road making in the state. Traditional roadway surfacing practices, whether they involved use of gravel, broken stone, or oyster shells (available in abundance in the Tidewater counties), were generally criticized (Johnson 1899; Sioussat 1899).

The report also found most Maryland bridges under 30 feet in length to be of simple timber beam, or king-post or queen-post form, although these spans were rapidly being replaced with short iron bridges, "some of which are of a flimsy construction" (Johnson 1899:206). The Maryland highway geologists recommended for short spans "a combination of masonry and I-beams, between which are transverse arches of brick, the whole covered with concrete, over which is laid the roadway." Reflecting the development of structural concrete, a technological advance of the nineteenth century of significance equal to the introduction of structural steel, this recommendation constituted the first official Maryland endorsement of concrete in bridge building. No extant examples of the unreinforced concrete, composite arch-and-beam bridge recommended by the 1899 report are known, although concrete culverts were being constructed in the state prior to 1903, when the first reinforced concrete highway bridge in Maryland was built (Johnson 1899:206-208, 1903:169).

The roadway reforms urged by the Maryland Road League and the Maryland Geological Survey capped a century of strain on the transportation network, resulting from the great growth of commerce and industry in the state. During the latter half of the nineteenth century, construction of railroads in

Maryland peaked, and the rail network partially eclipsed the overland roadway system as the primary conveyor of freight and crops. The twentieth century, however, would bring a dramatic reversal of this temporary eclipse, under the pervasive influence of yet another technological advance that profoundly affected Maryland road and bridge building: automobile and truck traffic.