

A
Short History
OF THE
Baltimore & Ohio
Railroad

Including
Locomotive Development



1827 to 1933

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PREFACE

This pamphlet has been prepared chiefly in answer to many requests that have come to us from teachers, students and others interested in the history of the beginning and development of railroads in the United States.

It is an abridged combination of the history published in 1927, the Centenary Catalogue and various pamphlets. It is divided into three parts, namely:

Short History of the Baltimore and Ohio Railroad.
Locomotive Development on the Baltimore and Ohio.
Early Locomotives, beginning with Newton's Idea, 1680.

F. X. MILHOLLAND
Asst. to Senior Vice-President

Baltimore, Md.
May 27, 1933

SHORT HISTORY
OF THE
BALTIMORE AND OHIO RAILROAD
1827 to 1933

SPURRED by the immediate success of the Erie Canal and alarmed by the possible reaction of that success upon their own brisk city, the business men of Baltimore began, in the fall of 1826, to consider the possibilities of constructing their own pathway through to the rapidly expanding country to the west of them. They hit upon the Ohio River, with its water reaches to much of the interior of North America, as the ultimate destination for that pathway. For the path itself, they elected to follow the example of England which was just laying down the first of a series of metal roads which became known as rail roads. The steam locomotive at first was beyond their imagination. They proposed to use as motive power for their rail road, horses; drawing flanged-wheel cars upon its level stretches while operating cableways upon inclined planes where there were grades to be overcome.

The first plans of these men of Baltimore quickly took enduring form. Chartered by the State of Maryland, February 28, 1827, and incorporated on April 24 of that same year, The Baltimore and Ohio Rail Road Company came into existence, with Philip E. Thomas as its president and George Brown as treasurer. The capital stock had been rapidly subscribed and in that very summer of 1827 rough reconnaissances for the new road were begun to the west of Baltimore. There were at that time no schools of engineering in America, save the United States Military Academy at West Point, and so, recourse was made to the engineering forces of the Army. These came to the aid of the new railroad. They located its original line and planned many of its earliest structures.

Virginia and Pennsylvania confirmed the charter of the Baltimore and Ohio; the former on March 8, 1827, and the latter on February 22, 1828. This cooperation secured, plans for the actual construction of the new line went ahead, with great rapidity. Jonathan Knight, who had been planning many public works in Pennsylvania, was brought to the aid of the army engineers and

remained with the Baltimore and Ohio for many years thereafter; most of them as its chief engineer. He gave great aid to the project.

Construction work on the railroad was formally begun on July 4, 1828, when the *First Stone* was laid in a field near the residence of James Carroll on the westerly edge, at that time, of the city of Baltimore. This was made a large public occasion and was preceded by a very pretentious street parade. At the ceremony the Masonic lodges laid the stone, being assisted by the venerable Charles Carroll of Carrollton, the town's chief citizen. It was on this occasion that the illustrious patriot said: "I consider this among the most important acts of my life, second only to my signing the Declaration of Independence, if even it be second to that." In the evening there were fireworks and more rejoicings.

BUILDING THE NEW RAILROAD

It was not, however, until 1830 that the new railroad was ready to begin business as a common carrier. By the beginning of that year its double-tracked line was completed from Baltimore to Ellicott's Mills, fourteen miles distant. Cars had been built and equipped with flanged wheels, horses secured, and on the twenty-fourth of May the regular operation of trains between the two terminals was begun. The road met with instant favor. And preparations went forward with renewed energy toward extending it westward from Ellicott's Mills.

Yet the problem of its motive power remained a vexatious one. There were many who scoffed at the plan to operate it with horses—all the way from Baltimore to the Ohio, three hundred miles distant. Among these was one, Peter Cooper, a rich and distinguished citizen of New York, who had made land investments in Baltimore and who was concerned as to the future of the town. Mr. Cooper called the attention of the directors of the railroad to the steam locomotive, which was a recognized device in England and which already had made its appearance here in the United States. When they were reluctant to experiment with this machine, he went to Baltimore and took with him the parts of an experimental locomotive, the *Tom Thumb*, which he set up and operated under its own steam power on the track which had been put down at Mount Clare, in the suburbs of Baltimore.

This was in the autumn of 1829. The *Tom Thumb* was not immediately successful. But Cooper persisted with the engine and in the spring of 1830 he triumphed with it. Even though on one of its earliest tests it raced with a horse-car on the adjacent track and, suffering a momentary breakdown of its mechanism, was beaten by the horse of flesh and bone. But in the long run the iron horse was to triumph. Gradually the directors gave ear to the man from New York. And presently they were advertising a competitive test for the best locomotive for the Baltimore and Ohio. To which there responded, in the summer of 1831, five engines. One of these, the *York*, built by Phineas Davis, of York, Pennsylvania, emerged an easy winner in the contest and was immediately purchased by the company and placed in its service. Davis was engaged as its chief mechanical engineer. As such he aided in establishing the company's own works at Mount Clare, which have continued from that day to this; building and repairing its locomotives and its cars, as well as performing many other useful services.

The steam locomotive upon the Baltimore and Ohio entered into swift development. In 1832 there emerged from Mount Clare the *Atlantic*, which was a distinct improvement upon the *York*. There followed, in quick succession, the *Traveller*, the *Arabian* and the *Mercury*. Each of these engines represented a distinct advance over its predecessors. But all of them had the upright type of boiler. The road clung tenaciously to this form, even after its compeers had shown the obvious advantages of the horizontal boiler. Eventually it capitulated. The *Lafayette* (renamed the *William Galloway* in 1927, in honor of the grandfather of C. W. Galloway, now the road's operating vice-president), which made its appearance upon the line in 1837, was the first engine which in its general form resembled the locomotive of today. After it, there were no more locomotives with vertical boilers built for Baltimore and Ohio.

SLOW PROGRESS AT FIRST

Long before the coming of the *Lafayette*, the Baltimore and Ohio had advanced its rails westward from Ellicott's Mills. By the beginning of 1832 it was at Frederick, sixty miles distant by rail from Baltimore, and on December 1, 1834, it had reached a point directly across the Potomac from Harper's Ferry. Thereafter its progress was not so rapid. Panic came upon the land

and most of its enterprises were halted. So it was not until November 5, 1842, that the iron horse first poked his nose into Cumberland. In the meantime—seven long years before—an important side line of the road had been completed; the Washington Branch, extending southwesterly from the Relay House and forming a most important link in the railroad route between New York, Philadelphia and the national capital. From the very beginning this line was highly profitable. It connected a group of cities already well developed and so capable of maintaining a railroad from the outset.

The Main Stem of the Baltimore and Ohio, as presently it became known, had no such sinecure. It was thrusting itself into an undeveloped and little-known country. Moreover, it was encountering physical obstacles such as no other railroad in the United States had as yet faced. The crossing of the stiff ranges of the Alleghenies proved to be no simple matter. Long tunnels had to be bored, large bridges built, heavy embankments and cuttings were a necessity; almost every mile of the way west of Cumberland.

No wonder, then, that it was not until the first day of January, 1853—almost a full twenty-five years after the first breaking of ground for the road—before Baltimore and Ohio actually reached its great objective, the bank of the Ohio. On that day, the first locomotive and train entered Wheeling. There were many rejoicings; and a huge celebration. But this last was eclipsed four years later when three trains of distinguished excursionists left Baltimore and journeyed through to Cincinnati and to St. Louis upon the extended lines and connections of Baltimore and Ohio.

THE EXPANDING RAILROAD

Work upon these had begun even before the completion of the original main stem into Wheeling. They were, chiefly, the Marietta and Cincinnati, the Ohio and Mississippi and the Central Ohio. There were no bridges then across the Ohio and these connections had to be reached from the main stem at Wheeling—and from the newly completed branch from Grafton to Parkersburg—by river steamers and ferries. It was not until after the Civil War that these three connecting railroads were brought into the main Baltimore and Ohio system.

In the great struggle of the Civil War, Baltimore and Ohio, by reason of its location, became the key railroad of the defense of the Union. It formed the most direct route through northern soil between the armies of the Union in the East and those in the West. Because of this, it was under almost constant attack. Repeatedly its tracks were torn up, its bridges and its buildings burned. There were weeks and months when its Main Stem was completely severed. It suffered enormous property loss. But at no time did the men in control of the property lessen their efforts to keep it open and effective. Of these the chief was John W. Garrett—for twenty-six years president of Baltimore and Ohio and one of the great guiding forces of its entire history. Mr. Garrett's aid in the preservation of the Union has never been adequately recognized.

CONTINUED GROWTH

In the years that followed right after the war he bent his efforts to the upbuilding of Baltimore and Ohio into one of the outstanding railroad systems of the United States. He not only brought into the parent company the three western roads, to which reference has just been made, but he extended its lines; in 1871, into Pittsburgh; and in 1874, into Chicago. He greatly upbuilt the property. And one of the final acts of his long term of office as its chief executive was to plan the extension of the Baltimore and Ohio into Philadelphia, which, by connection with the Philadelphia and Reading and Central Railroad of New Jersey system made it possible for the company to operate its through freight and passenger trains in and out of the port of New York. The acquisition of the Staten Island Rapid Transit Company at about this time perfected its freight terminal arrangements there.

In more recent years have come the entrance of the system into Youngstown, Akron, Cleveland and—upon the purchase of the former Cincinnati, Hamilton and Dayton—into Dayton, Toledo and Detroit. Its most recent entrance is, in this year of its centenary, into the important city of Indianapolis. The purchase of the Cincinnati, Indianapolis and Western has not only given it a direct line into the capital of Indiana, but also into the capital of Illinois—Springfield—which had heretofore been reached only by its indirect lines.

In the administrations of the last three presidents of the company—Messrs. L. F. Loree, Oscar G. Murray and Daniel Willard—great sums of money have been expended in keeping the road in the forefront of American systems. In the present administration alone (that of Daniel Willard, who became president of the company January 1, 1910) there has been spent over \$400,000,000 or nearly half the present physical value of the property, in the acquisition or rebuilding of lines, bridges, locomotives, cars and the like. Within twenty years virtually a new railroad has been created. Not alone physically. Baltimore and Ohio has a passing pride in the quality of its service. It operates, for instance, three of the finest of American trains — the *Capitol Limited*, the *National Limited* and the *Columbian*. The basis of the reputation of these trains is upon their comfort and dependability without excessive speed.

THE CENTENARY

On February 28, 1927, the Baltimore and Ohio Railroad celebrated at Baltimore, Md., its one hundredth birthday anniversary. This celebration took the form of a dinner, held at the Lyric Theater, Baltimore. Here was gathered a cosmopolitan audience, including many prominent officers of the Government, leading railway officials throughout the country and a number of citizens of Baltimore. A particularly interesting group among the guests was made up of Baltimore and Ohio veteran employees from various branches of the service, including many of those who have served the Railroad for fifty years and more.

The dinner was followed by addresses by Daniel Willard, president of the Baltimore and Ohio; Howard W. Jackson, then mayor of Baltimore, and Newton D. Baker, a director of the Baltimore and Ohio and former Secretary of War. Governor Ritchie, of Maryland, who had been expected to speak, was unavoidably absent on account of illness. Following these addresses there were presented three outstanding episodes in the history of the Baltimore and Ohio, entitled, "The Meeting in George Brown's House, February, 1827;" "The Laying of the First Stone of the Baltimore and Ohio," and "The Passing of the Horse Car and the Coming of Steam."

President Willard, in his address, announced that beginning on September 24, following, a great transportation exhibition would be held in honor of the one hundredth anniversary of the Baltimore and Ohio, at Halethorpe, near Baltimore.

This exhibition came to be known as "The Fair of the Iron Horse."

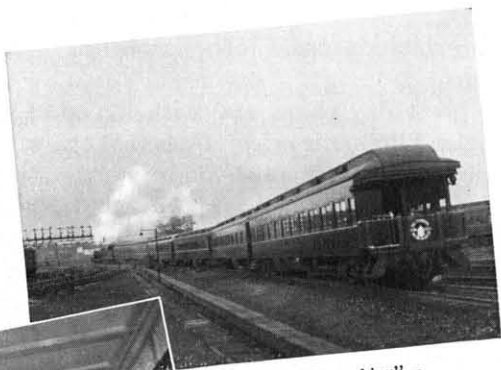
The great day came, and with it one of the most complete, historic and dramatic celebrations that the world has ever known. Beautiful buildings housed the most interesting devices used by man for the purpose of transportation, both original models and replicas, from the ox-cart of the Ptolemies and the travois of the Indians, down to the monster locomotives of today. The Hall of Transportation, which was the largest of these buildings, was devoted chiefly to exhibits of this nature. The Traffic and Allied Services Buildings housed exhibits depicting the various departments of the Railroad and those of our allied services, such as the telegraph, the telephone, the Post Office, the express companies and the steamship lines.

The most important single feature of "The Fair of the Iron Horse" was the Pageant, which gave a beautiful, accurate and interesting portrayal of the history of inland transportation on the North American Continent. Its presentation required, in addition to the forty Blackfoot Indians sent by the Great Northern Railway, some 700 characters, a large number of spectacular floats, and many horses, mules, oxen and vehicles of every kind. The character parts were chosen from the rank and file of Baltimore and Ohio employees. Machinists and clerks stepped into the roles of Peter Cooper, Henry Clay, Samuel Morse, Abraham Lincoln, and other well-known figures of history. Chief clerks, secretaries and waiters became street urchins; women stenographers and statisticians became passengers on horse cars and ox-carts or vendors of balloons; children of employees donned the garments of a century ago and became youthful travelers on river boat and sailing car. It was truly a dream of the past.

"The Fair of the Iron Horse" was attended by more than 1,250,000 people, averaging 57,513 a day. There were representatives from practically every state in the Union and from other countries, including England, Scotland, France, Canada and South Africa.

Through the use of loud speakers, the words of the Pageant were broadcast by the Narrator to the vast audiences as the drama of transportation rolled by with rhythmic majesty before the reviewing stand.

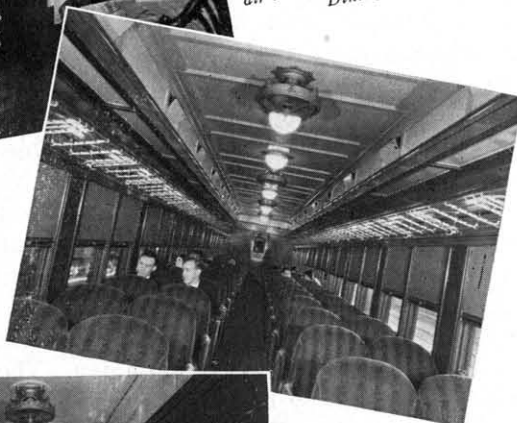
As the story of the Pageant was being read, the various examples of the modes of transportation mentioned therein passed in



*The "Columbian"—
First completely air-conditioned
and air-cooled train in railroad
history, leaving Washington,
D.C., for New York, N. Y.*



*Interior of Baltimore and Ohio
air-conditioned Colonial Type
Dining Car*



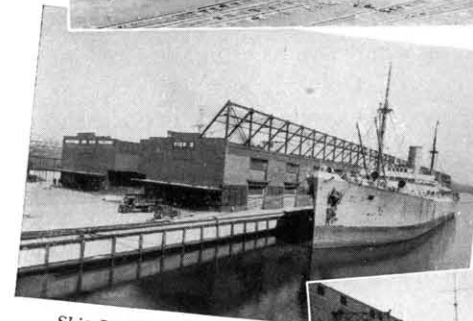
*Interior of Baltimore
and Ohio air-conditioned
individual seat coach*



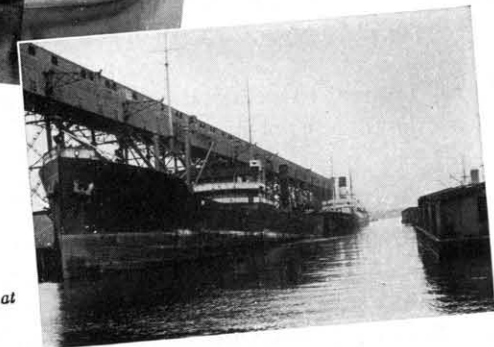
*Interior of Baltimore and
Ohio air-conditioned Club
Lounge car*



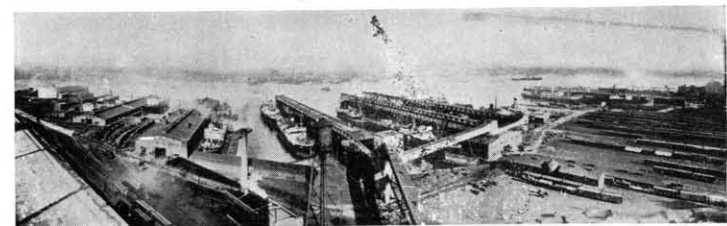
*Ground View of the Bal-
timore and Ohio Locust
Point Marine Terminal,
Showing Portion of the
Yards and Grain Elevator*



*Ship Loading at One of the
Merchandise Piers*



*Vessels Taking on Cargo at
the Grain Pier*



*Panorama of the Piers at the Baltimore and Ohio Locust Point
Marine Terminal, Baltimore Md.*

review. Under the title, "England, the Mother of Railways," for instance, came England's latest passenger locomotive, the *King George V*, which was sent across the ocean by the Great Western Railway for this occasion.

"Our Contemporaries" included locomotives from the Canadian National, the Canadian Pacific, the New York Central, the Delaware and Hudson, the Pennsylvania, the Great Northern, the Nashville, Chattanooga and St. Louis, the Western Maryland, the Reading Company and the old "Satilla" engine, property of Mr. Henry Ford.

As "The Dawn of a New Century" was heralded, the Baltimore and Ohio's magnificent *President Washington* locomotive, pulling the *Capitol Limited*, drew up before the grandstand. Here it was met by de luxe motor coaches which are used in the Company's New York-Brooklyn-Jersey City trainside service. Scores of "passengers" alighted from the train, were escorted to the motor coaches and "made the journey" from Jersey City to New York and Brooklyn.

A grand finale of the characters of the Pageant marching afoot completed the spectacular show. Pausing before the grandstand they sang "America," then tripped gaily off the "stage." At the conclusion of the last performance on October 15, "Auld Lang Syne" brought to a dramatic close this magnificent demonstration of overland transportation in America.

INTO THE SECOND CENTURY

Outstanding in achievements since 1927 has been the air-conditioning of cars and complete trains. In the early part of July, 1929, after ten years of intensive study and investigation, the Baltimore and Ohio Railroad equipped one of its coaches with air-conditioning apparatus commercially available at the time, but not especially designed for railway purposes. The result of these experiments showed that the air in railroad cars could be actually cleansed and cooled while the cars were in motion. Confidence in the new invention was such that the apparatus, especially designed, was installed in the Baltimore and Ohio colonial dining car *Martha Washington*, and a test run was made in a regular train from Baltimore to Cumberland, Md., April 14, 1930. The test was successful, and a week later the car was put in continuous service for the duration of the summer months.

On May 24, 1931, for the first time in railroad history, the Baltimore and Ohio inaugurated two complete trains with air-conditioned cars, when the *Columbian* afternoon trains left Washington and New York that day. Subsequently, on July 20, 1931, air-conditioned cars were introduced on two additional trains in morning service between Washington and New York.

Continuing to augment this improvement in its service, the railroad introduced on April 20, 1932, the first long-distance air-conditioned train, when the *National Limited*, running daily between New York and St. Louis was so equipped, including sleeping cars. The *Capitol Limited* was likewise fitted up a month later.

Featuring these air-conditioned trains are their cleanliness, quietude, and the automatic control of temperature and humidity. Nothing in railroad travel has been more revolutionary since the advent of the Pullman car. Parallel with air-conditioning, pre-cooling was used for rendering the temperature comfortable to passengers occupying sleeping cars at stations prior to attachment to regular trains.

Other improvements in passenger service—all making toward comfort for the passenger—have taken place in the five years that have elapsed since the Centenary celebration. The individual seat coach is quite different from the unit double-seat coach as well as the reclining seat car which offers overnight comfort for those who do not care to use the sleeping car and, in addition, the convenience of a lunch counter is open all night in case one desires food or refreshments.

The individual bedroom car was another improvement, as was the more recent private-section sleeping car. These cars contain ten regular sections and four "private" sections. The private sections are like the other sections except the beds are slightly recessed to allow standing position while dressing or undressing, and immediately adjoining is a private washroom and toilet.

The trucks underneath all Baltimore and Ohio passenger cars have been made uniformly six-wheeled, and they have been "rubber-heeled"—rubber shock absorbers having been put in between all metal parts. Besides, through exhortation and watchfulness, special attention has been given to the manner in which trains are smoothly started and stopped without consciousness of the passengers. Longer locomotive runs have been established so that not so many stops have to be made to change engines on through runs.

The design and development of a water-tube firebox with as many self-supporting shapes as possible to avoid the use of staybolts and radial stays in side and crown sheets of the firebox, replacing the side sheets of the firebox with a double row of tubes extending from a hollow mud ring at the bottom as a manifold and connected at the top end to a header located alongside and connected by cross circulating tubes to a steam drum, replacing the crown sheet and forming the top of the firebox with inspection plugs located in the mud rings and the header opposite the ends of the tubes for giving ready access for turbinizing and cleaning without removing the lagging. The steam drum is connected to the shell of the boiler at the front end and water legs at the rear, and circulation is established through the hollow mud ring and the side wall tubes. A number of these locomotives is now in satisfactory service, and staybolt failures are no longer a troublesome factor.

The Baltimore and Ohio has introduced for high-speed freight and heavy passenger service, Mallet Articulated locomotives with large diameter driving wheels. By this arrangement the cylinder stresses are distributed between two sets of main driving wheels, resulting in a better distribution of the stresses throughout the frames of the locomotives.

A radio broadcast of a regular program from a moving train over a nation-wide hook-up was accomplished for the first time in American railroad history, on Easter Sunday night, March 27, 1932. This feat was achieved by the Columbia Broadcasting System in conjunction with the Baltimore and Ohio Railroad Company. (See page 18, showing broadcasting car and station.)

The broadcasting zone chosen was the historic line between Washington and Baltimore, the first to enter Washington in 1835; over which the inventor, Morse, sent his first telegraph message in 1844; where Lincoln ended his memorable journey to the White House in 1861; (where history repeated itself on March 2, 1933, when the present Chief Executive, the Honorable Franklin D. Roosevelt, completed his trip for his inauguration); where one of the pioneer air meets took place in 1910; where the "Fair of the Iron Horse," commemorating the first century of railroading in America, was held in 1927.

In addition to equipping the colonial dining car, "Molly Pitcher," like a studio, with microphones, etc., the Columbia Broadcasting System also established a pick-up station in the

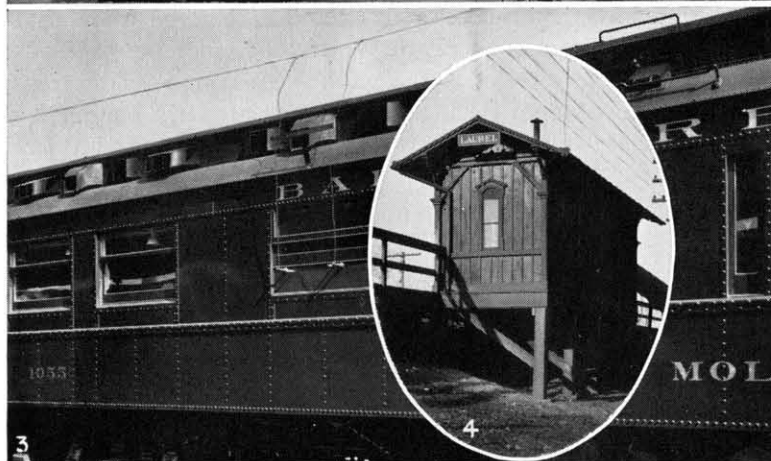
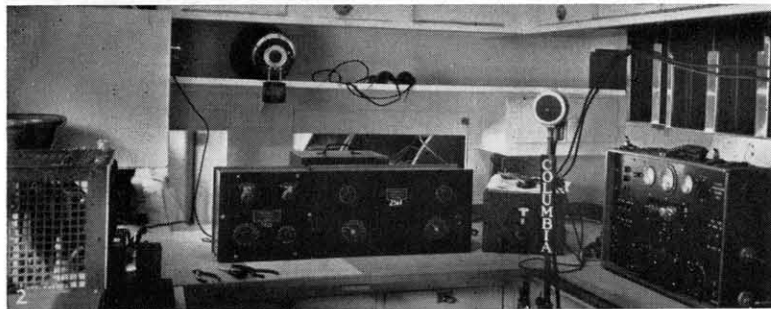
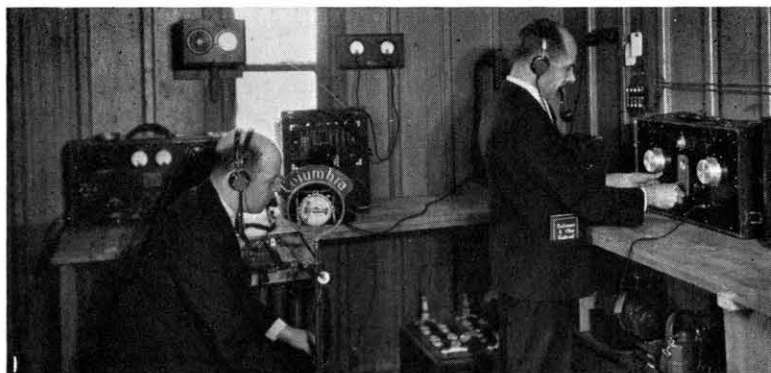
B. & O. depot at Laurel, Md., midway between Washington and Baltimore. The broadcast station on the train was Station X2XDY and the one in the depot at Laurel was Station X2XDZ, both of which were licensed by the Federal Radio Commission. In other parts of the train which consisted of parlor cars and lounge cars, receiving sets had been installed and enabled officials of both companies and representatives of the press to listen in as the train sped through the night.

In these recent years the map of the Baltimore and Ohio has also been extended. By the acquisition of the Buffalo, Rochester and Pittsburgh Railway and the Buffalo and Susquehanna Railroad Corporation, the railroad has added a new district—the Buffalo-Rochester District—and now reaches these two important Great Lakes cities.

Another 1,000-mile line—the former Chicago and Alton Railroad, which was sold to the Baltimore and Ohio under foreclosure proceedings in 1930, is now operated by it and the railroad's western frontier now reaches Kansas City, Mo., and a tie-up has been effected between its two former extremities, Chicago and St. Louis, by a direct line connecting these important gateways to the West, Northwest and Southwest.

Thus prepared, Baltimore and Ohio has entered upon the seventh year of its second century. It long since accustomed itself to its role as servant of the public. As such it endeavors at all times to conduct itself as a railroad, properly equipped, for the prompt, safe and efficient carriage of men and their goods.

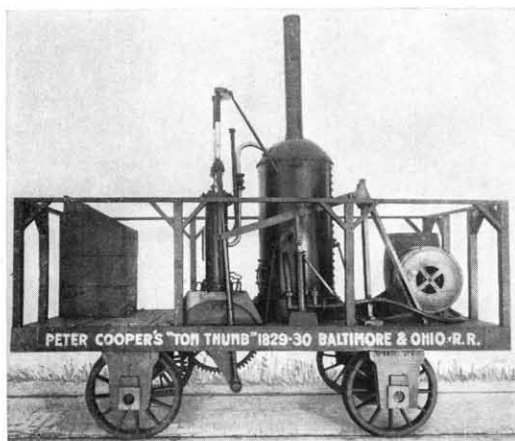
For its past it needs make no apologies; for the future it offers every promise of sustained and increased service and usefulness.



1. Tuning apparatus at Laurel (Md.) Station.
2. Pantry of "Molly Pitcher" dining car, changed into broadcast control room.
3. Antennae were strung along roof of the car and across the ends.
4. Master pick-up station at Laurel, Md.

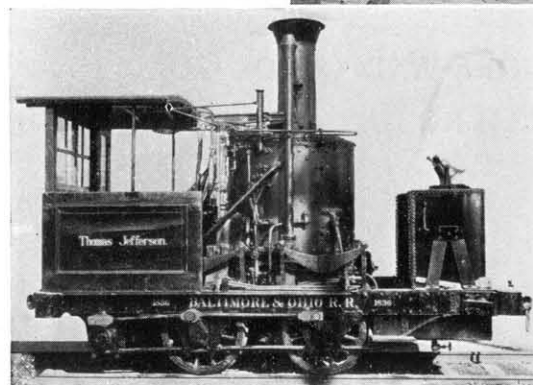
LOCOMOTIVE DEVELOPMENT

ON THE
BALTIMORE AND OHIO
RAILROAD



1. TOM THUMB

2. YORK



3. THOMAS JEFFERSON

4. ATLANTIC

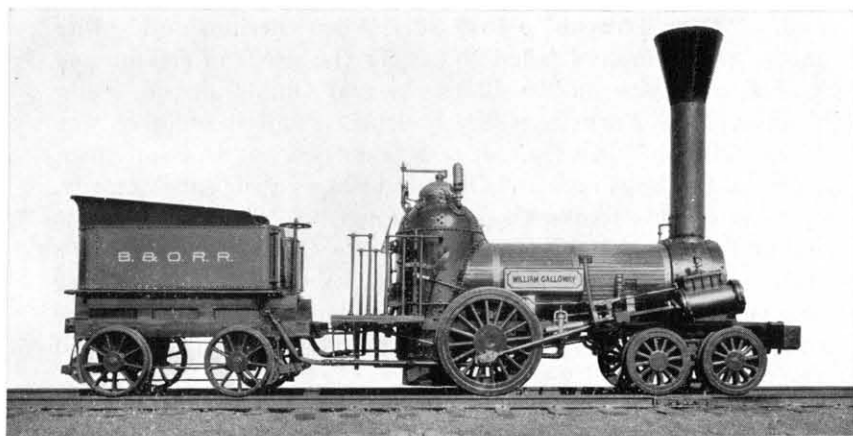


1. **"Tom Thumb"**—1829-30. When the horse and other means of locomotion failed to supply the needs of freight and passenger service on the Baltimore and Ohio Railroad, Peter Cooper, New York inventor, built his small locomotive, the "Tom Thumb," in 1829. It was first tried out in September, 1829, on the Baltimore and Ohio, but not working satisfactorily, was taken back to the shop for improving. The engine made its first successful trip from Baltimore to Ellicott's Mills, a distance of thirteen miles and return, August 25, 1830, pushing a small open car with eighteen passengers aboard, making the outgoing trip in one hour and a quarter without a break, and the return trip in fifty-seven minutes.

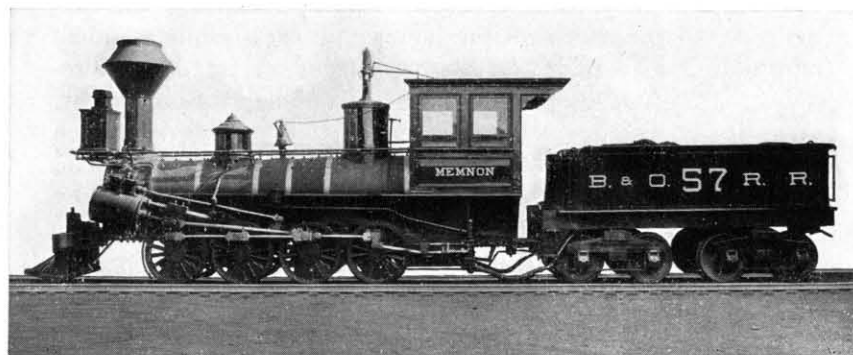
2. **The York.** The efficacy of steam locomotion on the Baltimore and Ohio had been demonstrated in 1830 by Peter Cooper's "Tom Thumb" engine which made a number of trips between Baltimore and Ellicott's Mills. Following this experience, the management on January 4, 1831, made a public offer of a prize of \$4,000 for the best engine meeting its requirements, *i. e.*, it must not exceed three and one-half tons in weight, and must be capable of drawing fifteen tons on a level, fifteen miles per hour. The engine was to be delivered to the railroad for trial not later than June 1, 1831. The "York," built by Phineas Davis, won the prize, and it went into regular service between Baltimore and Ellicott's Mills, completing the trip one way in an hour.

3. **The "Thomas Jefferson"** is an improved grasshopper type locomotive and one of the first of the early locomotives to have a cab for the engineer. It was built in 1836 by the firm of Davis, Winans and Gartner, in Ross Winans' shops in Baltimore, Md. The "Thomas Jefferson" was the first locomotive to enter the State of Virginia. It was operated in switching service at the Baltimore and Ohio Mt. Clare Shops, Baltimore, Md., as late as 1893.

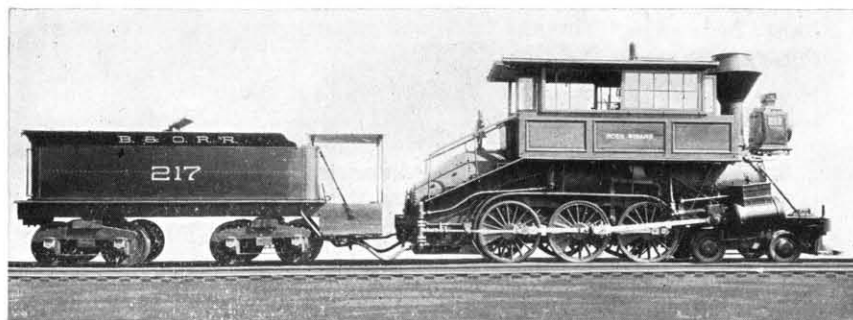
4. **"Atlantic"**—1832. The "Atlantic," grasshopper type of locomotive, invented and built at York, Pa., in 1832 by Phineas Davis, whose first locomotive, "York," having given such good service, encouraged the Baltimore and Ohio in making the contract. Early in June, 1832, the engine was completed as far as possible in the York Shops, and ox teams were used to convey it to Baltimore, where it was finished on June 28. The first



5. WILLIAM GALLOWAY



6. MEMNON, No. 57



7. ROSS WINANS, No. 217

trip made between Baltimore and Ellicott's Mills was a complete success and the engine was promptly put into regular service. The "Atlantic" has a record of actual service of sixty years, which is unparalleled in the history of the world, and it is still capable of running under its own steam.

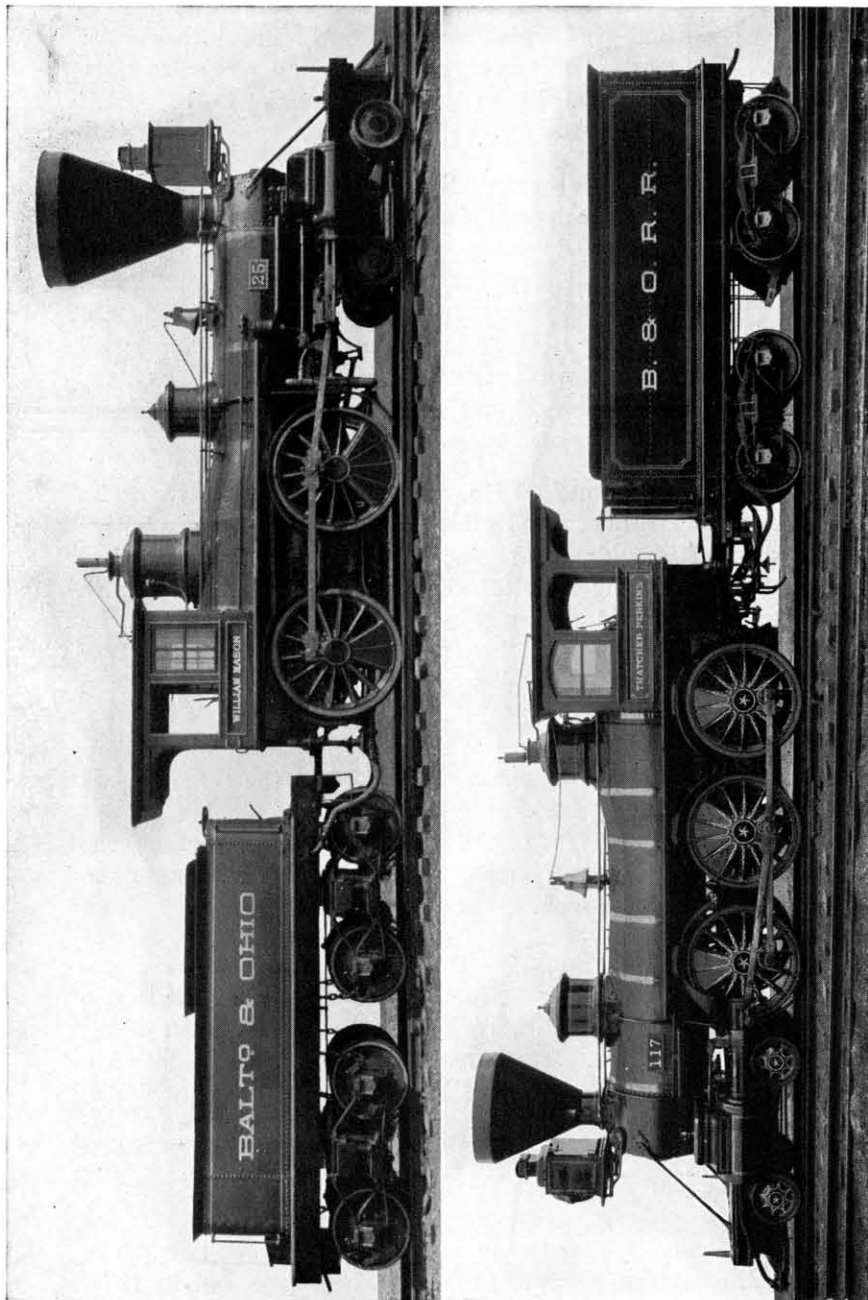
5. "William Galloway"—1837. This locomotive was built by the leading locomotive builders of America, William Norris and Company, Philadelphia, in 1837. It was the first engine with a horizontal boiler and six wheels on the Baltimore and Ohio, representing the first stage of transition from the old vertical boiler types. It was originally named the "Lafayette," but later renamed after the grandfather of C. W. Galloway, the present vice-president in charge of operation of the Baltimore and Ohio.

6. The "Memnon"—1848, was the first locomotive to be built for the Baltimore and Ohio by the Baldwin Locomotive Company. It introduced the grate provided with a rocking bar in the center having interlocked fingers on fixed bars, one in front and one behind, designed for using Cumberland coal as its fuel. Owing to valuable service rendered during the Civil War in hauling supplies and soldiers it is sometimes called the "Old War Horse."

The "Memnon" is peculiar in that the four front wheels constitute a truck, although these wheels are of the same size as the four rear wheels—four feet in diameter—and all eight wheels are coupled. The weight of the engine is about $23\frac{1}{2}$ tons, the tractive power 13,200 pounds, and the boiler pressure 100 pounds to the square inch.

7. The "Camel-Back."—The famous "Camel-Back" locomotives, designed by Ross Winans for the Baltimore and Ohio Railroad, represent a distinctive type in the development of the American locomotive. These locomotives were constructed in the Mount Clare Shops of the Baltimore and Ohio at Baltimore, and were used in freight service during the years 1848 to 1873.

The name is derived from the fact that, due to the extremely long fire-box, it was necessary to place the engineer's cab on the top of the boiler, so that the engine would not be too long. The first "Camel-Backs" were of the eight-wheel type, but in 1853,



8. WILLIAM MASON, No. 25

9. THATCHER PERKINS, No. 117

Hayes and Davis, finding that a four-wheel truck under the front would give better service, changed to the twelve-wheel type. Other improvements were added from time to time.

8. The "William Mason"—1856. This is the first locomotive built by William Mason, of Taunton, Mass., for the Baltimore and Ohio Railroad.

Mason is often referred to as the "Father of the American type of engine" because he introduced the revolutionary idea of turning out products of beauty as well as of utility. Former designs of engines were often crude and grotesque, but in making the plans for his locomotive, Mason changed uncouthness to elegance. In doing so, however, not a single essential point lost the slightest degree of efficiency or usefulness.

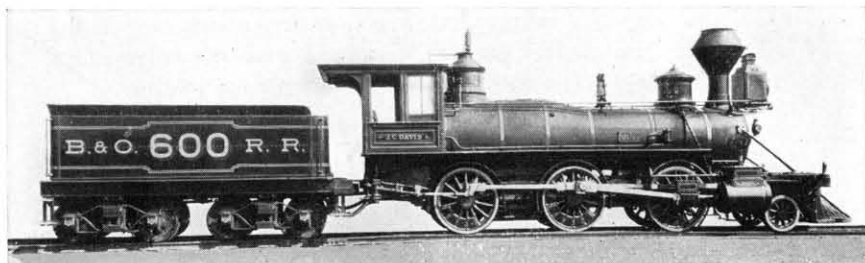
The "William Mason" weighs 28 tons. It has link motion valve gear and round smoke boxes set on cylinder saddles. The boiler is wagon top, about 46 inches in diameter next to the smoke box, the cylinders are 15 by 22 inches, and the four driving wheels are 60 inches in diameter.

It was exhibited at both the Chicago World's Fair of 1893, and at the St. Louis Exposition of 1904, and operated under its own steam at the "Fair of the Iron Horse," Halethorpe, Baltimore, 1927.

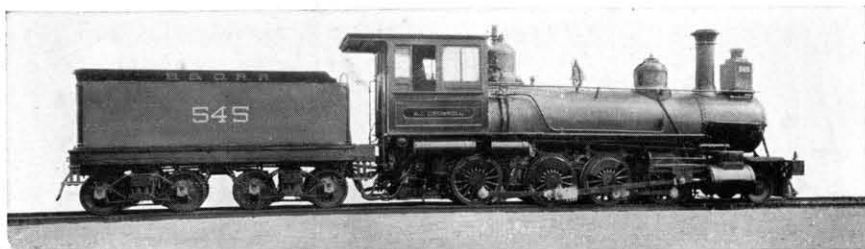
9. The "Thatcher Perkins," No. 117—1863. The "Thatcher Perkins," first ten-wheel type of engine of the Baltimore and Ohio, was designed and built by Thatcher Perkins at the Mount Clare Shops of the Baltimore and Ohio at Baltimore, for the particular purpose of hauling first-class passenger trains over the heavy grades of the Allegheny Mountains between Cumberland, Md., and Grafton, W. Va.

In addition to its sturdy construction the lines are symmetrical and graceful, presenting an unusually attractive appearance. Mr. Perkins was master of machinery for the Baltimore and Ohio at that time.

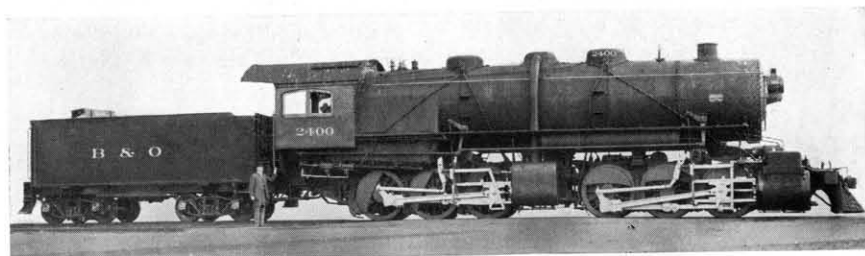
The boiler is extended wagon top, 47 inches in diameter; the cylinders are 19 by 26 inches; the drivers, 64½ inches in diameter and the total weight, 90,700 pounds.



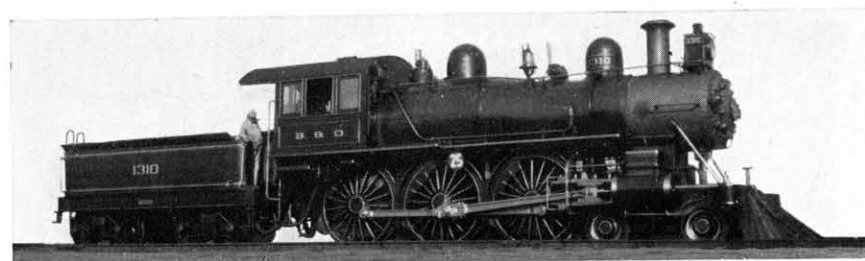
10. J. C. DAVIS, No. 600



11. A. J. CROMWELL, No. 545



12. J. E. MUHLFELD, No. 2400



13. No. 1310

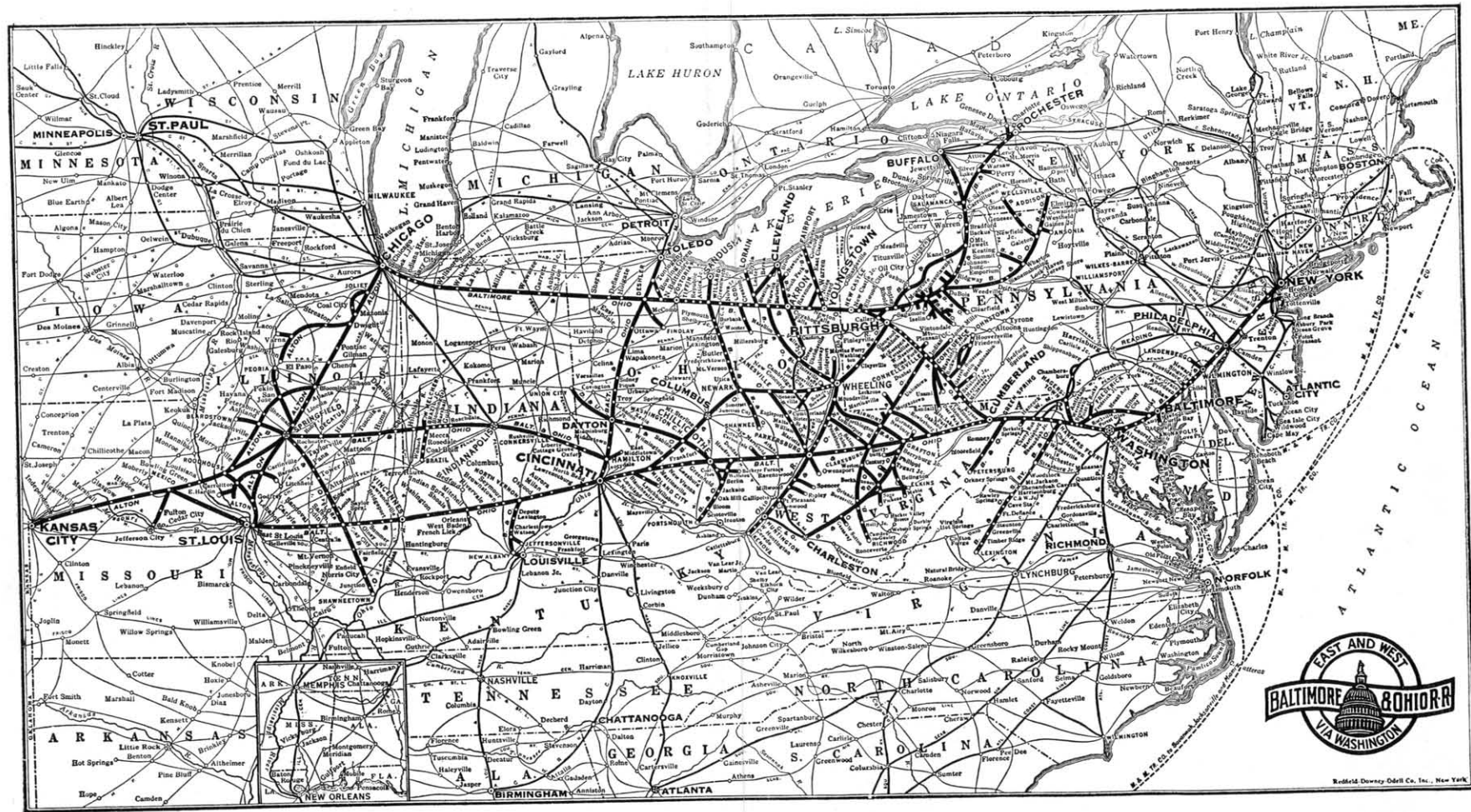
10. The "J. C. Davis," No. 600—1875, known as the "Mogul 600," was the first passenger Mogul locomotive in the world. Designed and built by J. C. Davis, master of machinery, at the Mt. Clare Shops of the Baltimore and Ohio in 1875. Was exhibited at World's Fair, Chicago, 1894, and St. Louis Exposition, 1904. Its success was remarkable in hauling passenger trains on the heavy seventeen-mile mountain grade (116 feet to the mile) over the Allegheny Mountains between Piedmont and Altamont.

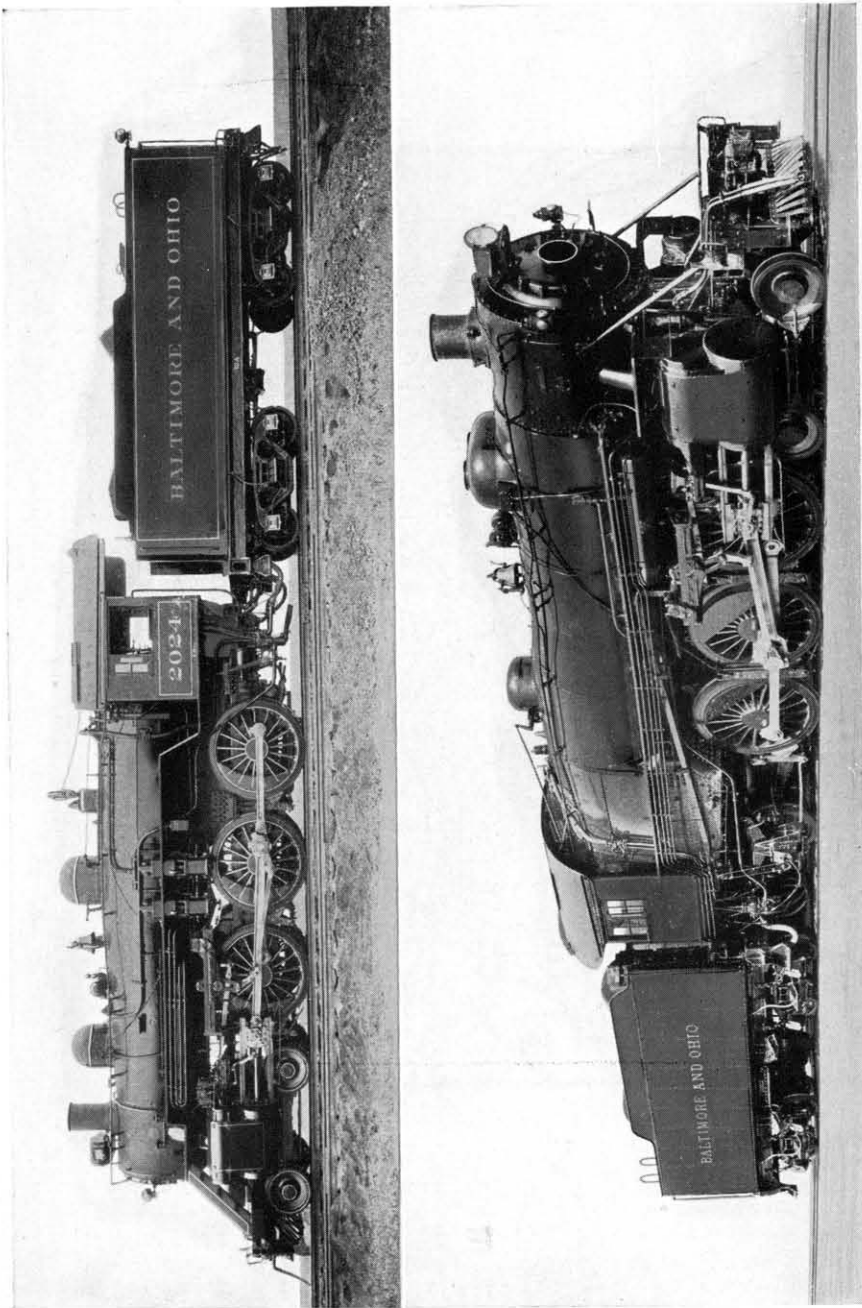
It won first honors as the finest and largest locomotive ever built up to that time at the Centennial Exposition at Philadelphia in 1876, fully meeting the expectations of its designers and builders. In 1926, to take part in the Sesqui-Centennial at Philadelphia, the "600" ran there from Baltimore under its own power and came back the same way.

11. The "A. J. Cromwell"—1888. In the year 1888, A. J. Cromwell, master of machinery of the Baltimore and Ohio Railroad, designed the Consolidation No. 545, which is named for him. The "A. J. Cromwell" is an improvement in design over the previous consolidation type of locomotives, wherein the application of double brick arches was applied to increase steam generation. The engine has cylinders 21 by 26 inches; eight driving wheels, 50 inches in diameter; 155 pounds boiler pressure, and a tractive power of 30,200 pounds. It was a very successful engine and is still in serviceable condition.

12. The "J. E. Muhlfeld," No. 2400—1904, nicknamed "Old Maud," was designed by the Baltimore and Ohio (J. E. Muhlfeld was then general superintendent of Motive Power) in conjunction with the American Locomotive Company. "Old Maud" was the first compound articulated Mallet locomotive operated in the United States. It is really two engines in one, for two sets of driving wheels and high-pressure cylinders are employed in combination with low-pressure cylinders using the exhaust steam from high-pressure cylinders comprising the compound system.

13. No. 1310—1896. The locomotive No. 1310 dispelled the theory that ten-wheel locomotives, because of additional pair of driving wheels, were unsuitable for high speed. It was





15. No. 5005

14. No. 2024

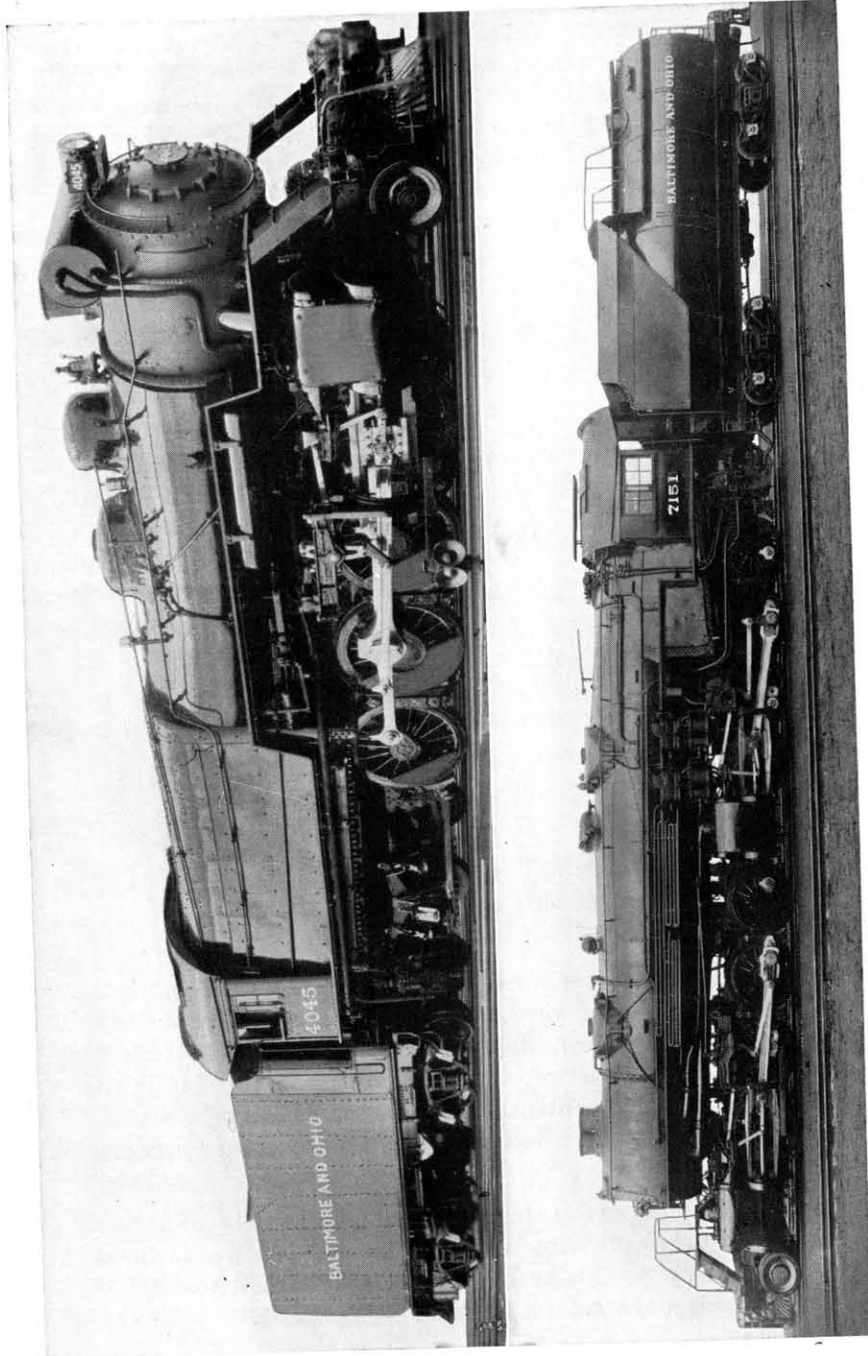
designed by Harvey Middleton, superintendent of Motive Power, for fast passenger service on the Baltimore and Ohio Railroad between Philadelphia and Washington. No. 1310 was the first locomotive in service on the road with underslung driving springs. It has cylinders 21 by 26 inches; 78-inch driving wheels; tractive power of 23,740 pounds; boiler pressure of 190 pounds, and weighs 77 tons.

14. The Baltimore and Ohio Locomotive No. 2024—1901, is a ten-wheel passenger type engine designed for heavy local service. The No. 2024 was built in 1901 and was modernized in the Mount Clare Shops of the Baltimore and Ohio Railroad at Baltimore in 1927.

The cylinders of this locomotive are 21 by 28 inches; the driving wheels 70 inches in diameter; the boiler pressure 200 pounds to the square inch. Its tractive effort is 30,000 pounds and the total weight 173,400 pounds. One of the features of this engine is that its steam pipes are placed on the outside.

15. The Baltimore and Ohio Passenger Locomotive, No. 5005—1924, is a very efficient, high-speed, Pacific type locomotive, having been developed from the Mikado type in 1924, for passenger service, and was selected for display in the Baltimore and Ohio centenary pageant in 1927 as representing another type of modern locomotive in use on the present-day Baltimore and Ohio.

This engine has outside steam pipes; cylinders 26 by 28 inches, with piston valves; driving wheels 74 inches in diameter, boiler pressure of 205 pounds to the square inch, tractive effort of 44,600 pounds and total weight of 299,000 pounds.

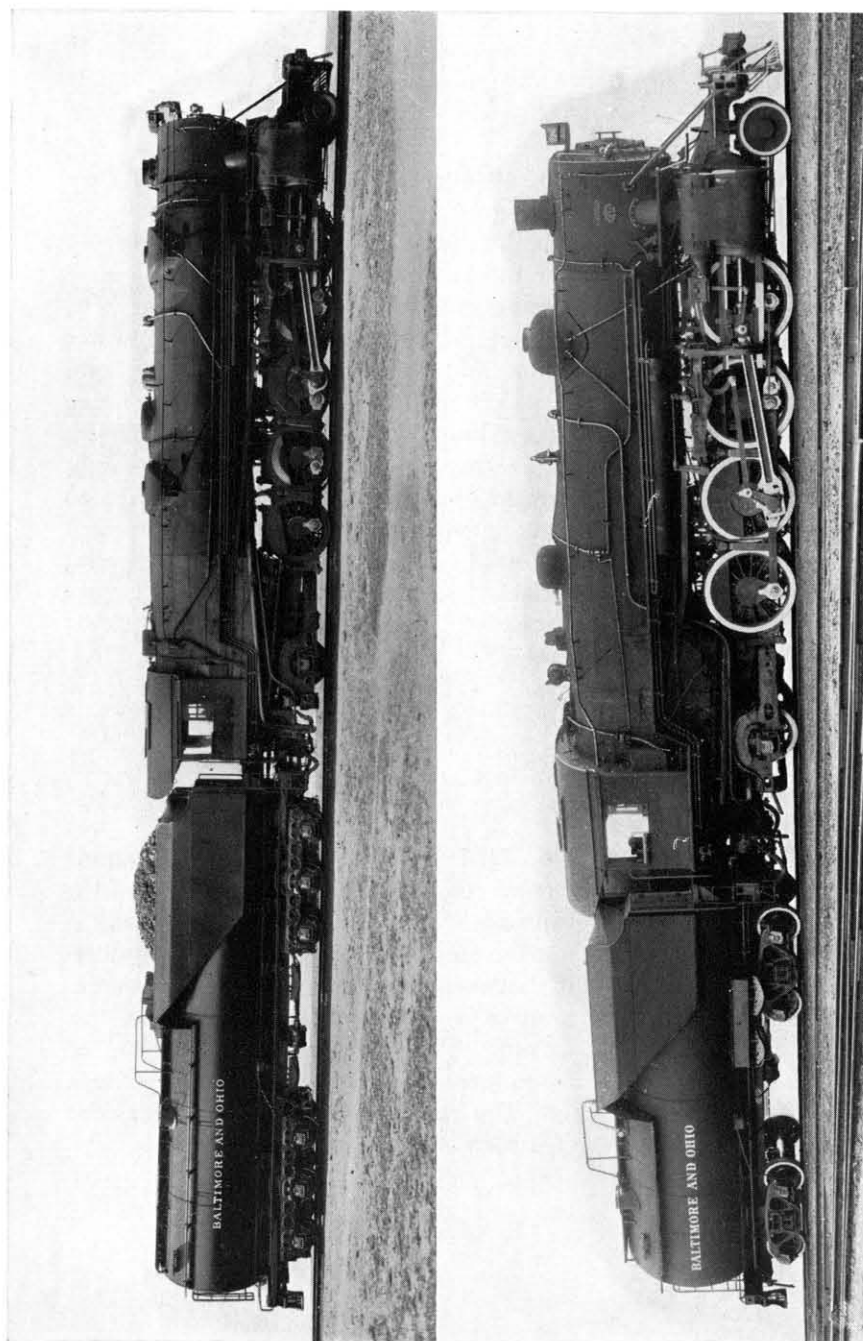


17. No. 7151

16. No. 4045

16. Locomotive No. 4045—1911, is a Mikado 2-8-2 type engine, built in 1911, redesigned in 1927 by George H. Emerson, chief of Motive Power and Equipment, at Mt. Clare Shops by new application of water tube boilers, having feed water heater and 50 per cent. maximum cut-off. The boiler consists of a shell of conventional design, to which is attached the water tube firebox, with a front and back head connected by two longitudinal drums 28 inches in diameter. It has a tractive power of 62,000 pounds, cylinders $25\frac{1}{2}$ by 32 inches, drivers 64 inches, boiler pressure 250 pounds, total weight of locomotive 326,000 pounds, weight of locomotive and tender 527,000 pounds; heating surface, firebox, 603 square feet; tubes and flues, 2,854 square feet; total heating surface, 3,457 square feet; superheater heating surface, 842 square feet; grate area, 73.5 square feet; water capacity of tender, 11,500 gallons; coal capacity of tender, 17 tons.

17. Locomotive No. 7151 is one of a number of simple Mallet type converted from compound engine in service on the Baltimore and Ohio Railroad which are used chiefly for hauling heavy freight trains over the mountain grades between Cumberland and Grafton and between Cumberland and Pittsburgh. The Mallet type locomotive is really two locomotives in one, having two sets of drivers. It weighs 491,300 pounds, has tractive power of 118,800 pounds and boiler pressure of 220 pounds to square inch. The tender has a capacity of 12,000 gallons of water and $17\frac{1}{2}$ tons of coal.



18. No. 6137

19. No. 4465

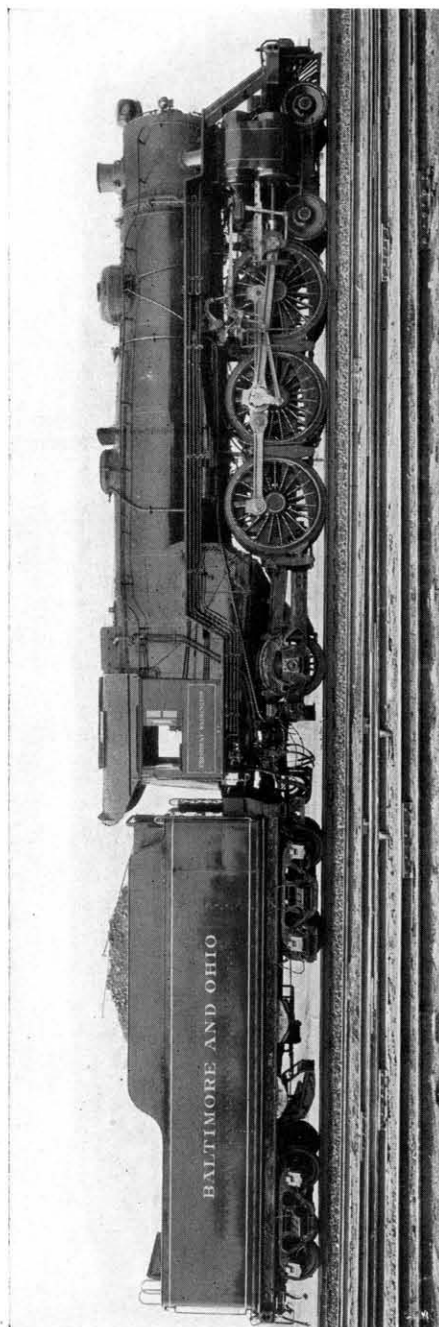
18. The Locomotive No. 6137—1926, of the Baltimore and Ohio Railroad, was built in 1926 and is known as the Santa Fe type, which of more recent years has been replacing the Mikado engine in heavy freight service, due to increased tractive power account of additional pair of driving wheels.

The Santa Fe type has two-wheel front truck, five pairs of drivers and two-wheel trailers, and received this name because it was first used on the Atchison, Topeka & Santa Fe Railroad. On the Baltimore and Ohio this type of engine is referred to as the 2-10-2 or "Ten-Coupled" locomotive. Tractive power 18,800 pounds.

19. Locomotive No. 4465—1920, is Mikado type and is used in freight service on the Baltimore and Ohio Railroad. The firebox is supported on truck, having all the driving wheels under the cylindrical part of the boiler. It weighs 163½ tons, and has a tractive effort of 63,200 pounds. It was built by the Baldwin Locomotive Works in 1920.

The Mikado received its name because the first one of its kind, having a wheel arrangement of 2-8-2, meaning with two-wheel front truck, four pairs of drivers and a two-wheel trailer truck, was built for the Japanese Government to be used on its railways, and was named after the Emperor of Japan, the Mikado.

The Baltimore and Ohio has more than 500 of the Mikado type locomotives for operation in fast freight train service on both its eastern and western lines.



20. PRESIDENT WASHINGTON, No. 5300

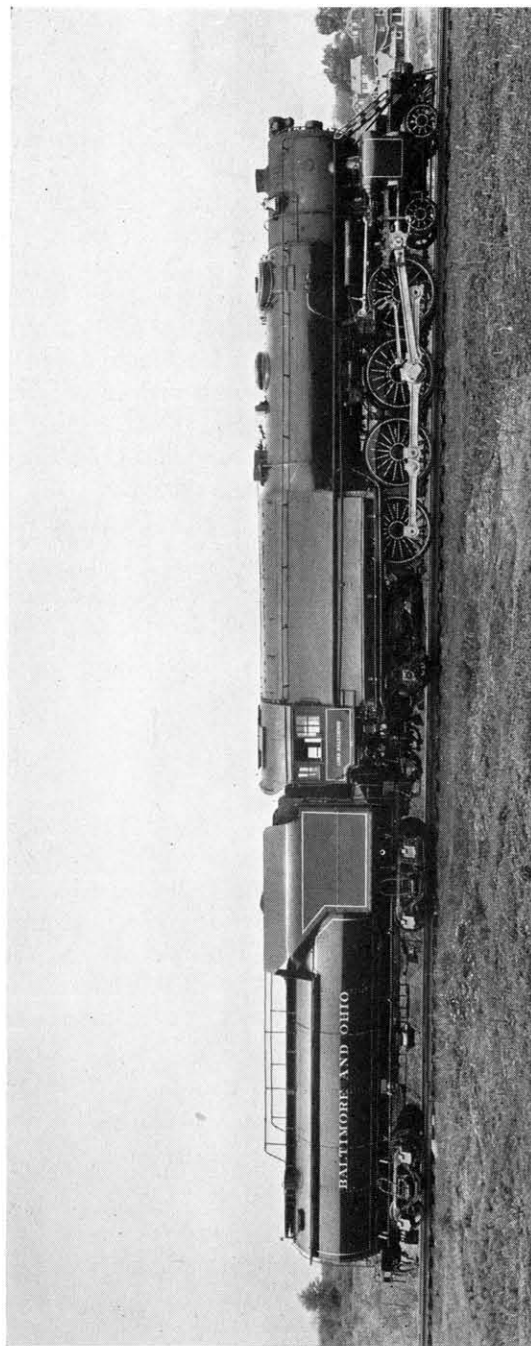
21. PHILIP E. THOMAS, No. 5501

20. The "President Washington," Locomotive No. 5300—1927, President class, Pacific type, named after the first President of the United States, is one of a series of twenty-one high-speed Pacific type locomotives built for the Baltimore and Ohio Railroad from the campus design by the Baldwin Locomotive Works in 1927 for high-speed heavy passenger traffic between Washington and New York. These locomotives mark the departure from the sombre black by the introduction of the new artistic color scheme of olive green with stripes of gold and maroon. Each is named after a President of the United States. They are equipped with all modern appliances, have 80-inch diameter driving wheels and train control device.

The total weight of the locomotive and tender is 540,000 pounds; heating surface—firebox, 390 square feet; tubes and flues, 3,448 square feet; total heating surface, 3,838 square feet; superheater heating surface, 950 square feet; grate area 70.3 square feet; water capacity of tender, 11,000 gallons; coal capacity of tender, 17½ tons.

21. The "Philip E. Thomas," No. 5501—1926. Mountain type locomotive used for heavy passenger service on the mountain grades of the Baltimore and Ohio Railroad, was designed by George H. Emerson, chief of Motive Power and Equipment, and built at the Mount Clare Shops of Baltimore and Ohio at Baltimore in 1926. Its twin, the "Lord Baltimore," of the same size, built the year previous, was at that time the largest passenger locomotive in the world.

The engine is named after the first president of the Baltimore and Ohio Railroad. It has cylinders 30 by 30 inches, driving wheels 74 inches in diameter, boiler pressure of 220 pounds to the square inch, and a total weight including tender of 659,000 pounds.



The No. 5510, with water-tube boiler designed by Col. George H. Emerson, Chief of Motive Power and Equipment of the Baltimore and Ohio

Locomotive 5510

Baltimore and Ohio mountain type locomotive No. 5510, Class T-1, with water tube firebox was placed in service in January, 1931, and has been in continuous passenger service hauling the Capitol Limited between Washington, D. C., and New Castle, Pa., a distance of 362 miles.

This locomotive has made over 200,000 miles since delivered, without general repairs, and will make considerable more mileage before shopping.

The following shows general characteristics of this locomotive:

Tractive power.....	65,000 pounds
Cylinders.....	27½" x 30"
Drivers.....	74"
Boiler pressure.....	250 pounds
Weight—Drivers.....	260,000 pounds
Weight—Engine.....	384,000 pounds
Weight—Engine and tender.....	657,000 pounds
Firebox heating surface.....	866 sq. ft.
Total heating surface.....	5,403 sq. ft.
Grate area.....	92 sq. ft.
Tender.....	{ 20 tons coal 18,000 gallons water

This locomotive was designed primarily for handling heavy passenger trains over the mountain grades without a helper. It can also be used for fast freight service.

This design of locomotive can be operated over the Main Line tracks between New York and Chicago, and Grafton, W. Va.

The most important feature of this locomotive is the water-tube firebox, developed on the Baltimore and Ohio, and the following shows some of the advantages over the conventional staybolt firebox:

Increased firebox heating surface and boiler capacity are provided. The firebox on Locomotive 5510 has approximately 75 per cent. more heating surface than the conventional firebox on a similar mountain type locomotive built at the same time.

This water-tube firebox with 866 square feet of heating surface was applied without increasing the weight on the two-wheel trailer.

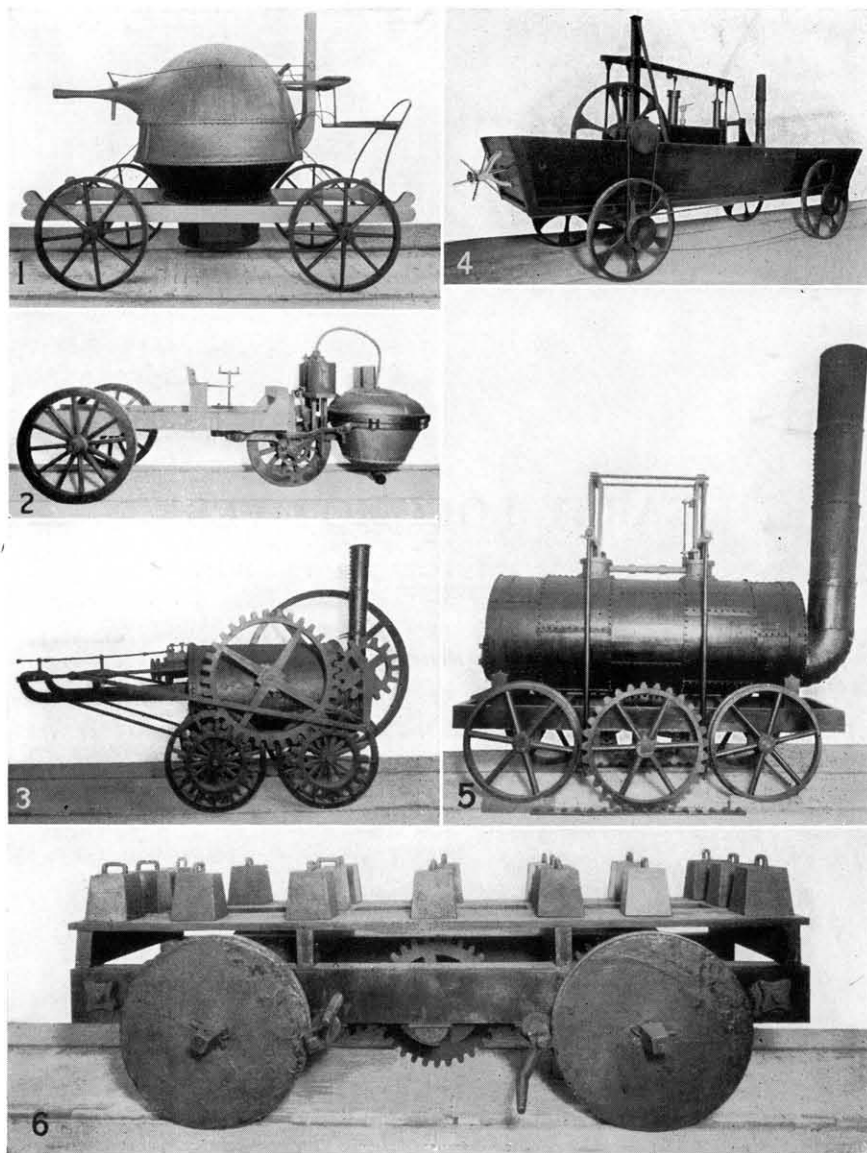
If the conventional firebox were made sufficiently large to equal the heating surface of the water-tube firebox, it would necessitate a four-wheel trailer truck.

EARLY LOCOMOTIVES

Beginning with

NEWTON'S IDEA

1680



1. NEWTON'S IDEA	4. OLIVER EVANS' SCOW
2. CUGNOT	5. BLINKINSOPP
3. TREVITHICK'S NEWCASTLE	6. HEDLEY'S MANUAL POWER

THE PANGBORN COLLECTION OF WOODEN LOCOMOTIVE MODELS

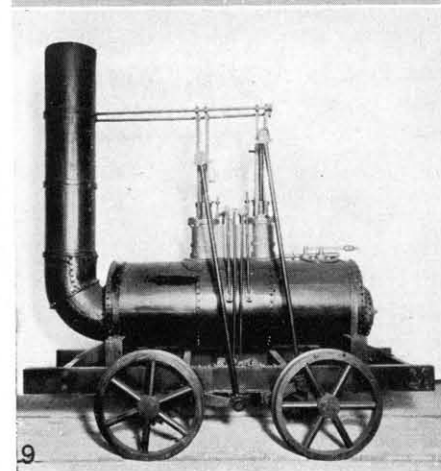
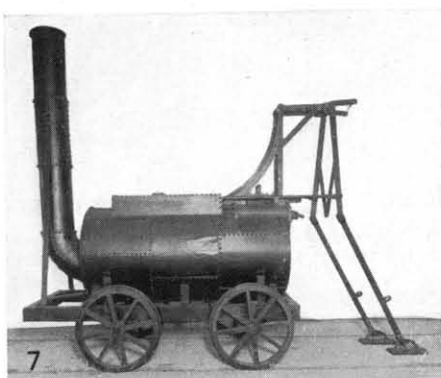
This collection of full-sized locomotive models, depicting the famous engines of the world of a century and even two centuries and a half ago, was devised by the late Major J. G. Pangborn, of Baltimore, for the World's Columbian Exposition of 1893 at Chicago and was first shown in the Baltimore and Ohio exhibit there. It was shown again in the railroads' exhibit at the Louisiana Purchase Exposition at St. Louis in 1904. This interesting group is now in the B. & O.'s Transportation Building on the site of the "Fair of the Iron Horse at Halethorpe, Baltimore, Md.

1680—Newton's Idea. The engine was never built, but the model was made from Sir Isaac Newton's drawings. It was to be propelled by the reaction of steam blowing in a horizontal plane against the atmosphere through a steam nozzle.

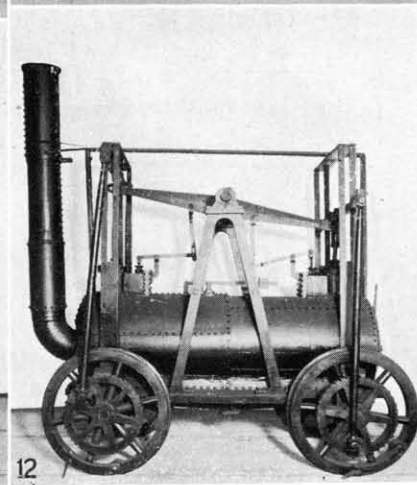
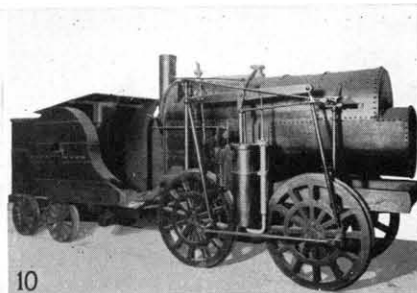
1769—Cugnot. The first engine in the world to move on land by steam. It was built by Nicholas Joseph Cugnot, a military engineer of France, to haul heavy cannon. The model is a reproduction of the original in the Conservatoire des Arts et Metiers, Paris.

1804—Evans' Scow. Built in Philadelphia, Pa., by Oliver Evans, a blacksmith and boat builder with a shop near the Schuylkill River. First to run on land in America. Was run to the Schuylkill River on wheels under its own steam, the wheels removed, and then proceeded by water down the river to the Delaware River, being propelled by a shaft extending through the back end, fitted with a paddle wheel.

1805—Trevithick's Newcastle. Richard Trevithick, the builder of stationary engines and advocate of higher boiler pressure, built a number of models to demonstrate his theory, which followed with the construction of locomotives. In 1805 he constructed a locomotive at Newcastle, sometimes called the Gateshead Locomotive. This was successfully operated and encouraged the use of steam engines. It consisted of a horizontal boiler with single horizontal cylinder extending forward,



7. BRUTON'S STEAM HORSE
8. PUFFING BILLY
9. BLUCHER



10. SEGUIN
11. STOURBRIDGE LION
12. HOWARD

from crossheads of which connecting rods engage with a geared crank shaft across the back of the boiler, on which was a large flywheel, the gear engaging with an idler gear, which in turn meshed into two gear wheels attached to driving wheel centers, treads of the driving wheels being flanged, engaging on the inside of a strap rail supported by wooden stringers. Engine had a return tubular boiler with the fire door and stack on the rear.

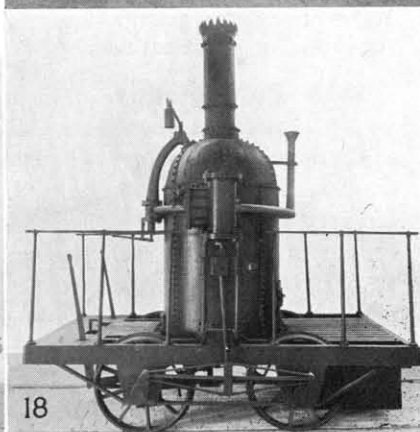
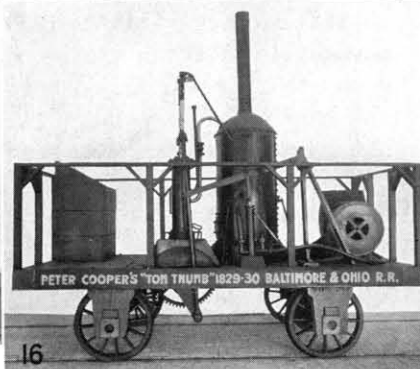
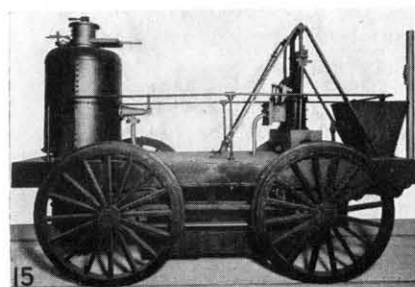
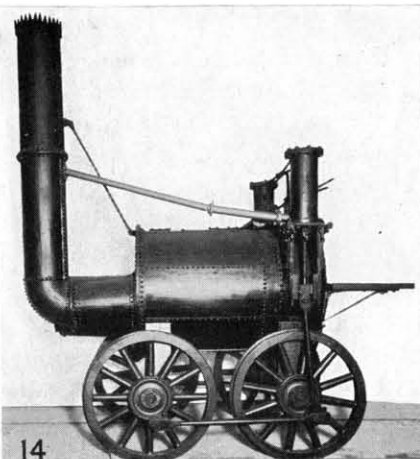
1812—Blenkinsopp. English rack rail locomotive, gearing into rack outside of the running rail, built by John Blenkinsopp. Two pair of driving wheels; horizontal boiler and two vertical cylinders. Weight about 5 tons. It was operated between Leeds and the Middleton Colliery, a distance of $3\frac{1}{2}$ miles.

1812—Hedley's Manual Power. English engine. Constructed by William Hedley of Wylam Colliery. With this engine he proved adhesion between smooth periphery of wheels and rails could be employed on locomotive driving wheels in hauling coal trains. The results obtained by this invention proved of great value in the development of the locomotive, dispensing with rack rail drive.

1813—Brunton's Steam Horse. Patented by William Brunton, an Englishman. The horse leg locomotive. The rear knuckle rods with their iron shod feet operated by horizontal cylinders like horses' legs. Legs pushed the engine forward. Rate of speed was too slow and lack of adhesion defeated the machine for practical use.

1813—Puffing Billy. The original Puffing Billy ran under its own steam at the English Railroad Centennial in 1925 and is the leading locomotive in point of interest at the South Kensington Museum, London. It was constructed at Wylam Colliery by William Hedley, assisted by the enginewrights, one of whom was Timothy Hackworth. The engine had a horizontal tubular boiler with two vertical cylinders located alongside at the rear. Rear of boiler connected by beams through crank shaft and gearing to two pairs of driving wheels.

1814—Blucher. One of George Stephenson's early productions employing transmission of power by gear wheels engaging gears on driving axles, with smooth tread flangless wheels on angle rails. Constructed for and used at the Killingworth



13. ROCKET
14. SANS PAREIL
15. NOVELTY

16. TOM THUMB
17. MERCURY
18. YORK

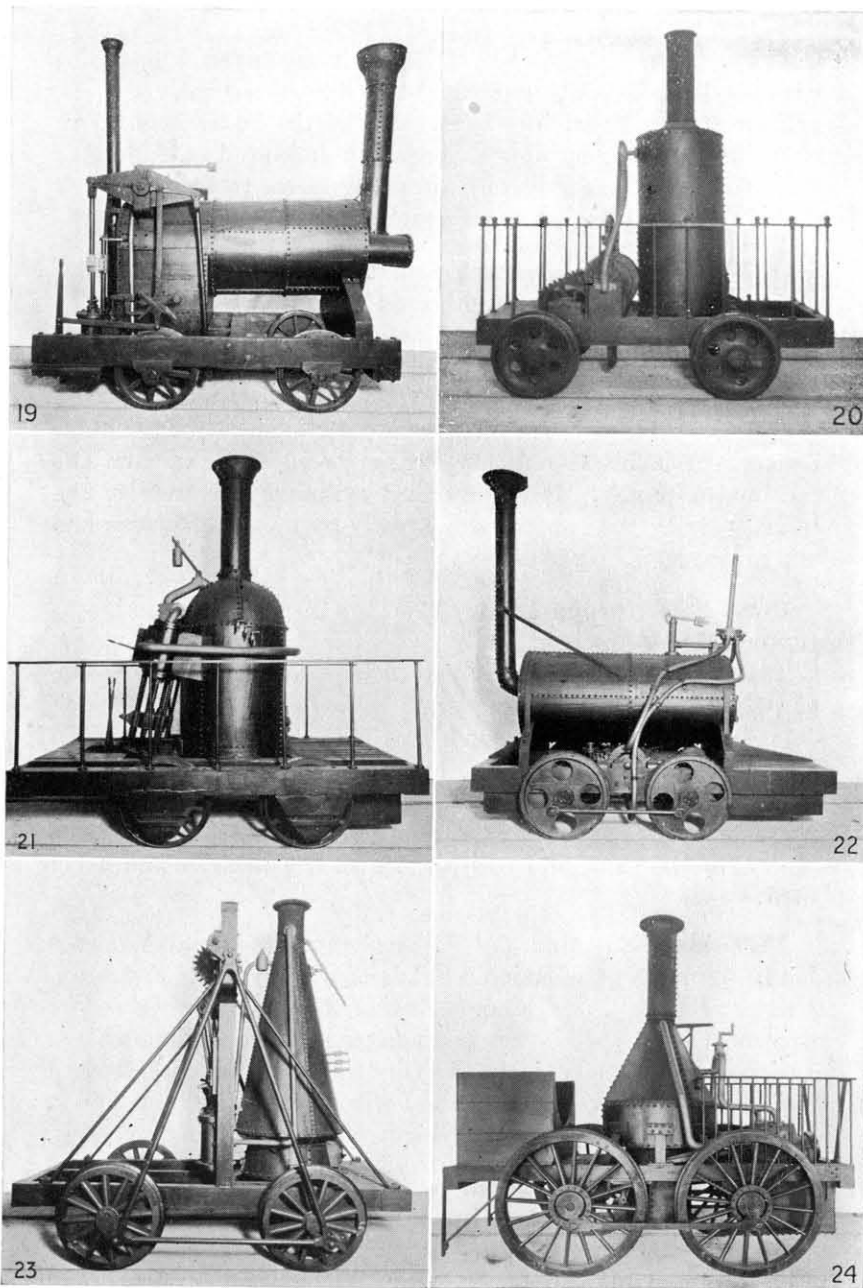
Colliery. Horizontal boiler 34 inches in diameter, 8 feet long with single 24-inch diameter flue; two 8-inch vertical cylinders, 24-inch stroke, fitted into the center of the boiler shell, with piston rods extending upward engaging crosshead extending to sides to take connecting rods dropping down to engage crank shaft belted with gear wheels engaging the axles of wheels.

1827-1832—Seguin. After Lieutenant Nicholas Joseph Cugnot had operated his locomotive on the streets of Paris with serious results in 1769, his machine was taken from him and he was locked up. Later he was released, but his treatment discouraged other inventors. In 1827, Seguin, chief engineer of the St. Etienne Railway, invented and patented the multitubular boiler used in his engine, employing forced draught from the fan on the tender. It had vertical cylinders alongside of the boiler, driving the two pairs of drivers by means of beams and connecting rods.

1828—Stourbridge Lion. The first English locomotive to run on rails in America. Built by Foster Rastrick & Company, of Stourbridge, England. Received in America in May, 1829, and placed in service in August, 1829, on a tramway at Honesdale, Pa., which later became a part of the Delaware & Hudson Railroad. Horatio Allen, the first American engineer, ran this locomotive. It had a horizontal boiler, vertical cylinders and walking beams connecting two pairs of drivers. It proved too heavy for the track and was withdrawn from service and never used.

1829—Rocket. Built by R. Stephenson & Company, England. Winner of the Rainhill Trials of the Liverpool and Manchester Railway, England. Engine had four wheels—two drivers at front 56½ inches in diameter and two trailing wheels, 34 inches in diameter, inclined cylinders 8 by 17 inches, located at the side at the rear end of the horizontal multitubular boiler. A world famous locomotive. Weight, a little more than five tons.

1829—Sans Pareil. Built by Timothy Hackworth, of England. Stephenson's competitor in the Rainhill Trial. Unequal to the *Rocket*, however. After the trial it was purchased by the Liverpool and Manchester Railway. Hackworth employed and proved the blast pipe or blower essential in generating steam in a locomotive.



19. JOHNSON
20. CHILDS
21. REMODELLED YORK

22. COSTELL
23. JAMES I
24. PHOENIX

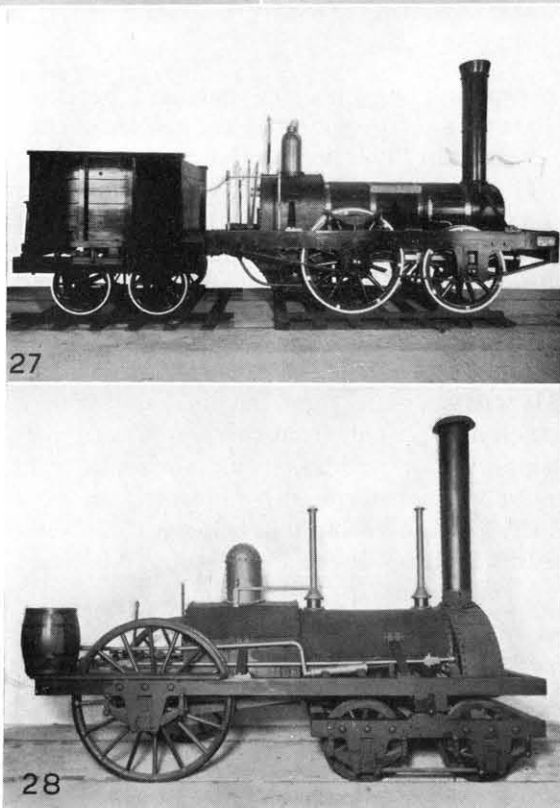
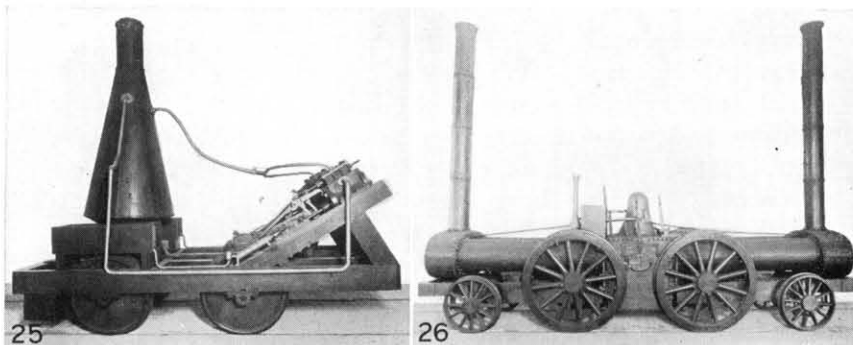
1829—Novelty. English locomotive. Built in the short space of seven weeks by J. Braithwaite and J. Ericsson. A close competitor of Stephenson's Rocket, the winner of the Rainhill Trial, being awarded second prize. Engine consisted of a boiler with horizontal barrel connecting to upright cylindrical firebox, coal being charged into the top of firebox through removable cover on grate above closed ashpan. Supplied with air for combustion by bellows worked by the engine. The two vertical cylinders were placed above the barrel and at the opposite end from the firebox, crossheads working on vertical guides at the outer end, had connecting rods connected to crank axles of the driving wheels. The United States *Monitor*, of Civil War fame, was designed by Ericsson.

1829—Howard. Designed and patented but not built, by William Howard, a civil engineer in the service of the Baltimore and Ohio Railroad. This locomotive had a horizontal boiler with vertical cylinders extending into the boiler at the forward and back ends, operating on walking beams, which in turn connected to cross heads, on outer end of which connecting rods extended to crank pins on the outside of the ratchet wheel located against outside of driving wheels and in which pawls engaged for transmitting the power to driving wheels.

1830—Mercury. 2-2-0 type English locomotive. One pair of drivers with a single pair front carrying wheels in main frame pedestal supported on springs, inside horizontal cylinders and crank axle, valve gear operated by eccentric on main axle. A notable early locomotive built by George Stephenson, it embodies the best features of the Planet type of locomotive which at that time was a popular construction.

1829-30—Tom Thumb. First American built locomotive. Built by Peter Cooper, of New York, to prove steam operation. Ran successfully on the rails of the Baltimore and Ohio, 1829-1830. Thereupon, in January, 1831, the directors offered \$4,000 as a prize for an engine weighing three and one-half tons to haul fifteen tons on the level at fifteen miles per hour. (See Second Section of this booklet, pages 20-21.)

1831—York. The first locomotive built by Phineas Davis, of York, Pa., winner of the \$4,000 prize in the Baltimore and Ohio competition at Mount Clare in 1831. Vertical boiler, no



25. JAMES II
26. SOUTH CAROLINA DOUBLE ENDER
27. OLD IRONSIDES
28. JERVIS EXPERIMENT

tubes, with center flue extending down from the crown to cylindrical drum firebox, carried on a frame supported on two pairs of drivers with outside cranks connected by trussed side bars with connecting rods to vertical cylinders, bolted to the top of sides of the boiler. Engine weighed $3\frac{1}{2}$ tons and, after experimenting, the *Remodelled York* was designed.

1831—Remodelled York. Representing the York as changed by Phineas Davis at Reeder's Shops at Baltimore, Md., in 1831, after the trial trip of the *York*. The cylinders were relocated on the back of the boiler and driving through spur gears on one pair of drivers. This engine proved too light for the grades. Weight $3\frac{1}{2}$ tons.

1831—Johnson. Awarded \$1,000 prize in the Baltimore and Ohio competition at Mount Clare. It had four flanged wheels; horizontal twin rectangular firebox, double flue boiler, twin vertical cylinders at the rear of the firebox, walking beam, single drivers. Shown on stone stringers and strap rails.

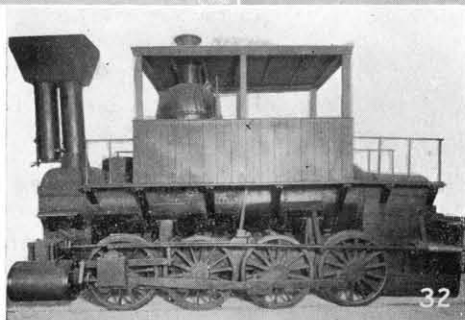
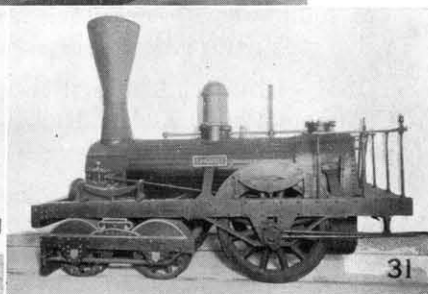
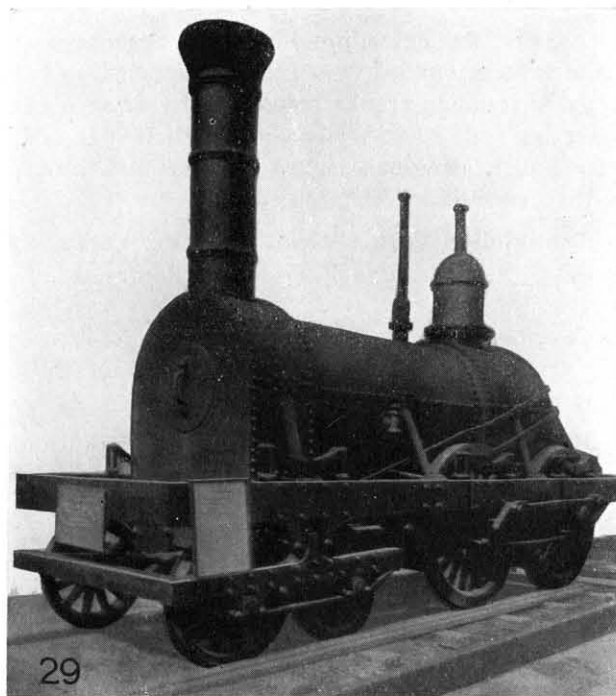
1831—James I. One of the five locomotives in the Baltimore and Ohio competition at Mount Clare. Built in New York. Ran successfully, but did not meet the conditions. It was equipped with two vertical cylinders and with link motion valve gear and vertical conical boiler.

1831—Childs. The first rotary locomotive. Built by Ezra Childs, of Philadelphia. Ran in the Baltimore and Ohio competition at Mount Clare, but did not win the prize.

1831—Costell. The first locomotive built in Philadelphia. Entered in the Baltimore and Ohio competition at Mount Clare, but failed to meet the requirements of the test. It had oscillating cylinders, four wheels, flanged drivers, horizontal boiler.

1831—James II. A modification of the *James I* with enlarged boiler, employing inclined cylinders with link motion valve gear. After minor changes it was bought by the Baltimore and Ohio Railroad and used until the latter part of 1836.

1831—Phoenix. Rebuilt from the *Best Friend* by moving the boiler from outside of the rear drivers to between the drivers. Built for and operated on the South Carolina and Hamburg Railroad, now part of the Southern Railway system. Horatio Allen, who was the engineer of the *Sourbridge Lion*, became the engineer of the *Best Friend*.



29. CAMPBELL

30. HERCULES

31. SANDUSKY

32. WINANS CAMELBACK

1832—Jervis Experiment. A very successful locomotive. Built by John B. Jervis, of New York, with the first bogie or front truck attached to frame by pin and bracket, working on friction rollers. Jervis was later associated with William Norris, the pioneer locomotive builder of Philadelphia.

1832—Old Ironsides. First Baldwin Locomotive Works locomotive. A four-wheeled engine modelled essentially on the English practice of the day, *i. e.*, the *Planet* class. Weight in running order, something over 5 tons. Rear driving wheels 54 inches in diameter with crank axle placed in front of firebox. The front wheels are simply carrying wheels and are 45 inches in diameter, on an axle back of the cylinder. Cylinders $9\frac{1}{2}$ inches in diameter, 13-inch stroke, attached horizontally on outside of D-shaped smokebox. Wheels made of heavy cast iron hubs with wooden spokes and rims and wrought iron tires. Wooden frames placed outside of wheels. Boiler 30 inches in diameter, containing 72 $1\frac{1}{2}$ -inch diameter copper tubes 7 feet long. Tender—four-wheel platform with wood sides and back carrying iron box for water inclosed in a wood casing. Valve given motion by a single loose eccentric for each cylinder, placed on driving axle between crank and hub of wheel. Engine reversed by changing position of eccentric on axle by lever operated from foot-board.

1833—South Carolina Double Ender. The first articulated locomotive. It was a 2-4-2 type, and was designed by Horatio Allen for the South Carolina Railroad. The engineer drove it from a seat located on the top of the firebox which was placed in the middle of the boiler and fired from the side with two barrels extending forward and backward from the firebox to smoke box at each end, each surmounted by a stack; single cylinder in each smokebox, located on the center line of the engine attached to crank axles on a single pair of drivers, located ahead and at rear of firebox, each engine consisting of one pair of driving wheels and one pair of carrying wheels, carried on articulated frame, hinged to firebox with roller support in the middle of the frame for carrying the boiler.

1837—Sandusky. The first locomotive built by Rogers, Ketchum and Grosvenor, of Paterson, N. J. It had a single pair of drivers, four-wheel swiveling truck, inside inclined

cylinders, horizontal boiler, square firebox, and was built for the Mad River and Lake Erie Railroad, later the Sandusky, Newark and Mansfield, now part of the Baltimore and Ohio.

1837—Hercules. 4-4-0 American type. Built by Eastwick and Harrison, of Philadelphia, for the Beaver Meadow Railroad, now part of the Lehigh Valley Railroad. One of the famous locomotives of that time. First in the world with equalizing frame and vibrating beam, or equalizer. Inclined cylinders, main rod connecting to rear drivers, valve motion operated by eccentric on rear axle and independent cut-off valve. Weight, 15 tons.

1837—Campbell. The first of the American or 4-4-0 type locomotives, with four drivers and four truck wheels. It had inside cylinders, horizontal boiler, round-top firebox and was constructed with the wheel arrangement patented by Henry R. Campbell, of Philadelphia, February 5, 1836, and built by Henry R. Campbell, chief engineer of the Philadelphia, Germantown & Norristown Railroad, and Robert Brooks, of Philadelphia.

1848—Winans' Camelback. Eight-wheel connected locomotive built by Ross Winans, of Baltimore, for the Baltimore and Ohio Railroad. Horizontal cylinders, drivers 43 inches in diameter, horizontal boiler with inclined top overhanging firebox, large cylindrical dome on forward part and cab built on top of the boiler. These engines were built in three sizes—small, with 17 by 22 inch cylinders and short firebox; medium, 19 by 22-inch cylinders and medium firebox; long, 19 by 22-inch cylinders and long firebox. Plate frames, solid bushed side rods, equipped with hook motion valve gear. Converted into Stephenson link motion about 1870. These were the principal freight locomotives until the introduction of the Consolidation type in 1873, and were in operation as switching engines until 1898. (See Second Section of this booklet, page 23.)

