Between 1869, when work on it began, and 1883, when it finally opened with celebrations unlike anything New Yorkers had ever seen, the Brooklyn Bridge remained constantly in the American consciousness. Lengthy articles about the Bridge’s construction, the politics behind its financing, and the lives of its designers, John A. Roebling and his son Washington, appeared frequently in local, national, and even international journals and newspapers. As the Bridge took shape over the East River, it became a powerful presence in the everyday life of New Yorkers and a major attraction for tourists.

After its completion, the Bridge continued to capture the imagination of many as a manifestation of the power of civilization to conquer nature; its towers were among the tallest structures on the continent, and its span the longest in the world. As John Roebling had predicted, it became an inspiration to Americans and a national landmark.

The images—most of which lie unknown, except to specialists, in the wonderful archives of New York’s museums and libraries—convey some of the excitement and fascination that the Bridge has always created. These images provide an understanding of the context in which the Bridge was built, survey the Roeblings’s engineering achievements, suggest what New York and Brooklyn looked like from the mid-nineteenth century through the time the Bridge was opened, and convey in brief a history of the way in which the Bridge has inspired countless artists and photographers.

The severe hardships engendered by the settlement and exploration of the American continent were often accompanied by an almost religious exultation at man’s ability to subdue nature. Industrialization and remarkable technological advances in the nineteenth century, especially in the New World, suggested a hope and sense of mission which found realization in the spirit of “Manifest Destiny.” This notion of the unity of the continent as divinely ordained was expressed well in Walt Whitman’s 1871 poem “Passage to India,” which hailed the movement of civilization to the Pacific coast and beyond. “Nature and Man shall be disjoin’d and diffused no more,” Whitman wrote. “The true son of God shall absolutely fuse them.” The actual physical joining of the East and West by bridge, canal, and railroad was thus more than metaphor; it was principle.

John Roebling believed in this principle. He saw the Brooklyn Bridge as an essential part of a continuous highway from East to West, and surveying for the Bridge was...
begun the same year (1869) that the transcontinental railroad was completed. Roebling’s sense of mission led him to view the forms of suspension-bridge design and the goals of engineering in metaphysical terms: the curve of a bridge’s cables was based on an elemental curve of nature, the catenary, and in the combination of tension and compression in his bridges Roebling saw the forces of nature in a state of idealized harmony.

In the 1872 painting *American Progress (Manifest Destiny)*, Roebling’s bridge over the East River symbolizes the critical role of transportation and communication in the westward movement of civilization. As the sun rises over the Bridge and the railroad network spreading out to the West, the figure of “Progress” draws a telegraph wire behind her, and men advance with plow and wagon, driving the wild beasts and the Indians ahead of them. The only women are an Indian and “Progress” herself. Not a hint of failure, backsliding, or complexity intrudes into this tidy image.

John A. Roebling was one of the greatest minds of nineteenth-century America. Born in Germany in 1806, he studied engineering in Berlin and was both a student and a friend of the metaphysician Georg Wilhelm Friedrich Hegel. Attracted by the democracy and economic opportunities of America, he left Germany with his brother Karl in 1831 to seek land in the United States for a colonizing party to follow. On 1,600 acres of cheap land he bought in Butler County, Pennsylvania, twenty-five miles from Pittsburgh, he laid out a little village called Saxonburg. Here he tried his hand at farming and canary breeding, both unsuccessfully, before rededicating himself to engineering.

Canal transportation was of vital importance at the time, and Roebling worked as surveyor and engineer for numerous construction projects of the Pennsylvania canal system. The many mountain chains in the state were crossed by means of portage railways, which carried barges and passenger cars up steep inclines using hemp rope and steam engines. The rope wore quickly and required frequent replacement. After an accident in which two men were killed when a rope failed, Roebling turned his attention to manufacturing rope from iron wire, remembering a description of such a cable in a German periodical. In 1841 he produced the first wire rope in America at his Saxonburg farm.

At Saxonburg, Roebling displayed the administrative abilities and ingenuity which were to be the hallmarks of his career. Using machines of his own design and the labor of his friends and neighbors, Roebling produced cables made from wire strands in which all the wires were evenly tensioned. The great strength and reliability of the new wire rope were soon proven in practice, and eventually all the Pennsylvania canals used the cables. Other applications were found in rigging, hoists, tow lines, and suspension structures.

Saxonburg, which became an industrial town, remained Roebling’s home until 1849. Seeking access to the market and industrial centers further east, he then moved his home and expanding business to Trenton, New Jersey.
When John Roebling died in 1869 following an accident on the Brooklyn Bridge site, his son Washington A. Roebling assumed his responsibilities. Trained at Rensselaer Polytechnic Institute in Troy, New York, Washington had worked on his father’s suspension bridges after graduation. Nonetheless, the building of the Brooklyn Bridge was an awesome task, which drove him to exhaustion.

Washington Roebling believed that management should take as many risks as labor, and he continually went down into the Bridge’s underwater foundations, or caissons, both in normal circumstances and in situations of crisis. In 1871 he experienced the terrible effects of caisson disease, or the bends, and in 1872 his physical suffering combined with anxiety and fatigue turned him into a permanent invalid. Although he never went to the Bridge site again, he continued to direct the construction of the Bridge—first from his home in Trenton, New Jersey, and later from his house on Brooklyn Heights.

A woman of tremendous fortitude and intelligence, Emily Roebling was her husband Washington’s chief aide in building the Bridge. She took Roebling’s correspondence, read all important documents to him, communicated in person with the board of directors and the engineers, and provided Roebling eyewitness accounts of the construction progress. Without her energy and reliability, Washington Roebling could not have continued on the project after 1872.

The twenty-one years before John Roebling designed the Brooklyn Bridge were years in which he perfected in practice his understanding of the technology of suspension-bridge construction while building a series of aqueducts and bridges. By the time he faced the challenge of the Brooklyn project he was a master in his profession.

In 1822, when exploitation of the anthracite coalfields around the eastern Pennsylvania town of Lackawaxen began, river transport provided the sole means of moving this coal to the New York market and the sea. The Delaware and Hudson Canal Company was formed to build a canal that would permit barge traffic from the fields to the Hudson River. Beginning at Honesdale, Pennsylvania, the canal entered the Hudson at Roundout, New York. After the 108-mile-long waterway was fully opened in 1829, traffic increased rapidly from 7,000 to 192,000 tons by 1841. Despite modest enlargements, the canal and its locks soon proved inadequate.

In 1847, in order to alleviate the bottleneck in the system, Roebling designed two aqueducts to carry the canal over the Delaware and Lackawaxen Rivers. These aqueducts allowed canal barges to avoid the congestion of river traffic and the hazards of river ice. The aqueduct over the Delaware also removed the need to dam that river in order to create a pool over which the barges could travel.

With the construction in 1849–50 of two additional Roebling-designed aqueducts (one at Cuddelback, New York, over the Neversink River and one at High Falls, New York, over the Roundout Creek), the passage to New York City was cut by a full day. The canal competed successfully with the expanding railroad system until the 1870s, when railroads became the faster and more economical way to haul freight.
All four of Roebling’s Delaware and Hudson aqueducts (and all of his subsequent bridges) were designed along the same lines as his Pittsburgh Aqueduct over the Allegheny River, built for the Pennsylvania State Canal in 1844–45. Unlike his competitor Charles Ellet, who left his cables bare, Roebling wrapped his cables with wire. These cables were attached to anchor bars, which were in turn connected to anchor plates. Although this sort of anchorage was used in Europe at the time, Roebling improved it by imbedding the anchor plates in masonry and pouring cement grout over the anchor bars in order to provide protection against rust. Roebling also introduced the use of a timber grillage between anchor plate and masonry to distribute stress—a technique he patented in 1846.

The 535-foot-long Delaware Aqueduct was divided in four spans supported by masonry piers and carried by 8-inch-diameter cables. Because the canal channel itself was constructed of timber arranged in a lattice truss able to carry the canal’s own deadweight between the piers, the cables only had to support the weight of the water in the canal. Solid iron rods rather than wires were used to hang the canal deck from the spanning cables.

When the canal system closed in 1898, the Delaware Aqueduct was easily converted to a highway bridge. The towpath for the draft animals was removed, and in the 1930s the bridge was redecked after a fire destroyed some of the original timber. The structure is now listed with the National Register of Historic Landmarks. It is considered the oldest suspension bridge in the world still completely intact.

The 170-foot-long single span of Roebling’s aqueduct over the Neversink River was the longest of his Delaware and Hudson aqueducts. It was carried by 9-inch-diameter cables, the largest ever made at the time. An analysis of the cables made in 1920 revealed no deterioration due to rust and no decline in the tensile strength of the cables’ iron-wire strands. Unfortunately, today nothing remains of the abandoned structure but its masonry abutments.

The success of Roebling’s Delaware and Hudson aqueducts greatly enhanced his prestige, and he was soon commissioned to design a bridge over the river at Niagara Falls. An international railway bridge over the Niagara gorge had first been suggested in 1845 by Major Charles Stuart, a civil engineer designing the route of Canada’s Great Western Railway. The critical problem was how to support the dynamic load of a moving freight train. This was a very different problem than how to support the static load of an aqueduct, and Roebling’s solution not only created the world’s first wire-cable suspension bridge for railroads but also produced some critical analysis of the question of safety in all suspension structures.

Roebling had long advocated substantial stiffening of bridge roadbeds in order to resist all possible tempest and stress. The failure of Charles Ellet’s suspension bridge over the Ohio River at Wheeling, West Virginia, in May 1854 confirmed his commitment to a system of trusses and inclined stays. After the Wheeling disaster, he added stays beneath the roadway of the Niagara Bridge in order to counter upward forces from the high winds frequently encountered at the site.
The bridge crossed the gorge in a single 825-foot span carried by four cables ten inches in diameter. Four masonry towers sixty feet high supported the cables themselves. There were two levels: a 24-foot-wide upper deck for a single railway track, and a 15-foot-wide lower deck for carriages and pedestrian traffic. The arrangement of the cables—designed to carry six times their working load—was unique, with two attached to the lower deck, and two to the upper deck. Also unprecedented was the system of stiffening trusses, fully eighteen feet long, that occupied the entire depth between the two decks. Roebling was obliged to use timber for these trusses because iron was considered too costly.

The first fully loaded train crossed the gorge in March 1855, and the bridge remained in service until 1897. Eventually the timber trusses and the masonry towers were replaced with iron and steel ones—a change that required no interruption of train service. In its last years of service, as locomotives and freight cars increased in weight, the bridge carried loads three times its supposed capacity. Although the bridge has long since disappeared, the town adjacent to its United States abutment is still known as Suspension Bridge, New York.

In 1857 Roebling was commissioned to build a highway bridge over the Allegheny River at Pittsburgh to replace an antiquated and deteriorating wooden-truss covered bridge. It was Roebling’s third project in Pittsburgh, following the aqueduct for the Pennsylvania canal and a bridge over the Monongahela River that he completed in 1846. The Allegheny Bridge was made up of four spans totaling a length of 1,030 feet. For the first time Roebling used iron rather than timber for the suspended roadway structure, and wood was used only for the roadbed itself. The spans were supported by four cables spun in place, the principal cables requiring 4,200 trips of the wire spinning shuttle, and the outer smaller cables requiring 1,400 trips. Wrought-iron trusses ran the whole length of the bridge to stiffen the roadway, and inclined stays provided further rigidity. Six elegant iron towers supporting the cables rested on three massive granite piers that were rounded to deflect ice and current. This was the first of Roebling’s bridges to be generously financed, suggesting the high confidence that investors placed in Roebling’s now proven genius. Although the bridge was considered so sound and fire resistant that no insurance was carried on it, an 1881 fire caused by cinders from steamboats severely damaged the roadbed, necessitating its replacement. The bridge was demolished in 1891 and replaced by a larger structure. The construction of the Allegheny Bridge, initially directed by John Roebling, was eventually supervised by his son Washington, who joined his father in 1858 at the age of twenty-one.

Roebling also involved his son in the building of his bridge over the Ohio River between Cincinnati, Ohio, and Covington, Kentucky. Such a bridge had been envisioned by the citizens of Ohio and Kentucky since the early nineteenth century, but the heavy river traffic which developed precluded any bridge that would impede passage by blocking the river with piers or by restricting the height of steam vessels. In an exhaustive analysis of 1846 Roebling refuted the arguments of the bridge opponents and assured the public of his command of the technology required. His confidence and experience allowed him to write: “The construction of suspension bridges is now so well understood that no competent builder will hesitate to resort to spans of 1,500 feet and more.”
Investment in the bridge company languished, however, until 1856, when an energetic and devoted bridge enthusiast was elected to the board. Soon Roebling was ready to begin work. Masonry towers 230 feet tall were built near each shore on top of great timber platforms that were sunk under the water line to keep their wood from ever drying out and deteriorating. Cables 12 -inches in diameter were strung out over the towers and anchored in abutments on each side of the river. The financial panic of 1857 and the Civil War interrupted construction from 1858 to 1863, but the work continued after the war with Washington Roebling, discharged from the Army, assisting his father.

The Cincinnati-Covington Bridge, still in use, has a span between the towers of 1,057 feet, which made it the longest in the world when it was completed in 1867. Wrought-iron beams are the cross members on which an oak and pine deck was originally built. Two wrought-iron trusses run the whole length of the bridge’s side, and Roebling’s use of diagonal stays increases the stiffness of the bridge appreciably. These stays, running crosswise to the vertical suspender cables, were a Roebling innovation. Roebling wrote that “their sole office is to counteract any undulations which might be imparted to the cables in a severe gale.” It was this precise understanding of the requirements of bridge engineering and its meticulous application which assured the success of all the suspension structures Roebling designed.

Brooklyn had a proud and distinctive personality when the bridge connecting it to Manhattan was begun. Up until the early nineteenth century it had retained the quality of the original Dutch settlement. Though the Dutch name of Breukelen had been anglicized, the rural tranquility persisted. From 1810 to 1847, however, the population swelled from 3,000 to 30,000. The very rapid growth of the city of New York, just across the East River, was the major factor behind this boom. Real estate speculation and improved ferry service also encouraged residential development on Long Island.

In the decades following Brooklyn’s 1834 incorporation as a city, the improvement of omnibus transportation enabled the extensive growth of once remote farming areas. The Consolidation Act of 1854 joined the towns of Williamsburg and Bushwick to Brooklyn, making it the third largest city in the United States. Though a large part of the population commuted each day to New York, Brooklyn had an extensive port and warehouse district with eight miles of piers and drydocks. Steel, glass, tinware, sugar refining, printing, and whiskey were all important Brooklyn industries.

The cultural and social center of Brooklyn was the Heights, an area developed by the Pierrepont family in the early 1800s and a neighborhood of imposing mansions rivaling those of New York by mid-century. The Eagle, Brooklyn’s important daily, began publication in 1841 as a Democratic campaign paper, and Walt Whitman was its editor from 1846 to 1848. The Academy of Music was built in 1861, and The Long Island Historical Society was established in 1863. Fulton Street was the commercial center of the city.

Before the building of the Brooklyn Bridge, ferries provided the essential link between Brooklyn and New York. In 1860, 32 million passengers used the East River ferries; by
1868 the number was more than 50 million. Thirteen ferry boats completed more than one thousand crossings each day.

Severe winters often made ferry crossings impossible, and the especially bitter winter of 1866–67 was important in persuading many influential Brooklynnites that a bridge to New York was essential. That December, Roebling’s Cincinnati bridge had opened with great success, confirming his abilities and insuring his choice as the designer of the bridge over the East River. Winning the contract was the fulfillment of Roebling’s career and the realization of his ideas of the 1850s.

Roebling himself had become obsessed with the idea of a bridge to Brooklyn after being icebound on a ferry in 1852. In 1856 he proposed a bridge over Blackwells Island (now Welfare Island); later he suggested a site nearer the present location. Although he submitted plans to the press in 1857 and 1860, the financial panic of 1857 and the Civil War delayed serious consideration of his proposal. Not until 1865 was a bridge company formed to seek support for construction and financing.

In 1969, Francis Valentine, an engineer for the New York City Department of Transportation, was sent to the department’s carpentry shop under the Brooklyn end of the Williamsburg Bridge to locate an engineering drawing needed for the repair of a small element of the Brooklyn Bridge. To his astonishment he found that the shop contained—in a state of complete disarray—some ten thousand of the Bridge’s original blueprints and drawings, including many by the Bridge’s chief engineers John and Washington Roebling.

It took Valentine four years to find someone who appreciated the documents’ significance. When he did, it was someone he played softball with, David Hupert, then with the Whitney Museum of American Art. In May 1976, Hupert mounted sixty-five of the drawings in the Whitney’s downtown gallery, and the exhibition was extremely well received by the public. Eventually the drawings found a home at the Municipal Archives of the City of New York, and Barbara Millstein of The Brooklyn Museum catalogued them. They are now available for study on microfilm.

The great attention to detail and the extensive use of color in these drawings allow us to experience the Bridge in a way that we never can when we see the structure itself. In some instances, as in a rendering of the boring for the foundation of the Brooklyn tower, the drawings have an almost photographic quality; in others, such as a depiction of men using a timber hoist, they are highly narrative. Still other drawings show us schemes for parts of the Bridge which were never built, giving us access to the thought processes of the Bridge’s engineers.

The Brooklyn Bridge drawings are among the most extensive records of any nineteenth-century bridge in the United States. Their quality and number, and the fact that they document one of the most remarkable engineering achievements of all time, make them a national treasure.
Each of the Brooklyn Bridge’s towers was built on top of a giant watertight chamber called a pneumatic caisson. A hollow wooden box with V-shaped sides and a solid roof of interlocking courses of timber, the caisson was partially constructed on land and then launched into the river. After launching, additional courses were added to the roof, and the first courses of stone for the tower were laid, depressing the caisson to the riverbed. Compressed air was then pumped into the chamber, prohibiting the entry of water. Men entered the chamber through air locks and began excavating the riverbed. As the digging went on below, the tower was simultaneously constructed above, forcing the caisson ever deeper. When the caisson reached ground firm enough to support the entire weight of the tower, it was filled with concrete.

The material that was excavated from the riverbed had to be removed from the caisson, and the engineers designed at least three methods for doing so. All involved the use of a water shaft that was to extend into a pool deeper than the caisson itself. A cart was lowered down the shaft, pulled to one side of the pool, filled, and then lifted up the shaft. In another scheme, a chamber was to be lowered from above, filled with debris dumped down two side chutes, and then hoisted to the top. Finally, in the system that was actually used, a “clamshell” scoop dropped down the shaft and, in an action Washington Roebling likened to that of a person picking up a handful of stones, grabbed the material the workers had deposited in the pool and brought it to the surface.

The Brooklyn Bridge was not the first bridge to be built on pneumatic caissons. Caissons had been invented in Europe (where Washington Roebling had studied them on a trip with his wife), and they had first been used in the United States in 1864 on a bridge at St. Louis designed by James Eads. Still, the Brooklyn Bridge’s caissons were the largest the world had ever seen.

The caisson for the Brooklyn side of the river weighed 3,000 tons and measured 168 by 102 feet—half a city block. It was built four miles upriver from its final resting place in a drydock about a hundred feet from the shore. On March 19, 1870, it was launched into the river, and on May 3 it was towed by tugs to a spot by the Fulton Ferry. There, the following day, it was maneuvered or “warped” into place in a three-sided basin that had been dredged out of the river.

Dredging this basin had proved difficult. The riverbed was so strewn with boulders that the material had to be blasted out during the night (so as not to disrupt the ferry) and dredged by day. After more than a month of blasting (with an average of thirty-five blasts a night) hardly a dent had been made. The original plan to dredge the entire basin to a depth of eighteen feet at high tide was abandoned, and only the edges of the basin were dug before the caisson was warped into place. In this, as in several other instances during the long years of building the Bridge, Washington Roebling and his engineers had to make quick and difficult decisions in the face of unforeseen circumstances.

Once in position, the Brooklyn caisson was built even bigger. Having measured 14 feet 6 inches high at launching (with a roof five feet thick), it grew seven feet taller as additional timber courses were laid on.
A number of measures were taken to insure that the caisson would remain airtight as it sunk into the riverbed. The seams were caulked with oakum, a rope permeated with tar; a special airtight varnish was applied to the timbers; the lower three feet of the caisson, inside and out, were clad in boiler plate; hot pitch was poured between all the courses of the roof; and a tin sheath was laid between the fourth and fifth courses and wrapped around the perimeter.

As mighty a structure as it was, the Brooklyn caisson would soon be surpassed by its New York counterpart. That caisson would be ten feet taller at completion.

The Brooklyn caisson was divided into six working chambers. At first digging was done entirely by hand. But it soon became apparent that this would take too long, and explosives were also used. This difficult work took place in an environment which was abominable. The men had to contend not only with heat, tremendous humidity, and an awful stench but also with the dreaded caisson disease, which science was just beginning to understand in the 1870s.

Washington Roebling knew that he would have to dig deeper on the New York side to reach a solid foundation. This would require a longer period of excavation and a longer underwater section of the stone tower. Roebling therefore modified the design of the New York caisson to meet the challenge of a situation even more hazardous than that on the Brooklyn side. The caisson itself was larger, measuring 102 by 172 feet, with seven more courses of timber. Each air lock had a capacity for sixty men instead of the twelve-man capacity of the air locks in the Brooklyn caisson. Thirteen air compressors were used instead of six. The caisson was now entirely sheathed in iron boilerplate to protect against fire, and the inside walls were whitewashed to reflect more light. Fifty sand-removal pipes each four inches in diameter extended to one foot above the working surface. As the top of a tube was opened from above, the compressed air of the chamber forced sand and small debris out. The New York caisson was sunk thirty-four feet deeper than the Brooklyn one. In the Brooklyn caisson, communication between the workers below and the men above had often been difficult; for the New York caisson an inventive mechanical communication system was developed. It used maps and indicators and short messages on boards channeled through a pipe.

The Bridge’s towers consisted of New York limestone below the high water mark and Maine granite above. The blocks were transported by schooner to Red Hook, Brooklyn, and then hauled to the tower on scows. Boom derricks hoisted the stones until the tower became too tall for the derricks to do the work. Then a system of pulleys run by steam was used. The stones were attached to a hook on the pulley by means of iron eyebolts attached to the blocks. At the top of the tower the blocks were placed on flat cars and moved near their final location. A boom derrick then placed them in their exact places in the stone course.

An average of twenty blocks an hour were laid, and construction was continuous except for the winter months. When complete, the New York tower contained 46,945 cubic yards of stone, and the Brooklyn tower 38,214.
The work on the Bridge was organized so that both the anchorage structures and the towers would be completed at once. Only when the anchorages were complete, ready to secure the cables and resist their tremendous pull, could cable spinning begin. The anchorage system John Roebling had devised in his earlier bridges was used here on a larger scale. Four 23-ton iron anchor plates, one for each of the four cables, were positioned at the bottom of both anchorages. Eighteen 12-foot-long eyebars radiated from the center of each plate, forming the first link in a double-tiered eyebar chain extending to the top of the anchorage. As the successive links of the chain were attached to each other they were encased in masonry. At the top, the number of eyebars in the last link of the chain was increased to thirty-eight, and each of the nineteen strands of wire that made up each cable was pinned between a pair of eyebars.

Made up of nine different bridges over the waterfront streets of New York and Brooklyn, the approaches provide access to the Bridge’s main span. They are constructed of granite-faced brick on a limestone foundation and measure 971 feet to the Brooklyn anchorage and 1,562 feet to the New York anchorage. By 1877, when work on the approaches began, $3.8 million had been spent buying up the land over which they would run.

The saga of the award of the contract for the Bridge’s cable wire was a sad and disturbing one for Washington Roebling. In the fall of 1876 Roebling liquidated his holdings in the Roebling wireworks so that the company could compete in the bidding; that December John A. Roebling’s Sons was given a contract to supply wire made of Bessemer steel. In January 1877, however, the Bridge board decided that crucible-cast steel was wanted instead, and J. Lloyd Haigh got the work with the lowest bid. Roebling doubted the strength and quality of Haigh’s wire, and, sure enough, on Thanksgiving Day, 1877, a wire broke. It was discovered that Haigh had been substituting lengths of faulty wire for ones which had passed inspection, and using Bessemer steel while charging for the more expensive crucible-cast kind. Nonetheless, he continued to supply the wire for the Bridge’s main cables. Roebling claimed this was because Abram Hewitt, a member of the Bridge board, was getting a ten percent kickback on Haigh’s payment in exchange for not foreclosing on a mortgage he held on Haigh’s wireworks. In designing the main cables, Roebling had called for wire six times stronger than necessary. He calculated that Haigh’s faulty wire was still five times stronger than needed and that there was, therefore, no cause for alarm. Later, however, when it came time to wrap the main cables and hang the suspenders, John A. Roebling’s Sons made the wire.

Washington Roebling was recuperating from caisson disease at his home in Trenton, New Jersey, when his master mechanic E. Frank Farrington wired him on August 14, 1876, with the news that two “travelers” had been fished out of the East River. Spliced together at their ends, these two ropes formed an “endless traveler” that served as a sort of giant conveyer belt between the anchorages. Worked back and forth through a system of pulleys by a steam engine, the traveler could transport men and wire across the river. On August 25, Farrington, who had worked with both Roeblings on the Niagara and Cincinnati bridges, had the honor of being the first man to cross the river.
using this rope. Riding in a boatswain's chair hanging from the traveler, he waved gamely to an estimated 10,000 spectators as the rope pulled him along.

After a second endless traveler had been hung, several other ropes were strung across the river—some to support a footbridge, others to hold the 40-foot-long, 4-foot-wide platforms on which the men would stand when binding the wires of the main cables. With the travelers, the footbridge, and the platforms in place, cable spinning began, and the travelers demonstrated their main function.

The steel wire for the cables was wound on 8-foot-wide drums each containing ten miles of wire spliced together. These drums were placed on the Brooklyn anchorage. To send a length of wire to the other side, workmen first looped the wire around a "carrier wheel" hung from the traveler, and then attached the wire to a horseshoe-shaped "shoe" on the anchorage. The traveler then pulled the wheel carrying the wire to New York, where the wire was taken off the wheel and secured to another shoe. Because the traveler formed a loop, two lengths of wire could be strung at once. As one carrier wheel transported a wire to New York, another carrier wheel returned empty to Brooklyn to pick up more wire. Men on the platforms adjusted each wire after it was spun to insure that all the wires in the cable were parallel. The trip from anchorage to anchorage took about ten minutes.

When about 280 wires had been strung together, they were bound at fifteen-inch intervals and became a strand. When nineteen strands had been made, they were wrapped with wire to form a cable. Each cable contained 3,315 miles of wire.

Each cable rests in 4-foot-high, u-shaped saddles below the roofs of the towers. The saddles are placed on rollers, providing the cables some flexibility to adapt to changes in load. The diagonal stays are attached to the towers at a point just below the saddles.

After the nineteen strands of a cable had been lashed together in their proper relation to one another, the cable was wrapped with soft wire and coated with white lead. The wrapping device, developed by John Roebling, was placed on a buggy that could accommodate the four men needed to perform the operation.

Composed entirely of steel, the Bridge floor represented a major industrial and technological innovation. No structure of such size had ever been built of steel, and the contractor had to design new machinery in order to manufacture the girders.

The floor was formed from open-work girders, or trusses, which are lighter and stronger than solid beams. The principal trusses were hung from the suspender cables, parallel to the towers, 7 feet 6 inches apart, with smaller trusses suspended halfway between. Bolted to these trusses at right angles were six rows of other trusses running the length of the Bridge. The floor was constructed from the towers and the anchorages outwards; as each girder was secured to the suspenders, planks were laid on top, creating a working platform for the suspension of the next section of floor.
The diagonal stays, which cross the vertical suspenders to create a web of wire, have, like the towers, inspired countless artists and writers. The hypotenuse of a right triangle formed by each stay in combination with the tower and roadway symbolized for Roebling the same sort of metaphysical harmony with nature as did the catenary curve of the main cables. At the same time the stays were essential to the overall strength of the Bridge.

Hundreds of stays span out from each tower to relieve the suspenders of some of the load. They are secured fifteen feet apart to the Bridge floor and are damped to the suspenders to further stiffen the structure. It has been calculated that the diagonal stays alone could support the roadway.

The Bridge’s pedestrian promenade was built eighteen feet above the roadway. John Roebling thought of it as an important urban amenity. “I need not state,” he wrote in his original plan, “that in a crowded commercial city, such a promenade will be of incalculable value.” The walkway was intended and has always been used as a place to exercise, socialize, relax on a bench, and enjoy the view of the city and river. It is more like a park than a street.

“The promenade,” E. Frank Farrington wrote, “is over fifteen feet wide, and so high that pedestrians will have an uninterrupted view of their surroundings. Invalids will here find the purest air and the brightest sunshine—when it shines anywhere at all. Here the orator and the poet will come for inspiration. Here Chawles and Arabella Seraphina will plight their faith, while Hezekiah and Jerusha from the back country will make this the terminus of their wedding ‘tower.’”

The Bridge’s opening day, proclaimed People’s Day, produced a frenzy of festivity unlike anything seen before. People poured into New York and Brooklyn by train, boat, and barge, and all the hotels were full. At noon, business virtually shut down, and President Chester A. Arthur and New York Governor Grover Cleveland led a parade down Broadway for the official opening. At 2 p.m., the President and his party began their walk across the Bridge as a band played “Hail to the Chief,” the North Atlantic Squadron fired a salute, and church bells tolled. Emily Roebling, representing her invalid husband, waited for the President at the Brooklyn terminal with Brooklyn Mayor Seth Low and several thousand invited guests. Later the President and the Governor went to personally congratulate Washington Roebling at his Brooklyn Heights home.

At eight p.m., with the Bridge cleared of all traffic, fifty great rockets began the climactic pyrotechnic display—an event recorded by the artist John Mackie Falconer as it appeared from the foot of Remsen Street in Brooklyn. While bells and whistles and cheers sounded from every direction, fireworks were dropped from gas balloons, shot off the Bridge, fired from boats, and set off over land. For the grand finale, five hundred rockets were fired simultaneously. All told, fourteen tons were exploded.

“Could there be a more astounding exhibition of the power of man to change the face of nature,” New York Congressman Abram Hewitt asked in his opening-day speech, “than
the panoramic view which presents itself to the spectator standing upon the crowning arch of the Bridge...In no previous period of the world’s history could this Bridge have been built. Within the last hundred years the greater part of the knowledge necessary for its erection has been gained... At the ocean gateway of such a nation, well may stand the stately figure of Liberty enlightening the world; and in hope and faith, as well as gratitude, we write upon the towers of our beautiful Bridge, to be illuminated by her electric ray, the words of exultation, Finis Coronat Opus.”

On Decoration Day, 1883, a week after the Bridge opened, huge holiday crowds turned out to enjoy the promenade in perfect spring weather. About 20,000 people were on the Bridge in the early afternoon when a crush of traffic from both directions effectively stopped all movement on the narrow stairs on the New York side. Someone tripped, there were screams, and a panic ensued in which twelve people were trampled to death.

Even before the Bridge was opened, New York stores and industries used it in advertisements associating their products or services with the Bridge’s strength and fame. Soon after it was completed, images of the Bridge began appearing on furnishings ranging from lamps to wallpaper.

The rapid growth of the city of Brooklyn in the mid-nineteenth century made clear the urgent need for a dependable transit link with New York. From 1810 to the end of the Civil War in 1865, Brooklyn’s population increased from 3,000 to almost 300,000. In 1870, the year construction of the Bridge began, fourteen ferries transported 37,000 passengers a day between the two cities. By 1883, 112,000 passengers were being carried.

Washington Roebling had initially opposed a heavy railway for the Bridge because he felt the concentrated load of a large locomotive would impose too much additional stress on the structure. He preferred instead a cable railway of tried and proven design similar to the system his father had used to move barges across the Pennsylvania canal portages. The cable cars were drawn by an endless steel wire rope driven by steam engines. There were terminals at both ends of the Bridge where passengers paid their five-cent fare and climbed a staircase to the train platform. When service commenced on September 24, 1883, there were twenty-four cars in operation and the trip across took five minutes. Six million passengers were carried that first year. By 1888, the number was 31 million, and the service was severely overburdened. With Roebling’s consent, eight steam locomotives were put into service.

In 1898, the year Brooklyn was incorporated into New York City, tracks for electric trolleys were laid on the Bridge and electric trains of the Brooklyn Elevated Company began running on the cable car tracks (replacing the cable cars except during rush hours). Ten years later, with half a million passengers crossing the Bridge each day, the cable cars were totally eliminated and their tracks were reinforced to permit expanded service of the electric trains. The trains continued running until 1944, the trolleys until 1950.
The City Beautiful movement, which was a major force in urban design in the decades before and after the turn of the century, was concerned with the planning of mass transportation, the building of grand public spaces, and the construction of monumental architecture inspired by Classical and Renaissance forms. These concerns were reflected in proposals involving the Bridge offered by a Brooklyn pastor named Dr. Newell Dwight Hills and a New York City Bridge Commissioner named Arthur O'Keefe in 1912.

In a talk entitled “What Can We Do to Make Brooklyn a More Attractive City?” Dr. Hillis proposed building a shore highway and constructing an elevated promenade that would run from Joralemon Street to the Navy Yard while passing the entrances to the Brooklyn and Manhattan Bridges. This scheme foretold the construction of the Brooklyn-Queens Expressway and the Brooklyn Heights promenade.

The proposal put forward by Commissioner O'Keefe was intended to improve the Brooklyn Bridge terminals, connect the Brooklyn Bridge to the Manhattan Bridge by a broad boulevard, and change the physical form of downtown Brooklyn. The streets from the Brooklyn Bridge to Brooklyn’s Borough Hall would be cleared for a wide boulevard which would lead to a new civic center, and the elevated trains would be removed from the lower part of Brooklyn’s Fulton Street. The Manhattan terminal would become a multileveled structure connecting to the city’s underground subways.

The origins of twentieth-century New York, both in its physical characteristics and its social institutions, can be traced to the years between 1870 and 1900. No single New York structure better symbolizes this era of progress and change than the Brooklyn Bridge. It embodies both the technological advances that were essential to the modernization of New York and the spirit of confidence that allowed designers, politicians, and the public to envision huge projects involving complicated administration and finance.

The New York of 1870 was a densely populated horizontal city in which the highest buildings were five and six stories. The great majority of people and commercial establishments were located below 23rd Street. Grand Central Depot, built between 1869 and 1871, was constructed at 42nd Street and Park Avenue in part because the city government had ruled that there could be no steam engines below that point—in other words, within the heart of the city.

By the 1880s some of the first skyscrapers had been built in lower Manhattan. Among the most notable was the Tribune building of 1873–75. It combined advances in steel and iron construction with the passenger elevator to create the beginnings of the vertical city. In 1899 a British journalist wrote, “when they find themselves a little crowded, they simply tilt a street on end and call it a skyscraper.”

The dazzle of New York at night was already a distinctive feature of the city when another British author told in 1882 of the electric lights on Broadway from 14th to 26th
Street. “The effect of light in the squares of the Empire City,” this correspondent wrote, “can scarcely be described, so weird and so beautiful is it.” The next year the electric lights on the Bridge were turned on, making it the first bridge in the world to be electrified.

The population density of lower Manhattan (330,000 persons per square mile on the Lower East Side by the late 1880s) was lessened somewhat by the development of apartment houses. The first of these houses, built for the middle class, were located north of the densest areas of the island. The famous Dakota apartment house, occupied in 1884, was so named, legend has it, because it was so far north and west of the central city that living there was like being in the Dakotas.

The effects of the crowded urban environment on people were addressed by such social reformers as Frederick Law Olmsted, who effected monumental change through his plans for New York’s Central Park (designed in 1857), Brooklyn’s Prospect Park (designed in 1866), and upper Manhattan’s Riverside Park (designed and built between 1873 and 1910). These open spaces, planned in a naturalistic and picturesque style derived from nineteenth-century English landscape theory, gave the city dweller sorely needed room for mental and physical release. Olmsted theorized that parks were integral to a democracy: they served as places where all classes could mix and experience one another’s company in an atmosphere lacking in the established social hierarchies. (For a comparison of the Bridge and Prospect Park see Albert Fein’s essay.)

The development of these parks as important cultural institutions was paralleled by the establishment in the late 1800s of museums and libraries. The American Museum of Natural History was established in 1869, The Metropolitan Museum of Art was founded in 1870, and The Brooklyn Museum opened its doors in 1897. In 1895 the New York Public Library was founded, and two years later the Brooklyn Public Library Association began to serve the public. Both libraries were formed from the consolidation of private and semi-private libraries.

The years after the Bridge opened brought radical physical and social change to Brooklyn. Although Brooklyn was known as New York’s bedroom as early as the mid-1850s, the surge of immigration to New York in the 1880s pushed more and more people across the river. The neighborhoods of Park Slope and Prospect Heights were built up in the 1880s, and by the turn of the century development had moved further inland. Brooklyn was no longer just for Brooklynnites: by the 1880s Coney Island was enjoyed by New Yorkers seeking release from the summer heat.

Essential to the development of both Brooklyn and New York was a sophisticated rapid transit system. By the end of the 1880s elevated railway lines had been established in both cities. Brooklyn also had electric trolleys (the dodging of which led to its baseball team’s name) by the late 1880s, and Manhattan acquired them at the turn of the century. Manhattan’s first subway, running from the Brooklyn Bridge to Grand Central to
Times Square to 145th Street, opened in 1904. Construction of an extension to Brooklyn was begun the following year.

When transportation problems forced John Roebling to consider relocating his wire-rope business from Saxonburg, Pennsylvania, Peter Cooper, the builder of America’s first locomotive, proposed Trenton, New Jersey, as a desirable location. Although Trenton was still a small town, it was well situated, with water and rail transport, skilled labor, and related industry nearby. In August 1848, Roebling purchased twenty-five acres at Trenton adjacent to canal and railway lines. The following year he moved his entire business there and began manufacturing both wire and cable. All of the buildings and machinery were designed by Roebling himself. The Trenton works—which included mills, furnaces, and laboratories—grew to employ almost 8,000 persons manufacturing every imaginable wire product from hairpins to harbor-defense nets.

At the turn of the century the need for specialty steel for new wire products made a large new plant of urgent importance to the Roebling company. In 1904, Charles Roebling, the third son of John Roebling and a masterful builder of the Roebling business after his father’s death, built a giant steel plant near Kinkora, New Jersey. Since there was no local housing, a new town called Roebling was built. The houses were of varying character—larger ones for management, smaller ones for laborers. About 750 families were settled there by 1930.

Roebling wire has been used in many of the most important suspension bridges built in the United States in the twentieth century. Among them are three New York bridges: the Williamsburg Bridge, the Manhattan Bridge, and the George Washington Bridge.

“The wonder and the triumph of this work of our own day is in the weaving of the aerial span that carries such burden of usefulness by human thought and skill, from the delicate threads of wire that a child could almost sever.”

The Bridge has inspired countless artists, writers, and poets since these lines were written by a journalist of 1883. One thinks immediately of such masterpieces as the famous Hart Crane poem “To Brooklyn Bridge” (published in 1930 with photographs by Walker Evans). The works illustrated on the following pages briefly survey this rich artistic history (see also Lewis Kachur’s essay “The Bridge as Icon”).