Science and Urban Life

**MAIN IDEA**
Advances in science and technology helped solve urban problems, including overcrowding.

**WHY IT MATTERS NOW**
American cities continue to depend on the results of scientific and technological research.

**Terms & Names**
- Louis Sullivan
- Daniel Burnham
- Frederick Law Olmsted
- Orville and Wilbur Wright
- George Eastman

---

**One American's Story**

The Brooklyn Bridge, connecting Brooklyn to the island of Manhattan in New York City, opened in 1883. It took 14 years to build. Each day, laborers descended to work in a caisson, or water tight chamber, that took them deep beneath the East River. E. F. Farrington, a mechanic who worked on the bridge, described the working conditions.

**A PERSONAL VOICE** E. F. FARRINGTON

“Inside the caisson everything wore an unreal, weird appearance. There was a confused sensation in the head... What with the flaming lights, the deep shadows, the confusing noise of hammers, drills, and chains, the half-naked forms flitting about... one might, if of a poetic temperament, get a realizing sense of Dante’s Inferno.”

---

Four years later, trains ran across the bridge 24 hours a day and carried more than 30 million travelers each year.

**Technology and City Life**

Engineering innovations, such as the Brooklyn Bridge, laid the groundwork for modern American life. Cities in every industrial area of the country expanded both outward and upward. In 1870, only 25 American cities had populations of 50,000 or more; by 1890, 58 cities could make that claim. By the turn of the 20th century, due to the increasing number of industrial jobs, four out of ten Americans made their homes in cities.

In response to these changes, technological advances began to meet the nation’s needs for communication, transportation, and space. One remedy for more urban space was to build toward the sky.

---

In 1883, New Yorkers celebrated the opening of the world’s longest suspension bridge, the 1,595-foot-long Brooklyn Bridge.
SKYSCRAPERS Architects were able to design taller buildings because of two factors: the invention of elevators and the development of internal steel skeletons to bear the weight of buildings. In 1890–1891, architect Louis Sullivan designed the ten-story Wainwright Building in St. Louis. He called the new breed of skyscraper a “proud and soaring thing.” The tall building’s appearance was graceful because its steel framework supported both floors and walls.

The skyscraper became America’s greatest contribution to architecture, “a new thing under the sun,” according to the architect Frank Lloyd Wright, who studied under Sullivan. Skyscrapers solved the practical problem of how to make the best use of limited and expensive space. The unusual form of another skyscraper, the Flatiron Building, seemed perfect for its location at one of New York’s busiest intersections. Daniel Burnham designed this slender 285-foot tower in 1902. The Flatiron Building and other new buildings served as symbols of a rich and optimistic society.

ELECTRIC TRANSIT As skyscrapers expanded upward, changes in transportation allowed cities to spread outward. Before the Civil War, horses had drawn the earliest streetcars over iron rails embedded in city streets. In some cities during the 1870s and 1880s, underground moving cables powered streetcar lines. Electricity, however, transformed urban transportation.

In 1888 Richmond, Virginia, became the first American city to electrify its urban transit. Other cities followed. By the turn of the twentieth century, intricate networks of electric streetcars—also called trolley cars—ran from outlying neighborhoods to downtown offices and department stores.

New railroad lines also fed the growth of suburbs, allowing residents to commute to downtown jobs. New York’s northern suburbs alone supplied 100,000 commuters each day to the central business district.

A few large cities moved their streetcars far above street level, creating elevated or “el” trains. Other cities, like New York, built subways by moving their rail lines underground. These streetcars, elevated trains, and subways enabled cities to annex suburban developments that mushroomed along the advancing transportation routes.

ENGINEERING AND URBAN PLANNING Steel-cable suspension bridges, like the Brooklyn Bridge, also brought cities’ sections closer together. Sometimes these bridges provided recreational opportunities. In his design for the Brooklyn Bridge, for example, John Augustus Roebling provided an elevated promenade whose “principal use will be to allow people of leisure, and old and young invalids, to promenade over the bridge on fine days.” This need for open spaces in the midst of crowded commercial cities inspired the emerging science of urban planning.

City planners sought to restore a measure of serenity to the environment by designing recreational areas. Landscape architect Frederick Law Olmsted spearheaded the movement for planned urban parks.

In 1857 Olmsted, along with English-born architect Calvert Vaux, helped draw up a plan for “Greensward,” which was selected to become Central Park, in New York City. Olmsted envisioned the park as a rustic haven in the center of the busy city. The finished park featured boating and
tennis facilities, a zoo, and bicycle paths. Olmsted hoped that the park’s beauty would soothe the city’s inhabitants and let them enjoy a “natural” setting.

**A Personal Voice**  
**FREDERICK LAW OLTMSTED**  
“The main object and justification [of the park] is simply to produce a certain influence in the minds of people and through this to make life in the city healthier and happier. The character of this influence . . . is to be produced by means of scenes, through observation of which the mind may be more or less lifted out of moods and habits.”

—quoted in *Frederick Law Olmsted’s New York*

In the 1870s, Olmsted planned landscaping for Washington, D.C., and St. Louis. He also drew the initial designs for “the Emerald Necklace,” Boston’s parks system. Boston’s Back Bay area, originally a 450-acre swamp, was drained and developed by urban planners into an area of elegant streets and cultural attractions, including Olmstead’s parks.

**CITY PLANNING**  
By contrast, Chicago, with its explosive growth from 30,000 people in 1850 to 300,000 in 1870, represented a nightmare of unregulated expansion. Fortunately for the city, a local architect, Daniel Burnham, was intrigued...
by the prospect of remaking the city. His motto was “Make no little plans. They have no magic to stir men’s blood.” He oversaw the transformation of a swampy area near Lake Michigan into a glistening White City for Chicago’s 1893 World’s Columbian Exposition. Majestic exhibition halls, statues, the first Ferris wheel, and a lagoon greeted more than 21 million visitors who came to the city.

Many urban planners saw in Burnham’s White City glorious visions of future cities. Burnham, however, left Chicago an even more important legacy: an overall plan for the city, crowned by elegant parks strung along Lake Michigan. As a result, Chicago’s lakefront today features curving banks of grass and sandy beaches instead of a jumbled mass of piers and warehouses.

New Technologies

New developments in communication brought the nation closer together. In addition to a railroad network that now spanned the nation, advances in printing, aviation, and photography helped to speed the transfer of information.

A REVOLUTION IN PRINTING By 1890, the literacy rate in the United States had risen to nearly 90 percent. Publishers turned out ever-increasing numbers of books, magazines, and newspapers to meet the growing demand of the reading public. A series of technological advances in printing aided their efforts.

American mills began to produce huge quantities of cheap paper from wood pulp. The new paper proved durable enough to withstand high-speed presses. The electrically powered web-perfecting press, for example, printed on both sides of a continuous paper roll, rather than on just one side. It then cut, folded, and counted the pages as they came down the line. Faster production and lower costs made newspapers and magazines more affordable. People could now buy newspapers for a penny a copy.

AIRPLANES In the early 20th century, brothers Orville and Wilbur Wright, bicycle manufacturers from Dayton, Ohio, experimented with new engines powerful enough to keep “heavier-than-air” craft aloft. First the Wright brothers built a glider. Then they commissioned a four-cylinder internal combustion engine, chose a propeller, and designed a biplane with a 40’4” wingspan. Their first successful flight—on December 17, 1903, at Kitty Hawk, North Carolina—covered 120 feet and lasted 12 seconds. Orville later described the take-off.

Vocabulary
internal combustion engine: an engine in which fuel is burned within the engine rather than in an external furnace

A PERSONAL VOICE ORVILLE WRIGHT

“After running the motor a few minutes to heat it up, I released the wire that held the machine to the track, and the machine started forward into the wind. Wilbur ran at the side of the machine . . . to balance it . . . . Unlike the start on the 14th, made in a calm, the machine, facing a 27-mile wind, started very slowly. . . . One of the life-saving men snapped the camera for us, taking a picture just as the machine had reached the end of the track and had risen to a height of about two feet.”

—quoted in Smithsonian Frontiers of Flight

The Garden City

Urban planning in the United States had European counterparts. In Tomorrow: A Peaceful Path to Social Reform (1898), for example, the British city planner Ebenezer Howard wrote of a planned residential community called a garden city.

Howard wanted to combine the benefits of urban life with easy access to nature. His city plan was based on concentric circles—with a town at the center and a wide circle of rural land on the perimeter. The town center included a garden, concert hall, museum, theater, library, and hospital.

The circle around the town center included a park, a shopping center, a conservatory, a residential area, and industry. Six wide avenues radiated out from the town center. In 1903, Letchworth, England served as the model for Howard’s garden city.
AVIATION PIONEERS

In 1892, Orville and Wilbur Wright opened a bicycle shop in Dayton, Ohio. They used the profits to fund experiments in aeronautics, the construction of aircraft. In 1903, the Wright brothers took a gasoline-powered airplane that they had designed to a sandy hill outside Kitty Hawk, North Carolina.

The airplane was powered by a 4-cylinder 12-horse-power piston engine, designed and constructed by the bicycle shop’s mechanic, Charles Taylor. The piston—a solid cylinder fit snugly into a hollow cylinder that moves back and forth under pressure—was standard until jet-propelled aircraft came into service in the 1940s.

The engine is the heaviest component in airplane construction. The design of lighter engines was the most important development in early aviation history.

<table>
<thead>
<tr>
<th>Date</th>
<th>Name of Engine</th>
<th>Approximate Weight per Unit of Horsepower</th>
</tr>
</thead>
<tbody>
<tr>
<td>1880s</td>
<td>Otto</td>
<td>440 lbs (200 kg)</td>
</tr>
<tr>
<td>1903</td>
<td>Wright</td>
<td>13 lbs (6 kg)</td>
</tr>
<tr>
<td>1910</td>
<td>Gnome</td>
<td>3.3 lbs (1.5 kg)</td>
</tr>
<tr>
<td>1918</td>
<td>V-12 Liberty</td>
<td>2 lbs (1 kg)</td>
</tr>
<tr>
<td>1944</td>
<td>Wright Cyclone</td>
<td>1.1 lbs (0.5 kg)</td>
</tr>
</tbody>
</table>

Source: *The History of Invention*, Trevor I. Williams

On December 17, Orville Wright made the first successful flight of a powered aircraft in history. The public paid little attention. But within two years, the brothers were making 30-minute flights. By 1908, the pioneer aviators had signed a contract for production of the Wright airplane with the U.S. Army.

By 1918, the Postal Service began airmail service, as shown in this preliminary sketch of a DH4-Mail. Convinced of the great potential of flight, the government established the first transcontinental airmail service in 1920.
Within two years, the Wright brothers had increased their flights to 24 miles. By 1920, convinced of the great potential of flight, the U.S. government had established the first transcontinental airmail service.

PHOTOGRAPHY EXPLOSION  Before the 1880s, photography was a professional activity. Because of the time required to take a picture and the weight of the equipment, a photographer could not shoot a moving object. In addition, photographers had to develop their shots immediately.

New techniques eliminated the need to develop pictures right away. George Eastman developed a series of more convenient alternatives to the heavy glass plates previously used. Now, instead of carrying their darkrooms around with them, photographers could use flexible film, coated with gelatin emulsions, and could send their film to a studio for processing. When professional photographers were slow to begin using the new film, Eastman decided to aim his product at the masses.

In 1888, Eastman introduced his Kodak camera. The purchase price of $25 included a 100-picture roll of film. After taking the pictures, the photographer would send the camera back to Eastman’s Rochester, New York, factory. For $10, the pictures were developed and returned with the camera reloaded. Easily held and operated, the Kodak prompted millions of Americans to become amateur photographers. The camera also helped to create the field of photojournalism. Reporters could now photograph events as they occurred. When the Wright brothers first flew their simple airplane at Kitty Hawk, an amateur photographer captured the first successful flight on film.