

Onset of the Industrial Revolution

As in Britain, the United States originally used water power to run its factories, with the consequence that industrialization was essentially limited to New England and the rest of the Northeastern United States, where fast-moving rivers were located. However, the raw materials (cotton) came from the Southern United States. It was not until after the American Civil War in the 1860s that steam-powered manufacturing overtook water-powered manufacturing, allowing the industry to fully spread across the nation.

Samuel Slater (1768–1835) is popularly known as the founder of the American cotton industry. As a boy apprentice in Derbyshire, England he learnt of the new techniques in the textile industry and defied laws against the emigration of skilled workers by leaving for New York in 1789, hoping to make money with his knowledge. Slater started Slater's mill at Pawtucket, Rhode Island, in 1793 and went on to own thirteen textile mills. Daniel Day established a wool carding mill in the Blackstone Valley at Uxbridge, Massachusetts in 1810, the third woolen mill established in the U.S. The Blackstone River and its tributaries, which cover more than 45 miles from Worcester to Providence, was the birthplace of America's Industrial Revolution. At its peak over 1100 mills operated in this valley, including Slater's mill, and with it the earliest beginnings of America's industrial and technological development. Samuel Slater, an apprentice in one of the largest textile factories in England, immigrated to the United States in 1789 upon learning that American states were paying bounties to British expatriates with a knowledge of cotton machinery. With Moses Brown, Slater established the first textile factory in the US in Pawtucket, Rhode Island. Slater went on to build several more cotton and wool mills throughout New England.

While on a trip to England in 1810, a Massachusetts merchant named Francis Cabot Lowell was allowed to tour the British textile factories, but not take notes. Realizing the War of 1812 had ruined his import business but that a market for domestic finished cloth was emerging in America, he memorized the design of textile machines, and on his return to the United States, he set up the Boston Manufacturing Company. Lowell and his partners built America's first cotton-to-cloth textile mill at Waltham, Massachusetts. After his death in 1817, his Associates built America's first planned factory town, which they named after him. This enterprise was capitalized in a public stock offering, one of the first uses of it in the United States. Lowell, Massachusetts, utilizing 5.6 miles of canals and ten thousand horsepower delivered by the Merrimack River, is considered the 'Cradle of the American Industrial Revolution'.

In the mid 1780s, Oliver Evans invented the grain elevator and hopper boy that would eventually replace the traditional gristmills. By the turn of the century, Evans also developed one of the first high-pressure steam engines and began establishing a network of machine workshops to manufacture and repair these popular inventions. In 1789, the widow of Nathaniel Greene recruited Eli Whitney to develop a machine to separate the seeds of short fibered cotton from the fibers. The resulting cotton gin could be made with basic carpentry skills but reduced the necessary labor by a factor of 50 and generated huge profits for cotton growers in the South. While Whitney did not realize financial success from his invention, he moved on to manufacturing rifles and other armaments under government contract that could be made with "expedition, uniformity, and exactness" — the foundational ideas for interchangeable parts.

Revolution in Transportation

The thirteen United States likewise controlled a greater area (from New Hampshire to Georgia) than any European nation since the fall of the Roman Empire. Even as the country grew even larger with the admission of Kentucky, Tennessee, and Ohio by 1803, the only means of transportation between these landlocked western states and their coastal neighbors was by foot, pack animal, or ship. Recognizing the success of Roman roads in unifying that empire, political and business leaders in the United States began to construct roads and canals to connect the disparate parts of the nation.

Early toll roads were constructed and owned by joint-stock companies that sold stock to raise construction capital like Pennsylvania's 1795 Lancaster Turnpike Company. In 1808, Secretary of the Treasury Albert Gallatin's Report on the Subject of Public Roads and Canals suggested that the federal government should fund the construction of interstate turnpikes and canals. While many Anti-Federalists opposed the federal government assuming such a role, the British blockade in the War of 1812 demonstrated the United States' reliance upon these overland roads for military operations as well as for general commerce. Construction on the National Road began in 1815 in Cumberland, Maryland and reached Wheeling, Virginia in 1818, but political strife thereafter ultimately prevented its western advance to the Mississippi River. Nevertheless, the road became a primary overland conduit through Appalachian Mountains and was the gateway for thousands of antebellum westward-bound settlers.

Like the turnpikes, the early canals were constructed, owned, and operated by private joint-stock companies but later gave way to larger projects funded by the states. The Erie Canal, proposed by Governor of New York De Witt Clinton, was the first canal project undertaken as a public good to be financed at the public risk through the issuance of bonds. When the project was completed in 1825, the canal linked Lake Erie with the Hudson River through 83 separate locks and over a distance of 363 miles (584 km). The success of the Erie Canal spawned a boom of other canal-building around the country: over 3,326 miles of artificial waterways were constructed between 1816 and 1840. Small towns like Syracuse, New York, Buffalo, New York, and Cleveland, Ohio that lied along major canal routes boomed into major industrial and trade centers, while exuberant canal-building pushed some states like Pennsylvania, Ohio, and Indiana to the brink of bankruptcy.

Steamboats

Despite the new efficiencies introduced by the turnpikes and canals, travel along these routes was still time-consuming and expensive. The idea of integrating a steam boiler and propulsion system can be first attributed to John Fitch and James Rumsey who both filed for patents or state monopolies on steamboats in the late 1780s. However, these first steamboats were complicated, heavy, and expensive. It would be almost 20 years until Robert R. Livingston contracted a civil engineer named Robert Fulton to develop an

economical steamboat. Fulton's paddle steamer, The North River Steamboat (erroneously referred to as the Clermont), made its first trip from New York City north on the Hudson River to Albany on August 17, 1807. By 1820, steamboat services had been established on all the Atlantic tidal rivers and Chesapeake Bay. The shallow-bottomed boats were also ideally suited navigating the Mississippi and Ohio Rivers and the number of boats on these rivers increased from 17 boats to 727 boats between 1817 and 1855. The speed of the steamboats decreased travel times between coastal ports and upstream cities by weeks and costs for transporting goods along these rivers by as much as 90%.

Because the physics and metallurgy of boilers were poorly understood, steamboats were prone to boiler explosions that killed hundreds of people between 1810s and 1840s. In 1838, legislation was enacted that mandated boiler inspections by federal agents under the threat of revocation of the operator's navigation licenses and lowered the threshold for liability in suits arising from such accidents. While Americans long resisted any government's power to regulate private property, these new rules demonstrated that many Americans believed that property rights did not override civil rights and set the precedent for future federal safety regulations.

Cotton Gin's Impact on American Cotton

American Production of Raw Cotton, 1790-1860 (bales)

Year	Production	Year	Production	Year	Production
1790	3,135	1815	208,986	1840	1,346,232
1795	16,719	1820	334,378	1845	1,804,223
1800	73,145	1825	532,915	1850	2,133,851
1805	146,290	1830	731,452	1855	3,217,417
1810	177,638	1835	1,060,711	1860	3,837,402

Production is measured in equivalent 500-pound bales, gross weight.

Eli Whitney's Invention of Cotton Gin

The cotton gin is a machine that is used to pull cotton fibers from the cotton seed. Eli Whitney invented the cotton gin in 1793 or 1794. At that time, Whitney was in the employ of Catherine Greene, the widow of General Nathaniel Greene. While there are claims that similar machines had been invented prior to Whitney's gin, there is no firm evidence to support such claims. Whitney was thus granted a patent on March 14th, 1794, for his "new and useful improvement in the mode of Ginning cotton."

The invention of the cotton gin caused a revolution in the production of cotton in the southern United States, and had an enormous impact on the institution of slavery in this country. Before the invention of the cotton gin, not only was the raising of cotton very labor intensive, but separating the fiber from the cotton seed itself was even more labor intensive. Only the largest plantations found raising cotton cost effective. The invention of the cotton gin and its manufacture changed that. Growing and cultivating cotton became a lucrative and less labor-intensive cash crop, contributing immensely to the rise of cotton production in the Deep South. This, in turn, led to an increase in the number of slaves and slaveholders, and to the growth of a cotton-based agricultural economy in the South.

While it cannot be stated with certainty that the invention of the cotton gin saved and sustained slavery in the United States, it certainly was a major factor in the spread of slavery into Georgia, Alabama, and Mississippi.

While visiting a plantation (Mulberry Grove) near Savannah, Georgia, Connecticut native Whitney used his familiarity with New England textile machinery to construct his engine (shortened to "gin"). It used wire teeth hammered into a rotating wooden cylinder to snare the cotton fibers and pull them through a grate. The slots in this grate were too narrow for the cotton seed to pass, so that the fibers were pulled away from the seed.

With low-cost ginning assured by Whitney's design, the Southern economy moved westward and planted cotton. Table 2 shows that American cotton production expanded 1000-fold from 1790 to 1860. In 1790, before the Whitney gin, almost all of the 3,000-plus bales of cotton made were sea-island cotton. By 1860, almost all of the 3.8 million bales grown were short-staple varieties.

Within 10 years, the value of the U.S. cotton crop rose from \$150,000 to more than \$8 million.