Introduction by series producer Deborah Cadbury

Isambard Kingdom Brunel's colossal ship, the Great Eastern

The great achievements celebrated in this series reveal as much about the human spirit as they do about technological endeavour. The period of over 125 years from the beginning of the 19th century saw the creation of some of the world's most remarkable feats of engineering, from Isambard Kingdom Brunel's extraordinary *Great Eastern*, the "Crystal Palace of the Seas" that he hoped would join the two ends of the British empire, to the Panama Canal, that linked the Atlantic and Pacific oceans more than half a century later.

The slowly evolving industrial revolution was the fertile ground that gave life to these dreams in iron, cement, stone and steel. The pioneers of the age were practical visionaries, seeing beyond the immediate horizon, the safe and the known as they cut a path to the future. Yet their unique masterpieces could never have been built without an army of unsung heroes, the craftsmen and workers also willing to risk their lives as they laboured to bring each dream to life. Not to mention the financiers and shareholders hanging on for the ride as reputations were lost and won.

The journey from the oldest "wonder" featured in the series, the Bell Rock Lighthouse, to the most recent, the Hoover Dam, illustrates the swiftly moving frontiers of technological progress. Each "wonder" serves as a unique monument, a marker for what was known at the time. The world was a very different place when the Bell Rock Lighthouse was created off the east coast of Scotland between 1807 and 1811.

Robert Stevenson, the grandfather of Robert Louis Stevenson, dreamed for years of making his mark on the world by bringing light to the treacherous Scottish coast. He aimed to take on the most dangerous place of all, the Bell Rock, a large reef, 11 miles out to sea, dangerously positioned in the approach to the Firth of Forth. In 1799, over 70 ships went down in a violent storm that raged along the coast, yet still the authorities opposed his plan. How could anyone build a lighthouse 11 miles out to sea, on a rock which was submerged by up to 16 feet of water for most of the day? Battling against the odds, Stevenson did eventually build his lighthouse and, to this day, it shines out across the North Sea, the oldest offshore lighthouse still standing anywhere in the world.

Isambard Kingdom Brunel's colossal ship, the *Great Eastern*, is the only wonder in this series that has not survived to the 21st century. In the early 1850s, Brunel hoped the *Great Eastern* would be his

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masterpiece, which would link the ends of the empire. At a time when most ships moored in the Thames were built to traditional designs in wood and powered by sail, Brunel's "Great Ship", was almost 700-feet long, a floating island made of iron, that he envisaged could carry 4,000 passengers in magnificent style as far as the antipodes without needing to refuel. The design was revolutionary with a double hull that made it unsinkable and powered by enormous engines as high as a house. He faced enormous criticism: his ship was too big, it was too expensive, it would sink, or break its back on the first big wave, if, that is, he could actually manage to launch it on to the Thames. In fact, it was the blue print for ship design for years to come.

In the summer of 1858, while the *Great Eastern* was being fitted out for her maiden voyage, London was in the grip of a crisis: "the Great Stink". The population had grown rapidly during the first half of the 19th century, yet there had been no provision for sanitation. Three epidemics of cholera had swept through London leaving over 30,000 dead. And sewage was everywhere, piling up in every gully and alleyway, in the cellars of houses in poor districts, even seeping through cracks in floorboards.

Leading engineer Joseph Bazalgette proposed a bold scheme to build the London sewers: 82 miles of sewage superhighway linked with over 1,000 miles of street sewers to provide an underground network beneath the city streets. He drove himself to the limits of endurance, struggling to realise his subterranean vision – a task made even more difficult since he was competing with the new underground railway, a network of roads and emerging overland railway systems. But his grand design for a sewer system transformed the city into the first glittering modern metropolis, setting a standard that was quickly copied the world over.

By the middle of the 19th century, the benefits brought by the host of advances of the industrial age were gradually beginning to reach America. One of the most spectacular achievements was the development of railways, notably the Transcontinental Railway, which reached right across the continent. With two teams, one building from the east and the other from California in the

Leading engineer Joseph Bazalgette is played by Mark McGann

west, they battled against hostile terrain, Native Americans, civil war and the Wild West. Yet in 1869, the tracks joined, shrinking the whole continent as the journey from New York to San Francisco was reduced from months to days.

That same year, a brilliant engineer, John Roebling, from Germany, won the contract to build the largest bridge in the world, the Brooklyn Bridge. It would stretch 1,600 feet, in one giant leap across the wide and turbulent East River, which separates New York from Brooklyn. The foundations would reach up to 70 feet below the river. The two mighty towers would dwarf much of New York. At the time, such a bold design seemed a miracle, and all to be built out of a new material: steel.

Yet John Roebling's ambitious dream was to cost him the extreme price of life itself and, unknowingly, he condemned his son to a shadow life. Determined to continue with his father's vision, Washington Roebling and his team had to face the horrors of a mysterious new disease, "caisson disease" – now known as the bends – as they laboured deep beneath the East River. Suffering great pain and paralysis when the great network of cables was spun across the great East River,

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Washington could only watch through a telescope from his window.

With the growth in travel and trade, by the late 19th century, shipping was big business. Having completed the Suez Canal in 1869, a Frenchman, Vicomte Ferdinand de Lesseps, dreamed of an even bolder scheme: the Panama Canal. He would cut a path across the Isthmus of Panama and unite the great oceans of the Atlantic and Pacific. The long journey around Cape Horn would become a danger of the past and the world itself a smaller place. But once out in the tropical heat of Panama, the French found themselves facing impenetrable jungle, dangerous mudslides and deathly tropical diseases as it proved to be an undertaking of nightmare proportions. The extravagant dream stole over 25,000 lives and 25 years elapsed before the oceans were finally united.

As people found their way across the vast American continent, they were stopped only by a poor or hostile environment, such as the desert regions of Arizona and Nevada. Even here, in the early 1900s, engineers began to realise it would be possible to make the desert bloom by building a dam across the Colorado River. Sixty stories high and with a larger volume than the Great Pyramid at Giza, the Hoover Dam would break all records. At the height of the depression, poverty-stricken workers earning just a few dollars a day, died from horrific explosions, carbon monoxide poisoning and heat exhaustion. It was Chief Engineer Frank Crowe who built it ahead of schedule and under budget, and notched up one more extraordinary piece of evidence for the ingenuity of man.

By the time President Roosevelt inaugurated the Hoover Dam in 1935, the last "wonder" described in this series, the world was transformed in almost every way possible. People's standard of living had increased greatly, the average life expectancy had almost doubled in the west and infant mortality had virtually disappeared. The £1 a week that Robert Stevenson had given his labourers to work a 12-hour day, seven days a week, wet or dry, had, by the time the Hoover Dam was lighting up the western deserts, turned into a wage that a working man, increasingly backed by unions, could live on more comfortably.

In one sense, the stories present a romantic view of man – of an individual who struggles to realise his dream and make a mark on the world. As the 19th century progressed, the men of genius took the stage in quick succession, each engrossed in his own creation to the exclusion of all else. Each in turn gave so much of himself, often denying relationships, sleep, basic human comforts and ultimately, in some cases, their lives. Yet the legacy of their great ambition and talent remains to this day. With the exception of Brunel's Great Ship, all the wonders have survived to the 21st century and are now celebrated as powerful symbols of the modern world. The wealth of inspiration and energy of the 19th century was the catalyst for the huge progress that marked the 20th century as the coming industrial giants stood on the shoulders of an earlier generation.