

# Robert Hooke

We know Robert Hooke mainly from the law that bears his name, which describes the extension of a spring as a function of the force applied to it. Other than that, Hooke has been almost forgotten. Undeservedly, as this “English Da Vinci” was a great and many-faceted scientist. After the Great Fire of London, he played a prominent role in the reconstruction of the city, not least as an architect.

## Hooke's Law

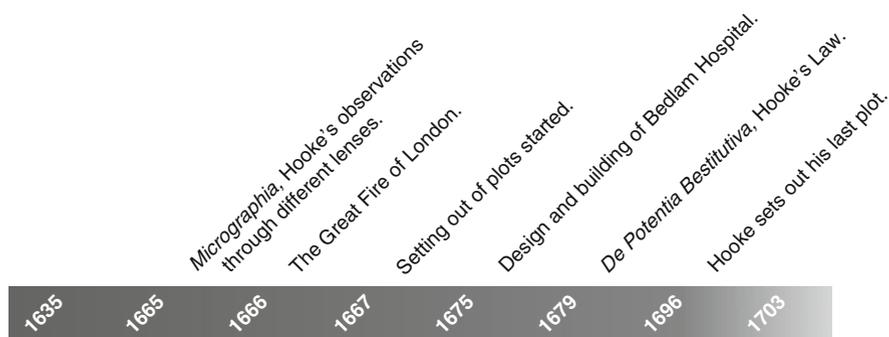
It is an experiment that almost all of us have conducted at least once at school: hang a series of different weights on a spring and measure the different degrees to which it extends. Hooke's Law states that the extension of a spring is in direct proportion with the load applied to it. Hooke published his law in 1679 in *De Potentia Bestitutiva*. It was just a small section in a comprehensive analysis of vibration and elasticity.

Three years earlier he lifted a corner of the veil in the form of an anagram, a popular way of making a discovery known in the seventeenth century. In *Helioscopes* Hooke announced his law as “cediinnoopssttuu,” an anagram of “Ut Pondus sic Tensio” (As the extension, so the weight). Hooke used the term “weight” for what would later be called “force” as, before Isaac Newton, the two concepts had not been clearly distinguished.

Hooke was a contemporary of renowned scientists like Newton, Robert Boyle, and Edmond Halley, who he met during his studies at Oxford and as Curator of Experiments at the Royal Society. Hooke's scientific interest varied from the small world of insects to the large world of the planets. In his book *Micrographia*, Hooke described the world through the lens of microscope and telescope. He is famous, for example, for his drawing of a flea but was equally at home observing the surface of the Moon and Jupiter.

During his life, Hooke regularly clashed with other scientists. He corresponded regularly with Newton on gravity, but when the latter published his theories, Hooke felt that he had not been given sufficient credit for his contribution. He had a similar conflict with Christiaan Huygens about who had invented the balance spring, an essential component of clocks and watches.

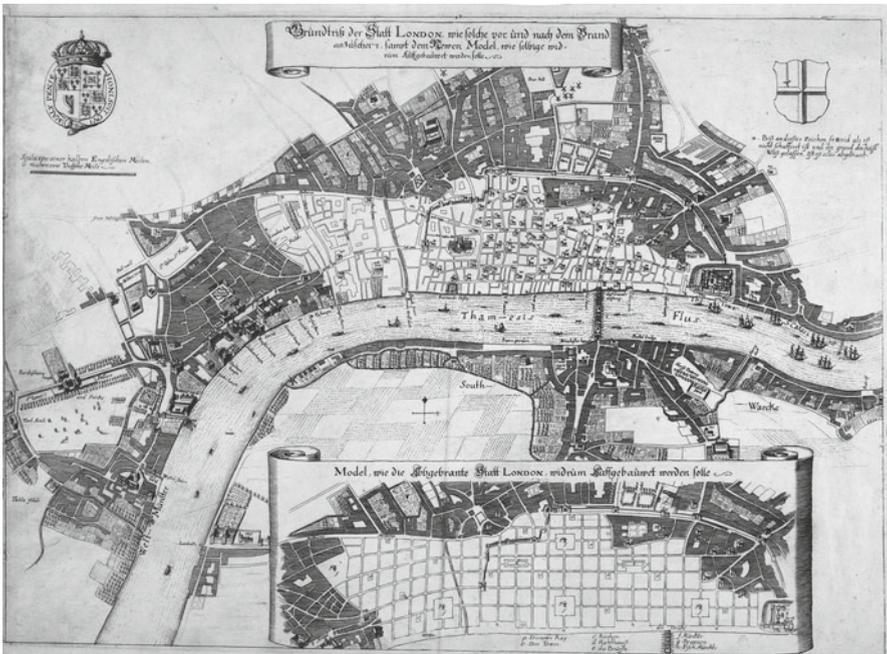
Despite Hooke's great scientific achievements, his name has been forced into the background over time and he has been overshadowed by his famous contemporaries.



Typical of Hooke’s banishment from scientific history is the lack of any pictures of him. According to reports by visitors to the Royal Society, there was still a portrait of Hooke next to that of Robert Boyle in 1710, but after that it disappeared. Newton is alleged to be responsible for the disappearance. Later, a stained glass window bearing a figurative portrait of Hooke was placed in St. Helen’s Church in Bishopsgate, London. That, too, was short-lived, as the church was badly damaged in 1993 when an IRA bomb exploded in the financial heart of the city.

### Land Surveyor and Architect

In the early morning of Sunday September 2, 1666, a fire broke out in a bakery in Pudding Lane. Five days later, the “Great Fire” had destroyed more than 13,000 houses and made 65,000 people homeless. Of the city’s 109 churches, 87 were burned out, including St. Paul’s cathedral – the greatest disaster of all. Only 20% of the area within the city walls had emerged unscathed. These were fearful days for Robert Hooke. The powerful wind spread the fire so quickly that he was afraid that it would destroy his home in Gresham College, but fortunately the flames came to a



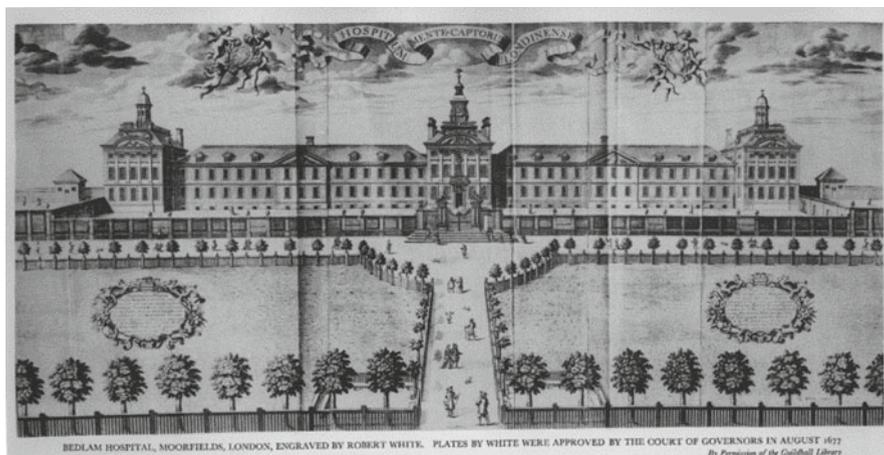
Map of London after the fire, with the burned out area shown in white. The insert at the bottom may be Robert Hooke’s street plan

halt just before they reached his block. Only a few steps from his door, Hooke found himself in the middle of the smoldering ruins of his city.

On the Thursday that the fire finally burned itself out completely, London's civic leaders met in Gresham College to discuss how to recover from the crisis. Only a charred skeleton remained of the original city hall, so Gresham College rapidly became the center of municipal government. For Hooke it heralded the start of a career he could never have imagined. Without asking for it, he suddenly found himself right at the spot where important decisions were being made about the reconstruction of London.

In the years that followed, Hooke's time was almost completely taken up by the reconstruction, first as a land surveyor and then as an architect. In the eyes of the city's leaders, his familiarity with the local area and his knowledge of geometry made him indispensable. For someone who had never had anything to do with running a city, Hooke enjoyed a considerable degree of trust.

After the fire had been extinguished, the people of London immediately started rebuilding their houses. King Charles II found this a little too hasty and instructed the city leaders to order all building activities to be halted until it was clear how the city should be reconstructed. On September 21, Hooke presented his plans to the city council. It consisted of a radical grid-style plan, with streets running only north-south and east-west, similar to the design of many modern American cities. Besides Hooke's proposal, a number of other plans had been submitted, including one by Christopher Wren, who presented his ideas directly to the King. None of the plans were eventually chosen as they were considered too radical and, above all, too expensive. Some of them even entailed demolishing sound buildings to make way for the new design. Neither the city nor the King possessed sufficient financial resources to pay for such a far-reaching operation. Furthermore, many people were eager to start rebuilding as, despite the great destruction, many foundations were still intact.



**Bedlam Hospital, designed and built by Robert Hooke**

On October 4, 1666, the King appointed Wren as the Royal representative in the official rebuilding commission. In turn, the city nominated Hooke as its representative. The most idealistic plans had already been dismissed and had given way to the practical realities of determining the fire damage and clearing the rubble. The rebuilding commission specified which streets should be widened and which alleyways should disappear. In the commission, Hooke was very busy drawing up new building specifications. The new houses had to be built of stone or brick and had to be cleaner, healthier, and safer than the old ones.

Six months after the fire, together with three others, Hooke was appointed by law as official surveyor for the reconstruction of London. On March 27, 1667, a start was made on setting out the streets, beginning with Fleet Street. After 9 weeks, they had set out the main streets, but it eventually took 2 years to complete the job.

In the meantime, they were also able to start setting out the plots for building. The first plot was designated on May 13, 1667. Nearly 30 years later, they had set out almost 8,400 plots, some 3,000 of which had been done by Hooke. House owners could submit a request to the city council for their plot to be designated. After the owner had cleared away all the rubble, the surveyor would visit the site and try to redesignate the plot on the basis of the old foundations. If necessary, he would use additional information provided by the owner himself or neighbors.

Generally, there were few problems designating the new plots and they encountered little resistance from the owners. Of course, there were disputes between neighbors and some people were unhappy as they had to give up part of their plots to widen streets or enlarge public buildings. Money was made available for compensation, raised through a tax on coal. The city council determined the level of compensation, usually on Hooke's advice.

Much has been written about the cooperation and power struggle between Wren and Hooke. In the eyes of the city, Hooke was the hero, who took the initiative at the right moment. For the Crown, however, it was Wren who was the hero: the young, visionary architect who was in the right place at the right time. The fact is that Wren was the prominent figure, made responsible by the King for rebuilding all public buildings and churches, including of course St. Paul's. He and Hooke, however, had an excellent relationship and they worked closely together, consulting each other almost daily. The more the construction plan for London took shape, the more Wren involved Hooke in the architectural work. In December 1670, Hooke was given his first independent assignment: to rebuild the new Royal College of Physicians, with an anatomical theater modeled on the one at the University of Leiden. This was to be followed by others, especially for private clients.

Around 1675, Hooke designed and built Bedlam Hospital, intended as a home for mental patients. This time he used the Palais des Tuileries in Paris as an example, much to the displeasure of Louis XIV, who considered it a downright insult that his palace should serve as an example for a lunatic asylum.

Hooke was above all a good technical draftsman, but never became a great architect. He had a good feeling for proportion and his buildings were pleasing to the eye. He was probably inspired by the architecture of the Doric order, one of the three architectural orders of classical Greece, which is characterized by very stately, clean lines.

The only one of Hooke's buildings that still stands is the monument to the Great Fire, a stately column 70 m high, topped off with a gilded urn of fire. Because of the close cooperation between Wren and Hooke, it is not certain who was responsible for the design of many of the buildings. Many of Hooke's drawings later turned up in an overview of Wren's designs and were therefore erroneously attributed to the latter.

During the rebuilding of London, Hooke had to deal with a large number of technical and organizational questions. For example, he devoted himself to finding the best way to build an arch. He discovered that the line of an arch that has to support a certain weight must be the inversion of a catenary, or free-hanging chain, with the same weight. In an appendix to *Helioscopes* he wrote, again in an anagram, that he had found "a true mathematical and mechanical form of all manner of Arches for Building." Two years after his death, his executor revealed the meaning of the anagram: "Ut pendet continuum flexile, sic stabit contiguum rigidum inversum" (As hangs a flexible cable so, inverted, stand the touching pieces of an arch).

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