Papin, Denis

(1647–1712?)

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Papin, Denis (1647–1712?), natural philosopher, was born in August 1647 in Blois, France, and baptized there on 22 August at the temple of Haut-Bourg St Jean, the fourth of the thirteen children of Denis Papin and his wife, Marie, *née* Pineau. His father was a royal counsellor and district revenue collector, his mother's forebears were medical practitioners, and both his parents held property. The extended family was staunchly protestant, a religion which was tolerated during Papin's early years. At the age of six he was put in the care of his uncle Nicholas, a medical practitioner at Saumur, and educated at the protestant academy in that town. From there he entered the medical faculty of the University of Angers: he came away with a low opinion both of the teaching and of his fellow students but considered it worthwhile to obtain the degree of MD in 1669. The following year he arrived in Paris intending to practise medicine, but soon became disillusioned and, having developed a taste and talent for mathematics and machinery, sought the patronage of the wife of the minister Colbert, herself from Blois. She arranged for him to lodge in the Louvre and to assist the Dutch physicist Christiaan Huygens, who had been invited to develop his many scientific interests under French protection.

At the time that Papin joined him in 1673, Huygens was investigating the force of gunpowder as a means of creating a vacuum under a piston in order to drive machinery, in particular to operate a pump to raise water from the Seine to the palace of Versailles. Papin, who was continuing the investigations into the preservation of foodstuffs under vacuum that he had begun at university, was led to consider the vacuum as a possible motive force. During this period Leibniz, then in Paris, became a regular visitor to Huygens's laboratory. Papin learnt a great deal from Leibniz and the friendship thus engendered lasted for many years. The pumps that Papin developed, together with his vacuum experiments, were described in his first treatise, *Nouvelles expériences du vuide* (1674); favourably received by the Académie des Sciences, it was republished in the *Journal des Savants* in 1765.

Huygens's invention of the coiled watch spring caught public attention on both sides of the English Channel, and when Lord Brouncker, president of the Royal Society, asked Huygens for an example, Papin was instructed to deliver it in person to Henry Oldenburg, the society's secretary. Papin arrived in London in July 1675, bearing the watch and a letter from Huygens testifying to his abilities. He swiftly made the acquaintance of Robert Boyle, whose friendship and patronage he enjoyed, and polished his English by translating Boyle's *Physico-Theological Considerations* into French. He joined fellow Huguenots of the Threadneedle Street congregation, and was found lodging and employment as a tutor by Oldenburg. He translated further works for Boyle and improved the latter's air-pump, before building one to his own superior design. From July 1676 to February 1679 he worked closely with Boyle on experiments connected with respiration, magnetism, air, and the chemistry of blood and various medicaments, which he described in his *Continuation of New Experiments* (1680).

To this fruitful period belongs the invention forever linked to Papin's name—his digester—though he had left Boyle's service before it was made public. From his experiments with air-pumps Papin realized that the boiling point of water would be raised if it was heated under pressure. He constructed a strong cylindrical vessel to hold water and a container for various foodstuffs, and sealed the vessel's lid to prevent the escape of steam. He also devised a safety valve, which proved to be a technically important feature in the later development of steam power. In this primitive pressure cooker, Papin found that food cooked rapidly, requiring less fuel, and that even old meat became tender, with much nourishment extracted from the softened bones, advantages which he considered would be of considerable value to poor families. He demonstrated his invention to the Royal Society in May 1679, and was permitted to publish *A New Digester or Engine for Softening Bones* in 1681 and his further developments as *A continuation of the new digester of bones, together with some improvements and new uses of the air pump* in 1687.

Papin remained in London and was for a while employed by Robert Hooke to write letters for the society at 2*s*. each. At a date probably between 1680 and 1682 he was elected to the Royal Society, he was briefly in Paris with Huygens in 1680, and the following year, equipped with pneumatic apparatus and a digester, went to Venice, where he was employed by Ambrose Sarotti as director of experiments to the academy whose members gathered weekly in Sarotti's palace. But this was unprofitable business, and early in 1684 Papin returned to London, where the Royal Society appointed him temporary curator of experiments at a small salary.

Prospects of a better life opened up in 1687 with Papin's appointment as professor of mathematics at the University of Marburg, in Germany. There he was reunited with other Huguenots who had fled France, among them his cousin Marie Papin and her husband, Jacques Maliverne, likewise a professor at the university, who shortly died, leaving his widow to support their small daughter, Charlotte. Papin's desire to marry Marie was opposed by the local pastor on the grounds of consanguinity and only achieved, on 1 January 1691, by special dispensation from the landgrave of Hesse.

In 1690 Papin designed a simple one-cylinder atmospheric steam engine, an account of which he published in the *Acta Eruditorum* of Leipzig. A modified version of this engine figured among the diverse machines published as *Fasciculus dissertationum de novis quibusdam machinis atque alliis argumentis philosophicis* (1695), but Papin seems to have been ignorant of the significance of his invention. Disappointed by the Marburg students' lack of interest in mathematics, he moved in 1696 to the landgrave's court at Kassel, where his principal occupation was to design a pumping machine to raise water from mines. In 1705 Leibniz sent him a diagram of Thomas Savery's high-pressure steam pump, which Papin modified, though without improving it. His design was published as *Ars nova ad aquam ignis adminiculo efficacissime elevandam* (1707). He then turned to steam propulsion for boats, in which he seems to have had only limited success.

Papin was back in London in 1707, lodging in the parish of St Ann, Westminster, where he remained, apart from a few months in Kassel during 1708 and 1709; his wife and stepdaughter apparently stayed in Germany. His old friends were now dead, and Isaac Newton proffered no welcome at the Royal Society, of which he was now president. However, Papin was paid for any experiments to which they had agreed beforehand. Bad feeling may have been caused by arguments over the priority of the invention of the steam engine. Papin's engine of 1690, in which the vacuum under the piston was created by condensation of steam, demonstrated the concept from which the Newcomen and all cylinder and piston engines descend. The arguments turn on whether Newcomen was aware of Papin's invention. It is unlikely that Newcomen knew of Papin's article in the *Acta Eruditorum*, but he could have read the brief review of Papin's *Fasciculus* in the *Philosophical Transactions* of the Royal Society in 1697.

Papin continued to send papers to the society, many of which were read but not thought worthy of publication. Some of these are now seen to contain innovative ideas, notably that on the Hessian bellows, demonstrated on 26 April 1711, which created a blast sufficient to melt or refine ores. This was the first suggestion for the creation of blast furnaces. The last that is heard of Papin is a letter of 23 January 1712 to Sir Hans Sloane: it is assumed that he died shortly afterwards, and was buried without being identified.

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