Britain sabotaged the steam engine of Leibniz and Papin

The Royal Society and Isaac Newton successfully obstructed the industrial and maritime use of steam power for 100 years, and then claimed the discovery for themselves. Philip Valenti reports.

This article is published as part of our ongoing series on the real origins of the American System. See EIR, *Dec. 1, 1995, 'The Anti-Newtonian Roots of the American Revolution," and Feb. 2, 1996, "Leibniz, Gauss Shaped America's Science Successes." The article that follows is adapted from a longer version, first published in* Fusion *magazine, December 1979.*

The early history of the invention of the steam engine shows without doubt that the British Royal Society, including Isaac Newton personally, deliberately prevented the industrial and naval applications of steam power for nearly 100 years. In fact, the Royal Society was so intent on burying Denis Papin's 1690 invention of a paddle-wheel-driven steamship, worked out in collaboration with Gottfried Wilhelm Leibniz, that it stole his work, and created a mythical story of how two British "Newtonian" heroes invented the steam engine for the sole purpose of raising water from coal mines—a myth that has persisted in the history books until today.

The project of discovering and perfecting a new source of power capable of effecting a dramatic human advance, was first initiated as a national effort by Jean-Baptiste Colbert (1619-83), the minister of the young French King Louis XIV.

In 1666, Colbert established the Academy of Sciences at Paris for this purpose, recruiting the Dutch scientist Christiaan Huygens (1629-95) as its first president. Huygens's program included "research into the power of gunpowder of which a small portion is enclosed in a very thick iron or copper case. Research also into the power of water converted by fire into steam," as well as experiments with vacuum pumps, wind-powered engines, and the communication of force by the collision of bodies.

In 1672, Huygens acquired two young students and collaborators: German diplomat Gottfried Wilhelm Leibniz (1646-1714); and Denis Papin (1647-1712?), a medical doctor introduced into the Academy by Madame Colbert. Within a year, Huygens and his new colleagues had successfully modified the von Guerike air pump, into an engine capable of transforming the force of exploding gunpowder into useful work.

Huygens proposed to create a vacuum within a cylinder under a piston, by exploding a charge of gunpowder at the cylinder's base. After the air was expelled through two valves fitted with leather collars, the collars collapsed, preventing air from reentering the cylinder. The pressure of the atmosphere then pushed the piston downwards into the cylinder, the motion of the piston being applied to perform work (**Figure 1**).

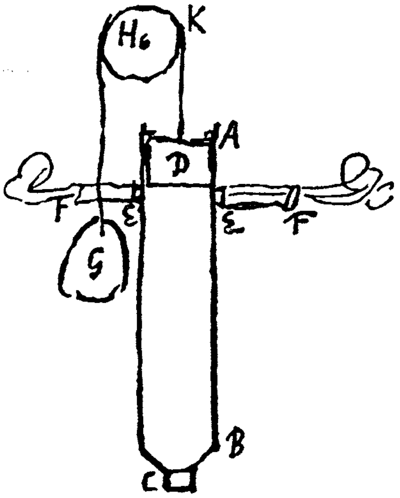
After successfully demonstrating a model gunpowder engine to Colbert, Huygens proposed, that since "the violent action of the powder is by this discovery restricted to a movement which limits itself as does that of a great weight," his invention might be used to "raise great stones for building, to erect obelisks, to raise water for fountains or to work mills to grind grain." It would also, he argued, permit the discovery of "new kinds of vehicles on land and water. And although it may sound contradictory, *it seems not impossible to devise some vehicle to move through the air*" (emphasis added).

While Papin advanced Huygens's work with improved engineering designs, Leibniz proceeded, in deliberate fashion, to discover and develop the science of dynamics and its mathematical tool, the calculus.

The new science of dynamics

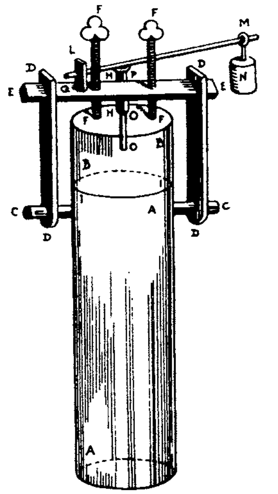
As opposed to the Newtonian dogma of "hard atoms" interacting in the "vacuum" of empty space, Leibniz proposed to study the supposedly "impenetrable" interior of things, to discover the true "geometrical" cause of phenomena. This

FIGURE 1
Huygens's gunpowder device



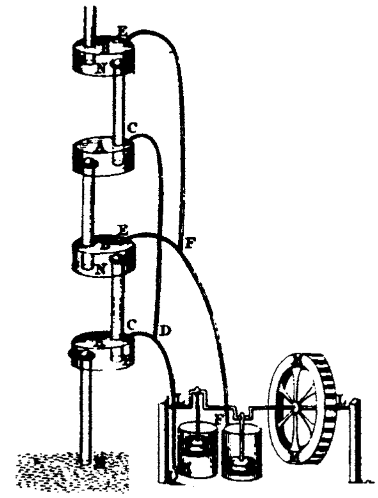
Christiaan Huygens designed this earliest internal combustion engine in 1673, using a charge of gunpowder to create a vacuum in a cylinder under a piston.

FIGURE 2
Papin's digester



Denis Papin's 1680 steam pressure cooker or "digester," with an adjustable safety valve at the top.

FIGURE 3
Papin's pneumatic fountain



In 1687, Papin illustrated the operation of his pneumatic pump by constructing a model fountain. Water was raised by alternate suction and pressure exerted by a pair of air pumps.

project led him to discover the grounds for universal progress, and the basis for a new science—*dynamics.* For Leibniz, matter cannot be divided linearly, like marks on a ruler, but rather in a manner suggestive of the modern Riemannian conception of nested manifolds, or "Worlds within Worlds." Thus, Leibniz develops his own concept of "infinite divisibility" in the *Monadology:*

"Each portion of matter is not only divisible *ad infinitum,* as the ancients recognized, but also each part is actually endlessly subdivided into parts, of which each has some motion of its own; . . .

"Each portion of matter may be conceived of as a garden full of plants, and as a pond full of fishes. But each branch of the plant, each member of the animal, each drop of its humors is also such a garden or such a pond. . . .

"Therefore there is nothing fallow, nothing sterile, nothing dead in the universe, no chaos, no confusion except in appearance. . . ."

Such an endless subdivision, Leibniz said, can account for the "perpetual and very free progress of the whole universe":

"Even if many substances have already reached great perfection, nevertheless on account of the infinite divisibility of the continuum, there always remain in the depths of things slumbering parts which must yet be awakened and become greater and better, and, in a word, attain a better culture. And hence progress never comes to an end."

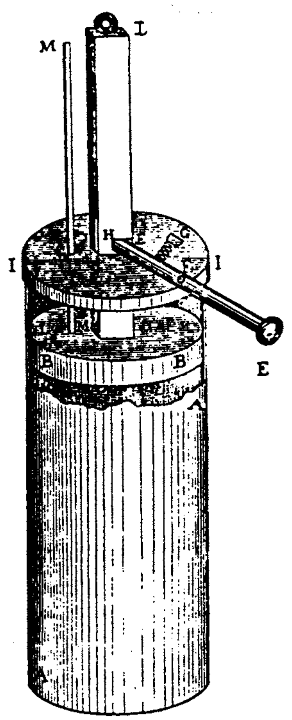
Equipped with a matter containing unlimited resources ("slumbering parts which must yet be awakened"), Leibniz transcended the science of mechanics that had dominated Western thinking since Archimedes. Where mechanics pertained to the passive effects of ancient machines—the lever, pulley, inclined plane, etc.—dynamics was conceived as the science of the active, living force (*vis viva,* or kinetic energy) of "violent actions"—like the explosion of gunpowder, and rapid expansion of high pressure steam.

Since it is limited to the study of, in Leibniz's words, "harmless sorts of effects," mechanics considers the total absolute force of bodies acted upon by the ancient machines, as directly proportional to the acquired velocity, or $F=mv$. In contrast, Leibniz considered the equivalence of the kinetic energy of a heavy body falling from a given height (violent action), to the work required to raise it to that height, and determined that the live force of a body in motion is directly proportional to the *square of the velocity;* that is, $F \propto mv^2$.

Leibniz's practical goal became to harness the most violent actions, i. e., those of the greatest velocity, for the purpose of advancing the material conditions of mankind. By applying the law of the conservation of *vis viva* to maximize the conversion of the kinetic energy of such actions into useful work, Leibniz envisioned mastering the direct force of explosions to power ships, carriages, airplanes, and factories. In contrast, how could a scientific establishment possibly invent anything useful while insisting, as the British Royal Society did throughout the 18th century, that one's preference between measuring force by mv or mv^2 is simply a matter of personal taste, or that Newton's useless "method of fluxions" is equivalent to Leibniz's calculus?

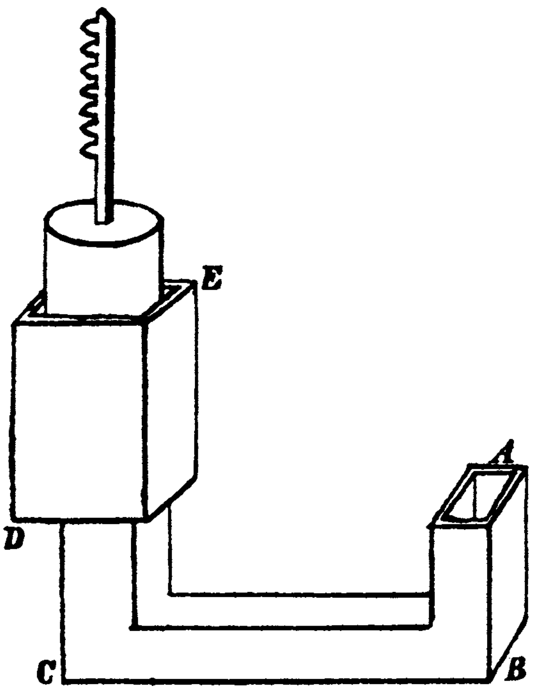
By 1675, the impact of the reactionary shift in the policies

FIGURE 4
Papin's 1690 engine



The first steam engine using a piston and cylinder was invented by Papin in 1690. He proposed to use steam instead of gunpowder to create a vacuum under a piston.

FIGURE 5
Piston with teeth for use with paddlewheel



In his 1690 treatise proposing an atmospheric steam engine using a piston and cylinder, Papin described how his engine could be used to rotate the axle of a paddlewheel and "propel ships against the wind."

of Louis XIV, which began with the French invasion of Holland in 1672, reached Colbert's Academy. The result was a forced exodus of Protestant scientists several years before Louis's 1685 revocation of Henri IV's 1598 Edict of Nantes that had decreed religious tolerance. Leibniz left Paris reluctantly to accept a post as librarian in the German state of Hanover, while Papin left for England.

By 1680, Papin had made a breakthrough toward controlling highly compressed steam, in the form of his "New Digester for softening Bones, etc."—a steam pressure cooker. This device consisted of a cylinder with thick walls (as prescribed by Huygens in his 1666 program), in which was enclosed water along with bones, tough meat, and so forth. The whole device was then placed on a fire to cook (**Figure 2**).

Although Papin's immediate motive was, as he wrote to Huygens, "to relieve poverty, and to get wholesome and agreeable foods from things that we ordinarily reject as useless," his digester was also a major advance toward the steam engine, because of a totally new feature: the safety valve. This allowed Papin to safely contain pressure many times that of the atmosphere and greater than any pressure previously controlled, limited only by the strength of the cylinder.

In 1687, Papin unveiled a new invention to transmit power pneumatically, in order to develop a means of spreading industrialization to areas where water power was not available (**Figure 3**). This idea was hotly opposed in the Royal Society, and Papin left England to accept a chair of mathematics at the University of Marburg in Hesse, bordering Hanover.

Steam power for transport

In 1690, Papin published an historic article in the *Acta Eruditorum* of Leipzig, "A New Method of Obtaining Very Great Moving Powers at Small Cost," where he proposed a means of using the power of expanding steam to operate a piston/cylinder engine. In the new invention, steam replaced the gunpowder charge of Huygens's cylinder, creating a more complete vacuum under the piston, and thereby taking advantage of the full force of atmospheric pressure (**Figure 4**).

Papin's concept was appropriated *in toto* in the Newcomen engine more than 20 years later. However, although Papin mentioned in passing the utility of his invention to "draw water or ore from mines," the article featured a lengthy and detailed discussion of the application of steam power to propelling ships equipped with paddlewheels:

"So, no doubt, oars fixed into an axis could be most conveniently driven round by my tubes, by having the rods of the pistons fitted with teeth, which would force round small wheels, toothed in like manner, fastened to the axis of the paddles. It would only be requisite that three or four tubes should be applied to the same axis, by which means its motion could be continued without interruption" (**Figure 5**).

Papin began to tackle the problem of "making very large tubes" by studying the means of refining ores more efficiently, and of manufacturing cylinders with appropriately smooth surfaces. This led him to the invention of an improved furnace, capable of reaching higher temperatures with a more efficient consumption of fuel. By 1695, Papin had adapted this hotter furnace to the rapid production of high-pressure steam, by constructing the furnace so that the fire surrounded the water, allowing the maximum surface area of water to be heated directly.

With this discovery, Papin was prepared to initiate a qualitative technological advance—not a linear extrapolation from his 1690 results, such as building larger atmospheric engines, but a proposal to directly harness the violent force of expanding steam. Papin wrote to Leibniz on July 25, 1698:

"The method in which I now use fire to raise water still rests on the principle of the rarefaction of water. But I now use a much easier method than that which I published. And furthermore besides using suction, I also use the force of the pressure which water exerts on other bodies when it expands. *These effects are not bounded, as in the case of suction.* So I am convinced that this discovery if used in the proper fashion will be most useful. . . . For myself I believe that this invention can be used for many other things besides raising water. I've made a little model of a carriage which is moved forward by this force: And in my furnace it shows the expected result. But I think that the unevenness and bends in large roads will make the full use of this discovery very difficult for land vehicles; but in regard to travel by water, I would flatter myself to reach this goal quickly enough if I could find more support than is now the case. . . . It gave me much joy to find that you also have some plans to put the moving force of fire to use, and I strongly hope that the little test you told me of succeeded to your satisfaction" (emphasis added).

Leibniz's concern, however, was much greater than simply using the "force of fire" to propel ships and carriages. He saw in Papin's work the unique experiment capable of irrefutably establishing the truth of his dynamical science, as well as advancing that science by the process of applying its principles to the measurement of the thermodynamic efficiency of Papin's machines, the "little test" referred to in Papin's July 25, 1698 letter.

Consider the implications of the Papin-Leibniz discussion once the word *effect* is translated to the modern term *work.* Both Leibniz and Papin agreed that the useful work performed by a heat engine, was to be measured by the height to which it could raise a given quantity of water. In his dynamics, Leibniz had used the example of the equivalence of the work required to raise a heavy body a given height, to the *vis viva* acquired by the body in falling from that height. Whereas in the case of the falling body, the *vis viva* is measured by the body's velocity, Leibniz proposed to measure the *vis viva* of expanding steam by its temperature. Applying the principle of the conservation of *vis viva,* Leibniz developed the following sort of relation:

vis viva consumed by machine = useful work + heat lost in overcoming friction + heat lost to superfluous cooling + . . . [other inefficiencies]

(where useful work is the height a given quantity of water is raised)

With this sort of analysis, Leibniz was prepared to compare the thermodynamic efficiencies of heat engines by measuring "the degree of heat required to make a given effect." This also led him to the formulation of his unique experiment: demonstrating that steam can "raise more than a column of air," i.e., that the direct power of expanding steam is greater than mere atmospheric pressure, as he wrote on Aug. 28, 1698:

"There is nothing which merits development more than the force of expansion [*la dilation*]; if one objects that expanded water can do no more than raise a cylinder of air, and that the stronger it [steam] is the higher it [cylinder of air] is raised and that therefore it is sufficient to use the weight of the falling cylinder—I reply that this higher elevation requires more time, allowing the steam to gradually cool, than *a quicker elevation of a heavier weight.* Thus either force is lost or more fire must be used" (emphasis added).

Clearly at issue in this "little test" is the validity of the mechanical worldview, which threatened to impose itself on emerging technology. Was steam power to be constrained to act passively, slowly pushing and pulling weights like some grotesque Rube Goldberg type of lever or pulley, or was it to be freed in all its violence—maximum *vis viva*—to effect a qualitative human advance?

Papin's invention stolen

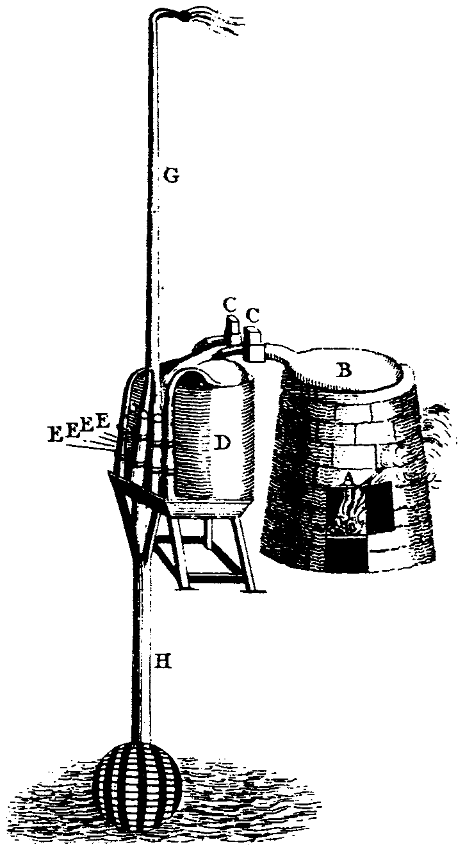
Despite the publicity given to Papin's invention, the British Parliament awarded an exclusive patent for "Raising Water by the Impellent Force of Fire" to one Thomas Savery, variously described as a "sea captain" and a "military engineer." The terms of the patent meant that any steam-powered device Papin might invent in England would come under the control of Savery.

Although news of Savery's patent reached Germany by 1699, it was not until 1704 that Leibniz, via "Hanoverian envoys" in London, was able to acquire some sort of description of Savery's device. Leibniz forwarded a sketch of the English "engine" to Papin, along with an evaluation of its capabilities. Based on further intelligence reports from his envoys, Leibniz concluded—correctly—that Savery's device did not work in full size (see **Figure 6**).

Savery proposed to doom steam to play the role of the ancient horse-driven windlass (hoist) and pulley, pulling water up one pipe and pushing it out of another, with one significant difference—Savery's "fire engine" was much more expensive than horses!

Leibniz continued to maintain friendly pressure on Papin throughout 1704, insisting that he accelerate research into

FIGURE 6
The Savery engine



In 1699, Thomas Savery was granted an exclusive patent by the English Parliament for a "fire engine," which did not work in full size.

applying violent force (including the combustion of alcohol) to the propulsion of ships and carriages, if not to airplanes. Leibniz argued that such a breakthrough would have the greatest world strategic impact.

Papin finally agreed, and in a letter (March 13, 1704), he revealed that he had already built a model paddlewheel boat, "which can carry about 4,000 pounds," and that he had developed a complete theory of rowing, "which can also be applied to land vehicles."

'Augment the powers of man to infinity'

By January 1705, Papin had received Leibniz's sketch of Savery's engine. This had the expected effect on Papin's thinking, as well as on the attitude of the Landgrave of Hesse, who took a renewed interest in Papin's work. In March, a self-confident Papin wrote to Leibniz:

"I can assure you that, the more I go forward, the more I find reason to think highly of this invention which, in theory, *may augment the powers of man to infinity;* but in practice I believe I can say without exaggeration, that *one man by this means will be able to do as much as 100 others can do without it*" (emphasis added).

What Papin achieved within two years of receiving Leibniz's sketch of the Savery device, was a genuine, direct-action steam engine, capable of being immediately applied to ships. Papin's engine successfully incorporated the dynamical innovations of 40 years of research, that began with the project initiated by Huygens in Colbert's Academy (**Figure 7**).

In the preface to his 1707 treatise, "New Method of Raising Water by the Force of Fire," Papin gives Leibniz full credit for providing the necessary impetus to advance his experiments. In Chapter 3, Papin comments on the "means to augment the effect of the machine" by increasing heat efficiency and pressure, arguing that, "in such a case one man could create almost as much of an effect as 500 others who have only those inventions used up to the present."

Although Leibniz and Papin had succeeded in bringing modern dynamical technology into being, making the industrial transformation of society possible for the first time, they were working within an increasingly aversive environment. Leibniz's loyal student and protector in Hanover was the Electress Sophie, who, until her untimely death in 1714, was next in line to become the ruling Queen of England, which made Leibniz the rallying point for the anti-imperialist faction in England and in the American colonies (see last week's *Feature*). This also made Leibniz the number-one enemy of the fledgling British Empire.

However, the relative tranquility of London again became attractive to Papin, and he resolved to go to England to demonstrate before the court and the Royal Society, the incontestable superiority of his model paddlewheeler and steam engine over Savery's device.

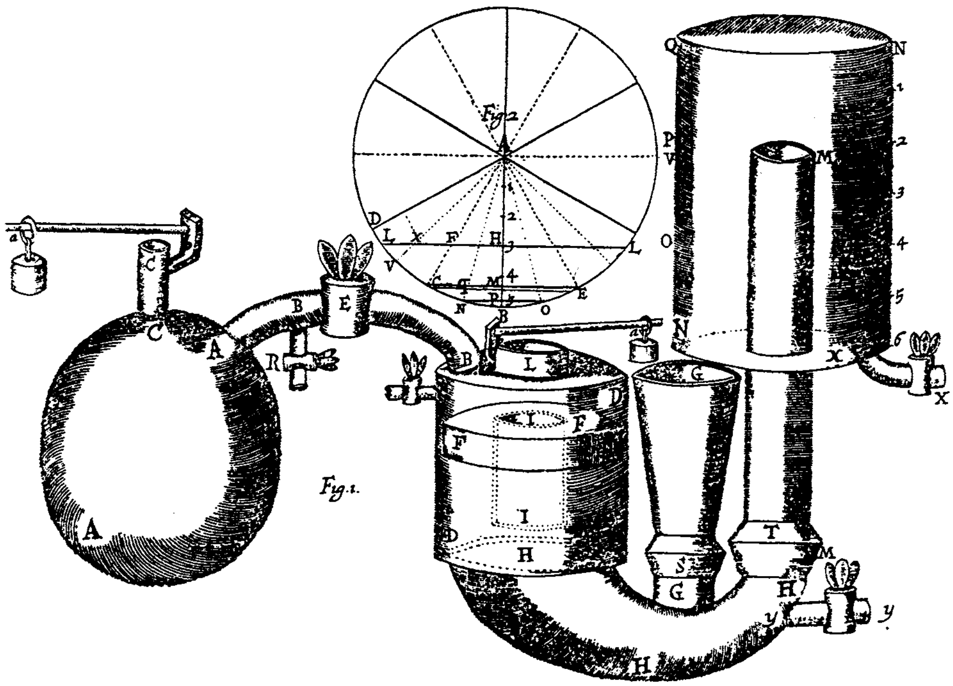
In a letter to Leibniz (Sept. 15, 1707), Papin asked that he help obtain the required permission for passage up the Weser River through Hanover. Leibniz tried to intervene with his friends among local magistrates, but Papin got no further than Munden before encountering the ignorant opposition of the Boatmen's Guild, no doubt incited by corrupt elements of the court. An official of Munden reported to Leibniz, on Sept. 27, 1707, that Papin "had the misfortune to lose here his little machine of a paddlewheel vessel . . . the Boatmen of this town having had the insolence to stop him and to take from him the fruit of his toil, with which he thought to introduce himself before the Queen of England. . . ."

At the mercy of Newton's mob

Despite the tragic encounter with this "mob of boatmen," Papin continued on to London, only to encounter an even more vicious mob—the British Royal Society, at the time headed by president-for-life Sir Isaac Newton.

When he arrived in England, Papin presented a copy of his treatise to the Royal Society along with a proposal, "Proposition by Dr. Papin, concerning a new invented boat

FIGURE 7
Papin's 1707 engine



Papin invented and successfully operated the world's first direct action steam engine, publishing his results in 1707. In 1708 he built the world's first steamboat, 100 years before Robert Fulton.

to be rowed by oars, moved with heat," which was recorded in the Royal Society Register of Feb. 11, 1708.

One pro-British history contains a succinct account of the fate of Papin's proposition:

"Papin, then at Cassel, submitted with his paper, a request for fifteen guineas to carry out experiments, but the Royal Society, like our own, did not hand out fifteen guineas at a time. Instead, the matter was referred to Savery in 1708, and in his letter of criticism turning down Papin's design there is a passage in which he damned the cylinder and piston, saying it was impossible to make the latter work because the friction would be too great!"

Papin then argued for his proposal before Newton himself, who rejected it, on the absurd and malicious pretext, that it would *cost too much.* Papin was then stranded in England without any means of support, completely at the mercy of Newton and Savery, whose exclusive patent covering all conceivable "fire engines" was still in effect. No record remains of Papin's subsequent activity in England besides a mere seven letters to the Royal Society, mostly repeated requests for money to carry out a variety of experiments. In his last letter, Jan. 23, 1712, Papin complained that a number of his inventions presented before the Royal Society had deliberately not been registered under his name:

"So there are at least six of my papers that have been read in the meetings of the Royal Society and are not mentioned in the Register. Certainly, Sir, I am in a sad case, since; even by doing good, I draw enemies upon me. Yet for all that I fear nothing because I rely upon God Almighty."

In 1712, Papin apparently vanished without a trace, not even a death notice. The witchhunt against the Leibnizians was reaching frenzied heights, based on the Royal Society's fraudulent and politically motivated frameup of Leibniz as a "plagiarizer" of the calculus from Newton (see *EIR,* Dec. 1, 1995.) Also, in 1712, "Thomas Newcomen" suddenly appeared to build his fabled fire engine "near Dudley Castle."

Newcomen's engine was simply a scaled-up atmospheric steam pump, based completely on a combination of two of Papin's earlier ideas: 1) the use of steam to create a vacuum and drive a piston (1690); 2) the use of a lever mechanism to transmit power from one pump to another (1687).

Compared to the level of conception and design achieved by Papin, Newcomen's "exotic lever" was a great step backwards. The realization of steam power would have to await the intervention of Leibniz's intellectual heirs in America.

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