Blaise Pascal (1623 – 1662)

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Blaise Pascal was a French mathematician, physicist, inventor, writer and Catholic philosopher. He was a child prodigy who was educated by his father, a tax collector in Rouen. Pascal's earliest work was in the natural and applied sciences where he made important contributions to the study of fluids, and clarified the concepts of pressure and vacuum by generalizing the work of Evangelista Torricelli. Pascal also wrote in defense of the scientific method.

In 1642, while still a teenager, he started some pioneering work on calculating machines, and after three years of effort and 50 prototypes he invented the mechanical calculator. He built twenty of these machines (called the Pascaline) in the following ten years. Pascal was a mathematician of the first order. He helped create two major new areas of research. He wrote a significant treatise on the subject of projective geometry at the age of sixteen, and later corresponded with Pierre de Fermat on probability theory, strongly influencing the development of modern economics and social science. Following Galileo and Torricelli, in 1646 he refuted Aristotle's followers who insisted that nature abhors a vacuum. His results caused many disputes before being accepted.


Pascal’s mechanical calculator, the “Pascaline”, on display at the Musée des Arts et Métiers, Paris

In 1646, he and his sister Jacqueline identified with the religious movement within Catholicism known by its detractors as Jansenism. His father died in 1651. Following a mystical experience in late 1654, he had his "second conversion", abandoned his scientific work, and devoted himself to philosophy and theology. His two most famous works date from this period: the Lettres provinciales and the Pensées, the former set in the conflict between Jansenists and Jesuits. In this year, he also wrote an important treatise on the arithmetical triangle. Between 1658 and 1659 he wrote on the cycloid and its use in calculating the volume of solids.

Pascal had poor health especially after his eighteenth year and his death came just two months after his 39th birthday.

Contributions to the physical sciences:

Pascal's work in the fields of the study of hydrodynamics and hydrostatics centered on the principles of hydraulic fluids. His inventions include the hydraulic press (using hydraulic pressure to multiply force) and the syringe. He has proven that hydrostatic pressure does not depend on the weight of the fluid but on the elevation difference. He demonstrated this principle by attaching a thin tube to a barrel full of water and filling the tube with water up to the level of the third floor of a building. This caused the barrel to leak, in what became known as Pascal's barrel experiment. By 1646, Pascal had learned of Evangelista Torricelli's experimentation with barometers. Having replicated an experiment that involved placing a tube filled with mercury upside down in a bowl of mercury, Pascal questioned what force kept some mercury in the tube and what filled the space above the mercury in the tube. At the time, most scientists contended that, rather than a vacuum, some invisible matter was present. This was based on the Aristotelian notion that creation was a thing of substance, whether visible or invisible; and this substance was forever in motion. Furthermore, "Everything that is in motion must be moved by something," Aristotle declared. Therefore, to the Aristotelian trained scientists of Pascal's time, a vacuum was an impossibility. How so? As proof it was pointed out:

“Light passed through the so-called "vacuum" in the glass tube.
Aristotle wrote how everything moved, and must be moved by something.
Therefore, since there had to be an invisible ‘something’ to move the light through the glass tube, there was no vacuum in the tube. Not in the glass tube or anywhere else. Vacuums -the absence of any and everything- were simply an impossibility.”

Following more experimentation in this vein, in 1647 Pascal produced Experiences nouvelles touchant le vide ("New Experiments with the Vacuum"), which detailed basic rules describing to what degree various liquids could be supported by air pressure. It also provided reasons why it was indeed a vacuum above the column of liquid in a barometer tube.

On 19 September 1648, after many months of Pascal's friendly but insistent prodding, Florin Périer, husband of Pascal's elder sister Gilberte, was finally able to carry out the fact finding mission vital to Pascal's theory. The account, written by Périer, reads:

"The weather was chancy last Saturday...[but] around five o'clock that morning...the Puy-de-Dôme was visible...so I decided to give it a try. Several important people of the city of Clermont had asked me to let them know when I would make the ascent...I was delighted to have them with me in this great work... "...at eight o'clock we met in the gardens of the Minim Fathers, which has the lowest elevation in town....First I poured sixteen pounds of quicksilver...into a vessel...then took several glass tubes...each four feet long and hermetically sealed at one end and opened at the other...then placed them in the vessel [of quicksilver]...I found the quick silver stood at 26" and 3.5 lines above the quicksilver in the vessel...I repeated the experiment two more times while standing in the same spot...[they] produced the same result each time... "I attached one of the tubes to the vessel and marked the height of the quicksilver and...asked Father Chastin, one of the Minim Brothers...to watch if any changes should occur through the day...Taking the other tube and a portion of the quick silver...I walked to the top of Puy-de-Dôme, about 500 fathoms higher than the monastery, where upon experiment...found that the quicksilver reached a height of only 23" and 2 lines...I repeated the experiment five times with care...each at different points on the summit...found the same height of quicksilver...in each case..."

Pascal replicated the experiment in Paris by carrying a barometer up to the top of the bell tower at the church of Saint-Jacques-de-la-Boucherie, a height of about fifty meters. The mercury dropped two lines.

In the face of criticism that some invisible matter must exist in Pascal's empty space, Pascal, in his reply to Estienne Noel, gave one of the seventeenth century's major statements on the scientific method, which is a striking anticipation of the idea popularised by Karl Popper that scientific theories are characterised by their falsifiability: "In order to show that a hypothesis is evident, it does not suffice that all the phenomena follow from it; instead, if it leads to something contrary to a single one of the phenomena, that suffices to establish its falsity." His insistence on the existence of the vacuum also led to conflict with other prominent scientists, including Descartes.