How to Cure the Toothache

Blaise Pascal

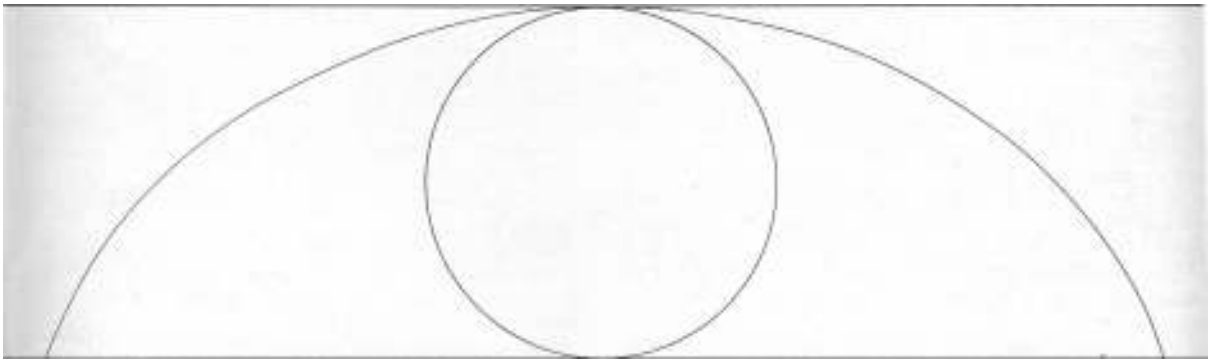

Figure 1 The path of the Cycloid

Development of computing devices has been attended by men of considerable ability. Few, however, have possessed genius as original as that of Blaise Pascal – a man who just to take his mind off the toothache created some of the most ingenious theorems in mathematics.

Figure 2 Blaise Pascal

Blaise Pascal was born on June 19, 1623. His father took sole charge of his education – in fact, the child never spent a day inside a school. At the age of 11 he performed his first scientific experiments when he noted that a piece of china struck by a hard object gave a ringing hum which ceased when the china was touched. From his experiments he wrote a paper on the qualities of sound.

At this stage his father wanted him to study classical languages and denied him any mathematical books. Nonetheless, Blaise took an interest in geometry and with no education in the subject independently rediscovered and proved one of Euclid's Theorems.

Word of his abilities soon spread and at 12 he was appointed to a commission to judge the procedures for reckoning longitudes.

Pascal was a mathematician of the first order. When he was 16 he published an important book on conic sections and wrote a significant treatise on the subject of projective geometry. The mathematician Descartes refused to believe that a boy of 16 could have written it.

Three years later he invented the first practical calculating machine.

In 1654 Pascal corresponded with Pierre de Fermat on problems submitted by a gambler friend who was losing heavily at dice. The friend was the Chevalier de Méré, and the specific problem was that of two players who want to finish a game early and, given the current circumstances of the game, want to divide the stakes fairly, based on the chance each has of winning the game from that point. Pascal's solutions laid the foundation for all subsequent developments in probability theory and statistics, strongly influencing the development of modern economics and social science. In this context his name is commemorated in Pascal's Triangle, a numerical technique used in the binomial theorem.

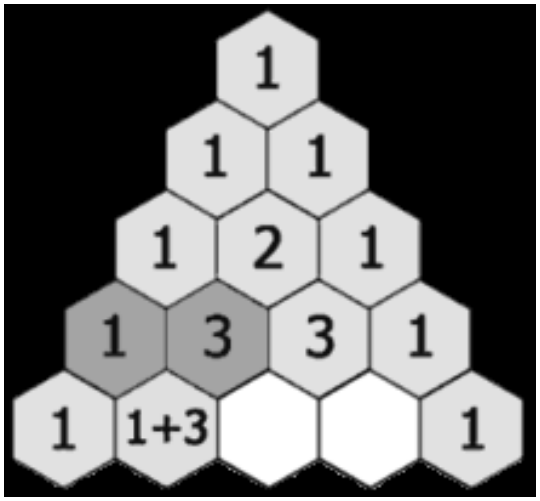

Figure 3 Pascal's Triangle in which each value is the sum of the two above it.

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.

Apart from his contributions to mathematics, Pascal invented a new type of wristwatch and experimented to prove the properties of atmospheric pressure. His 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 generalising the work of Evangelista Torricelli. His research into hydrostatics led to the hydraulic press and his name is further remembered in Pascal's Principle which describes the properties of a fluid at rest in a closed vessel.

In 1646 along with his sister Jacqueline, he had come under the influence of a Catholic religious sect known as Jansenism, and by his early thirties, following the death of his father in 1651, and a mystical experience in late 1654 (after a carriage accident which almost cost him his life), the intensity of his beliefs caused him to reject his scientific activities. Devoting his life to meditation and religious writings, Pascal produced such noteworthy books as his 'Pensees' – a work whose brilliance inspired Voltaire.

Never strong, Pascal grew chronically sick in his later years. In 1658, four years before his death, he made a brief excursion back into mathematics when, to relieve a serious attack of toothache, he devoted eight days to contemplating the properties of the cycloid and its use in calculating the volume of solids. The cycloid is the figure traced by a point on the rim of a circle which rolls along a straight line.

Pascal discovered and proved six interesting properties of this curve, and announced them in the form

of problems with the offer of a prize to anyone coming forward with the solutions. After issuing the challenge, he discovered that four of the problems had already been solved by Roberval, so he made his judgment on the remaining two. Unfortunately, he didn't tell the contestants.

Figure 4 Pascal studying the cycloid, by Augustin Pajou, 1785, Louvre.

Solutions came from the astronomer Huygens and Sir Christopher Wren, among others, and an Englishman, John Wallis, duly laid claim to the prize. Pascal rejected the claim and coolly awarded the prize to himself, refusing to reveal his own proofs until after examining the contestants' solutions. The indignant Wallis concluded that Pascal has stolen the competitors' proofs. Despite the bad feeling, the discussion raised by this contest provided an important stimulus in the development of differential and integral calculus.

As his illnesses worsened, Pascal published six treatises on geometrical subjects, consisting of some 200 pages of compact reasoning and over 40 diagrams, some of great complexity. Considering the effort of formulating these theorems, reducing them into geometrical proofs and checking, it must be ranked as one of the creative achievements of all time that Pascal wrote it completely in 18 days. He worked on two treatises at a time, despatching his manuscripts page by page to the printers without even keeping copies for reference. In total, Pascal's writings are not extensive but are of great originality. And while his early conversion was of great ultimate benefit to French philosophy, we can only speculate on the mathematical discoveries that he might have made if he had chosen to.

In all, Pascal was a mathematician, physicist, inventor, writer and Catholic philosopher. Pascal also wrote a defence of the scientific method.

He died just two months after his thirty-ninth birthday.