

Blaise Pascal: His science and his faith, Doug Hayhoe, March 2024

Pascal was a scientific and mathematical genius. But his theological insights even greater.

Introduction

In Grade 9, I became fascinated with numbers and happened upon Pascal's triangle. It's a very simple arrangement (Figure 1). You start with 1 in the top row, and add another number 1 to the next row below. Each number in the rows below must equal the sum of the two numbers just above. In the 5th row, for example, the number 6 is the sum of the 3 and 3 just above the 6.

This simple arrangement describes many useful patterns in mathematics. Take the binomial theorem for example. You probably remember that $(x + y)^2 = x^2 + 2xy + y^2$, which can also be written as $(x + y)^2 = 1x^2 + 2xy + 1y^2$.

Notice that the coefficients of the terms on the right, 1 2 1, are the 3rd row of Pascal's triangle. But few of us remember that $(x + y)^6 = 1x^6 + 6x^5y^1 + 15x^4y^2 + 20x^3y^3 + 16x^2y^4 + 6x^1y^5 + 1y^6$. This is where Pascal's triangle comes in handy. The coefficients are just the 7th row in Figure 1.

							1							
						1	1							
				1	2	1								
			1	3	3	1								
		1	4	6	4	1								
	1	5	10	10	5	1								
1	6	15	20	15	6	1								
1	7	21	35	35	21	7	1							

Figure 1 Pascal's triangle – first 8 rows

A simple definition of mathematics

"Mathematics is the science of patterns."
You can't get any simpler than this!

Pascal's triangle, in fact, was discovered long before Pascal. But he included it in his post-humous [Treatise on Arithmetical Triangle](#), and so it was named in Europe after him. It certainly represents his mindset!

Pascal's Genius

Pascal's triangle may not have been anything new. But in 1639, when he was just 16, Pascal did prove something new in projective geometry and conics. It had never been done before, even though the study of conics began with the Greeks.

Take any conic such as a circle or ellipse. In it, inscribe a hexagon (ABCDEF), as in Figure 2. Extend the three pairs of *opposite* sides until they meet outside of the conic. (For example, when you extend opposite sides FE and BC, they meet at point P.) Then the three intersection points (MNP) form a straight line. (Note: this doesn't work when you extend non-opposite sides such as DE and AF to meet at point I.)¹

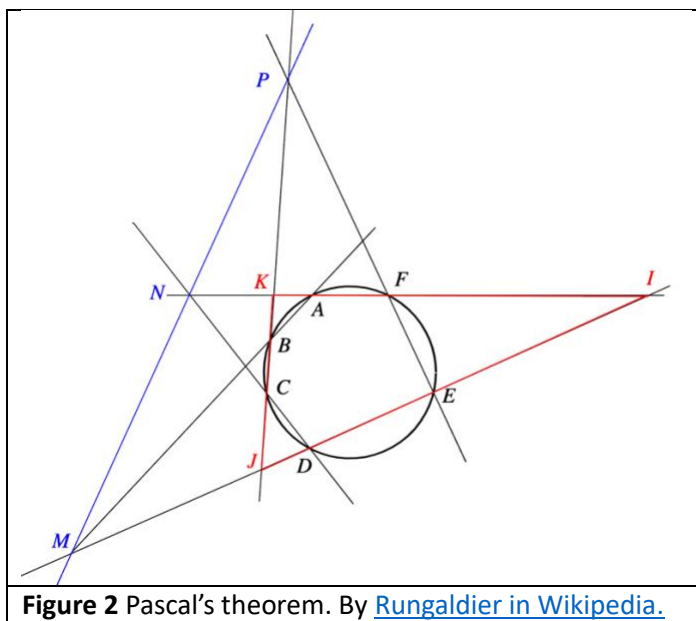


Figure 2 Pascal's theorem. By [Rungaldier in Wikipedia](#).

¹ Andrew Nunn has demonstrated Pascal's theorem for all the conics – circle, ellipse, parabola, hyperbola – using the common geometry software, *The Geometer's Sketchpad*. See the Appendix for examples.

A few years later, when he was 19, Pascal showed his genius in technology. To help his father with tedious calculations in the tax department where he worked, he invented the first mechanical calculator, later called a Pascaline (Figure 3). In honour of this, the renowned Swiss computer scientist, Niklaus Wirth, called the computer language he invented PASCAL.



Figure 3 A Pascaline signed by Pascal in 1652, in the *Conservatoire national des arts et métiers* in Paris, France. [Photograph by Rama.](#)

Pascal's greatest scientific discovery was about atmospheric pressure, made when he was 25. He reasoned that the atmospheric pressure on us is due to the weight of air in the atmosphere above. While he may not have been the first to realize this, he was the first to measure it scientifically.

He proposed climbing a mountain, measuring atmospheric pressure at the bottom and top. Since his own health was not good, he used a relative. For the experiment, "[Pascal's brother-in-law had to carefully pour \[the liquid mercury\] into a bowl and place four-foot glass tubes in the mercury, measuring the height at different points.](#)" It worked! Pascal's experiment soon became a model of carefully controlled scientific investigation that has been followed for almost four centuries.

In recognition of Pascal's ground-breaking work, a unit of atmospheric pressure in the Metric system is called a "pascal." Standard atmospheric pressure on Earth is 101,325 Pa, or 14.7 lbs/in², if you use the old units that I grew up with. The atmospheric pressure where you live, however, probably varies from day to day, as the weather goes through its highs and lows. These changes in the atmosphere, unfortunately, cause headaches for some people, like my wife!

After his ground breaking work on pressure, Pascal was not finished with mathematics. During a spiritual low in his life, when he hung out with gamblers, one of them asked for help in solving a problem: "How do you fairly divide the stakes if the game was stopped midway through?" Pascal worked out the answer with another math genius of the time Pierre de Fermat. This collaboration between Pascal and Fermat led to the foundation of probability theory.

(More details about Pascal's scientific and mathematical work are found at the Wikipedia website [Blaise Pascal.](#))

Pascal's Spiritual Conversion

Although Pascal, like most others in France at that time, was brought up in the Catholic faith, it didn't have much impact on him in his early days. In 1646, however, he experienced what he called "a first conversion." He had come into contact with a "splinter group" called Jansenists. They largely followed the theology of Augustine, who emphasized the key role of grace in salvation (see my essay *The Legacy of Saint Augustine*).

After this, however, Pascal fell away and became friends with a more worldly group of libertines. It was during this time, as I mentioned above, that he thought more about probability in connection with gambling outcomes. But in 1654 he had a profound "second conversion," which seared itself on his heart for the rest of his life.

During his second conversion, Pascal had a deep encounter with Christ. To describe it, he later wrote: "Fire. God of Abraham, God of Isaac, God of Jacob, not of the philosophers and the scholars. God of Jesus Christ." It ended with Psalm 119:6, "I will not forget Thy word" (KJV). Eight years later, after his death, these words were found written on the inside of his jacket.



[Anonymous portrait of Blaise Pascal](#)

Pascal's Writings

In addition to being a skilled mathematician and physicist, Pascal was also a great writer. After his second conversion, he dedicated his time to defending his spiritual beliefs. Two main books carrying his succinct and witty sayings are readily available.

In his anonymous *Provincial Letters*, Pascal attacked bad religious arguments such as casuistry, ["the mere use of complex reasoning to justify moral laxity."](#) He also weighed in on scientific matters such as Galileo's support of a sun-centred solar system. This new view proposed that Earth rotates daily on its axis, and revolves yearly around the Sun. For us "moderns," it's difficult to imagine anything more obvious. But many in the early 1600s, especially Church leaders, clung to the old geocentric model that Earth stood still, while Sun, Moon, and stars revolved daily around it. For one thing, this kept mankind at the physical centre of the universe.

In his *Letters*, Pascal's argument to the Church leaders in Rome went something like this:

"Imprisoning Galileo will never prove that Earth remains stationary. In fact, if it can be proved by scientific observation that Earth and not the Sun rotates daily, 'the arguments of all mankind together' will not keep Earth from rotating daily, carrying all of you religious leaders rotating with it!" (This is a paraphrase.)

Christians today who support conspiracy theories that go against obvious scientific facts would do well to pay attention to this argument!

But Pascal wasn't all in with logical reasoning. In fact, he opposed natural theology, the idea that we can learn about God sufficiently from observation and reason. This is especially apparent in his second book called *Pensées* ("Thoughts"). This was to be his masterpiece, his great defense of his Christian faith. Unfortunately, he died at the early age of 39, before he could complete it. But after his death, his ideas, statements, and many pithy sayings on scraps of paper, prepared for this book, were collected and published. It has since been hailed as one of the greatest prose works of the French language.

Some of Pascal's carefully composed and profoundly thought-out statements
• It is not certain that everything is uncertain • If God does not exist, one will lose nothing by believing in him; while if he does exist, one will lose everything by not believing in him (known as Pascal's wager) • Man is equally incapable of seeing the nothingness from which he emerges and the infinity in which he is engulfed. • The supreme function of reason is to show us that some things are beyond reason • The heart has its own reason, which reason does not know • There is a God-shaped vacuum in the heart of each man which cannot be satisfied by any created thing but only by God the Creator, made known through Jesus Christ. • In order to humiliate that superb power of reasoning, which claims it must judge of the things which the will chooses, ... [God wished] that these truths enter from the heart to the mind, and not from the mind to the heart.

Some of Pascal's deepest thoughts, however, can't be put into a single sentence. Here is one:

"Man is but a reed, the weakest thing in nature; but he is a thinking reed. It is not required that the entire universe arm itself to crush him: a vapour, a drop of water suffices to kill him. But if the universe crushed him, man would still be more novel than that which kills him, because he knows he is dying, and [he knows] the advantage that the universe has over him, of which the universe knows nothing." ([*Pensées*](#), p. 264).

Conclusion

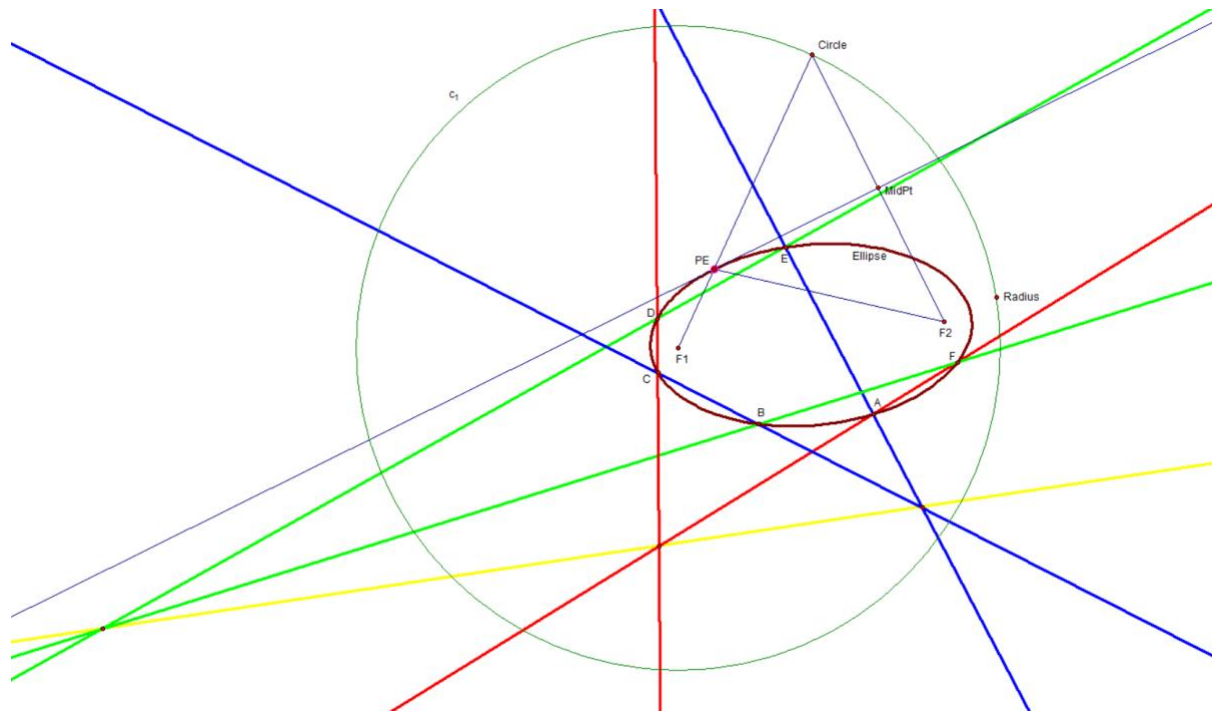
In the title to his book, [*Neither Angel nor Beast: The Life and Work of Blaise Pascal*](#), Francis X. J. Coleman quotes Pascal's own reflections on what humans are, neither angels nor beasts. He then begins the book by saying that "Pascal was a mathematician, a physicist, an inventor, a theologian, a philosopher, and the greatest prose stylist in the French language." In his succeeding chapters, Coleman develops and comments on each of these characteristics in detail.

For me, it suffices to say that Pascal is another great example of someone who believed fully in God's two books, nature and Scripture. But he went further than this. When he realized that his unique ability to investigate both mathematics and nature didn't satisfy the deepest core of his heart, he welcomed Jesus Christ into his life on the deepest level. And he never regretted it!

Appendix

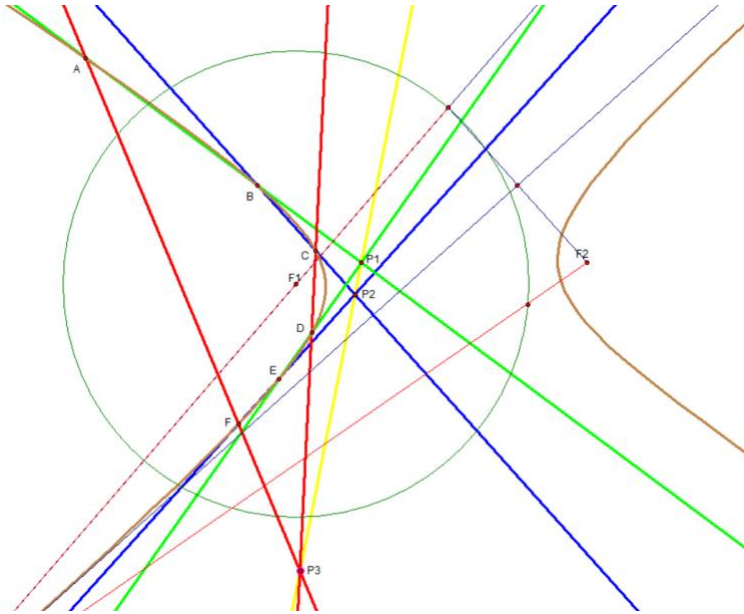
Here is Andrew Nunn's demonstration of Pascal's Theorem for the ellipse and hyperbola, using *The Geometer's Sketchpad* software.

The Ellipse



The brown ellipse is created using the thin lines and the circle. Then points A B C D E F describe the hexagon. The pairs of opposite sides are coloured green, blue and red. And, indeed, the intersections of these pairs of coloured lines always lie on the yellow "Pascal's Line".

The Hyperbola



The thin lines are construction lines to create the hyperbola. The hyperbola has foci F_1 & F_2 and is brown. The hexagon is ABCDEF, all on the left branch of the hyperbola. The opposite sides of the hexagon are coloured red, green and blue, and the intersections of these pairs of coloured lines are labeled P_1 , P_2 , P_3 . These 3 last points always lie on the yellow straight line "Pascal's Line".