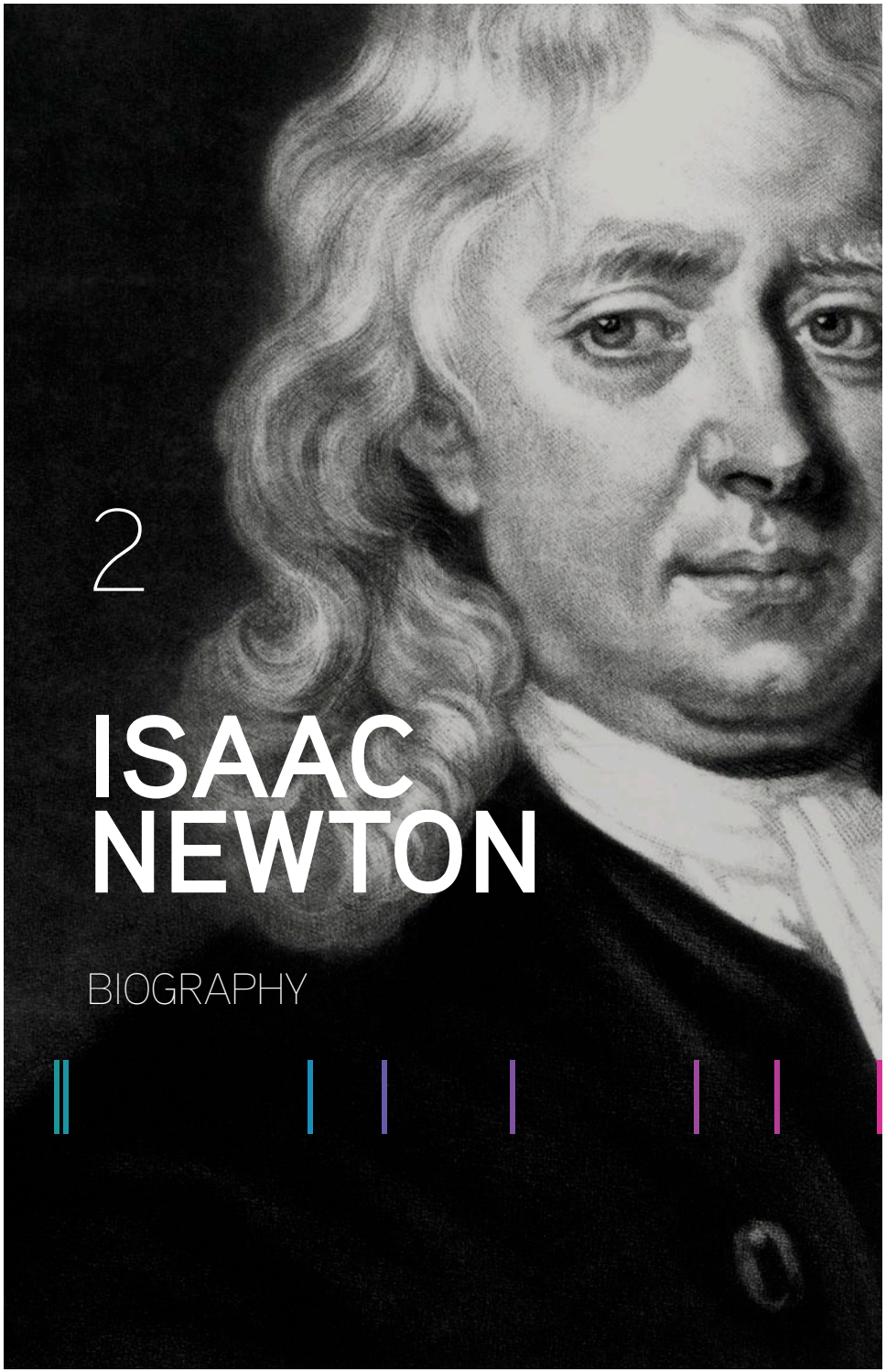


2

ISAAC NEWTON

BIOGRAPHY

BIG HISTORY PROJECT

Born
January 4, 1643
Lincolnshire, England

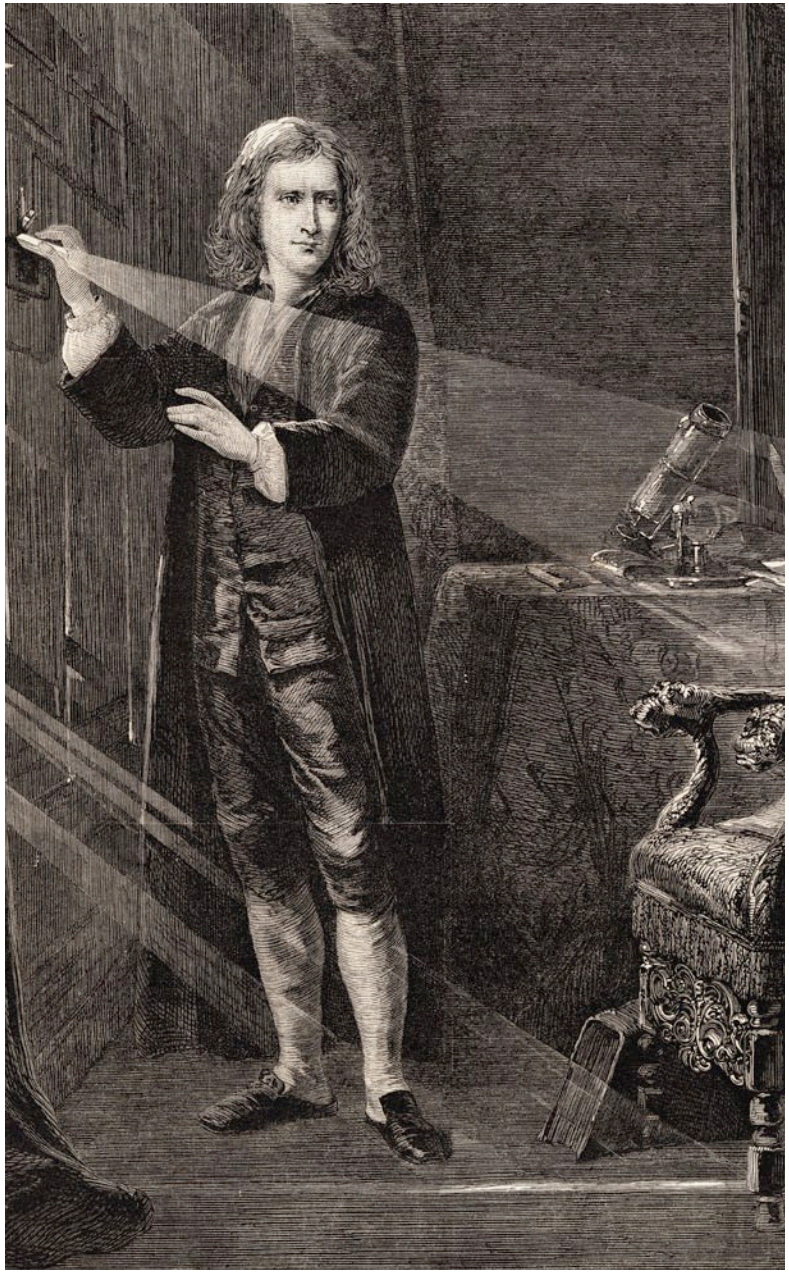
Died
March 31, 1727
London, England

ISAAC NEWTON

PHYSICS, GRAVITY & LAWS OF MOTION

By Cynthia Stokes Brown

Sir Isaac Newton developed the three basic laws of motion and the theory of universal gravity, which together laid the foundation for our current understanding of physics and the Universe.



Early life and education

Newton was born prematurely and not expected to survive. His dad had died before his birth, and when he was 3 his mother remarried and left him with his grandparents on a farm in Lincolnshire, England, about 100 miles north of London, while she moved to a village a mile and a half away from him. He grew up with few playmates and amused himself by contemplating the world around him.

His mother returned when Newton was 11 years old and sent him to King's School, eight miles away. Rather than playing after school with the other boys, Newton spent his free time making wooden models, kites of various designs, sundials, even a water clock. When his mother, who was hardly literate, took him out of school at 15 to turn him into a farmer, the headmaster, Henry Stokes, who recognized where Newton's talents lay, prevailed on her to let Newton return to school and prepare for university.

Newton attended Cambridge University from 1661 to 1665. The university temporarily closed soon after he got his degree because people in urban areas were dying from the plague. Newton retreated to his grandparents' farm for two years, during which time he proved that "white" light was composed of all colors and started to figure out calculus and universal gravitation — all before he was 24 years old.

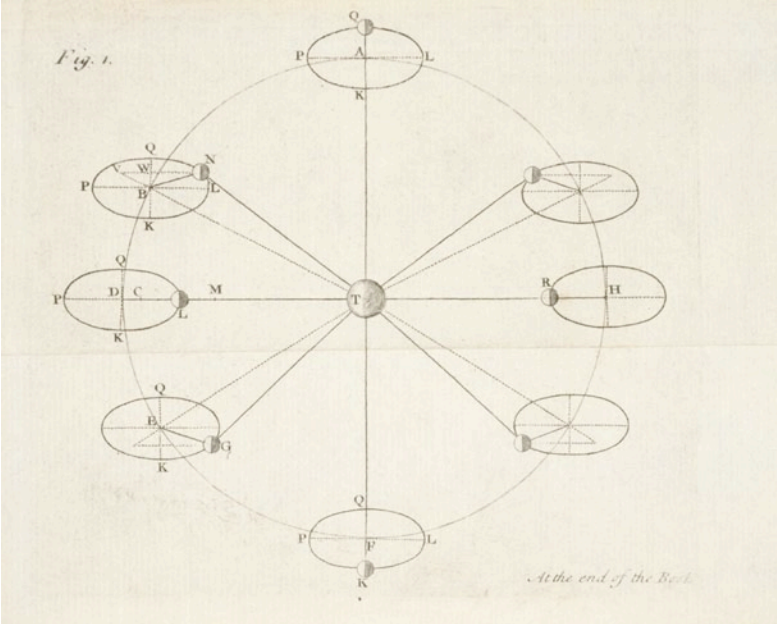
It was on his grandparents' farm that Newton sat under the famous apple tree and watched one of its fruits fall to the ground. He wondered if the force that pulled the apple to the ground could extend out to the Moon and keep it in its orbit around Earth. Perhaps that force could extend into the Universe indefinitely.

At Cambridge

After the plague subsided, Newton returned to Cambridge to earn his master's degree and become a professor of mathematics there. His lectures bored many of his students, but he continued his own thinking and experiments, undaunted. When his mother died, he inherited enough wealth to leave his teaching job and move to London, where he became the president of the Royal Society of London for Improving Natural Knowledge, the top organization of scientists in England, for 25 years.

Laws of motion and gravity

Newton's most important book was written in Latin; its title was translated as *Mathematical Principles of Natural Philosophy* (1687). It proved to be one of the most influential works in the history of science. In its pages Newton



asserted the three Laws of Motion, elaborated Johannes Kepler's Laws of Motion, and stated the Law of Universal Gravitation. The book is primarily a mathematical work, in which Newton developed and applied calculus, the mathematics of change, which allowed him to understand the motion of celestial bodies. To reach his conclusions he also used accurate observations of planetary motion, which he made by designing and building a new kind of telescope, one that used mirrors to reflect, rather than lenses to refract, light.

Newton's three Laws of Motion are:

01 Every body continues at rest or in motion in a straight line unless compelled to change by forces impressed upon it. (Galileo first formulated this, and Newton recast it.)

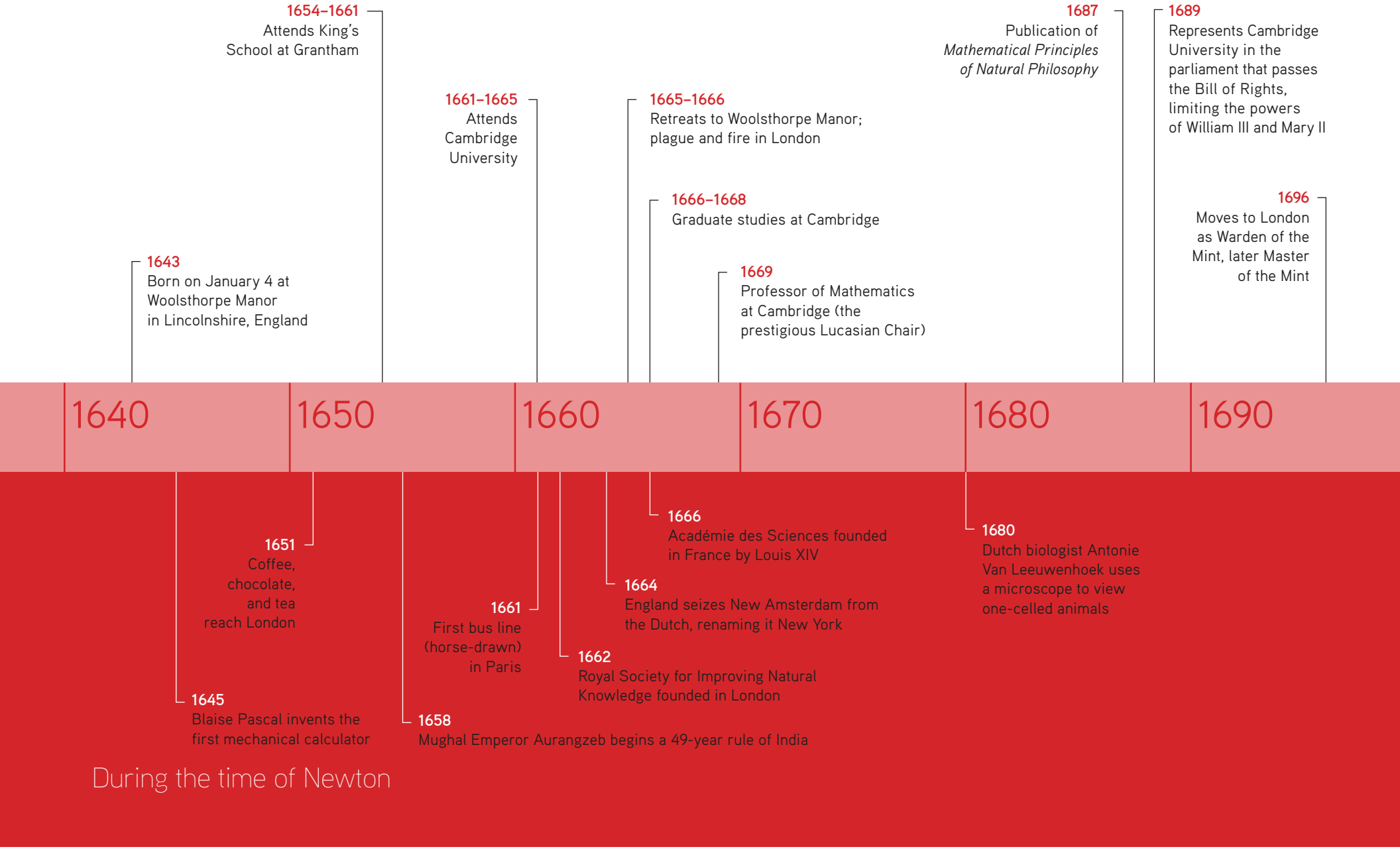
02 Every change of motion is proportional to the force impressed and is made in the direction of the straight line in which that force is impressed. (A planet would continue outward into space but is perfectly balanced by the Sun's inward pull, which Newton termed "centripetal" force.)

03 To every action there is always opposed an equal reaction, or the mutual action of two bodies on each other is always equal and directed to contrary parts.

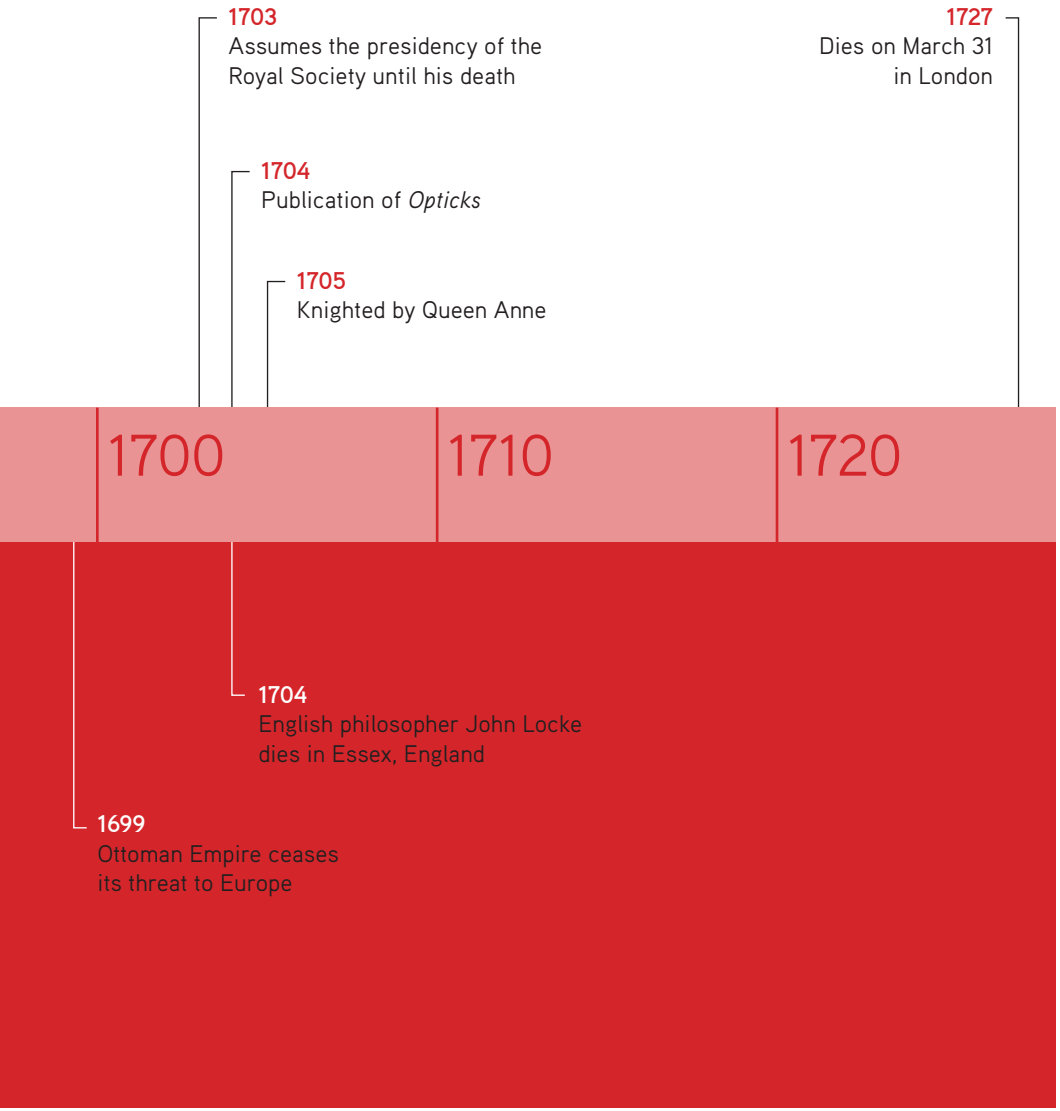
Putting these laws together, Newton was able to state the Law of Universal Gravitation: "Every particle of matter attracts every other particle with a force proportional to the product of the masses of the two particles and inversely proportional to the square of the distance between them." Stated more simply, the gravitational attraction between two bodies decreases rapidly as the distance between them increases.

This calculation proved powerful because it presented the Universe as an endless void filled with small material bodies moving according to harmonious, rational principles. Newton understood gravity as a universal property of all bodies, its force dependent only on the amount of matter contained in each body. Everything, from apples to planets, obeys the same unchanging laws. By combining physics, mathematics, and astronomy, Newton made

Timeline of Newton's life



During the time of Newton



a giant leap in human understanding of Earth and the cosmos. Newton's mathematical method for dealing with changing quantities is now called the calculus. Newton did not publish his method but solved problems using it. Later the German scientist Gottfried Wilhelm von Leibniz also worked out "the calculus", and his notation proved easier to use. Newton accused Leibniz, in a nasty dispute, of stealing his ideas, but historians now believe that each invented the calculus independently.

Recognition

Newton was made a knight by Queen Anne in 1705 and, at his death in 1727, he was buried in London's Westminster Abbey. He now rests in a place of prominence near the poet Geoffrey Chaucer and the astronomer John Herschel. Shortly before he died, Newton remarked:

> I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the seashore and diverting myself in now and then finding a smoother pebble or prettier shell than ordinary, while the great ocean of truth lay all undiscovered before me.

Sources

Christianson, Gale E. *Isaac Newton*.
Oxford: Oxford University Press, 2005.

Wills, John E. Jr. 1688: *A Global History*.
New York and London: W. W. Norton, 2001.

Image credits

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Isaac Newton performing an experiment
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