Isaac Newton

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Sir Isaac Newton , PRS, (4 January 1643 - 31 March 1727) [OS: 25 December 1642 - 20 March 1727] was an English mathematician, physicist, astronomer, alchemist, chemist, inventor, and natural philosopher who is generally regarded as one of the most influential scientists and mathematicians in history..

Newton wrote the *Philosophiae Naturalis Principia Mathematica* in which he described universal gravitation and the three **laws of motion**, laying the groundwork for classical mechanics. By deriving Kepler's laws of planetary motion from this system, he was the first to show that the motion of objects on Earth and of celestial bodies are governed by the same set of natural laws. The unifying and deterministic power of his laws was integral to the scientific revolution and the advancement of heliocentrism.

Among other scientific discoveries, Newton realized that the spectrum of colours observed when white light passes through a prism is inherent in the white light and not added by the prism (as Roger Bacon had claimed in the 13th century), and notably argued that light is composed of particles. He also developed a law of cooling, describing the rate of cooling of objects when exposed to air. He enunciated the principles of conservation of momentum and angular momentum. Finally, he studied the speed of sound in air, and voiced a theory of the origin of stars. Despite this renown in mainstream science, Newton spent more time working on either alchemy or chemistry, than physics.

Newton played a major role in the history of calculus, sharing credit with Gottfried Leibniz. He also made contributions to other areas of mathematics, for example the generalized binomial theorem. The mathematician and mathematical physicist Joseph Louis Lagrange, said that "Newton was the greatest genius that ever existed and the most fortunate, for we cannot find more than once a system of the world to establish."

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1. Biography

1.1 Early years

Newton was born in Woolsthorpe-by-Colsterworth (at Woolsthorpe Manor), a hamlet in the county of Lincolnshire. Newton was born prematurely, and no one expected him to live; indeed, his mother, Hannah Ayscough Newton, is reported to have said that his body at that time could have fit inside a quart mug (Bell, 1937). His father, Isaac, had died three months before Newton's birth. When Newton was two, his mother went to live with her new husband, leaving her son in the care of his grandmother.

According to E.T. Bell (1937, Simon and Schuster) and H. Eves:

Newton began his schooling in the village schools and was later sent to The Kings Grammar School (Grantham) where he became the top boy in the school. At Kings he lodged with the local apothecary, William Clarke and eventually became engaged to the apothecary's stepdaughter, Anne Storer, before he went off to Cambridge University at the age of 19. As Newton became engrossed in his studies, the romance cooled and Miss Storer married someone else. It is said he kept a warm memory of this love, but Newton had no other recorded 'sweethearts' and never married.

However, William Stukeley and Mrs Vincent, the source which Bell and Eves have embroidered so unhelpfully, merely say that Newton entertained 'a passion' for her while he lodged at the Clarke house. Mrs Vincent's maiden name was Katherine Storer, not Anne.

From the age of about twelve until he was seventeen, Newton was educated at The King's School in Grantham (where his signature can still be seen upon a library window sill). He was removed from school and by Oct 1659 he was to be found at Woolsthorpe where his mother attempted to make a farmer of him. He was, by later reports of his contemporaries, thoroughly unhappy with the work. It appears to be Henry Stokes, master at the King's School, who persuaded his mother to send him back to school so that he might complete his education. This he did at the age of eighteen, achieving an admirable final report. His teacher said:

His genius now begins to mount upwards apace and shine out with more strength. He excels particularly in making verses. In everything he undertakes, he discovers an application equal to the pregnancy of his parts and exceeds even the most sanguine expectations I have conceived of him.

In June 1661 he matriculated to Trinity College, Cambridge. At that time, the college's teachings were based on those of Aristotle, but Newton preferred to read the more advanced ideas of modern philosophers such as Descartes and astronomers such as Galileo, Copernicus and Kepler. In 1665 he discovered the generalized binomial theorem and began to develop a mathematical theory that would later become calculus. Soon after Newton had obtained his degree in 1665, the University closed down as a precaution against the Great Plague. For the next 18 months Newton worked at home on calculus, optics and law of gravitation. Newton was a strange character, often not sharing information he had discovered unless he was asked. Calculus for example, was something he had invented 30 years before he had told anyone else about it.

1.2 Middle years

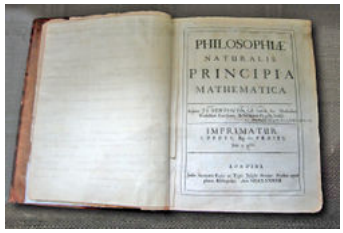
Mathematical research

Newton became a fellow of Trinity College in 1669. In the same year he circulated his findings in *De Analysi per Aequationes Numeri Terminorum Infinitas (On Analysis by Infinite Series)* , and later in*De methodis serierum et fluxionum* (On the Methods of Series and Fluxions), whose title gave rise to the "method of fluxions".

Optics

From 1670 to 1672 he lectured on *optics* . During this period he investigated the refraction of light, demonstrating that a prism could decompose white light into a spectrum of colours, and that a lens and a second prism could recompose the multicoloured spectrum into white light. He also showed that the coloured light does not change its properties, by separating out a coloured beam and shining it on various objects. Newton noted that regardless of whether it was reflected or scattered or transmitted, it stayed the same colour. Thus the colours we observe are the result of how objects interact with the incident already-coloured light, not the result of objects generating the colour. For more details, see Newton's theory of colour. Many of his findings in this field were criticized by later theorists, the most well-known being Johann Wolfgang von Goethe, who postulated his own colour theories.

Gravity and motion



In 1679, Newton returned to his work on mechanics, i.e., gravitation and its effect on the orbits of planets, with reference to Kepler's laws of motion, and consulting with Hooke and Flamsteed on the subject. He published his results in De Motu Corporum (1684). This contained the beginnings of the laws of motion that would inform the Principia.

The *Philosophiae Naturalis Principia Mathematica* (now known as the Principia) was published on 5 July 16871 with encouragement and financial help from Edmond Halley. In this work Newton stated the three universal laws of motion that were not to be improved upon for more than two hundred years. He used the Latin word gravitas (weight) for the force that would become known as gravity, and defined the law of universal gravitation. In the same work he presented the first analytical determination, based on Boyle's law, of the speed of sound in air.

With the *Principia*, Newton became internationally recognised. He acquired a circle of admirers, including the Swiss-born mathematician Nicolas Fatio de Duillier, with whom he formed an intense relationship that lasted until 1693. The end of this friendship led Newton to a nervous breakdown.

1.3 Later life

In the 1690s Newton wrote a number of religious tracts dealing with the literal interpretation of the Bible. Henry More's belief in the infinity of the universe and rejection of Cartesian dualism may have influenced Newton's religious ideas. A manuscript he sent to John Locke in which he disputed the existence of the Trinity was never published. Later works -- The Chronology of Ancient Kingdoms Amended (1728) and Observations Upon the Prophecies of Daniel and the Apocalypse of St. John (1733) -- were published after his death. He also devoted a great deal of time to alchemy.

2. Newton's Three Laws of Motion

The famous three laws of Newton are:

Newton's First Law (also known as the Law of Inertia) states that an object at rest tends to stay at rest and that an object in motion tends to stay in motion unless acted upon by a net external force.
Newton's Second Law states that an applied force equals the rate of change of momentum. For constant mass: F=ma, or force equals mass times acceleration. In other words, the acceleration produced by a net force on an object is directly proportional to the magnitude of the net force and inversely proportional to the mass. In the MKS system of measurement, mass is given in kilograms, acceleration in meters per second squared, and force in newtons (named in his honor).
Newton's Third Law states that for every action there is an equal and opposite reaction.

3. See also

* History of calculus
* Newton v. Leibniz calculus controversy
* "Standing on the shoulders of giants"
* Newton-Cotes formulas