

SHORT BIOGRAPHIES OF FAMOUS MATHEMATICIANS

(a biased alphabetical list)

Circa 1600-present

<http://www.allmath.com/biography.asp>

Abel, Niels Henrik [ahbel] (1802--29)

Mathematician, born in Finnøy, Norway. He showed mathematical genius by the age of 15, and in 1823 proved that there was no algebraic formula for the solution of a general polynomial equation of the fifth degree. He developed the concept of elliptic functions independently of Carl Gustav Jacobi, and the theory of Abelian integrals and functions became a central theme of later 19th-c analysis.

Babbage, Charles (1791--1871)

Mathematician and inventor, born in London, England, UK. He studied at Cambridge, where he became professor of mathematics (1828--39), and spent most of his life attempting to build two calculating machines. His "difference engine" was intended for the calculation of tables of logarithms and similar functions by repeated addition performed by trains of gear wheels. An unfinished portion of the machine is now in the Science Museum, London. His "analytical engine" was designed to perform many different computations, using punched cards. The idea was too ambitious to be realized by the mechanical devices available at the time, but can now be seen to be the essential germ of the electronic computer of today, and Babbage is thus regarded as the pioneer of modern computers.

Bernoulli, Daniel [bernoolee] (1700--82)

Mathematician, born in Groningen, The Netherlands, the son of Johann Bernoulli. He studied medicine and mathematics, and became professor of mathematics at St Petersburg in 1725. In 1732 he returned to Basel to become professor of anatomy, then botany, and finally physics. He worked on trigonometric series, mechanics, vibrating systems, and hydrodynamics (anticipating the kinetic theory of gases), and solved a differential equation proposed by Jacopo Riccati, now known as Bernoulli's equation.

Bernoulli, Jakob or Jacques [bernoolee] (1655--1705)

Mathematician, born in Basel, Switzerland, the brother of Johann Bernoulli. He became professor of mathematics at Basel in 1687. He investigated infinite series, the cycloid, transcendental curves, the logarithmic spiral, and the catenary. In 1690 he applied Gottfried Leibniz's newly discovered differential calculus to a problem in geometry, first using the term integral. His *Ars conjectandi* (1713) was an important contribution to probability theory.

Bernoulli, Johann or Jean [bernoolee] (1667--1748)

Mathematician, born in Basel, Switzerland, the brother of Jakob Bernoulli. He did mathematical and chemical research, and became professor at Groningen (1695) and Basel (1705). He wrote on differential equations, finding the length and area of curves, isochronous curves, and curves of quickest descent. He founded a dynasty of mathematicians which continued for two generations.

Bolyai, János (1802--60)

Mathematician, born in Cluj, Romania. After attempting to prove Euclid's parallel postulate, he realized that it was possible to have a consistent system of geometry in which this postulate did not hold, and so became one of the founders of non-Euclidean geometry.

Boole, George (1815--64)

Mathematician and logician, born in Lincoln, Lincolnshire, EC England, UK. He was largely self-taught, and though without a degree was appointed professor of mathematics at Cork in 1849. He did important work on finite differences and differential equations, but is primarily known for his *Mathematical Analysis of Logic* (1847) and *Laws of Thought* (1854), pioneering works in modern symbolic logic.

Borel, (Félix Edouard Justin) Emile [borel] (1871--1956)

Mathematician and French statesman, born in Saint Affrique, S France. He studied then taught at the Ecole Normale Supérieure, and became professor at the Sorbonne in 1909. In addition to his mathematical work, he was active in politics, scientific popularization, and journalism; he was a member of the Chamber of Deputies (1924--36) and minister for the navy (1925--40). His mathematical work was mainly in analysis, measure theory, and probability.

Brouwer, Luitzen Egbertus Jan [brower](1881--1966)

Mathematician, born in Overschie, The Netherlands. He studied at Amsterdam University at the age of 16, where he was professor (1912--51). He founded the intuitionist or constructivist school of mathematical logic, which does not accept the law of the excluded middle, and in which the existence of a mathematical object can only be proved by giving an explicit method for its construction. He also made fundamental advances in topology, proving the invariance of dimension, and the fixed point theorem named after him.

Cantor, Georg (Ferdinand Ludwig Philipp) (1845--1918)

Mathematician, born in St Petersburg, Russia. He studied at Berlin and Göttingen, and in 1877 became professor of mathematics at Halle. He worked out a highly original arithmetic of the infinite which resulted in a theory of infinite sets of different sizes, adding a new and important branch to mathematics. He suffered a nervous breakdown in 1884, and died in an asylum.

Cartan, Elie (Joseph) [kah(r)tä](1869--1951)

Mathematician, born in Dolomieu, SE France. He held posts at Montpellier, Lyon, and (1912--40) the Sorbonne, becoming one of the most original mathematicians of his time. He worked on Lie groups and differential geometry, and founded the subject of analysis on differentiable manifolds, which is essential to modern fundamental physical theories. Among his discoveries are the theory of spinors, the method of moving frames and the exterior differential calculus. His son, Henri-(Paul) Cartan (1904--) also became a mathematician, known for his work in the theory of analytic functions.

Cauchy, Augustin Louis, Baron [kohshee](1789--1857)

Mathematician, born in Paris, France. He studied to become an engineer, but ill health forced him to retire and teach mathematics at the Ecole Polytechnique. He did important work on partial differential equations, the wave theory of light, and the mathematical theory of elasticity, but is primarily remembered as the founder of the theory of functions of a complex variable. In algebra he gave a definitive account of the theory of determinants, and developed the ideas of group theory.

Cayley, Arthur [kaylee](1821--95)

Mathematician, born in Richmond, SW Greater London, England, UK. He studied languages and mathematics at London and Cambridge, graduated with distinction, but on failing to find a position in mathematics, took up law and was called to the bar in 1849. In 1863 he became professor of pure mathematics at Cambridge. He originated the theory of invariants and covariants, and worked on the theories of matrices and analytical geometry, and on theoretical astronomy.

Chebyshev, Pafnuty Lvovich [chebischof](1821--94)

Mathematician, born in Okatovo, Russia. A graduate of Moscow University, he became an assistant at St Petersburg in 1847 and later professor (1860--82). In number theory he made important contributions to the theory of the distribution of prime numbers, and in probability theory he proved fundamental limit theorems. His theory of approximation to functions by polynomials has become important in modern computing. The mathematical school that he founded at St Petersburg influenced Russian mathematics for the rest of the century.

Dedekind, (Julius Wilhelm) Richard [daydekind](1831--1916)

Mathematician, born in Braunschweig, Germany. He studied at Göttingen, where he wrote his doctoral thesis under Carl Friedrich Gauss in 1852. He taught at Göttingen (1854--8), then in Zürich, and returned to Braunschweig in 1862 as professor at the Polytechnic. He gave one of the first precise definitions of the real number system, did important work in number theory, and introduced many concepts which have become fundamental in modern algebra, in particular that of an "ideal", building on the work of Ernst Kummer.

de Moivre, Abraham [duh mwahvruh](1667--1754)

Mathematician, born in Vitry, NE France. A Protestant, he moved to England in c.1686, and supported himself by teaching. His principal work is *The Doctrine of Chances* (1718) on probability theory, but he is best remembered for the fundamental formula on complex numbers known as de Moivre's theorem.

De Morgan, Augustus (1806--71)

Mathematician, born in Madura, India. He studied at Cambridge, and became the first professor of mathematics at University College, London (1828). He helped to develop the notion of different kinds of algebra, and collaborated with Boole in the development of symbolic logic.

Desargues, Girard [dayzah(r)g](1591--1661)

Mathematician, born in Lyon, SC France. By 1626 he was in Paris, and took part as an engineer in the siege of La Rochelle in 1628. He founded the use of projective methods in geometry, inspired by the theory of perspective in art, and introduced the notion that parallel lines "meet at a point at infinity". His work on the sections of a cone greatly influenced Pascal. From 1645 he began a new career as an architect in Paris and Lyons.

Descartes, René [daykah(r)t], Lat Renatius Cartesius(1596--1650)

Rationalist philosopher and mathematician, born in La Haye, WC France. Trained at the Jesuit College at La Flèche, he remained a Catholic throughout his life, but soon became dissatisfied with scholasticism. While serving in the Bavarian army in 1619, he conceived it to be his task to refound human knowledge on a basis secure from scepticism. He expounded the major features of his project in his most famous work, the *Meditationes de prima philosophia* (1641, *Meditations on First Philosophy*). He began his enquiry by claiming that one can doubt all one's sense experiences, even the deliverances of reason, but that one cannot doubt one's own existence as a thinking being: *cogito, ergo sum* ("I think, therefore I am"). From this basis he argued that God must exist and cannot be a deceiver; therefore, his beliefs based on ordinary sense experience are correct. He also argued that mind and body are distinct substances, believing that this dualism made possible human freedom and immortality. His *Discours de la méthode pour bien conduire sa raison, et chercher la vérité dans les sciences* (1637, *Discourse on the Method for Rightly Conducting One's Reason and Searching for Truth in the Sciences*) contained appendices in which he virtually founded co-ordinate or analytic geometry, and made major contributions to optics. In 1649 he moved to Stockholm to teach Queen Christina of Sweden.

Dirichlet, Peter Gustav Lejeune [diriklay](1805--59)

Mathematician, born in Düren, Germany. He entered the Collège de France in Paris (1822), became extraordinary professor at Berlin (1828), and professor at Göttingen (1855). His main work was in number theory, Fourier series, and the boundary value problems in mathematical physics which now carry his name.

Euler, Leonhard [oyler](1707--83)

Mathematician, born in Basel, Switzerland. He studied mathematics there under Jean Bernoulli, and became professor of physics (1731) and then of mathematics (1733) at the St Petersburg Academy of Sciences. In 1738 he lost the sight of one eye. In 1741 he moved to Berlin as director of mathematics and physics in the Berlin Academy, but returned to St Petersburg in 1766, soon afterwards losing the sight of his other eye. He was a giant figure in 18th-c mathematics, publishing over 800 different books and papers, on every aspect of pure and applied mathematics, physics and astronomy. His *Introductio in analysin infinitorum* (1748) and later treatises on differential and integral calculus and algebra remained standard textbooks for a century and his notations, such as

e and π have been used ever since. For the princess of Anhalt-Dessau he wrote *Lettres à une princesse d'Allemagne* (1768--72), giving a clear non-technical outline of the main physical theories of the time. He had a prodigious memory, which enabled him to continue mathematical work and to compute complex calculations in his head when he was totally blind. He is without equal in the use of algorithms to solve problems.

Fermat, Pierre de [fermah](1601--65)

Mathematician, born in Beaumont-de-Lomagne, S France. He studied law at Toulouse, where he became a councillor of parliament. His passion was mathematics, most of his work being communicated in letters to friends containing results without proof. His correspondence with Pascal marks the foundation of probability theory. He studied maximum and minimum values of functions in advance of the differential calculus, but is best known for his work in number theory, the proofs of many of his discoveries being first published by Leonhard Euler a hundred years later. His 'last theorem' was the most famous unsolved problem in mathematics: it states that there are no integers positive x , y , and z with $x^n+y^n=z^n$ if n is greater than 2; a proof was announced by British mathematician Andrew Wiles in 1993. In optics, Fermat's principle was the first statement of a variational principle in physics: the path taken by a ray of light between two given points is the one in which the light takes the least time compared with any other possible path.

Fourier, (Jean Baptiste) Joseph, Baron [fooryay](1768--1830)

Mathematician, born in Auxerre, C France. He accompanied Napoleon to Egypt (1798), and on his return (1802) was made prefect of the department of Grenoble, and created baron (1808). He then took up his first interest, applied mathematics, and while working on the flow of heat discovered the equation for it which now bears his name. To solve it, he showed that many functions of a single variable can be expanded in a series of sines of multiples of the variable (the Fourier series).

Frege, (Friedrich Ludwig) Gottlob [frayguh](1848--1925)

Mathematician and logician, born in Wismar, Germany. He studied at Jena and Göttingen, and became professor of mathematics at Jena (1896). His *Begriffsschrift* (1879, Concept-script) outlined the first complete system of symbolic logic. The technical difficulties involved gave rise to his distinctive philosophical doctrines, forcefully set out in his *Grundlagen der Arithmetik* (1884, The Foundations of Arithmetic). His *Grundgesetze der Arithmetik* (1893--1903, Basic Laws of Arithmetic) contained a postscript acknowledging that Russell had spotted a contradiction in his thinking. Depressed by the poor reception of his ideas, he wrote little after 1903.

Gödel or Goedel, Kurt [goedl](1906--78)

Logician and mathematician, born in Brünn, Moravia (now Brno, Czech Republic). He studied and taught in Vienna, then emigrated to the USA in 1940 and joined the Institute of Advanced Study at Princeton. He became a US citizen in 1948. He stimulated significant work in mathematical logic and propounded one of the most important proofs in modern mathematics: Gödel's proof, published in 1931 with reference to Russell's *Principia mathematica*, showed that any formal logical system adequate for number theory must contain propositions not provable in that system .

Galois, Evariste [galwah](1811--32)

Mathematician, born in Bourg-la-Reine, NC France. He was educated privately and at the Collège Royal de Louis-le-Grand. Despite mathematical ability he failed the entrance for the Ecole Polytechnique to study maths, and settled for the Ecole Normale Supérieure in 1829 to train as a teacher, but was expelled in 1830 for republican sympathies. He engaged in political agitation, was imprisoned twice, and was killed in a duel aged 21. His mathematical reputation rests on fewer than 100 pages of posthumously published work of original genius in the branch of higher algebra known as group theory.

Gauss, (Johann) Carl Friedrich [gows](1777--1855)

Mathematician, born in Brunswick, Germany. A prodigy in mental calculation, he conceived most of his mathematical theories by the age of 17, and was sent to study at Brunswick and Göttingen. He wrote the first modern book on

number theory, in which he proved the law of quadratic reciprocity, and discovered the intrinsic differential geometry of surfaces. He also discovered, but did not publish, a theory of elliptic and complex functions, and pioneered the application of mathematics to such areas as gravitation, magnetism, and electricity. In 1807 he became professor of mathematics and director of the observatory at Göttingen, and in 1821 was appointed to conduct the trigonometrical survey of Hanover, for which he invented a heliograph. The unit of magnetic induction has been named after him.

Hamilton, Sir William Rowan (1805--65)

Mathematician, the inventor of quaternions, born in Dublin, Ireland. At the age of nine he knew 13 languages, and at 15 he had read Newton's Principia, and begun original investigations. In 1827, while still an undergraduate, he was appointed professor of astronomy at Dublin and Irish Astronomer Royal; in 1835 he was knighted. His first published work was on optics, and he then developed a new approach to dynamics which became of importance in the 20th-c development of quantum mechanics. He introduced quaternions as a new algebraic approach to three-dimensional geometry, and they proved to be the seed of much modern algebra.

Hardy, Godfrey (Harold) (1877--1947)

Mathematician, born in Cranleigh, Surrey, SE England, UK. He studied at Cambridge, was professor of geometry at Oxford (1919--30), then returned to Cambridge as professor of pure maths (1931--42). He was an internationally important figure in mathematical analysis, collaborating with John Littlewood in much of his work in analytic number theory. He was greatly influenced by the work of Srinivasa Ramanujan. His mathematical philosophy was described for the layman in his book *A Mathematician's Apology* (1940). In his one venture into applied maths he developed (concurrently with, but independent of, Wilhelm Weinberg) the Hardy--Weinberg law fundamental to population genetics.

Hilbert, David (1862--1943)

Mathematician, born in Königsberg, Germany. He studied at Königsberg and became professor there (1893). He moved to Göttingen in 1895, where he critically examined the foundations of geometry. He made important contributions to the theory of numbers, the theory of invariants and algebraic geometry, and the application of integral equations to physical problems. He later extended his axiomatic approach to geometry to an attempt to base all mathematics on finitely many axioms - an approach shown to be inadequate by Gödel in 1931. At the International Congress of Mathematicians in 1900 he listed 23 problems which he regarded as important for contemporary mathematics; the solutions of many of these have led to interesting advances, while others are still unsolved.

Jacobi, Carl Gustav Jacob [jakohbee](1804--51)

Mathematician, born in Potsdam, Germany. As professor of mathematics at Königsberg (1827--42), his book *Fundamenta nova* (1829) was the first definitive study of elliptic functions, which he and Niels Henrik Abel had independently discovered. He also made important advances in the study of differential equations, the theory of numbers, and determinants.

Klein, (Christian) Felix [kliyn](1849--1925)

Mathematician, born in Düsseldorf, Germany. He studied at the University of Bonn, and held chairs at Erlangen (1872--5), Munich (1875--80), Leipzig (1880--6), and Göttingen (1886--1913). He worked on geometry, including non-Euclidean geometry, function theory (in which he developed Bernhard Riemann's ideas), and elliptic modular and automorphic functions. His Erlanger Programm showed how different geometries could be classified in terms of group theory. He also wrote on the history of mathematics, encouraged links between pure and applied mathematics and engineering, and promoted general mathematical education.

Kummer, Ernst Eduard (1810--93)

Mathematician, born in Sorau, Germany. He studied at Halle, and taught at the Gymnasium in Liegnitz (1832--42). He was professor of mathematics at Wrocław, Poland (formerly Breslau, Germany) (1842--55), and at Berlin

from 1855. He added to the work of Gauss on the hypergeometric series, and worked in number theory. In trying to prove Pierre de Fermat's last theorem, he introduced "ideal numbers", later developed by Richard Dedekind into one of the fundamental tools of modern algebra. He also developed the Kummer surface, the wave surface in four dimensional space.

Lagrange, Joseph Louis, (Count of the Empire) [lagrãzh], (1736--1813)

Mathematician and astronomer, born in Turin, Italy. In 1766 he became director of the Berlin Academy, and published papers on many aspects of number theory, mechanics, the stability of the Solar System, and algebraic equations. His major work was the *Mécanique analytique* (1788, *Analytical Mechanics*), and he was appointed professor of mathematics at the Ecole Polytechnique, heading the committee reforming the metric system (1795). He was made a senator and a count by Napoleon. The Lagrangian point in astronomy, the Lagrangian function in mechanics, and several notions in mathematics are all named after him.

Lambert, Johann Heinrich (1728--77)

Mathematician, born in Mülhausen, Germany. Largely self-educated, he worked as a secretary and tutor, and in 1764 moved to Berlin, where Frederick the Great became his patron. He was among the first to appreciate the nature of the Milky Way, and in an inconclusive attempt to give a rigorous proof of Euclid's parallel postulate he established several theorems in non-Euclidean geometry. He also demonstrated that Pi is an irrational number (1768). The first to show how to measure scientifically the intensity of light (1760), the unit of light intensity is now named after him.

Laplace, Pierre Simon, Marquis de [laplas], (Count of) Laplace (1749--1827)

Mathematician and astronomer, born in Beaumont-en-Auge, NW France. He studied at Caen, and became professor of mathematics at the Ecole Militaire, Paris. He applied his mathematical knowledge to physical astronomy, particularly the stability of orbits in the Solar System. His five-volume *Mécanique céleste* (1799--1825, *Celestial Mechanics*) is a landmark in applied mathematics. In his study of the gravitational attraction of spheroids, he formulated the fundamental differential equation in physics which now bears his name. He entered the Senate in 1799, and was made a peer in 1815.

Lebesgue, Henri (Léon) [luhbeg](1875--1941)

Mathematician, born in Beauvais, N France. He studied at the Ecole Normale Supérieure, and taught at Rennes, Poitiers, the Sorbonne, and the Collège de France. Following the work of Emile Borel and René Baire (1874--1932), he developed the theory of measure and integration which bears his name, and applied it to many problems of analysis, in particular to the theory of Fourier series.

Legendre, Adrien-Marie [luzhãdr](1752--1833)

Mathematician, born in Paris, France. He studied at the Collège Mazarin, became professor of mathematics at the Ecole Militaire (1775--80), a member of the Académie des Sciences (1783), and professor at the Ecole Normale (1795). He made major contributions to number theory and elliptical functions, but due to the jealousy of his colleague Laplace, he received little recognition or reward for his work.

Leibniz, Gottfried Wilhelm [liybnits](1646--1716)

Philosopher and mathematician, born in Leipzig, Germany. He studied there and at Altdorf, spent time in Paris and London, and in 1676 became librarian to the Duke of Brunswick at Hanover. He also travelled in Austria and Italy, and went in 1700 to persuade Frederick I of Prussia to found the Prussian Academy of Sciences in Berlin, of which he became the first president. A man of remarkable breadth of knowledge, he made original contributions to optics, mechanics, statistics, logic, and probability theory. He conceived the idea of calculating machines, and of a universal language. He wrote on history, law, and political theory, and his philosophy was the foundation of 18th-c Rationalism. He was involved in a controversy with Isaac Newton over whether he or Newton was the inventor of integral and differential calculus; the Royal Society formally declared for Newton in 1711, but the matter was never really resolved. Unpopular with George of Hanover, he was left behind in 1714 when the Elector moved his

court to London (as George I). He died in Hanover two years later, without real recognition and with almost all his work unpublished. Probably his greatest influence (eg on Bertrand Russell) was as a mathematician and a pioneer of modern symbolic logic.

Lie, (Marius) Sophus [lee](1842--99)

Mathematician, born in Nordfjordeide, Norway. He studied at Oslo University, then supported himself by giving private lessons. He became professor of mathematics at Oslo, then succeeded Felix Klein at Leipzig (1886), and returned to Oslo in 1898. His study of contact transformations arising from partial differential equations led him to develop an extensive theory of continuous groups of transformations, now known as Lie groups. This theory has become a central part of 20th-c mathematics, and has important applications in quantum theory.

Liouville, Joseph [lyooveel](1809--82)

Mathematician, born in St Omer, N France. He studied at the Ecole Polytechnique and the Ecole des Ponts et Chaussées, where he trained as an engineer. He taught at the Ecole Polytechnique, the Collège de France, and the University of Paris. In 1836 he founded the Journal de Mathématiques, which he edited for nearly 40 years. His work in analysis continued the study of algebraic function theory begun by Niels Abel and Carl Jacobi, and he studied the theory of differential equations, mathematical physics, and celestial mechanics.

Lobachevsky, Nikolay Ivanovich [lobachefskée](1792--1856)

Mathematician, born in Nizhni Novgorod, Russia. He became professor at Kazan in 1816, where he spent the rest of his life. In the 1820s he developed a theory of non-Euclidean geometry in which Euclid's parallel postulate did not hold. A similar theory was discovered almost simultaneously and independently by János Bolyai.

Maclaurin, Colin [muhklorin](1698--1746)

Mathematician, born in Kilmodan, Argyll and Bute, W Scotland, UK. He studied at Glasgow, became professor at Aberdeen (1717), and in 1725 was appointed to the chair of mathematics at Edinburgh. His best-known work, Treatise on Fluxions (1742) gave a systematic account of Newton's approach to the calculus, taking a geometric point of view rather than the analytical one used in mainland Europe.

Mersenne, Marin [mairsen](1588--1648)

Mathematician and scientist, born in Oize, N France. He became a Minim Friar in 1611, and lived in Paris. Devoting himself to science, he corresponded with all the leading scientists of his day, including Descartes, Fermat, Pascal, and Hobbes, acting as a clearing house for scientific information. A pioneer in the theory of prime numbers, he also experimented with the pendulum and found the law relating its length and period of oscillation, studied the acoustics of vibrating strings and organ pipes, and measured the speed of sound. He also wrote on music, mathematics, optics, and philosophy.

Minkowski, Hermann [mingkofskée](1864--1909)

Mathematician, born near Kaunas, Lithuania. He was professor at Königsberg (1895), Zürich (1896), where he taught Einstein, and Göttingen (1902). He discovered a new branch of number theory, the geometry of numbers, and gave a precise mathematical description of space-time as it appears in Einstein's relativity theory.

Monge, Gaspard, comte de (Count of) Péluse [möz](1746--1818)

Mathematician, physicist, and founder of descriptive geometry, born in Beaune, E France. He was professor of mathematics at Mézières (1768), and professor of hydraulics at the Lycée in Paris (1780). He helped to found the Ecole Polytechnique (1794), and became professor of mathematics there. The following year there appeared his Leçons de géométrie descriptive, in which he stated his principles regarding the general application of geometry to the arts of construction (descriptive geometry). During the Revolution he was minister for the navy, and in charge of the national manufacture of arms and gunpowder. He was made a senator (1805), but lost his honours at the Restoration, and died in poverty.

Napier, John [nappyer](1550--1617)

Mathematician, the inventor of logarithms, born at Merchiston Castle, Edinburgh, EC Scotland, UK. He studied at St Andrews, travelled in Europe, then settled down to a life of literary and scientific study. He described his famous invention in *Mirifici logarithmorum canonis descriptio* (1614, *Description of the Marvellous Canon of Logarithms*), and also devised a calculating machine, using a set of rods called Napier's bones.

Newton, Sir Isaac (1642--1727)

Physicist and mathematician, born in Woolsthorpe, Lincolnshire, EC England, UK. He studied at Cambridge. In 1665--6 the fall of an apple is said to have suggested the train of thought that led to the law of gravitation. He studied the nature of light, concluding that white light is a mixture of colours which can be separated by refraction, and devised the first reflecting telescope. He became professor of mathematics at Cambridge in 1669, where he resumed his work on gravitation, expounded finally in his famous *Philosophiæ naturalis principia mathematica* (1687, *Mathematical Principles of Natural Philosophy*). In 1696 he was appointed warden of the Mint, and was master of the Mint from 1699 until his death. He also sat in parliament on two occasions, was elected President of the Royal Society in 1703, and was knighted in 1705. During his life he was involved in many controversies, notably with Leibniz over the question of priority in the discovery of calculus.

Noether, (Amalie) Emmy [noeter] (1882--1935)

Mathematician, born in Erlangen, Germany. She studied at Erlangen and Göttingen. Though invited to Göttingen in 1915 by David Hilbert, as a woman she could not hold a full academic post at that time, but worked there in a semi-honorary capacity until she emigrated to the USA in 1933 to Bryn Mawr and Princeton. One of the leading figures in the development of abstract algebra, the theory of Noetherian rings has been an important subject of later research.

Pascal, Blaise [paskal](1623--62)

Mathematician, physicist, theologian, and man-of-letters, born in Clermont-Ferrand, C France. He invented a calculating machine (1647), and later the barometer, the hydraulic press, and the syringe. Until 1654 he spent his time between mathematics and the social round in Paris, but a mystical experience that year led him to join his sister, who was a member of the Jansenist convent at Port-Royal, where he defended Jansenism against the Jesuits in *Lettres provinciales* (1656--7). Fragments jotted down for a case book of Christian truth were discovered after his death and published as the *Pensées* (1669, *Thoughts*).

Peano, Giuseppe [payahnoh](1858--1932)

Mathematician, born in Cuneo, Italy. He taught at the University of Turin, and was known for his work on mathematical logic. The symbolism he invented was the basis of that used by Bertrand Russell and Alfred Whitehead in *Principia mathematica*. He also promoted Interlingua, a universal language based on uninflected Latin.

Poincaré, (Jules) Henri [pwa karay](1854--1912)

Mathematician, born in Nancy, NE France, the cousin of Raymond Poincaré. He studied at Paris, where he became professor in 1881. He was eminent in physics, mechanics, and astronomy, and contributed to many fields of mathematics. He created the theory of automorphic functions, using new ideas from group theory, non-Euclidean geometry, and complex function theory. The origins of the theory of chaos are in a famous paper of 1889 on real differential equations and celestial mechanics. Many of the basic ideas in modern topology, triangulation, and homology are due to him. He gave influential lecture courses on such topics as thermodynamics, and almost anticipated Einstein's theory of special relativity, showing that the Lorentz transformations form a group. In his last years he published several books on the philosophy of science and scientific method, and was also well known for his popular expositions of science.

Ramanujan, Srinivasa [ramahnujan](1887--1920)

Mathematician, born in Erode, India. The child of poor parents, he taught himself from an elementary English textbook. Although he attended college, he did not graduate. While working as a clerk, he was persuaded to send

over 100 theorems that he had discovered to Godfrey Hardy at Cambridge, including results on elliptic integrals, partitions, and analytic number theory. Hardy was so impressed that he arranged for him to come to Cambridge in 1914. He was the first Indian to be elected a Fellow of the Royal Society.

Riemann, (Georg Friedrich) Bernhard [reeman] (1826--66)

Mathematician, born in Breselenz, Germany. He studied at Göttingen and Berlin universities, and became professor of mathematics at Göttingen (1859). His early work was on the theory of functions, but he is best remembered for his development of non-Euclidian geometry, important in modern physics and relativity theory. His profound conjecture (the Riemann hypothesis) about the behaviour of the zeta (or Riemann) function, which he showed determines the distribution of the prime numbers, has resisted proof since its publication in 1857.

Russell, Bertrand (Arthur William) Russell, 3rd Earl (1872--1970)

Philosopher, mathematician, prolific writer and controversial public figure, born in Trelleck, Monmouthshire. He studied at Cambridge, where he became a fellow of Trinity College in 1895. His most original contributions to mathematical logic and philosophy belong to the period before World War 1, as in *Principles of Mathematics* (1903), which argued that the whole of mathematics could be derived from logic, and the monumental *Principia mathematica* (with Whitehead, 1910--13), which worked this out in a complete formal system. Russell's famous "theory of types" and "theory of descriptions" belong to this same period. Politics became his dominant concern during the War, and his active pacifism caused the loss of his Trinity fellowship in 1916 and his imprisonment in 1918, during which he wrote his *Introduction to Mathematical Philosophy* (1919). He then made his living by lecturing and journalism, and became a celebrated controversialist. He visited the Soviet Union, where he met Lenin, Trotsky, and Gorky; he also taught in Beijing (1920--1). In 1927, with his second wife, Dora, he founded and ran a progressive school near Petersfield. In 1931 he succeeded his elder brother as 3rd Earl Russell. His second divorce (1934) and re-marriage (1936) helped to make controversial his book *Marriage and Morals* (1932); and his lectureship at City College, New York was terminated in 1940 after complaints that he was an "enemy of religion and morality". The rise of fascism led him to renounce his pacifism in 1939; his fellowship at Trinity was restored in 1944, and he returned to England after World War 2 to be honoured with an Order of Merit, and to give the first BBC Reith Lectures in 1949. He was awarded the Nobel Prize for Literature in 1950. He had meanwhile continued publishing important philosophical work, mainly in epistemology, and in 1945 published the best-selling *History of Western Philosophy*. He also wrote a stream of provocative, popular works on social, moral, and religious questions, such as *Why I am not a Christian* (1957). After 1949 he became a leading figure in the cause of nuclear disarmament, and in 1961 was again imprisoned after a demonstration in Whitehall. The last major publications were his three volumes of *Autobiography* (1967--9).

Sylvester, James Joseph (1814--97)

Mathematician, born in London, England, UK. He studied at Cambridge but, as a Jew, was disqualified from graduating. He became professor at University College, London (1837), and the University of Virginia (1841--5). Returning to London he worked as an actuary, and was called to the bar in 1850. He then took up academic life again, becoming professor of mathematics at Woolwich (1855--70), at Johns Hopkins University, Baltimore (1877--83), and at Oxford (1883--94). He made important contributions to the theory of invariants and to number theory.

Turing, Alan (Mathison) [tooring] (1912--54)

Mathematician, born in London, England, UK. He studied at Cambridge and Princeton, worked in cryptography during World War 2, then joined the National Physical Laboratory (1945) and the computing laboratory at Manchester (1948). He provided a precise mathematical characterization of computability, and introduced the theoretical notion of an idealized computer (since called a Turing machine), laying the foundation for the field of artificial intelligence. He committed suicide after being prosecuted for homosexuality.

Von Neumann, John [noyman], originally Johann von Neumann(1903--57)

Mathematician, born in Budapest, Hungary. He escaped from Hungary during the Communist regime (1919), studied at Berlin and Zürich, and emigrated to the USA in 1933, to join the Institute for Advanced Study, Princeton.

Equally at home in pure and applied mathematics, he wrote a major work on quantum mechanics (1932), which led him to a new axiomatic foundation for set theory, and participated in the atomic bomb project at Los Alamos during World War 2, providing a mathematical treatment of shock waves. His mathematical work on high-speed calculations for H-bomb development contributed to the development of computers, and he also introduced game theory (1944), which was a major influence on economics.

Wallis, John (1616--1703)

The leading English mathematician before Isaac Newton, born in Ashford, Kent, SE England, UK. He studied at Cambridge, and took orders, but in 1649 became professor of geometry at Oxford. His *Arithmetica infinitorum* (1655, *The Arithmetic of Infinitesimals*) was a stimulus for Newton's work on calculus and the binomial theorem. He also wrote on proportion, mechanics, grammar, logic, decipherment (he deciphered encrypted messages intercepted from Royalist supporters), theology, and the teaching of the deaf. He was one of the founders of the Royal Society.

Weierstrass, Karl (Theodor Wilhelm) [viyershtrahs](1815--97)

Mathematician, "the father of modern analysis", born in Ostenfelde, Germany. A failed law student from Bonn, he took a teacher's certificate at Münster and taught mathematics in secondary schools (1842--56) while working privately on analysis. The publication of his memoir on Abelian functions (1854) brought him an honorary doctorate and a post at the Royal Polytechnic School, Berlin. He published relatively little, but became famous for his lectures, in which he gave a systematic account of analysis with previously unknown rigour, inspiring many of his students to become creative mathematicians.

Weyl, Hermann [viyl](1885--1955)

Mathematician, born in Elmshorn, Germany. He studied at Göttingen under David Hilbert, and became professor at Zürich (1913) and Göttingen (1930). Refusing to stay in Nazi Germany, he went to Princeton in 1933. He made important contributions to the theory of Riemann surfaces, the representation theory of Lie groups, the mathematical foundations of relativity and quantum mechanics, and the philosophy of mathematics. His book *Symmetry* (1952) is a largely non-technical account of the relation between group theory and symmetry in pattern and design.

Wiles, Andrew (John) (1953--)

Mathematician, born in Cambridge, Cambridgeshire, EC England, UK. He studied at Clare College, Cambridge, and joined Princeton University in 1980. In 1993 he announced that he had solved one of mathematics' oldest mysteries, Fermat's last theorem - a problem which had intrigued him since childhood. His proof makes use of the Taniyama-Weil conjecture, a problem in number theory dealing with the nature of elliptic curves. In 1986 US mathematician Kenneth A Ribet had shown that, if this conjecture could be solved, a proof of Fermat's theorem would follow. Inspired by Ribet's work, Wiles devoted seven years to solving a special case of the conjecture, and by 1994 it had been accepted that a proof of the theorem had indeed been found.

Zermelo, Ernst Friedrich Ferdinand [tsairmeloh] (1871--1953)

Mathematician, born in Berlin. He studied at Berlin, Halle, and Freiburg universities, and was professor at Göttingen (1905--10) and Zürich (1910--16). He gave the first axiomatic description of set theory in 1908. Although later modified to avoid the paradoxes discovered by Bertrand Russell and others, it remains one of the standard methods of axiomatizing the theory. He also first revealed the importance of the axiom of choice, when he proved in 1904 that any set could be well-ordered, a key result in many mathematical applications of set theory.