

# A Guide to Inventions and Discoveries: From Adrenaline to the Zipper

See also [Famous Firsts in Aviation](#), [Nobel Prizes](#).

## **Adrenaline:**

(isolation of) [John Jacob Abel](#), U.S., 1897.

## **Aerosol can:**

Erik Rotheim, Norway, 1926.

## **Air brake:**

[George Westinghouse](#), U.S., 1868.

## **Air conditioning:**

[Willis Carrier](#), U.S., 1911.

## **Airship:**

(non-rigid) Henri Giffard, France, 1852; (rigid) [Ferdinand von Zeppelin](#), Germany, 1900.

## **Aluminum manufacture:**

(by electrolytic action) [Charles M. Hall](#), U.S., 1866.

## **Anatomy, human:**

(*De fabrica corporis humani*, an illustrated systematic study of the human body) [Andreas Vesalius](#), Belgium, 1543; (comparative: parts of an organism are correlated to the functioning whole) [Georges Cuvier](#), France, 1799–1805.

## **Anesthetic:**

(first use of anesthetic—ether—on humans) [Crawford W. Long](#), U.S., 1842.

## **Antibiotics:**

(first demonstration of antibiotic effect) [Louis Pasteur](#), Jules-François Joubert, France, 1887; (discovery of penicillin, first modern antibiotic) [Alexander Fleming](#), Scotland, 1928; (penicillin's infection-fighting properties) [Howard Florey](#), [Ernst Chain](#), England, 1940.

## **Antiseptic:**

(surgery) [Joseph Lister](#), England, 1867.

## **Antitoxin, diphtheria:**

[Emil von Behring](#), Germany, 1890.

## **Appliances, electric:**

(fan) Schuyler Wheeler, U.S., 1882; (flatiron) Henry W. Seely, U.S., 1882; (stove) Hadaway, U.S., 1896; (washing machine) Alva Fisher, U.S., 1906.

## **Aqualung:**

[Jacques-Yves Cousteau](#), Emile Gagnan, France, 1943.

## **Aspirin:**

Dr. Felix Hoffman, Germany, 1899.

## **Astronomical calculator:**

The Antikythera device, Greece, first century B.C.. Found off island of Antikythera in 1900.

## **Atom:**

(nuclear model of) [Ernest Rutherford](#), England, 1911.

## **Atomic structure:**

(formulated nuclear model of atom, Rutherford model) [Ernest Rutherford](#), England, 1911; (proposed current concept of atomic structure, the Bohr model) [Niels Bohr](#), Denmark, 1913.

## **Atomic theory:**

(ancient) [Leucippus](#), [Democritus](#), Greece, c. 500 B.C.; [Lucretius](#), Rome c.100 B.C.; (modern) [John Dalton](#), England, 1808.

## **Automobile:**

(first with internal combustion engine, 250 rpm) [Karl Benz](#), Germany, 1885; (first with practical high-speed internal combustion engine, 900 rpm) [Gottlieb Daimler](#), Germany,

1885; (first true automobile, not carriage with motor) René Panhard, Emile Lavassor, France, 1891; (carburetor, spray) [Charles E. Duryea](#), U.S., 1892.

**Autopilot:**

(for aircraft) [Elmer A. Sperry](#), U.S., c.1910, first successful test, 1912, in a Curtiss flying boat.

**Avogadro's law:**

(equal volumes of all gases at the same temperature and pressure contain equal number of molecules) [Amedeo Avogadro, Italy](#), 1811.

**Bacteria:**

[Anton van Leeuwenhoek](#), The Netherlands, 1683.

**Balloon, hot-air:**

[Joseph and Jacques Montgolfier](#), France, 1783.

**Barbed wire:**

(most popular) Joseph E. Glidden, U.S., 1873.

**Bar codes (computer-scanned binary signal code):**

(retail trade use) Monarch Marking, U.S. 1970; (industrial use) Plessey Telecommunications, England, 1970.

**Barometer:**

[Evangelista Torricelli](#), Italy, 1643.

**Bicycle:**

Karl D. von Sauerbronn, Germany, 1816; (first modern model) James Starley, England, 1884.

**Big Bang theory:**

(the universe originated with a huge explosion) [George LeMaitre](#), Belgium, 1927; (modified LeMaitre theory labeled "Big Bang") [George A. Gamow](#), U.S., 1948; (cosmic microwave background radiation discovered, confirms theory) [Arno A. Penzias](#) and [Robert W. Wilson](#), U.S., 1965.

**Blood, circulation of:**

[William Harvey](#), England, 1628.

**Boyle's law:**

(relation between pressure and volume in gases) [Robert Boyle](#), Ireland, 1662.

**Braille:**

[Louis Braille](#), France, 1829.

**Bridges:**

(suspension, iron chains) James Finley, Pa., 1800; (wire suspension) Marc Seguin, Lyons, 1825; (truss) Ithiel Town, U.S., 1820.

**Bullet:**

(conical) Claude Minié, France, 1849.

**Calculating machine:**

(logarithms: made multiplying easier and thus calculators practical) [John Napier](#), Scotland, 1614; (slide rule) William Oughtred, England, 1632; (digital calculator) [Blaise Pascal](#), 1642; (multiplication machine) [Gottfried Leibniz](#), Germany, 1671; (important 19th-century contributors to modern machine) Frank S. Baldwin, Jay R. Monroe, Dorr E. Felt, W. T. Ohdner, [William Burroughs](#), all U.S.; ("analytical engine" design, included concepts of programming, taping) [Charles Babbage](#), England, 1835.

**Calculus:**

[Isaac Newton](#), England, 1669; (differential calculus) [Gottfried Leibniz](#), Germany, 1684.

**Camera:**

(hand-held) [George Eastman](#), U.S., 1888; (Polaroid Land) [Edwin Land](#), U.S., 1948.

**"Canals" of Mars:**

[Giovanni Schiaparelli](#), Italy, 1877.

**Carpet sweeper:**

Melville R. Bissell, U.S., 1876.

**Car radio:**

[William Lear](#), Elmer Wavering, U.S., 1929, manufactured by Galvin Manufacturing Co., "Motorola."

**Cells:**

(word used to describe microscopic examination of cork) [Robert Hooke](#), England, 1665; (theory: cells are common structural and functional unit of all living organisms) [Theodor Schwann](#), [Matthias Schleiden](#), 1838–1839.

**Cement, Portland:**

Joseph Aspdin, England, 1824.

**Chewing gum:**

(spruce-based) John Curtis, U.S., 1848; (chicle-based) Thomas Adams, U.S., 1870.

**Cholera bacterium:**

[Robert Koch](#), Germany, 1883.

**Circuit, integrated:**

(theoretical) G.W.A. Dummer, England, 1952; (phase-shift oscillator) [Jack S. Kilby](#), Texas Instruments, U.S., 1959.

**Classification of plants:**

(first modern, based on comparative study of forms) [Andrea Cesalpino](#), Italy, 1583; (classification of plants and animals by genera and species) [Carolus Linnaeus](#), Sweden, 1737–1753.

**Clock, pendulum:**

[Christian Huygens](#), The Netherlands, 1656.

**Coca-Cola:**

John Pemberton, U.S., 1886.

**Combustion:**

(nature of) [Antoine Lavoisier](#), France, 1777.

**Compact disk:**

RCA, U.S., 1972.

**Computers:**

(first design of analytical engine) [Charles Babbage](#), 1830s; (ENIAC, Electronic Numerical Integrator and Calculator, first all-electronic, completed) John Presper Eckert, Jr., John Mauchly, U.S., 1945; (dedicated at University of Pennsylvania) 1946; (UNIVAC, Universal Automatic Computer, handled both numeric and alphabetic data) 1951; (personal computer) Steve Wozniak, U.S., 1976.

**Concrete:**

(reinforced) Joseph Monier, France, 1877.

**Condensed milk:**

[Gail Borden](#), U.S., 1853.

**Conditioned reflex:**

[Ivan Pavlov](#), Russia, c.1910.

**Conservation of electric charge:**

(the total electric charge of the universe or any closed system is constant) [Benjamin Franklin](#), U.S., 1751–1754.

**Contagion theory:**

(infectious diseases caused by living agent transmitted from person to person) [Giolamo Fracastoro](#), Italy, 1546.

**Continental drift theory:**

(geographer who pieced together continents into a single landmass on maps) Antonio Snider-Pellegrini, France, 1858; (first proposed in lecture) Frank Taylor, U.S. 1912; (first comprehensive detailed theory) [Alfred Wegener](#), Germany, 1912.

**Contraceptive, oral:**

Gregory Pincus, Min Chuch Chang, John Rock, [Carl Djerassi](#), U.S., 1951.

**Converter, Bessemer:**

William Kelly, U.S., 1851.

**Cosmetics:**

Egypt, c. 4000 B.C.

**Cosmic string theory:**

(first postulated) Thomas Kibble, UK, 1976.

**Cotton gin:**

[Eli Whitney](#), U.S., 1793.

**Crossbow:**

China, c. 300 B.C.

**Cyclotron:**

[Ernest O. Lawrence](#), U.S., 1931.

**Defibrillator:**

Dr. William Bennett Kouwenhoven, U.S., 1932; (implantable) M. Stephen Heilman, MD, Dr. Alois Langer, Morton Mower, MD, Michel Mirowski, MD, 1980.

**Deuterium:**

(heavy hydrogen) [Harold Urey](#), U.S., 1931.

**Disease:**

(chemicals in treatment of) crusaded by [Philippus Paracelsus](#), 1527–1541; (germ theory) [Louis Pasteur](#), France, 1862–1877.

**DNA:**

(deoxyribonucleic acid) Friedrich Meischer, Germany, 1869; (determination of double-helical structure) [F. H. Crick](#), England and [James D. Watson](#), U.S., 1953.

**Dye:**

(aniline, start of synthetic dye industry) [William H. Perkin](#), England, 1856.

**Dynamite:**

[Alfred Nobel](#), Sweden, 1867.

**Electric cooking utensil:**

(first) patented by St. George Lane-Fox, England, 1874.

**Electric generator (dynamo):**

(laboratory model) [Michael Faraday](#), England, 1832; [Joseph Henry](#), U.S., c.1832; (hand-driven model) Hippolyte Pixii, France, 1833; (alternating-current generator) [Nikola Tesla](#), U.S., 1892.

**Electric lamp:**

(arc lamp) Sir Humphrey Davy, England, 1801; (fluorescent lamp) A.E. Becquerel, France, 1867; (incandescent lamp) Sir Joseph Swann, England, [Thomas A. Edison](#), U.S., contemporaneously, 1870s; (carbon arc street lamp) [Charles F. Brush](#), U.S., 1879; (first widely marketed incandescent lamp) Thomas A. Edison, U.S., 1879; (mercury vapor lamp) Peter Cooper Hewitt, U.S., 1903; (neon lamp) Georges Claude, France, 1911; (tungsten filament) [Irving Langmuir](#), U.S., 1915.



[Thomas Alva Edison](#) (1847–1931)  
*Library of Congress*

**Electrocardiography:**

Demonstrated by Augustus Waller, Switzerland, 1887; (first practical device for recording activity of heart) [Willem Einthoven](#), 1903, Netherlands.

**Electromagnet:**

William Sturgeon, England, 1823.

**Electron:**

Sir Joseph J. Thompson, England, 1897.

**Electronic mail:**

Ray Tomlinson, U.S., 1972.

**Elevator, passenger:**

(safety device permitting use by passengers) [Elisha G. Otis](#), U.S., 1852; (elevator utilizing safety device) 1857.

**E = mc<sup>2</sup>:**

(equivalence of mass and energy) [Albert Einstein](#), Switzerland, 1907.

**Engine, internal combustion:**

No single inventor. Fundamental theory established by [Sadi Carnot](#), France, 1824; (two-stroke) Etienne Lenoir, France, 1860; (ideal operating cycle for four-stroke) Alphonse Beau de Roche, France, 1862; (operating four-stroke) [Nikolaus Otto](#), Germany, 1876; (diesel) [Rudolf Diesel](#), Germany, 1892; (rotary) [Felix Wankel](#), Germany, 1956.

**Evolution:**

(organic) [Jean-Baptiste Lamarck](#), France, 1809; (by natural selection) [Charles Darwin](#), England, 1859.

**Exclusion principle:**

(no two electrons in an atom can occupy the same energy level) [Wolfgang Pauli](#), Germany, 1925.

**Expanding universe theory:**

(first proposed) [George LeMaitre](#), Belgium, 1927; (discovered first direct evidence that the universe is expanding) [Edwin P. Hubble](#), U.S., 1929; (Hubble constant: a measure of the rate at which the universe is expanding) Edwin P. Hubble, U.S., 1929.

**Falling bodies, law of:**

[Galileo Galilei](#), Italy, 1590.

**Fermentation:**

(microorganisms as cause of) [Louis Pasteur](#), France, c.1860.

**Fiber optics:**

Narinder Kapany, England, 1955.

**Fibers, man-made:**

(nitrocellulose fibers treated to change flammable nitrocellulose to harmless cellulose, precursor of rayon) Sir Joseph Swann, England, 1883; (rayon) [Count Hilaire de Chardonnet](#), France, 1889; (Celanese) Henry and Camille Dreyfuss, U.S., England, 1921; (research on polyesters and polyamides, basis for modern man-made fibers) U.S., England, Germany, 1930s; (nylon) [Wallace H. Carothers](#), U.S., 1935.

**Frozen food:**

[Clarence Birdseye](#), U.S., 1924.

**Gene transfer:**

(recombinant DNA organism) Herbert Boyer, Stanley Cohen, U.S., 1973; (human) Steven Rosenberg, R. Michael Blaese, W. French Anderson, U.S., 1989.

**Geometry, elements of:**

[Euclid](#), Alexandria, Egypt, c. 300 B.C.; (analytic) [René Descartes](#), France; and [Pierre de Fermat](#), Switzerland, 1637.

**Gravitation, law of:**

[Sir Isaac Newton](#), England, c.1665 (published 1687).

**Gunpowder:**

China, c.700.

**Gyrocompass:**

[Elmer A. Sperry](#), U.S., 1905.

**Gyroscope:**

[Jean Léon Foucault](#), France, 1852.

**Halley's Comet:**

[Edmund Halley](#), England, 1705.

**Heart implanted in human, permanent artificial:**

Dr. Robert Jarvik, U.S., 1982.

**Heart, temporary artificial:**

Willem Kolff, Netherlands, U.S., 1957.

**Helicopter:**

(double rotor) Heinrich Focke, Germany, 1936; (single rotor) [Igor Sikorsky](#), U.S., 1939.

**Helium first observed on sun:**

[Sir Joseph Lockyer](#), England, 1868.

**Heredity, laws of:**

[Gregor Mendel](#), Austria, 1865.

**Holograph:**

[Dennis Gabor](#), England, 1947.

**Home videotape systems (VCR):**

(Betamax) Sony, Japan, 1975; (VHS) Matsushita, Japan, 1975.

**Ice age theory:**

[Louis Agassiz](#), Swiss-American, 1840.

**Induction, electric:**

[Joseph Henry](#), U.S., 1828.

**Insulin:**

(first isolated) [Sir Frederick G. Banting](#) and [Charles H. Best](#), Canada, 1921; (discovery first published) Banting and Best, 1922; (Nobel Prize awarded for purification for use in humans) [John Macleod](#) and Banting, 1923; (first synthesized), China, 1966.

**Intelligence testing:**

[Alfred Binet](#), Theodore Simon, France, 1905.

**Interferon:**

Alick Isaacs, England, Jean Lindemann, Switzerland, 1957.

**Isotopes:**

(concept of) [Frederick Soddy](#), England, 1912; (stable isotopes) J. J. Thompson, England, 1913; (existence demonstrated by mass spectrography) Francis W. Aston, England, 1919.

**Jet propulsion:**

(engine) [Sir Frank Whittle](#), England, Hans von Ohain, Germany, 1936; (aircraft) *Heinkel He 178*, 1939.

**Kinetic theory of gases:**

(molecules of a gas are in a state of rapid motion) [Daniel Bernoulli](#), Switzerland, 1738.

**Laser:**

(theoretical work on) [Charles H. Townes](#), [Arthur L. Schawlow](#), U.S., [N. Basov](#), [A. Prokhorov](#), U.S.S.R., 1958; (first working model) [T. H. Maiman](#), U.S., 1960.

**Lawn mower:**

Edwin Budding, John Ferrabee, England, 1830–1831.

**LCD (liquid crystal display):**

Hoffmann-La Roche, Switzerland, 1970.

**Lens, bifocal:**

[Benjamin Franklin](#), U.S., c.1760.

**Leyden jar:**

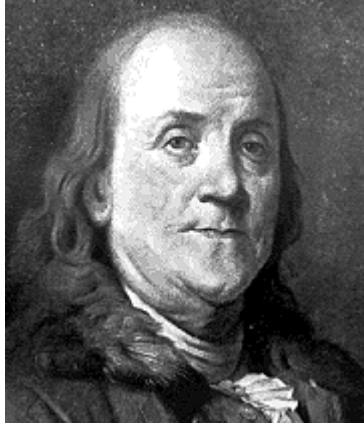
(prototype electrical condenser) Canon E. G. von Kleist of Kamin, Pomerania, 1745; independently evolved by Cunaeus and P. van Musschenbroek, University of Leyden, Holland, 1746, from where name originated.

**Light, nature of:**

(wave theory) [Christian Huygens](#), The Netherlands, 1678; (electromagnetic theory) [James Clerk Maxwell](#), England, 1873.

**Light, speed of:**

(theory that light has finite velocity) [Olaus Roemer](#), Denmark, 1675.



Benjamin Franklin (1706–1790)

**Lightning rod:**

[Benjamin Franklin](#), U.S., 1752.

**Lock, cylinder:**

[Linus Yale](#), U.S., 1851.

**Locomotive:**

(steam powered) [Richard Trevithick](#), England, 1804; (first practical, due to multiple-fire-tube boiler) [George Stephenson](#), England, 1829; (largest steam-powered) Union Pacific's "Big Boy," U.S., 1941.

**Loom:**

(horizontal, two-beamed) Egypt, c. 4400 B.C.; (Jacquard drawloom, pattern controlled by punch cards) Jacques de Vaucanson, France, 1745, [Joseph-Marie Jacquard](#), 1801; (flying shuttle) [John Kay](#), England, 1733; (power-driven loom) [Edmund Cartwright](#), England, 1785.

**Machine gun:**

(hand-cranked multibarrel) [Richard J. Gatling](#), U.S., 1862; (practical single barrel, belt-fed) [Hiram S. Maxim](#), Anglo-American, 1884.

**Magnet, Earth is:**

[William Gilbert](#), England, 1600.

**Match:**

(phosphorus) François Derosne, France, 1816; (friction) Charles Sauria, France, 1831; (safety) J. E. Lundstrom, Sweden, 1855.

**Measles vaccine:**

[John F. Enders](#), Thomas Peebles, U.S., 1953.

**Metric system:**

revolutionary government of France, 1790–1801.

**Microphone:**

[Charles Wheatstone](#), England, 1827.

**Microscope:**

(compound) Zacharias Janssen, The Netherlands, 1590; (electron) [Vladimir Zworykin](#) et al., U.S., Canada, Germany, 1932–1939.

**Microwave oven:**

Percy Spencer, U.S., 1947.

**Motion, laws of:**

[Isaac Newton](#), England, 1687.

**Motion pictures:**

[Thomas A. Edison](#), U.S., 1893.

**Motion pictures, sound:**

Product of various inventions. First picture with synchronized musical score: *Don Juan*, 1926; with spoken dialogue: *The Jazz Singer*, 1927; both Warner Bros.

**Motor, electric:**

[Michael Faraday](#), England, 1822; (alternating-current) [Nikola Tesla](#), U.S., 1892.

**Motorcycle:**

(motor tricycle) Edward Butler, England, 1884; (gasoline-engine motorcycle) [Gottlieb Daimler](#), Germany, 1885.

**Moving assembly line:**

[Henry Ford](#), U.S., 1913.

**Neptune:**

(discovery of) [Johann Galle](#), Germany, 1846.

**Neptunium:**

(first transuranic element, synthesis of) [Edward M. McMillan](#), Philip H. Abelson, U.S., 1940.

**Neutron:**

[James Chadwick](#), England, 1932.

**Neutron-induced radiation:**

[Enrico Fermi](#) et al., Italy, 1934.

**Nitroglycerin:**

Ascanio Sobrero, Italy, 1846.

**Nuclear fission:**

[Otto Hahn](#), Fritz Strassmann, Germany, 1938.

**Nuclear reactor:**

[Enrico Fermi](#), Italy, et al., 1942.

**Ohm's law:**

(relationship between strength of electric current, electromotive force, and circuit resistance) [Georg S. Ohm](#), Germany, 1827.

**Oil well:**

[Edwin L. Drake](#), U.S., 1859.

**Oxygen:**

(isolation of) [Joseph Priestley](#), England, 1774; [Karl Scheele](#), Sweden, 1773.

**Ozone:**

Christian Schönbein, Germany, 1839.

**Pacemaker:**

(internal) Clarence W. Lillehie, Earl Bakk, U.S., 1957.

**Paper:**

China, c.100 A.D.

**Parachute:**

Louis S. Lenormand, France, 1783.

**Pen:**

(fountain) Lewis E. Waterman, U.S., 1884; (ball-point, for marking on rough surfaces) John H. Loud, U.S., 1888; (ball-point, for handwriting) Lazlo Biro, Argentina, 1944.

**Periodic law:**

(that properties of elements are functions of their atomic weights) [Dmitri Mendeleev](#), Russia, 1869.

**Periodic table:**

(arrangement of chemical elements based on periodic law) [Dmitri Mendeleev](#), Russia, 1869.

**Phonograph:**

[Thomas A. Edison](#), U.S., 1877.

**Photography:**

(first paper negative, first photograph, on metal) [Joseph Nicéphore Niepce](#), France, 1816–1827; (discovery of fixative powers of hyposulfite of soda) [Sir John Herschel](#), England, 1819; (first direct positive image on silver plate, the daguerreotype) [Louis Daguerre](#), based on work with Niepce, France, 1839; (first paper negative from which a number of positive prints could be made) [William Talbot](#), England, 1841. Work of these four men, taken together, forms basis for all modern photography. (First color images) [Alexandre Becquerel](#), Claude Niepce de Saint-Victor, France, 1848–1860; (commercial color film with three emulsion layers, Kodachrome) U.S., 1935.

**Photovoltaic effect:**

(light falling on certain materials can produce electricity) [Edmund Becquerel](#), France, 1839.

**Piano:**

(Hammerklavier) Bartolommeo Cristofori, Italy, 1709; (pianoforte with sustaining and damper pedals) John Broadwood, England, 1873.

**Planetary motion, laws of:**

[Johannes Kepler](#), Germany, 1609, 1619.

**Plant respiration and photosynthesis:**

[Jan Ingenhousz](#), Holland, 1779.

**Plastics:**

(first material, nitrocellulose softened by vegetable oil, camphor, precursor to Celluloid) Alexander Parkes, England, 1855; (Celluloid, involving recognition of vital effect of camphor) [John W. Hyatt](#), U.S., 1869; (Bakelite, first completely synthetic plastic) [Leo H. Baekeland](#), U.S., 1910; (theoretical background of macromolecules and process of polymerization on which modern plastics industry rests) [Hermann Staudinger](#), Germany, 1922; (polypropylene and low-pressure method for producing high-density polyethylene) Robert Banks, Paul Hogan, U.S., 1958.

**Plate tectonics:**

[Alfred Wegener](#), Germany, 1912–1915.

**Plow, forked:**

Mesopotamia, before 3000 B.C.

**Plutonium, synthesis of:**

[Glenn T. Seaborg](#), [Edwin M. McMillan](#), Arthur C. Wahl, Joseph W. Kennedy, U.S., 1941.

**Polio, vaccine:**

(experimentally safe dead-virus vaccine) [Jonas E. Salk](#), U.S., 1952; (effective large-scale field trials) 1954; (officially approved) 1955; (safe oral live-virus vaccine developed) [Albert B. Sabin](#), U.S., 1954; (available in the U.S.) 1960.

**Positron:**

[Carl D. Anderson](#), U.S., 1932.

**Pressure cooker:**

(early version) [Denis Papin](#), France, 1679.

**Printing:**

(block) Japan, c.700; (movable type) Korea, c.1400, [Johann Gutenberg](#), Germany, c.1450; (lithography, offset) [Aloys Senefelder](#), Germany, 1796; (rotary press) [Richard Hoe](#), U.S., 1844; (linotype) [Ottmar Mergenthaler](#), U.S., 1884.



[Johann Gutenberg](#)  
(c. 1400–1468)

**Probability theory:**

[René Descartes](#), France, and [Pierre de Fermat](#), Switzerland, 1654.

**Proton:**

[Ernest Rutherford](#), England, 1919.

**Prozac:**

(antidepressant fluoxetine) Bryan B. Malloy, Scotland, and Klaus K. Schmiegel, U.S., 1972; (released for use in U.S.) Eli Lilly & Company, 1987.

**Psychoanalysis:**

Sigmund Freud, Austria, c.1904.

**Pulsars:**

Antony Hewish and Jocelyn Bell Burnel, England, 1967.

**Quantum theory:**

(general) Max Planck, Germany, 1900; (sub-atomic) Niels Bohr, Denmark, 1913; (quantum mechanics) Werner Heisenberg, Erwin Schrödinger, Germany, 1925.

**Quarks:**

Jerome Friedman, Henry Kendall, Richard Taylor, U.S., 1967.

**Quasars:**

Marten Schmidt, U.S., 1963.

**Rabies immunization:**

Louis Pasteur, France, 1885.

**Radar:**

(limited to one-mile range) Christian Hulsmeyer, Germany, 1904; (pulse modulation, used for measuring height of ionosphere) Gregory Breit, Merle Tuve, U.S., 1925; (first practical radar—radio detection and ranging) Sir Robert Watson-Watt, Scotland, 1934–1935.

**Radio:**

(electromagnetism, theory of) James Clerk Maxwell, England, 1873; (spark coil, generator of electromagnetic waves) Heinrich Hertz, Germany, 1886; (first practical system of wireless telegraphy) Guglielmo Marconi, Italy, 1895; (first long-distance telegraphic radio signal sent across the Atlantic) Marconi, 1901; (vacuum electron tube, basis for radio telephony) Sir John Fleming, England, 1904; (triode amplifying tube) Lee de Forest, U.S., 1906; (regenerative circuit, allowing long-distance sound reception) Edwin H. Armstrong, U.S., 1912; (frequency modulation—FM) Edwin H. Armstrong, U.S., 1933.

**Radioactivity:**

(X-rays) Wilhelm K. Roentgen, Germany, 1895; (radioactivity of uranium) Henri Becquerel, France, 1896; (radioactive elements, radium and polonium in uranium ore) Marie Skłodowska-Curie, Pierre Curie, France, 1898; (classification of alpha and beta particle radiation) Pierre Curie, France, 1900; (gamma radiation) Paul-Ulrich Villard, France, 1900.

**Radiocarbon dating, carbon-14 method:**

(discovered) Willard F. Libby, U.S., 1947; (first demonstrated) U.S., 1950.

**Radio signals, extraterrestrial:**

first known radio noise signals were received by U.S. engineer, Karl Jansky, originating from the Galactic Center, 1931.

**Radio waves:**

(cosmic sources, led to radio astronomy) Karl Jansky, U.S., 1932.

**Razor:**

(safety, successfully marketed) King Gillette, U.S., 1901; (electric) Jacob Schick, U.S., 1928, 1931.

**Reaper:**

Cyrus McCormick, U.S., 1834.

**Refrigerator:**

Alexander Twining, U.S., James Harrison, Australia, 1850; (first with a compressor device) the Domelse, Chicago, U.S., 1913.

**Refrigerator ship:**

(first) the *Frigorifique*, cooling unit designed by Charles Teller, France, 1877.

**Relativity:**

(special and general theories of) Albert Einstein, Switzerland, Germany, U.S., 1905–1953.

**Revolver:**

[Samuel Colt](#), U.S., 1835.

**Richter scale:**

[Charles F. Richter](#), U.S., 1935.

**Rifle:**

(muzzle-loaded) Italy, Germany, c.1475; (breech-loaded) England, France, Germany, U.S., c.1866; (bolt-action) [Paul von Mauser](#), Germany, 1889; (automatic) [John Browning](#), U.S., 1918.

**Rocket:**

(liquid-fueled) [Robert Goddard](#), U.S., 1926.

**Roller bearing:**

(wooden for cartwheel) Germany or France, c.100 B.C.

**Rotation of Earth:**

[Jean Bernard Foucault](#), France, 1851.

**Royal Observatory, Greenwich:**

established in 1675 by [Charles II](#) of England; [John Flamsteed](#) first Astronomer Royal.

**Rubber:**

(vulcanization process) [Charles Goodyear](#), U.S., 1839.

**Saccharin:**

Constantine Fuhlberg, [Ira Remsen](#), U.S., 1879.

**Safety pin:**

Walter Hunt, U.S., 1849.

**Saturn, ring around:**

[Christian Huygens](#), The Netherlands, 1659.

**“Scotch” tape:**

Richard Drew, U.S., 1929.

**Screw propeller:**

Sir Francis P. Smith, England, 1836; [John Ericsson](#), England, worked independently of and simultaneously with Smith, 1837.

**Seat belt:**

(three point) Nils Bohlin, Sweden, 1962.

**Seismograph:**

(first accurate) [John Milne](#), England, 1880.

**Sewing machine:**

[Elias Howe](#), U.S., 1846; (continuous stitch) [Isaac Singer](#), U.S., 1851.

**Solar energy:**

First realistic application of solar energy using parabolic solar reflector to drive caloric engine on steam boiler, [John Ericsson](#), U.S., 1860s.

**Solar system, universe:**

(Sun-centered universe) [Nicolaus Copernicus](#), Warsaw, 1543; (establishment of planetary orbits as elliptical) [Johannes Kepler](#), Germany, 1609; (infinity of universe) [Giordano Bruno](#), Italian monk, 1584.

**Spectrum:**

(heterogeneity of light) [Sir Isaac Newton](#), England, 1665–1666.

**Spectrum analysis:**

[Gustav Kirchhoff](#), [Robert Bunsen](#), Germany, 1859.

**Spermatozoa:**

[Anton van Leeuwenhoek](#), The Netherlands, 1683.

**Spinning:**

(spinning wheel) India, introduced to Europe in Middle Ages; (Saxony wheel, continuous spinning of wool or cotton yarn) England, c.1500–1600; (spinning jenny) [James Hargreaves](#), England, 1764; (spinning frame) [Sir Richard Arkwright](#), England, 1769; (spinning mule, completed mechanization of spinning, permitting production of yarn to keep up with demands of modern looms) [Samuel Crompton](#), England, 1779.

**Star catalog:**

(first modern) [Tycho Brahe](#), Denmark, 1572.

**Steam engine:**

(first commercial version based on principles of French physicist [Denis Papin](#)) [Thomas Savery](#), England, 1639; (atmospheric steam engine) [Thomas Newcomen](#), England, 1705; (steam engine for pumping water from collieries) Savery, Newcomen, 1725; (modern condensing, double acting) [James Watt](#), England, 1782; (high-pressure) Oliver Evans, U.S., 1804.

**Steamship:**

Claude de Jouffroy d'Abbans, France, 1783; [James Rumsey](#), U.S., 1787; [John Fitch](#), U.S., 1790; (high-pressure) Oliver Evans, U.S., 1804. All preceded [Robert Fulton](#), U.S., 1807, credited with launching first commercially successful steamship.

**Stethoscope:**

[René Laënnec](#), France, 1819.

**Sulfa drugs:**

(parent compound, para-aminobenzenesulfanamide) Paul Gelmo, Austria, 1908; (antibacterial activity) [Gerhard Domagk](#), Germany, 1935.

**Superconductivity:**

(theory) [John Bardeen](#), [Leon Cooper](#), John Scheiffer, U.S., 1957.

**Symbolic logic:**

George Boule, 1854; (modern) [Bertrand Russell](#), [Alfred North Whitehead](#), England, 1910–1913.

**Tank, military:**

Sir Ernest Swinton, England, 1914.

**Tape recorder:**

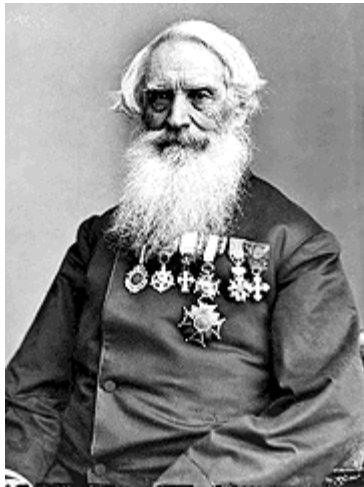
(magnetic steel tape) [Valdemar Poulsen](#), Denmark, 1899.

**Teflon:**

DuPont, U.S., 1943.

**Telegraph:**

[Samuel F. B. Morse](#), U.S., 1837.



[Samuel F. B. Morse](#) (1791–1872)  
*Library of Congress*

**Telephone:**

[Alexander Graham Bell](#), U.S., 1876.

**Telescope:**

Hans Lippershey, The Netherlands, 1608; (astronomical) [Galileo Galilei](#), Italy, 1609; (reflecting) [Isaac Newton](#), England, 1668.

**Television:**

(Iconoscope–T.V. camera tube) [Vladimir Zworykin](#), U.S., 1923, and also kinescope (cathode ray tube) 1928; (mechanical disk-scanning method) successfully demonstrated by J.L. Baird, Scotland, C.F. Jenkins, U.S., 1926; (first all-electric television image) [Philo T. Farnsworth](#), U.S., 1927; (color, mechanical disk) Baird, 1928; (color, compatible with black and white) George Valensi, France, 1938; (color, sequential rotating filter) [Peter](#)

[Goldmark](#), U.S., [first introduced, 1951](#); (color, compatible with black and white) commercially introduced in U.S., National Television Systems Committee, 1953.

**Thermodynamics:**

(first law: energy cannot be created or destroyed, only converted from one form to another) [Julius von Mayer](#), Germany, 1842; [James Joule](#), England, 1843; (second law: heat cannot of itself pass from a colder to a warmer body) [Rudolph Clausius](#), Germany, 1850; (third law: the entropy of ordered solids reaches zero at the absolute zero of temperature) [Walter Nernst](#), Germany, 1918.

**Thermometer:**

(open-column) [Galileo Galilei](#), c.1593; (clinical) Santorio Santorio, Padua, c.1615; (mercury, also Fahrenheit scale) [Gabriel D. Fahrenheit](#), Germany, 1714; (centigrade scale) [Anders Celsius](#), Sweden, 1742; (absolute-temperature, or Kelvin, scale) [William Thompson, Lord Kelvin](#), England, 1848.

**Tire, pneumatic:**

Robert W. Thompson, England, 1845; (bicycle tire) [John B. Dunlop](#), Northern Ireland, 1888.

**Toilet, flush:**

Product of Minoan civilization, Crete, c. 2000 B.C. Alleged invention by "Thomas Crapper" is untrue.

**Tractor:**

Benjamin Holt, U.S., 1900.

**Transformer, electric:**

[William Stanley](#), U.S., 1885.

**Transistor:**

[John Bardeen](#), [Walter H. Brattain](#), [William B. Shockley](#), U.S., 1947.

**Tuberculosis bacterium:**

[Robert Koch](#), Germany, 1882.

**Typewriter:**

[Christopher Sholes](#), Carlos Glidden, U.S., 1867.

**Uncertainty principle:**

(that position and velocity of an object cannot both be measured exactly, at the same time) [Werner Heisenberg](#), Germany, 1927.

**Uranus:**

(first planet discovered in recorded history) [William Herschel](#), England, 1781.

**Vaccination:**

[Edward Jenner](#), England, 1796.

**Vacuum cleaner:**

(manually operated) Ives W. McGaffey, U.S., 1869; (electric) Hubert C. Booth, England, 1901; (upright) J. Murray Spangler, U.S., 1907.

**Van Allen (radiation) Belt:**

(around Earth) [James Van Allen](#), U.S., 1958.

**Video disk:**

Philips Co., The Netherlands, 1972.

**Vitamins:**

(hypothesis of disease deficiency) [Sir F. G. Hopkins](#), [Casimir Funk](#), England, 1912; (vitamin A) Elmer V. McCollum, M. Davis, U.S., 1912–1914; (vitamin B) McCollum, U.S., 1915–1916; (thiamin, B<sub>1</sub>) Casimir Funk, England, 1912; (riboflavin, B<sub>2</sub>) D. T. Smith, E. G. Hendrick, U.S., 1926; (niacin) Conrad Elvehjem, U.S., 1937; (B<sub>6</sub>) Paul Gyorgy, U.S., 1934; (vitamin C) C. A. Hoist, T. Froelich, Norway, 1912; (vitamin D) McCollum, U.S., 1922; (folic acid) Lucy Wills, England, 1933.

**Voltaic pile:**

(forerunner of modern battery, first source of continuous electric current) [Alessandro Volta](#), Italy, 1800.

**Wallpaper:**

Europe, 16th and 17th century.

**Wassermann test:**

(for syphilis) August von Wassermann, Germany, 1906.

**Wheel:**

(cart, solid wood) Mesopotamia, c.3800–3600 B.C.

**Windmill:**

Persia, c.600.

**World Wide Web:**

(developed while working at CERN) [Tim Berners-Lee](#), England, 1989; (development of Mosaic browser makes WWW available for general use) Marc Andreessen, U.S., 1993.

**Xerography:**

[Chester Carlson](#), U.S., 1938.

**Yellow Fever:**

(transmission of) [Walter Reed](#), U.S., 1900.

**Zero:**

India, c. 600; (absolute zero temperature, cessation of all molecular energy) [William Thompson, Lord Kelvin](#), England, 1848.

**Zipper:**

W. L. Judson, U.S., 1891.