

A century of science

The 20th Century witnessed fantastic advancement in all branches of science. In the span of 66 years, man took off from the ground into air, and eventually into space. One man changed the face of science once and for all with his general theory of relativity. As penicillin was discovered to save lives, so was invented the atomic bomb to kill. With the advent of computer, and subsequently the Internet, the world truly became a small place. It has indeed been a century of science.

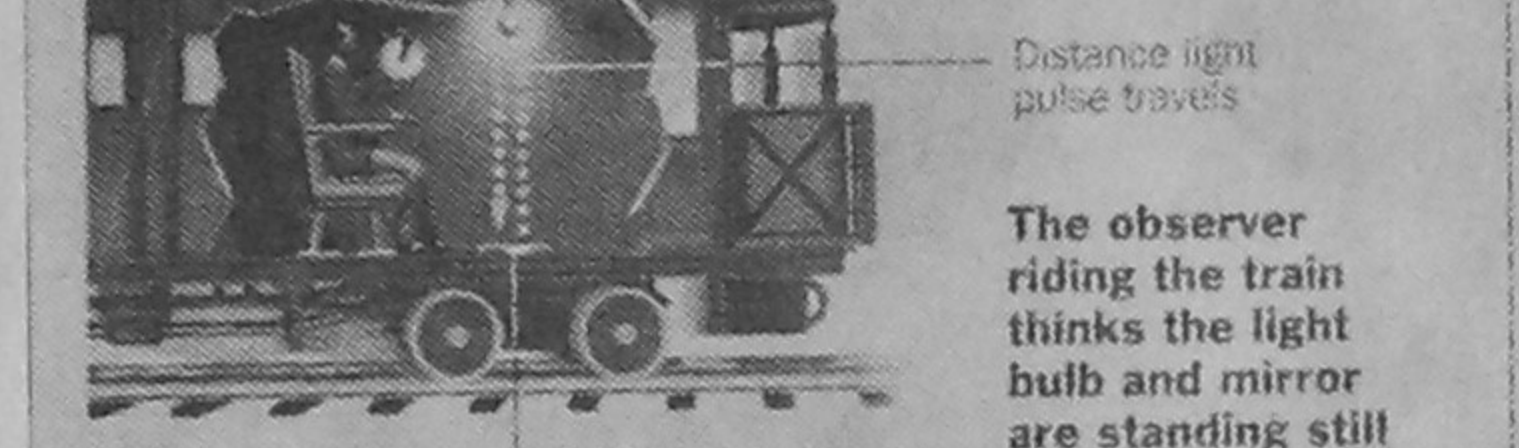
- 1900 : Sigmund Freud publishes *The Interpretation of Dreams*
- 1901 : Max Planck presents his quantum theory at a meeting of the German Physical Society in Berlin
- 1901 : Austrian physician Karl Landsteiner shows that there are at least three types of human blood, which he labels A, B and O. These distinctions make blood transfusions possible. Landsteiner will also discover the Rh factor
- 1902 : Scottish cardiologist James Mackenzie invents the polygraph machine, better known as the lie detector
- 1903 : Marie Curie shares the Nobel Prize for Physics with Henri Becquerel and her husband Pierre for their discovery of radio-activity; she will win a second Nobel for Chemistry, in 1911, for isolating the radioactive element radium
- 1903 : The *Flyer*, a plane built by American inventors Wilbur and Orville Wright, makes the first powered flight
- 1905 : French psychologist Alfred Binet devises the first intelligence tests
- 1905 : German chemist Walther Nernst explains why absolute zero (about -273°C) can never be reached; this becomes the third law of thermodynamics
- 1906 : British biochemist Frederick Hopkins postulates that "accessory food factors" are required for human health; these are now known as vitamins
- 1906 : German neurologist Alois Alzheimer identifies a disorder that causes the progressive loss of intellectual functioning
- 1907 : Belgian-American chemist Leo Baekeland patents Bakelite, the world's first true plastic
- 1908 : Hans Geiger invents a machine that translates invisible nuclear radiation into audible clicks
- 1910 : German bacteriologist Paul Ehrlich uses a form of arsenic to combat syphilis; his work forms the basis of modern chemotherapy
- 1911 : Ernest Rutherford, Hans Geiger and Ernest Marsden discover the structure of the atom
- 1911 : Austrian-American physicist Victor Hess detects radiation coming from outer space; it is later dubbed cosmic rays
- 1912 : Hiram Bingham finds Machu Picchu, a 15th century Inca settlement high in the Peruvian Andes
- 1912 : German meteorologist Alfred Wegener proposes the theory of continental drift
- 1912 : Charles Dawson announces that he has found the fossilised remains of a human-like creature on Piltdown Common in Sussex, England. Christened *Eoanthropus dawsoni*, "Piltdown Man" will be exposed as a fraud in 1953
- 1913 : Dr Albert Schweitzer, a missionary, opens a hospital in Lambarene, French Equatorial Africa (now Gabon), for treatment of leprosy and sleeping sickness
- 1916 : Albert Einstein publishes his general theory of relativity
- 1917 : US astronomer George Hale builds a 100-inch reflecting telescope — the world's largest — on California's Mount Wilson
- 1918 : American astronomer Harlow Shapley describes the size and structure of the Milky Way galaxy
- 1918 : A world-wide influenza epidemic kills more than 25 million people, including some 500,000 Americans
- 1919 : British physicist Ernest Rutherford artificially splits an atom
- 1921 : Swiss psychiatrist Hermann Rorschach introduces the inkblot test
- 1921 : Canadian physician Frederick Banting and colleagues find a treatment for diabetes: insulin isolated from the pancreas of fatal calves
- 1922 : British archaeologist Howard Carter opens the tomb of Tutankhamun, a little-known pharaoh who died in 1325 BC
- 1924 : French physicist Louis de Broglie describes his theory that all matter behaves as both a particle and a wave, just as light does; this notion will lead to the electron microscope
- 1925 : The teaching of evolution comes under fire at the Scopes "monkey trial" in Tennessee
- 1926 : American physicist Robert Goddard conducts the first successful launch of a liquid-fuelled rocket
- 1927 : Werner Heisenberg devises his "uncertainty principle"
- 1927 : Belgian astronomer and priest Georges Lemaitre proposes that the universe began with a big bang; the explosion of a highly condensed mass, which he refers to as a "cosmic egg"
- 1928 : Scottish bacteriologist Alexander Fleming discovers penicillin
- 1928 : American anthropologist Margaret Mead publishes *Coming of Age in Samoa*
- 1928 : Greek-American physician George Papanicolaou develops the Pap smear, a screening test for cervical and uterine cancer
- 1929 : Hungarian-born biochemist Albert Szent-Gyorgyi isolates vitamin C
- 1929 : US astronomer Edwin Hubble provides evidence that the universe is expanding
- 1929 : American physicist Ernest Lawrence dreams up the cyclotron, the first atom smasher
- 1930 : US Astronomer Clyde Tombaugh discovers Pluto, the ninth planet
- 1930 : Austrian physicist Wolfgang Pauli proposes the existence of neutrinos
- 1933 : Teams in Germany and Britain independently invent radar
- 1934 : French physicists Irene and Frédéric Joliot-Curie artificially induce radioactivity
- 1935 : US seismologist Charles Richter develops a scale for measuring the strength of earthquakes
- 1935 : Austrian zoologist Konrad Lorenz describes the process of imprinting, during which young birds attach themselves to a being or an object
- 1935 : First use of lobotomy to treat mental illness
- 1936 : John Maynard Keynes publishes *The General Theory of*

- 1938 : *Employment, Interest and Money* — controlled electric shocks that cause temporary loss of consciousness and seizure — is first used on mental patients
- 1938 : After analysing decades of temperature readings, British engineer George Callendar describes what is later known as the greenhouse effect
- 1939 : First flight by a jet aircraft, built by Germany's Ernst Heinkel
- 1939 : Swiss chemist Paul Müller determines that DDT is a powerful insecticide
- 1940 : French boys searching for their dog stumble onto the Lascaux cave, whose walls are covered with spectacular paintings and engravings dating from the Ice Age
- 1940 : American surgeon Charles Drew devises a method for long-term storage of blood plasma, which can then be used for transfusions
- 1941 : US researchers Lyle Goodhue and William Sullivan adapt an earlier idea for dispersing liquids and powders in a spray. Result: the aerosol can
- 1942 : A team headed by Italian physicist Enrico Fermi produces the first nuclear chain reaction
- 1942 : Frenchmen Jacques-Yves Cousteau and Emile Gagnan perfect the Aqua-Lung, a self-contained underwater breathing apparatus, or scuba
- 1942 : Germany successfully launches the V-2, a surface-to-surface missile developed with the help of rocket scientist Werner von Braun
- 1943 : British mathematician and cryptographer Alan Turing helps build an electronic computer, the Colossus, that will be used by the Allies to crack German codes

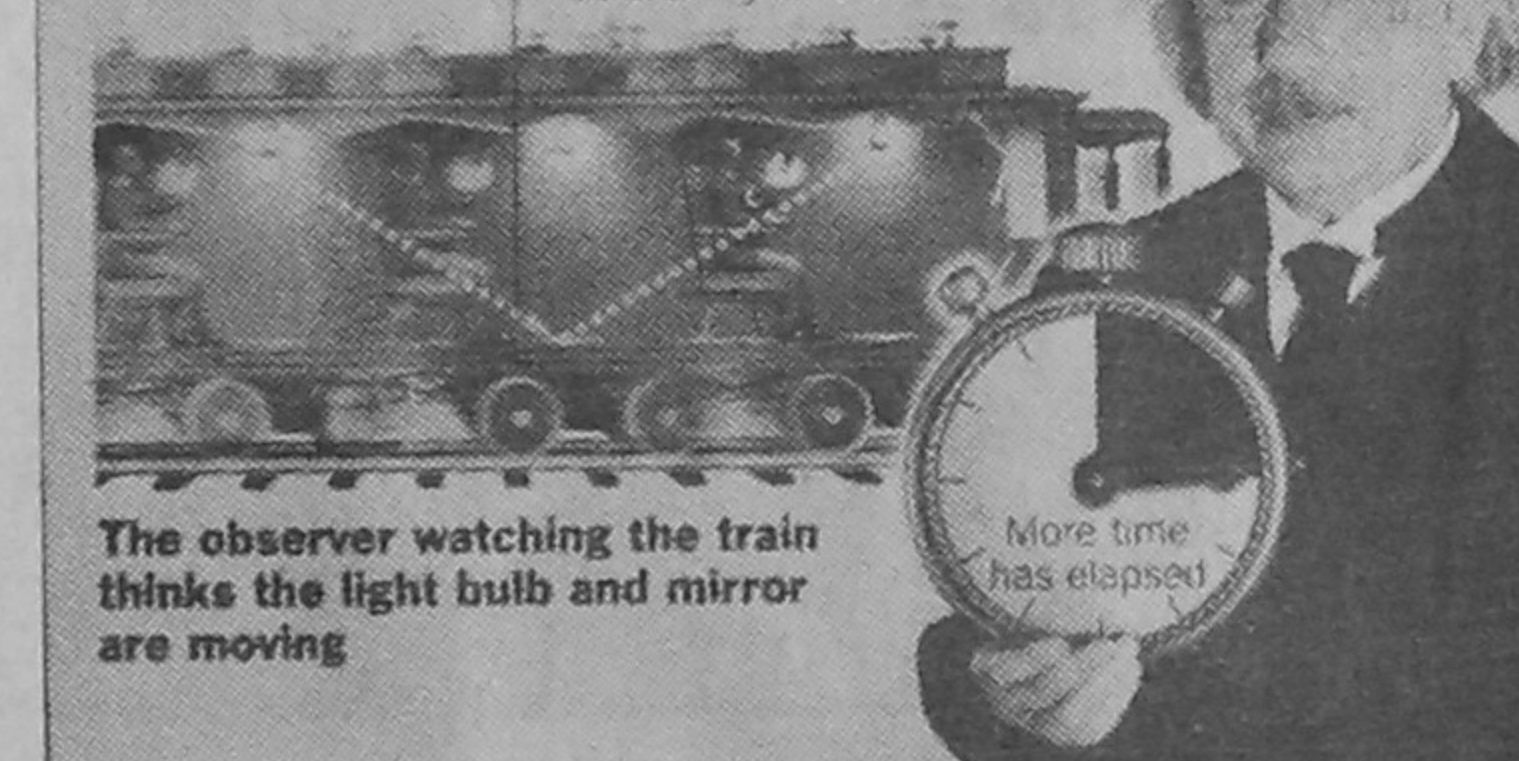
relativity and time

A moving clock runs slower than a stationary one from the perspective of a stationary observer

1 A man riding a moving train is timing a light beam that travels from ceiling to floor and back again. From his point of view, the light moves straight down and straight up.



2 From trackside, Einstein sees man, bulb and mirror moving sideways; the light traces a diagonal path. From Einstein's viewpoint, the light goes farther. But since lightspeed is always the same, the event must take more time by his clock.



Dutch physician Willem Kolff invents the dialysis machine, used to cleanse the blood when a patient's kidneys malfunction

After accidentally swallowing synthetic LSD, Swiss chemist Albert Hofmann discovers the drug's hallucinogenic effects

Publication of *Being and Nothingness* establishes Jean-Paul Sartre as the leading French existentialist

In Mexico, American plant pathologist Norman Borlaug starts developing high-yield grains that, two decades later, will fuel the green revolution

US pilots cruising at high altitudes discover powerful west-to-east wind system, later called jet streams

Raytheon technician Percy Spencer accidentally discovers microwave cooking when microwave signals melt a candy bar in his pocket

John Mauchly and John Eckert unveil ENIAC, the first fully electronic computer

Bedouin shepherds find Dead Sea Scrolls hidden in clay jars in Israel's Qumran Cave, overlooking the Dead Sea

American Edwin Land demonstrates the Polaroid camera he invented

Norwegian ethnologist Thor Heyerdahl sails from Peru to Polynesia on the wooden raft *Kon-Tiki* to support his theory that pre-Inca peoples reached South Pacific islands by sea and colonised them

US Air Force test pilot Charles (Chuck) Yeager breaks the sound barrier

A research team at Bell Laboratories led by William Shockley, John Bardeen and Walter Brattain invents the transistor

the equivalence of gravity and acceleration

Without external clues, it's impossible to tell if you're being pulled downward by gravity or accelerating upward. Your legs will feel the same pressure; a ball will fall precisely the same way

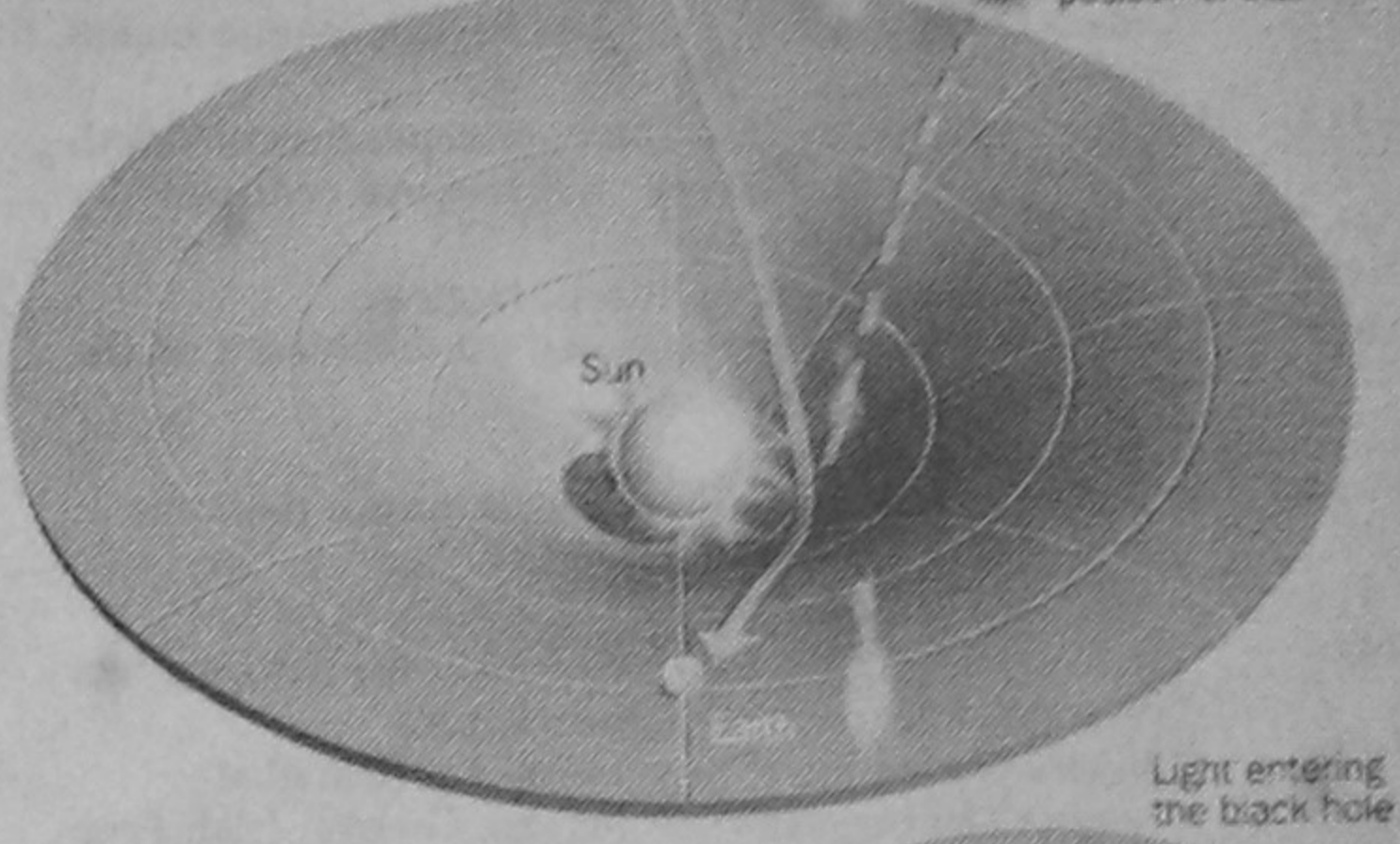
The realization that gravity and acceleration are equivalent was a key insight that eventually allowed Einstein to construct his theory of general relativity.



relativity and gravity

According to relativity, gravity is not a force; it's a warping of space-time (which is an amalgam of time and space) that happens in the presence of mass. The warping is analogous to the bending of a rubber sheet when a weight is placed on it

1 When starlight passes near a massive body, such as the sun, the shortest route is a curved line that follows the curvature of space-time. Thus, the starlight appears to be coming from a different point than its actual origin. The observation of this effect in 1919 convinced physicists that Einstein's strange theory was right.

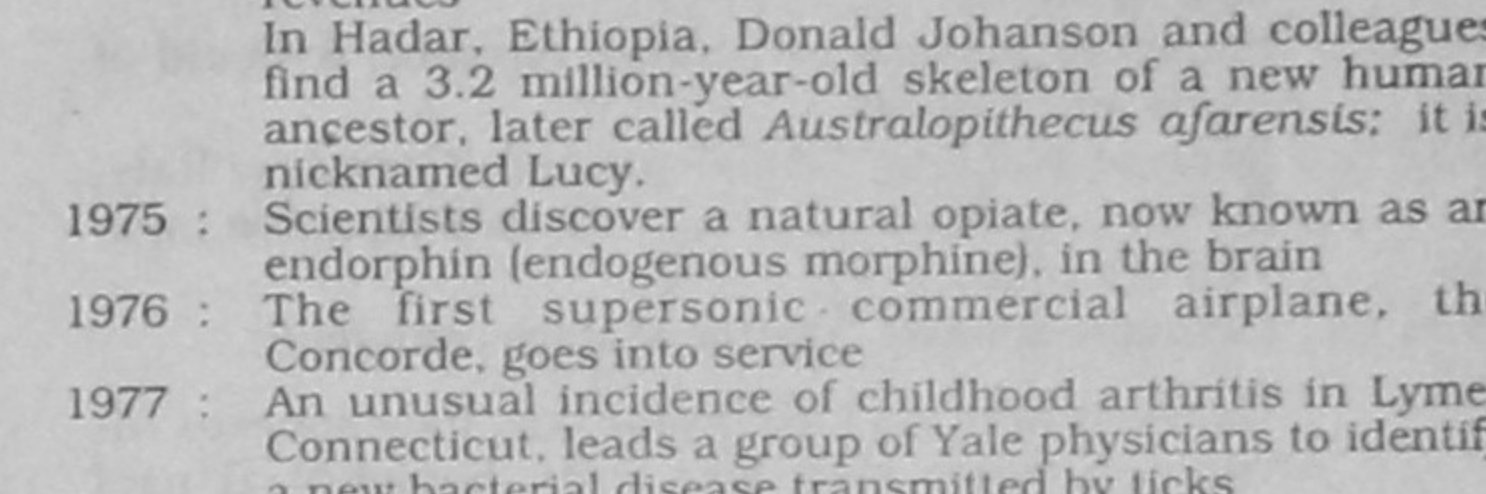


2 If a mass is concentrated enough, the curvature of space-time becomes infinite. This phenomenon is known as a black hole because a light beam that comes too close will never escape.

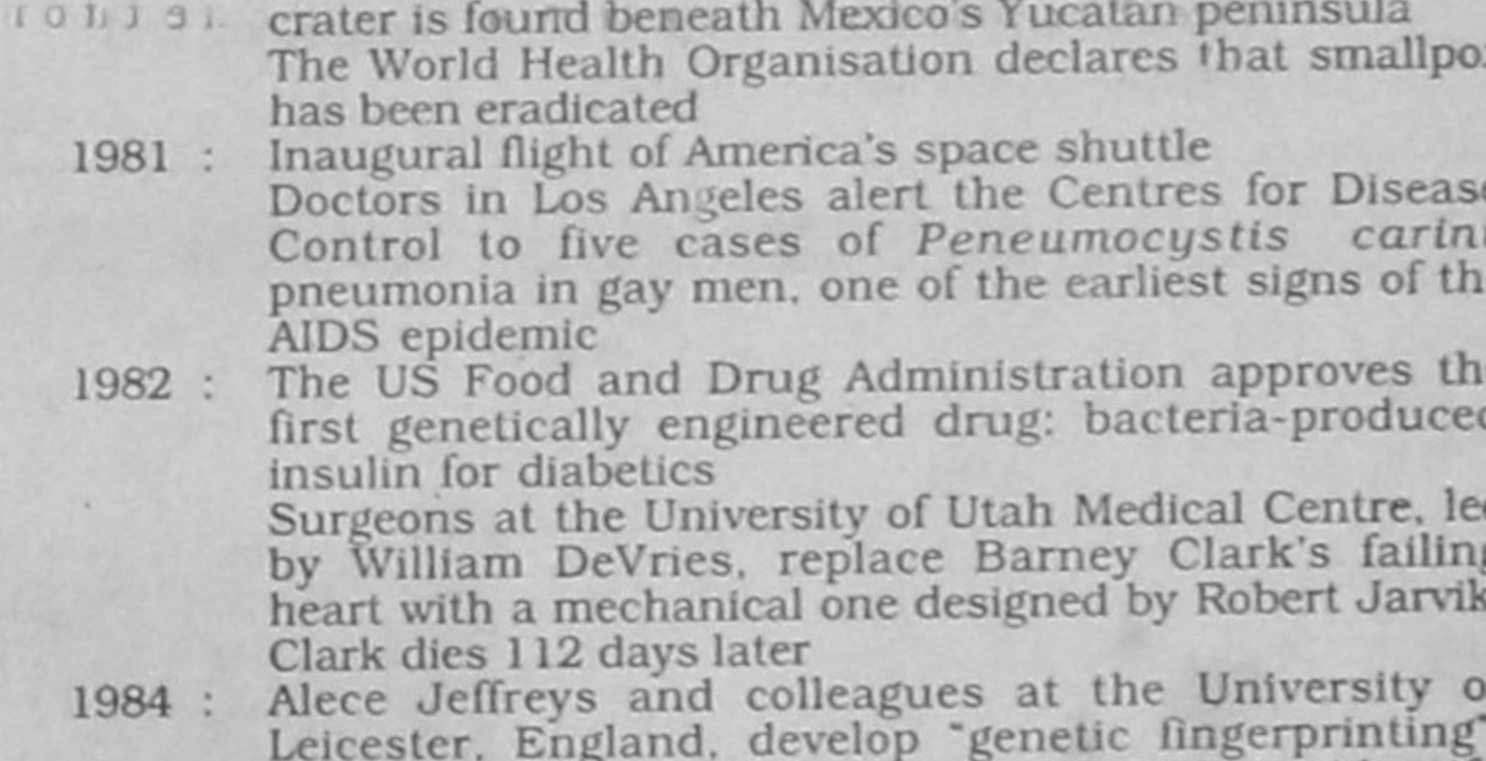
relativity and length

A moving object appears to shrink in the direction of motion, as seen by a stationary observer

1 The man now observes a light beam that travels the length of the train car. Knowing the speed of light and the travel time of the light beam, he can calculate the length of the train.



2 Einstein is not moving, so the rear of the train is moving forward from his point of view to meet the beam of light; for him, the beam travels a shorter distance. Because the speed of light is always the same, he will calculate the train's length as shorter—even after he allows for his faster-ticking clock. As the train approaches the speed of light, its length shrinks to nearly zero.



- 1948 : US chemist Willard Libby develops radiocarbon dating, which can determine the age of objects made of organic materials, such as wood and bone
- 1948 : The US Air Force starts Projects Blue Book to gather data on UFO sightings
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- 1952 : US virologist Jonas Salk develops the first effective polio vaccine
- 1952 : British chemist Rosalind Franklin's X-ray photographs of DNA show that the molecule has a helical structure
- 1953 : The first sex-change operation is performed on a patient named George Jorgensen, later known as Christine Jorgensen
- 1953 : James Watson and Francis Crick announce that they have deciphered the structure of DNA
- 1954 : US endocrinologists Gregory Pincus, John Rock and C. R. Garcia develop the birth-control pill
- 1956 : The US explodes a hydrogen bomb at Bikini Atoll, in the South Pacific
- 1957 : A new sleeping pill, thalidomide, is prescribed in Britain and Germany. It is later found to cause severe birth defects and taken off the market
- 1957 : Soviets send the first artificial satellite, Sputnik, into orbit around Earth
- 1958 : Electrical engineer Wilson Greatbatch invents the first implantable cardiac pacemaker; it is powered by a zinc-mercury battery
- 1959 : In Tanzania's Olduvai Gorge, Mary Leakey finds the fossilised skull of a human ancestor who lived 1.8 million years ago
- 1959 : Engineer Robert Noyce makes the first integrated circuit, or microchip
- 1959 : Marvin Minsky and John McCarthy establish the Artificial Intelligence Laboratory at MIT
- 1960 : The bathyscaphe *Trieste* descends 35,800 ft in the Mariana Trench to the deepest spot in the oceans
- 1960 : US physicist Theodore Maiman builds a working laser
- 1960 : British ethologist Jane Goodall begins studying chimpanzee behaviour in Tanzania
- 1960 : The discovery of an 11th century Norse settlement at L'Anse aux Meadows, Newfoundland, confirms that Europeans reached the New World centuries earlier than Columbus did
- 1961 : American astronomers Allan Sandage and Thomas Matthews discover quasars
- 1962 : US marine biologist Rachel Carson publishes *Silent Spring*
- 1963 : The tranquilliser Valium is introduced
- 1964 : The US Surgeon General first warns that smoking can be hazardous to human health
- 1964 : US surgeon Michael DeBakey performs the first successful coronary-artery bypass operation
- 1965 : American radio astronomers Arno Penzias and Robert Wilson accidentally discover cosmic background radiation, which bolsters the Big Bang theory of the origin of the universe
- 1967 : R Buckminster Fuller's geodesic dome is a hit at the Montreal Exposition
- 1967 : South African surgeon Christian Barnard performs the first successful human-heart transplant; his patient, Louis Washkansky, survives 18 days
- 1969 : American astronauts walk on the moon
- 1969 : Swiss-born psychiatrist Elisabeth Kübler-Ross

Space odyssey

- 1903 : Russia's Konstantin Tsiolkovsky publishes "Exploring Space with Reactive Devices," the first great rocketry study
- 1920 : Goddard publishes the first of only two rocketry papers he will ever write
- 1926-39 : Goddard launches the first liquid-fueled rockets, eventually building models that climb past 9,000 ft and break the speed of sound
- 1944 : Germany, inspired in part by homegrown rocketeer Hermann Oberth and in part by Goddard, launches the first V-2 rockets against London and Paris
- 1945 : German rocketeers, led by Wernher von Braun, are brought to America to design rockets for the US
- 1957 : The U.S.S.R. launches Sputnik 1, the first satellite
- 1958 : The U.S. answers with the smaller Explorer 1
- 1961 : The U.S.S.R.'s Yuri Gagarin becomes the first human being in space; America's Alan Shepard follows the next month
- 1967 : NASA launches the 36-story Saturn V, then—and still—America's largest rocket
- 1969 : Apollo 11, launched by a Saturn V, lands the first men on the moon
- 1986 : Shuttle Challenger explodes, killing seven astronauts; the next month, the U.S.S.R. launches the first component of the Mir space station
- 1981 : The U.S. launches the first space shuttle
- 1995 : First American astronaut flies aboard Mir
- 1998 : Assembly begins of International Space Station

Sigmund Freud

He opened a window on the unconscious — where, he said, lust, rage and repression battle for supremacy — and changed the way we view ourselves



- 1985 : Robert Gallo, of the US National Cancer Institute, and Luc Montagnier, of France's Pasteur Institute, each publish the genetic sequence of the AIDS virus. The two are identical
- 1986 : French and American oceanographers find the *Titanic* at a depth of nearly 13,000 feet in the Atlantic
- 1986 : The US space shuttle *Challenger* explodes 73 sec after lift-off
- 1987 : An explosion at an ageing nuclear reactor in Chernobyl, Ukraine, releases radiation into the atmosphere
- 1987 : The US Food and Drug Administration approves the antidepressant Prozac
- 1988 : A *Brief History of Time*, by British physicist Stephen Hawking, becomes a surprise best seller
- 1988 : Harvard receives the first patent for a genetically-engineered animal
- 1988 : The French government approves use of RU 486, the so-called abortion pill
- 1989 : The tanker *Exxon Valdez* runs aground in Alaska's Prince William Sound, spilling 11 million gallons of crude oil. It is the worst oil spill in US history
- 1990 : Formal start of the Human Genome Project, an international effort to map and sequence all human DNA
- 1990 : Launch of the Hubble Space Telescope. It fails to operate properly, but is repaired three years later by space-walking astronauts
- 1991 : Jack Revorkian, also known as Dr. Death, performs his first assisted suicide
- 1991 : Tourists hiking in the Tyrolean Alps discover, protruding from a glacier, the freeze-dried remains of a man who died about 3300 BC
- 1993 : Princeton mathematician Andrew Wiles reveals his proof for Fermat's Last Theorem, which was proposed in the 17th century
- 1993 : Researchers at George Washington University clone human embryos and nurture them in vitro for several days
- 1994 : Comet Shoemaker-Levy 9 crashes into the planet Jupiter
- 1994 : Near France's Ardèche river, explorers discover the Chauvet cave, whose paintings are believed to be more than 30,000 years old
- 1996 : A British government report on "mad cow disease" raises questions about the safety of British beef
- 1997 : NASA reports that a Martian meteorite may contain the remains of ancient microbes. The evidence is later challenged
- 1997 : Scottish researchers clone a sheep named Dolly from cells of an adult ewe
- 1997 : A computer called Deep Blue beats world chess champion Garry Kasparov in a six-game match
- 1997 : NASA's Sojourner spacecraft roams the surface of Mars and sends pictures back to Earth