



THE ENGINEERING INSTITUTE OF CANADA

and its member societies

L'Institut canadien des ingénieurs

et ses sociétés membres

EIC's Historical Notes and Papers Collection

(Compilation of Articles, Notes and Papers previously published as
Articles, Cedargrove Series, and EIC Working Papers)

ENGINEERING HISTORY PAPER #72

“An International Timeline of Inventions, Innovations, Products and Constructions in Engineering”

By Andrew H. Wilson

(produced as Cedargrove Series #48/2018 – Jan 2018)

EIC HISTORY AND ARCHIVES

© EIC 2018

Abstract

The research for this paper was done to provide background information for the author's sesquicentennial project on *150 Years of Canadian Engineering*. It is one of several intended for this purpose.

The paper lists, by year, some of the non-Canadian inventions, innovations, products and constructions associated with engineering that have affected technical, economic and social progress, world-wide, since 1867. It has been highly selective rather than definitive, and has drawn no conclusions of its own.

About the Series

Principally, the Cedargrove Series is intended to preserve some of the research, writings and oral presentations that the author has made over the past half-century but has not yet published. It is, therefore, the modern-day variant of the privately-published books and pamphlets written by his forebears, such as his paternal grandfather and grandmother and his grandfather's brother John.

About the Author

He is a graduate in mechanical engineering and the liberal arts and has held technical, administrative, research and management positions in industry in the United Kingdom and the public service of Canada, from which he retired over 30 years ago.

He became actively interested in the history of engineering on his appointment in 1975 to chair the first history committee of the Canadian Society for Mechanical Engineering, and served both CSME and the Engineering Institute of Canada in this capacity for varying periods until 2003. He has researched, written and edited historical material for both organizations and for the Canadian Society of Senior Engineers. He is also a past president of CSME and EIC.

Introduction

Canada did not play a part in the inventions, innovations, products and constructions - or in the odd disaster - listed in what follows. Other background papers in the author's sesquicentennial project series have the corresponding Canadian information.

The list is selective and limited to a very few entries for each year since 1867...ones that have some importance for the progress of engineering and of society. They have been grouped in accordance with the time periods used in the author's sesquicentennial project. Some, especially those originating in the United States, have influenced engineering activities in this country.

If some well-known inventions/innovations are missing from the list, they may have originated in Canada, or have appeared before 1867.

1867-1918:

1867: Invention of dynamite by Alfred Nobel; Babcock & Wilcox received a U.S. Patent for their first fire-tube boiler

1868: Mendeleev's periodic table of the (then 66) elements published

1869: George Westinghouse granted a U.S. patent for his air brake; on May 10, the last spike was driven on the first U.S. trans-continental railroad, at Promontary Summit, Utah

1870: American William Lyman patented the first rotating wheel can opener

1871: A great fire destroyed Chicago

1872: The overland telegraph linking Australia with England completed; the first stainless steel developed by Woods and Clark in the U.K.; asphalt used in the construction of 5th Avenue, New York

1873: Americans Levi Strauss and Jacob Davis patented blue jeans

1874: The first Remington typewriter manufactured; Eads Bridge, the first major one of steel, built over the Mississippi at St. Louis; French inventor Louis Janin's barbed wire invention patented in the U.S. by Joseph Glidden

1875: Completion of Bazalgette's network of sewers in London, England

1876: Otto's four-stroke, gas-driven, internal combustion engine developed; Alexander Graham Bell and Elisha Gray invented the telephone, for which Bell received the U.S. patent; Emile Berliner patented the microphone; a 150 hp water tube boiler was displayed by Babcock & Wilcox (B&W) at the Centennial Exhibition in Philadelphia

1877: Thomas Edison invented the phonograph

1878: Joseph Swan invented his incandescent light bulb in England

1879 Edison developed *his* incandescent light bulb in America

1880: Oliver Heaviside patented the coaxial cable in the U.K.; the Pelton wheel, an impulse water turbine, patented by L.A. Pelton in the United States

1881: Alexander Kirk built and installed the first 1800 ihp triple expansion marine steam engine at Glasgow, Scotland; arc welding demonstrated for the first time by Russian Nikolai Benardos at the Paris Exhibition of Electricity; also exhibited was an American electric tricycle; instant coffee was patented in France by Alphonse Altais

1882: Edison opened the Pearl Street Power Station to supply electricity in New York, the steam being raised by four B&W boilers; the fourth (Douglass) Eddystone lighthouse completed in the English Channel; the Gotthard Rail Tunnel completed in the Alps, then the longest in the world

1883: The Roeblings' Brooklyn Bridge opened in New York; the Maxim machine gun developed in England

1884: Charles Parsons built his first steam turbine in England

1885: German Gottlieb Daimler built the first motorcycle, and Karl Benz a prototype of his automobile; William Jenney erected the first skyscraper, the nine-storey Home Insurance Building in Chicago, using an all-steel frame (the other essential component of the skyscraper, the elevator, dates back to 1852); transformers became essential for use in AC/DC power systems

1886: Alternating current electrical power systems came into use, thanks principally to Nicola Tesla and George Westinghouse; Americans Josephine Cochrane and George Butters patented the first commercially successful automatic dishwasher; the first modern oil tanker, the SS *Zoroaster*, owned by Alfred Nobel's brother Ludvig, was launched in Sweden; the Severn River Tunnel completed in the U.K.

1887: The Eiffel Tower opened in Paris; the first electric streetcars built in the U.S. with (Sprague) trolley poles

1888: Edward Butler, in England, built a three-wheeled, gas-driven vehicle, with a four-stroke engine that had coil ignition, rotary valves and a float-fed carburetor; John Boyd Dunlop, a Scot, invented the pneumatic bicycle tire

1889: S.Z. de Ferranti designed the first AC generating station in the U.K.

1890: The Forth (cantilever, railway) Bridge completed in Scotland; the second phase of the London Underground Railway opened

- 1891: Thomas Edison invented motion pictures; a three-phase electric induction motor was designed by Russian engineer Mikhail Dolivo-Dobrovolsky; the Pike's Peak railway completed in Colorado
- 1892: American Jesse W. Reno invented the 'inclined elevator,' better known as the escalator; the first practical application in the U.S., by Westinghouse, of the electric induction motor
- 1893: Diesel's high-compression internal combustion engine developed in Germany; a dishwasher demonstrated at the Chicago World's Fair
- 1894: London's Tower Bridge opened; the Bunker Hill Bridge (in 2017 the last remaining example of Haupt truss design) built in North Carolina
- 1895: German engineer Wilhelm Roentgen discovered X-rays; Gulielmo Marconi, in Italy, sent and received the first radio signals; the design of the Zeppelin airship patented in Germany; the first hydro-electric power plant opened at Niagara Falls, New York, by Tesla and Westinghouse
- 1896: Charles King drove the first automobile in the city of Detroit; Henry Ford built his first vehicle, the quadricycle
- 1897: Parsons' ship *Turbinia*, demonstrated at the Spithead Review, opened up a new era of marine propulsion; the first Stanley *Steamer* motor car appeared (with underseat fire-tube boiler) in the U.S.; J.J. Thompson, at Cambridge, England, discovered the electron
- 1898: (The original) Rheinfelden hydro plant in Germany began operations; the Curies discovered radium and polonium
- 1899: Miller Reese Hutchison received a U.S. patent for a hearing aid; Jugner, in Sweden, invented the nickel-cadmium battery
- 1900: The first electric washing machine in use in the United States; Willis Carrier designed one of the first air conditioning machines; R.E. Olds opened the first assembly-line automobile factory in Lansing, Michigan; Eastman Kodak introduced its *Brownie* camera
- 1901: The gigantic *Spindletop* oil strike occurred in Texas and helped seal the dominance of gasoline as the preferred automobile fuel, over steam and electricity; American C.L. Horrock developed the first 'telescope' shock absorber for automobiles; Englishman H.C. Booth received a patent for an electrically-driven, suction-operated 'vacuum' cleaner; U.S. patent granted to Frank Hornby for the meccano set
- 1902: The Armour Building in Kansas City became the first office building to have air conditioning with each room controlled individually; the original Aswan Dam built on the River Nile; France's Louis Renault developed drum brakes for his automobiles; Pitney Bowes postage meter patented in the U.S.;
- 1903: The Wright Brothers flew a heavier-than-air aircraft at Kittyhawk, North Carolina; the marketing of

Harley-Davidson motorcycle began at Milwaukee, Wisconsin; Dutch doctor Willem Einthoven built the first practical ECG machine in Germany

1904: The Trans-Siberian Railway completed across Russia; Ambrose Fleming, in Britain, invented the thermionic diode; Benjamin Holt, in California, developed the first successful steam-driven, crawler tractor - the caterpillar (which led to the founding of the Caterpillar Tractor Company in 1925); Prandtl presented his 'boundary layer' theory, important for aeronautics and fluid flow generally

1905: Einstein published his special theory of relativity

1906: The first air conditioned hospital opened in Boston; SOS became the international distress signal; the *Dreadnought* battleships brought into service in Britain by Admiral Fisher; American Lee De Forest invented the triode amplifier

1907: Norwegian-American Ole Evinrude designed and built a simple, detachable, reliable outboard motor for small boats; Belgian Leo Baekeland developed the first phenol-formaldehyde, mouldable 'plastic' - bakelite; the lighted New Year's Ball fell for the first time at Times Square, New York,

1908: The first of the mass-produced Ford *Model T* rolled off the production line; the Middle East oil age began with a gusher from the Masjid-i-Suleiman well; the first solar collector was developed in the U.S.; the Makotote Railway Bridge opened in New Zealand; Pyrex glassware was manufactured by Corning Inc.

1909: The Haber-Bosch process for 'fixing' nitrogen was developed; Blériot flew the English Channel in an aeroplane; the first synthetic rubber produced in Germany

1910: The first aircraft take-off from a ship accomplished by the U.S. Navy; the RMS *Olympic* passenger liner (a *Titanic* sistership) launched at Belfast; the start up of the Alfa Romeo racing car company in Italy; manufactured asphalt came into use for paving roads; the first domestic refrigerator appeared in the U.S.

1911: The first Indy-500 motor race held; Charles Kettering in the U.S. developed the automobile electric starter; the Geiger counter invented in England by a German nuclear physicist, J.W. Geiger; Kamerlingh-Onnes discovered superconductivity; C.T.R. Wilson developed his 'cloud chamber' - the first particle detector; French engineer Eugène Freyssinet built a three-span prestressed concrete bridge; cellophane first manufactured by Swiss chemist Jacques Branderberg

1912: The RMS *Titanic* sank in the North Atlantic, off Newfoundland

1913: Stainless steel further developed in England by Harry Brearley, while studying how to eliminate rust in steel; Ford started up the first moving assembly line for automobiles; the Haber-Bosch process for making ammonia developed in Germany; Austrian engineer Victor Kaplan developed the water turbine that bears his name; the first dishwasher marketed in the United States

1914: The Panama Canal opened; Dodge, in the U.S., built the first car body of steel; World War I began and contributed to the advancement of engineering generally, and weapons development (including the caterpillar-tracked tank and poison gas), transportation and aeronautics in particular;

1915: The first ASME Boiler and Pressure Vessel Code published; the catalytic cracking process first used with heavy crude petroleum in an American refinery

1916: The first gypsum-based Sheetrock drywall used in the United States; Einstein published his general theory of relativity; the first unmanned aerial vehicles (UAVs, drones) developed in Germany

1917: Production began of the inexpensive Fordson tractor, by Henry's company; E.H. Armstrong invented the superheterodyne circuit that improved radio signal reception; Rutherford, at Cambridge, discovered the proton

1918: Airmail service was inaugurated in the United States; pulverized coal used for the first time in the U.S. as boiler fuel; World War I ended...but the flu' pandemic began

1919-1945

1919: Although they had been invented earlier, the general installation of rotary dial phones began; the chlorination of urban water supplies began in the United States; two U.S. airmen flew the Atlantic with two stops along the way, several months before the non-stop Alcock and Brown flight

1920: The yellow warning light added to the red and the green in U.S. traffic lights

1921: Crop-dusting by aeroplane began; 'knock' eliminated from gasoline engines

1922: The American *Duesenberg* automobile was the first to have four-wheel hydraulic brakes; the original Rose Bowl stadium opened at Pasadena

1923: The first successful flight of the Cierva autogyro; Arthur Scherbius in Germany developed the *Enigma* coding machine (used in World War II); Freyssenet built significant thin-shell airship hangars at Orly Airport in Paris

1924: Clarence Birdseye received a patent for a machine that froze fish effectively (but it was not until 1930 that frozen food 'took off')

1925: John Logie Baird, in Britain, transmitted the first recognizable TV image; lighter air-cooled aircraft engines made bigger, faster planes possible; the Fischer-Tropsch process for making hydrocarbons developed in Germany; the first all-welded oil pipeline over 200 miles long was built between Texas and Louisiana

1926: Robert Goddard launched the first liquid-fuelled rocket; the American *Pierce Arrow* was the first

production car to have power steering; demonstrations of radio-controlled cars took place in New York City and elsewhere in the United States; the first car named for Walter Chrysler was made in the U.S.

1927: The last *Model T* Ford rolled off the production line; the 'iron lung' invented by Drinker and Shaw at Harvard; Lindberg flew the Atlantic non-stop from New York to Paris; the Holland Tunnel completed between New Jersey and New York; Hollywood produced the first 'talkies'; Maytag washers were equipped with agitators

1928: Alexander Fleming discovered penicillin; Charles F. Jenkins in the United States received the first licence for an experimental TV station; Baird produced crude colour images via television; Link introduced his 'trainer' - an electromechanical flight simulator

1929: The Ambassador Bridge opened between Detroit and Windsor; Swiss engineer Andreas Stihl received a patent for his gas-powered, two-stroke, air-cooled chain saw

1930: Farnsworth received a U.S. patent for his contributions to the beginnings of TV; Carothers, at DuPont, developed synthetic rubber (neoprene); the Chrysler Building opened in New York

1931: A heat pump air conditioning system installed in a Los Angeles office building; the Caterpillar Company marketed its diesel tractor; Mercedes-Benz, in Germany, introduced the first automobile with an independent front suspension system; the Empire State Building completed in New York; the first air conditioning heat pump system installed in California; the British adopted '999' as their emergency telephone number, the first such world-wide

1932: American Amelia Earhart flew solo across the Atlantic (from Harbour Grace, Nfld.) in a Lockheed *Vega*; tractors with rubber wheels first appeared in the United States; the Sydney Harbour Bridge was completed in Australia; Cockroft and Walton 'split' the atom at Cambridge; and the first 20-mile section of the new German *autobahn* opened

1933: The sale of 'sliced bread' became commonplace; FM radio developed by E.H. Armstrong in the U.S.; the Tennessee Valley Authority, a federal economic planning agency, established to manage electric power generation and distribution, water management and economic development; polyethylene accidentally discovered by Fawcett and Gibson at ICI in England

1934: Installation of first 'fax' machine that used the telegraph to send 'wire' photographs; in France, Citroën sold the first successful mass-market front-wheel-drive cars

1935: Rural electrification began in the United States; the Hoover Dam was built on the Colorado River in Nevada to supply both water and electricity; the first of thousands of DC-3 aircraft flew (and a few are still flying today); a trans-pacific air mail service was inaugurated by Pan American Airlines; Robert Watson-Watt, in the U.K., developed the first practical radar; fibreglas patented by Owens-Corning in the United States; Carothers at DuPont developed nylon

1936: The 80,000 ton RMS *Queen Mary* was launched at Clydebank, Scotland

1937: The development of the first aircraft jet engines by Whittle in England and von Ohain in Germany; the airship *Hindenburg* exploded during its arrival at Lakehurst, N.J., effectively ending this form of travel; the Golden Gate Bridge opened at San Francisco, as was Route 66 from Chicago to Los Angeles; Westinghouse, in the U.S., built the first Van de Graaf particle accelerator

1938: The first window air conditioner was marketed in the U.S.; Ray Plunkett accidentally discovered teflon at DuPont; the first small scale oil wells began operating in the Gulf of Mexico; Chester Carlson invented xerography in the United States

1939: Laszlo Biro perfected the pen that bears his name; the first automobile air conditioning system installed (in a Packard); the first electronic computer, the Atanasoff-Berry, developed; American and British airlines inaugurated trans-pacific passenger service; air conditioning added to Packard and Nash cars in the U.S.; Sikorsky, in the United States, developed the first practical single rotor helicopter; in France, Citroën built prototypes of its 2 horse-power car (which became famous post-World War II); in Germany, the development of the flying bomb (V-1, in 1944) began; World War II began in Europe and, until 1945, contributed to the advancement of engineering generally, and especially to weaponry, aeronautics and communications

1940: A working version of the cavity magnetron developed at the University of Birmingham, England; the ubiquitous and long-serving *Jeep* - later, the American 'workhorse' of WW II - was designed; automatic transmission for cars introduced; Oldsmobile introduced the first mass-produced car with fully automatic transmission; the Tacoma Narrows Bridge was opened, and was destroyed months later by the wind; the Rockefeller Center was completed in New York

1941: The Grand Coulee Dam on the Columbia River in the United States completed; the first chemical recovery boiler was installed by Babcock & Wilcox; Whinfield and Dickson of ICI in England patented the first polyester fibre; the U.S. and Japan entered World War II

1942: The U.S.-Canada Alaska Highway began operation; the first self-sustaining nuclear reaction established by Fermi and his colleagues at Chicago; the Manhattan atomic bomb project began, and the Oakridge National Laboratory was established

1943: The Hanford, Washington, nuclear plant was established for processing plutonium for the atomic bombs; *Colossus*, a first generation vacuum-tubed programmable logic calculator, was built by Tommy Flowers in England for wartime code-breaking; the *Bombe*, an electro-magnetic device, also built by Alan Turing and other cryptologists at Bletchley to decipher messages from the German *Enigma* machines

1944: The last British battleship, the *Vanguard*, was launched on Clydeside; Werner von Braun, in Germany, used technology developed by Robert Goddard to design and build the V-2 rocket (a form of drone) used against the British in World War II; Johannes Croning, also in Germany, invented shell moulding (metal casting, using a sand-resin mixture)

1945: The dropping of the first two atomic bombs by the United States effectively ended World War II; Turing in Britain and von Neumann in the U.S. worked independently on stored-program computers; the first successful kidney dialysis machine built in Holland;

1946-2017

1946: The ENIAC computer, developed by Mauchly and Eckert in the U.S., began operations

1947: Shockley, Bardeen and Brittain's point-contact transistor developed at Bell Labs; Howard Hughes' huge seaplane *Spruce Goose* made its one and only flight; the first microwave ovens marketed; Chuck Yeager broke the sound barrier in a Bell X-1 aircraft; the first top-loading automatic washing machines marketed by Whirlpool and General Electric in the U.S.

1948: The basic oxygen steel-making process developed by Swiss engineer Robert Durrer; Williams and Kilburn at the University of Manchester built a 'baby' stored-program computer

1949: The first jet-powered commercial aircraft, the de Havilland *Comet*, flew; the first telephone pager was patented in the U.S. by Alfred Gross; the slipforming technique was first used in heavy concrete construction in the U.S.; American engineer James Wright mixed silicone oil and boric acid and the product was commercialized as the toy, silly putty

1950: The Dutch began to build the Delta Works to control and contain the North Sea; the pressurized water nuclear reactor designed by Babcock & Wilcox in the U.S. was subsequently used in power plants world-wide; Wacker, in Germany, was the first company to commercialize silicones

1951: Eckert and Mauchly designed the UNIVAC computer, the first to use magnetic tape instead of punched cards; the power steering of cars introduced; direct long-distance telephone dialling began; the first hard rock tunnel-boring machine was built in the United States by James S. Robbins

1952: Navigation opened on the Volga-Don Canal joining the Caspian and Black Seas; the first thermonuclear weapon exploded at Los Alamos, New Mexico

1953: The four-wheeled Zamboni ice-resurfacing machine patented in the U.S.

1954: The first U.S. coast-to-coast colour TV program transmitted; the first transistorized electronic calculator (computer) produced by IBM; Texas Instruments introduced the first all-transistor radio; Charles H. Townes invented the maser

1955: The first hydrogen bomb detonated at Bikini Atoll in the Pacific; the sea trials of the nuclear submarine, USS *Nautilus*, took place; the Salk anti-polio vaccine was developed; Christopher Cockerell built his prototype hovercraft; IBM engineers designed the first disc drive for random-access storage in

computers; silicon began to replace germanium as the preferred electronic semiconductor; nuclear plants supplied power in several parts of the United States; Arco, Idaho, became the first town to have all its electrical needs supplied by nuclear power; the first jack-up mobile offshore oil drilling rig used by Zapata Oils (a G.H.W. Bush company) in the Gulf of Mexico

1956: Submarine cable-based transatlantic telephone service began; the Lake Pontchartrain Causeway completed in Louisiana; the hard drive developed by IBM; TV remote control invented; the first international conference on artificial intelligence held in the United States

1957: The first Russian earth satellite, *Sputnik I*, launched; the first nuclear power reactor in the United States went critical at Shippingport, PA; FORTRAN, a programming language, became commercially available (ALGOL followed in 1958 and COBOL in 1959); this was the year that more international travellers went by air than went by ship; the International Atomic Energy Authority established by the U.N. at Vienna; float glass developed by Pilkington and Bickerstaff in England; the Salk polio vaccine developed in the U.S.

1958: Kilby, in the U.S., invented the integrated circuit; the Haloid Company (now Xerox) began marketing its photocopier, invented by Chester Carlson; Roger Bacon, at Union Carbide in Cleveland, developed the first high-performance carbon fibres; *Explorer I*, the U.S.'s first earth satellite, launched; ARPA was created by the U.S. Department of Defence as a research-promoting unit in response to Russia's Cold War activities

1959: The Noyce integrated circuit invented; the first ultrasound image of an infant *in utero* seen on a computer screen by Dr. Ian Donald at the University of Glasgow; New Zealand opened the world's first large geothermal electrical generation plant; Nils Bohlin, in Sweden, patented the first three-point car seat belt; Russian spacecraft *Luna 3* reached the moon and sent back pictures of the dark side of it

1960: 'The Pill' contraceptive was licensed in the U.S.; Hashimoto's practical answering machine went on sale in the U.S.; the first laser built by T.H. Maiman, based on work by Townes and Schawlow; the first teflon-coated non-stick frying pans marketed in the U.S.; Ohio State University 'landed' a project to develop driverless cars; the Digital Equipment Company in the United States introduced its PDP series of (non-air-conditioned) computers intended principally for the scientific and engineering markets; the first totally-internal pacemaker was developed at the University of Buffalo; the RCA-designed weather satellite *Tyros I* launched; Piccard's Swiss-designed, Italian-built bathyscaphe *Trieste* reached the deepest known part of the Pacific Ocean near Guam

1961: Russian Yuri Gagarin was the first human to fly in space; American Alan Shepherd also flew in space in the spacecraft *Freedom 7*; the French and British electrical grids were connected by a submerged cable in the English Channel; the IBM *Selectric* typewriter was marketed; long-distance telephone dialling began in the United States

1962: The first light-emitting diodes (LEDs) marketed; U.S.'s first communications satellite, *Telstar I*,

began transmitting telephone, telecast and data signals; the field effect transistor developed by RCA in the U.S.; the Sikorsky S-64 *Skycrane* helicopter first flew; the NS *Savannah* commissioned; John Charnley developed the first successful artificial hip replacement procedure

1963: Valentina Tereshkova is the first woman to fly in space; the touchtone phone introduced in the U.S.

1964: The first all-transistor pocket calculators appeared on the market; the PDP-8, built by DEC, became the world's first mini-computer; Kemeny and Kurtz developed the BASIC programming language in the U.S.; Russia completed the first large-scale magnetohydrodynamics plant for the production of electricity; the *Shinkansen*, the first Japanese 'bullet train' began service; U.S. National Academy of Engineering established; the Forth (suspension, road) Bridge was completed in Scotland; the Verrazano Narrows Bridge completed across the entrance to New York's harbour

1965: The first fibre optic data transmission system demonstrated by Borner in Germany; Du Pont engineer Stephanie Kwolek developed the synthetic fibre, kevlar; American Motors in the U.S. introduced automatic push-button cruise control in its large-sized cars; the *Gateway* catenary arch was completed at St. Louis, MO

1966: U.S. Spacecraft *Surveyor 1* touched down on the moon; the first Russian *Soyuz* spacecraft launched; Russian and American spacecraft soft-landed on the moon; full colour TV available on all three major networks in the U.S.; Xerox manufactured the first practical 'fax' machine; the first football field (in Houston, Texas) covered by artificial turf; the British developed an electronic fuel injection system for cars

1967: NASA first used the *Saturn* space rocket, designed by von Braun and Rudolph; the first 4-computer ARPANET packet switching network began operations; Alan Shugart at IBM invented the floppy disc; the first wall unit microwave ovens marketed; the first cash-dispensing automated teller machines installed in England; the first successful heart transplant performed by Dr. Christiaan Barnard in South Africa

1968: The original computer 'mouse' developed by Douglas Engelbart at Stanford Research Institute; the first '911' call was made in the U.S.; Jack Kilby invented the first hand-held electronic calculator; the Apollo 8 spacecraft took humans beyond the influence of the earth's gravity for the first time

1969: The lunar module of the U.S. spacecraft *Apollo 11* landed on the moon, with Armstrong and Aldrin on board; R.H. Dennard invented the dynamic random access memory, a critical computer component; the Boeing Company's wide-bodied, turbo-fan-powered 747 aircraft flew commercially; the Internet was 'born' when four ARPANET computers were linked; the term *mechatronics* coined in Japan to cover electro-mechanical control systems

1970: The Aswan High Dam (and Lake Nasser) completed on the River Nile; the first CD-ROM patented by J.T. Russell of the U.S. Battelle Laboratory; air bags used in cars for the first time; three Corning Glass Company researchers developed a commercially successful fibre optic cable

1971: The Intel Company introduced the 'computer on a chip'; the compact answering machine was marketed; Tomlinson developed e-mail (which needed the PC for wider use); Soviet *Salyut 1* space station was placed in orbit; the *Tokamak* nuclear fusion machine operated; the first clinical CAT-scan performed at a London hospital

1972: Maxime A. Faget, while at NASA, patented the design of a reusable spacecraft, which evolved into the Space Shuttle; the first waste-to-energy boiler installed by Babcock & Wilcox in the United States; the Transamerica Pyramid Building completed in San Francisco; the VCR, designed originally by Phillips, was marketed; the home video game craze began

1973: U.S. space station *Skylab* placed in orbit; the supersonic *Concorde* made its first commercial transatlantic flight; Martin Cooper of Motorola made the first portable cellphone call; the two towers of the World Trade Center in Lower Manhattan were completed; the U.S. Department of Defence launched its GPS positioning system; the Sydney Opera House opened

1974: Norio Taniguchi in Japan was the first to use the term *nanotechnology* in a conference paper; the *Intel 8080*, an eight-bit microprocessor, made by Intel in the U.S., and made the first PC's possible; the Sears Tower completed in Chicago

1975: Loire River Bridge (longest cable-stayed to date) completed in France; the Suez Canal reopened to shipping (after the 1967 War); Britain's North Sea oil flow began from the Argyll Field; the *Altair 8800*, the first home computer, marketed to hobbyists and began the microcomputer (PC) revolution; a prototype electronic camera was made by Steven Sasson at the Eastman Kodak Company

1976: The British-French supersonic *Concorde* aircraft began commercial service between London, Paris and New York; the first large *Cray* computer installed

1977: The first of six Space Shuttles built; fibre-optic telephone traffic began

1978: Soyuz 6, 26 and 27 were the first three spacecraft to be linked together in space; the USSR grounded further passenger flights of its supersonic TU-144 aircraft (although it carried freight for several more years); Norita International airport at Tokyo opened; the Sony *Walkman* portable audio cassette player designed in Japan; the second 'oil shock' began

1979: The Three Mile Island reactor accident happened in the U.S.; Moggridge, in England, designed the first laptop computer; Matthews invented 'voicemail' in the U.S.; N.V. Philips of Holland demonstrated the CD audio player; Bricklin and Frankston introduced the VisiCalc spreadsheet for the Apple II computer

1980: Steve Jobs and Steve Wozniak took the Apple Computer Company public; the Sony *Walkman* marketed; the Gotthard road tunnel - then the longest - opened in the Alps

1981: The first Space Shuttle mission flown; the IBM personal computer, using the MS-DOS operating system designed by Microsoft, introduced; Kodama, in Japan, began work on 3D printing; IBM marketed its home computer

1982: River Thames movable flood barrier completed; the Commodore 64 low-end computer introduced at a Las Vegas exhibition; the first commercial MRI machine put on the market by EMI in the U.K.; American Barney Clark received a surgically implanted *Jarvik 7* artificial heart

1983: The 'Internet' of linked computer systems became ready for use; Sun Microsystems introduced its UNIX workstation; solar electric generating plants developed in California; the Itaipu hydro dam completed on the Brazil/Paraguay border

1984: The first cell phones became generally available; the Bank of America Center completed at Houston, Texas

1985: Microsoft introduced its operating software, Windows 1.0; antilock braking systems became available on American cars

1986: The U.S. Space Shuttle *Challenger* destroyed on lift-off; the Rutan/Yeager *Voyager* lightweight aircraft circumnavigates the world non-stop in 9 days; the Russian space station *MIR* and the American *Skylab* launched into a low earth orbit; the Chernobyl nuclear accident happened; the Hong Kong & Shanghai Bank headquarters completed in Hong Kong

1987: The Montreal Protocol international agreement phased out CFC refrigerants

1988: The *Alpha Piper* oil rig exploded in the North Sea; the first trans-atlantic fibre optic cable installed

1989: The massive oil spill by the *Exxon Valdez* in Alaskan waters; experiments at Carnegie Mellon University pioneered techniques for steering autonomous vehicles

1990: The World-Wide Web invented by Tim Berners-Lee; the Hubble optical telescope launched into space

1991: The digital camera developed by Kodak

1992: Text messaging became possible

1993: Commercial use of 3D printing began in the United States; the U.S. DoD's GPS positioning system became fully operational; the 'rebirth' of work on artificial intelligence

1994: Voice-over Internet Protocols (VoIP) introduced; the Channel Tunnel opened between England and France; the Kansai Airport opened at Osaka, Japan

1995: The NASA spacecraft *Galileo* reached the planet Jupiter; U.S. Space Shuttles docked with Russia's *MIR* space station; the GPS system in full operation

1996: First version of the JAVA programming language released; the first trans-pacific fibre optic cable installed

1997: Toyota *Prius* hybrid car debuted; the Tsing Ma Bridge completed at Hong Kong

1998: The building of the International Space Station (ISS) began

1999: Construction of London's Millennium Dome completed; only 3% of the America's work force remained in agriculture; the first two modules of the ISS joined in orbit; the Petronas Towers completed at Kuala Lumpur; the Jin Mao Tower completed at Shanghai

2000: The first crews manned the ISS; GPS systems were applied to private cars etc.; more than 1 billion people worldwide used super-lightweight cell phones; a *Concorde* accident in July killed everyone on board and suspended flights for over a year; new semiconductor switches enabled long-range DC transmission; the Øresund tunnel/island/bridge opened between Denmark and Sweden; London's Millennium Pedestrian Bridge opened - and closed for modifications a few days later

2001: The World Trade Center in New York and the Pentagon in Washington attacked from the air on September 11 by Islamic terrorists; Apple introduced the iTunes mobile device to download, play and store digital music files; its *iPod* marketed

2002: The Alqueva Dam in Portugal began filling the largest artificial lake in Europe; the European Space Agency's largest satellite to date, the *Envisat*, launched; the world's tallest outdoor elevator went into service at Bailong, China; the rotating lift lock was put into service at Falkirk, Scotland; the private SpaceX Company was founded by Elon Musk to build advanced rockets, spacecraft and other devices

2003: The U.S. Space Shuttle *Columbia* was destroyed on re-entry; the trans-atlantic supersonic *Concorde* air service terminated; Venice, Italy, began building a series of flood gates at three of its lagoon inlets; China became the third nation to put a human being into earth orbit

2004: The cable-stayed Millau Viaduct opened in France

2005: Hurricane *Katrina* devastated New Orleans and the Gulf of Mexico; the Turning Torso building opened at Malmö, Sweden

2006: Quinghai-Tibet high altitude railway began operating

2007: Apple's *iPhone* marketed; the total length of high-pressure transmission pipelines around the world was 3.5 million km, of which 64% carried natural gas, 19% petroleum products, and 17% crude oil

2008: The Large Hadron Collider was completed at CERN, on the French-Swiss border; the Three Gorges Dam completed on the Yangzee in China

2009: The Royal Caribbean Line's 230,000 gross tons cruise ship *Oasis of the Seas* built to carry 6,000 passengers

2010: The spectacular, two-month-long rescue of 33 trapped miners in Chile successfully completed; the *Deepwater* oil rig disaster happened in the Gulf of Mexico; the world's tallest building, the Burj Kalifa, finished in Dubai; Apple's *iPad* marketed; Holland's Delta Works series of dams and barriers against the North Sea completed; the Olympic (Bird's Nest) stadium opened at Beijing

2011: The ISS completed; the Quingdao-Haiwan Bridge completed in China; Boeing's 747 *Dreamliner* went into service; the last Space Shuttle mission flown to the ISS

2012: The Skytree Tower completed in Tokyo; the cruise ship *MS Costa Concordia* sank after smashing on a rocky ledge next to Giglio Island off the Tuscan coast - its subsequent salvage being a significant piece of engineering; the Aighai Suspension Bridge opened in Japan; the rover *Curiosity* landed on Mars

2013: The Marmaray Tunnel opened at Istanbul, joining Europe to Asia; the new One World Trade Center topped out in New York

2014: The Ebola world health emergency began in West Africa; the *Costa Concordia* refloated and towed to a scrap yard; Apple introduced iPhones 6 and 6+, and the Apple watch; the European Space Agency's spacecraft *Rosetta* ended a 10-year journey to rendezvous with a comet

2015: NASA's New Horizons spacecraft ended a nine-year journey to Pluto; NASA's reconnaissance orbiter found water on Mars; SpaceX launched a reusable rocket into orbit, and recovered it; the Paris Climate Accord approved

2016: The Apple Computer Company took in \$215bn in revenue and spent \$10bn on R&D; the Zhangjiajie glass bridge opened in China; the Gotthard Base (rail) Tunnel - the longest and deepest - opened in the Alps; the extension to the Panama Canal opened

2017: The cable-stayed third, second road, Forth Bridge opened at Queensferry; Waymo (a Google offshoot) began testing truly driverless cars; self-driving trucks (with a monitoring human in the cab) carried loads on highways from Texas to California; the world's longest pedestrian suspension bridge opened near Zermatt, Switzerland; also in Switzerland, the steepest funicular railway in the world went into service near Lucerne; the 214,000 gross tons, South Korean-built, Danish-owned container ship *Madrid Maersk* entered service

What does the immediate future hold? For example....continuation of the development of driverless cars, the Internet of Things, artificial intelligence, quantum computing and 3D printing applications, more nanotechnology, biomedical and space innovations...

Sources

Many of the achievements listed were gleaned from newspapers, magazine articles and wikipedia.

Other sources included:

Constable and Somerville, *A Century of Innovation*, Joseph Henry Press, Washington, D.C., 2003

Craughwell, *30,000 Years of Inventions*, Black Dog and Leventhal Publishers Inc., 2012

Steam: Its Generation and Use, the Babcock & Wilcox Company, Barberton, Ohio (J.B. Kitto, technical editor), 41st edition

<http://www.greatachievements.org>

<http://www.discoverychannel.com.au/images/the-history-of-skyscrapers>

<http://www.internetociety.org/internet/history-internet/brief-history-internet>

<http://wonderfulengineering.com/10greatest-modern-day-engineering-marvels>

<http://www.nachi.org/history-of-concrete.htm>