

fact  scope

MACHINES & INVENTIONS



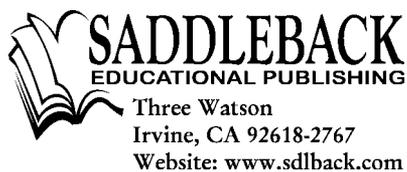


fact scope

Machines & Inventions



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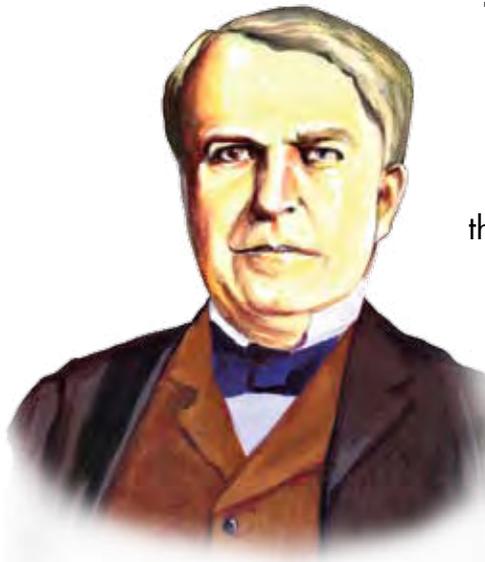
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Machines and Inventions



An invention is the creation of something new. Most of the early inventions were a result of necessity. Many modern inventions are a result of previous inventions, innovations, or additions to existing devices. Inventions like machines have changed the way people live and do work.

Machines are devices that assist in human tasks.



Thomas Edison

Thomas Edison had 1,093 patents. These included patents for the light bulb, electric railways, and the movie camera.

On his death in 1931, he held 34 patents for the telephone,

141 for batteries, 150

for the telegraph, and 389 patents for electric light and power.

First Rickshaw

An American Baptist minister, Jonathan Scobie, invented the first rickshaw in 1869. He built the rickshaw or *jinrikisha* to transport his invalid wife around the streets of Yokohama in Japan.

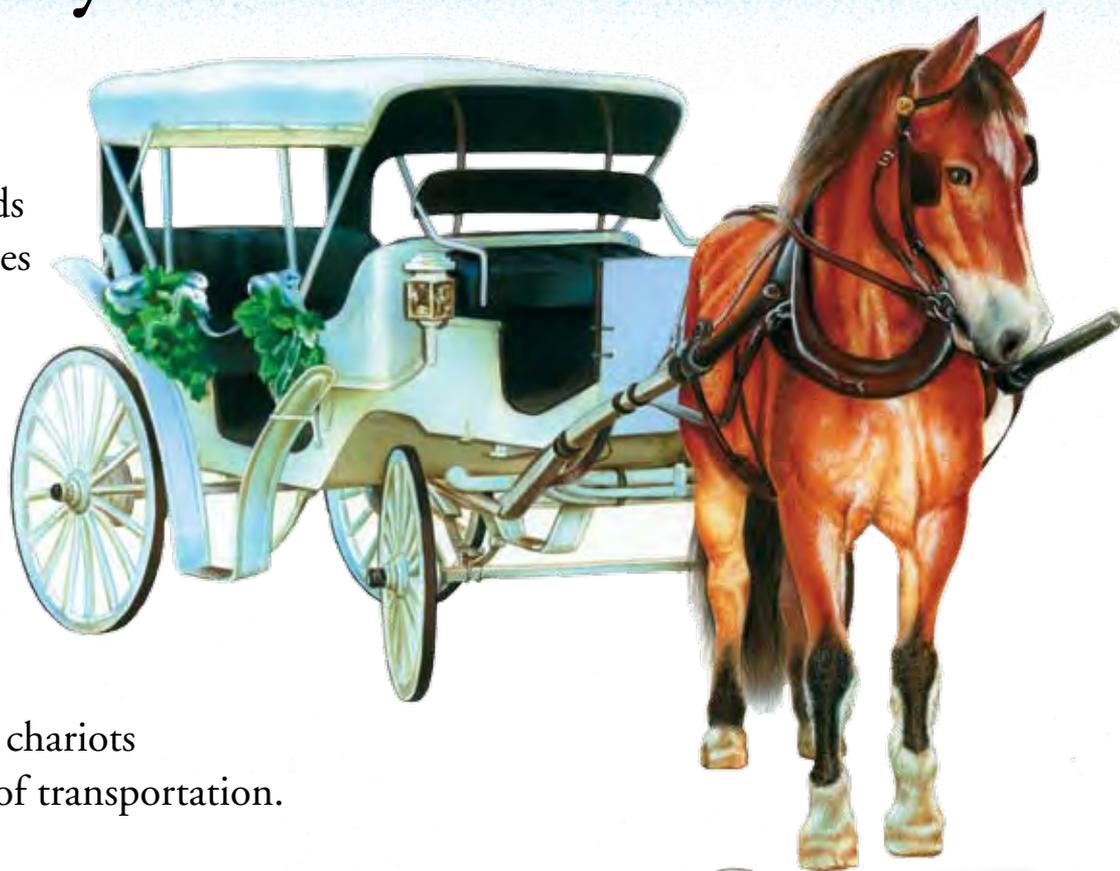
fact scope

- Any idea that can be patented is called an invention.
- Patents are documents, which publicly disclose an invention.
- Patents provide the inventor legal protection against unauthorized use.
- In 1894 Lord Kelvin predicted that radio had no future; and that the heavier-than-air flying machines were an impossibility.
- In 1876 Alexander Graham Bell registered his patent for the telephone one hour before Elisha Gray patented his design. The patent was finally given to Bell.



History of Inventions

Humans have been inventing machines for thousands of years. Early machines include the wheel, plough, catapult, and writing tools. The invention of the plough gave rise to early civilizations. The invention of the wheel led to the invention of carts and chariots and the development of transportation.



Accidental Discovery

Dutch eyeglass maker Hans Lippershey accidentally discovered the telescope in 1698. Lippershey was looking through two lenses, one held in front of the other, when he realized that it was producing magnified images.

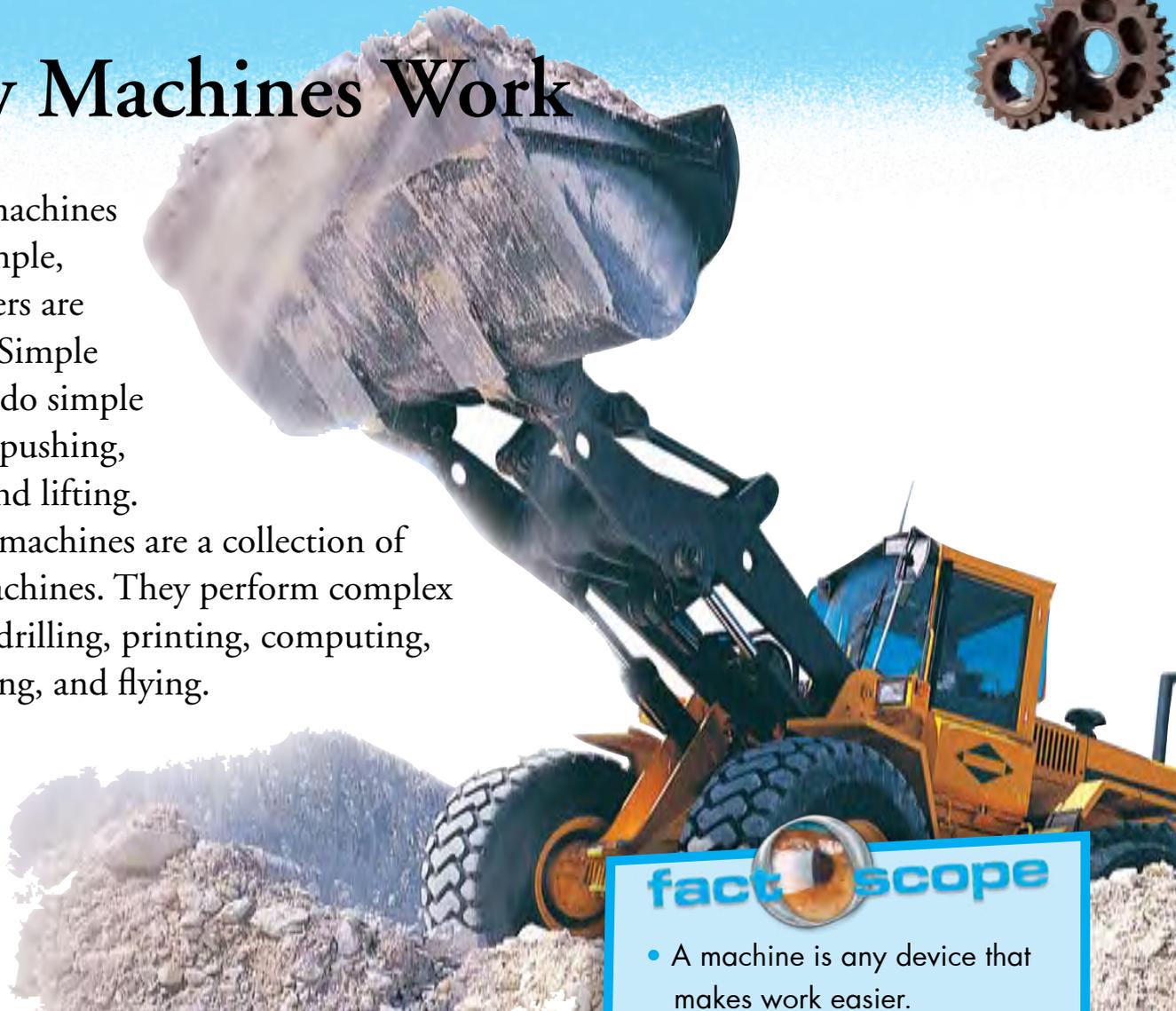
fact scope

- The electric battery was invented in Italy by Alessandro Volta in 1800.
- Domestic gas lighting was invented in England by William Murdoch in 1800.
- American inventor, Oliver Evans, designed the first refrigeration machine in 1805.
- The spectroscope was invented in Germany by Joseph von Fraunhofer in 1814.
- The stethoscope was invented in France by René Laënnec in 1819.
- Waterproof cloth was invented in Scotland by Charles Macintosh in 1823.

How Machines Work



Some machines are simple, while others are complex. Simple machines do simple work like pushing, pulling, and lifting. Complex machines are a collection of simple machines. They perform complex tasks like drilling, printing, computing, transporting, and flying.



Wheel and Axle

A wheel and axle is really two machines in one because each can be used in different ways.



Pulley

The pulley is actually a wheel and axle with a rope or chain attached to it.

fact scope

- A machine is any device that makes work easier.
- Simple machines are simple because most have only one moving part.
- Some simple machines are so simple that they do not have any moving parts at all!
- Simple machines put together make a complex machine, like a lawn mower or car.
- In science, "work" means making something move.
- There are only six types of simple machines. Each can be used in many different ways.
- The gear is sometimes called a simple machine, but it is really just a wheel with teeth.
- The inclined plane is one of the simplest of machines.



Wheel

The invention of the wheel forever changed the way humans would travel. The wheel is believed to have been invented in Asia around 8,000 years ago. The oldest known wheel, however, was discovered in a mosaic in Sumer, in present day Iraq. Since then the wheel has undergone many changes and found many uses.



fact scope

- Wheeled vehicles were probably developed in Sumer during the Uruk period, as early as 3000 BCE.
- The first wheels were solid wooden disks; spoked wheels were invented later.
- Wheels with axles were invented in Mesopotamia.
- By 1500 BCE, Egyptians had begun to use vehicles with spoked wheels. Egyptian chariots became lighter, stronger, and faster.

How the Wheel was Invented

Stage 1: Humans placed rollers beneath heavy objects to move them more easily.

Stage 2: Logs or sticks were placed under the heavy object to drag it. This was the invention of the sledge.

Stage 3: Humans combined round logs and the sledge. They used several logs or rollers in a row.

Stage 4: The sledge became grooved with use. Humans discovered that the deep grooves actually helped the sledge to move a greater distance.

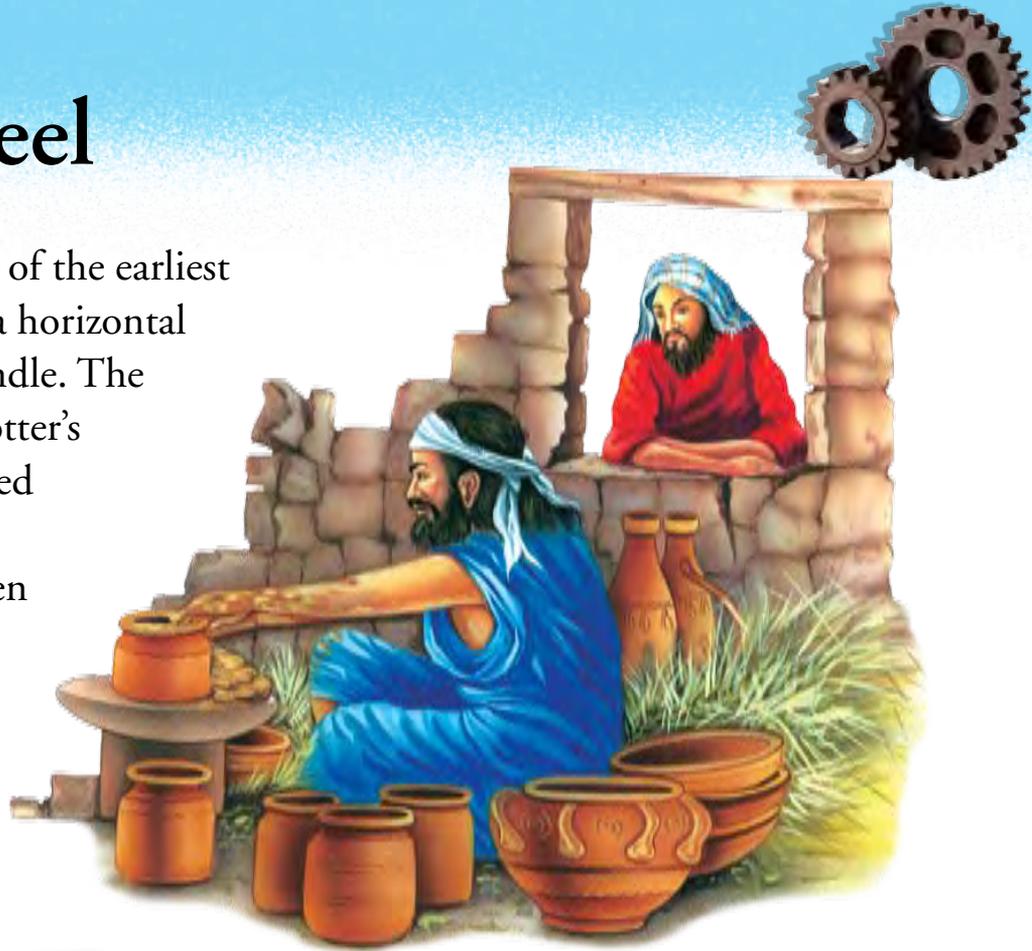
Stage 5: The rollers were changed into wheels.

Romans

The Romans produced the greatest variety of wheeled vehicles. They made different types of chariots. They had chariots for war, hunting, and racing.

Potter's Wheel

The potter's wheel is one of the earliest uses of the wheel. It is a horizontal wheel that revolves on a spindle. The revolving spindle and the potter's hand shapes the clay mounted on the wheel. The potter's wheel is believed to have been invented in Southwest Asia around 6500 BCE.



fact scope

- The potter's wheel was invented in the Bronze Age.
- Native Americans made pottery without using the wheel.
- The potter's wheel is also known as the potter's lathe.
- The potter's lathe is used in shaping round ceramic wares.
- It is believed that the potter's wheel first came into use between 6000 BCE and 2400 BCE.
- Modern scholars suggest that the potter's wheel was first developed in either Mesopotamia, Egypt, or China.

Spinning the Wheel

By the 18th century, small boys apprenticed to the potter turned the wheel, and since the 19th century, mechanical power has been used to spin the wheel.



First Evidence

The first evidence of the potter's wheel was found in Egyptian paintings. Egyptian potters were highly skilled and were respected members of the Egyptian society.



Shadoof

The shadoof is a simple machine that is used to draw water from wells and canals.

It is a seesaw pole with a weight and a bucket tied at each end. It was invented in Ancient Egypt during the New Kingdom, around 1600 BCE. Ancient Egyptians used it to draw water from the Nile River to irrigate their fields.



fact scope

- *Shaduf* is an Arabic word.
- A shadoof is a crane-like device that is used as an irrigation tool.
- The shadoof was originally developed in ancient Sumer. It is still used in many areas of Africa and Asia to draw water.
- The shadoof was used extensively in ancient Egypt.
- Shadoofs can be used in a series where they can be used to raise water to a height exceeding the range of a single shadoof.
- It is sometimes believed that the massive stones used in building the pyramids of Egypt were raised by an ancient variant of the shadoof.
- It is estimated that a shadoof can raise over 660 gallons of water per day.

Egyptians

Egyptians irrigated their fields with the help of shadoofs. They used shadoofs to move water from the reservoirs to the fields and irrigation channels.

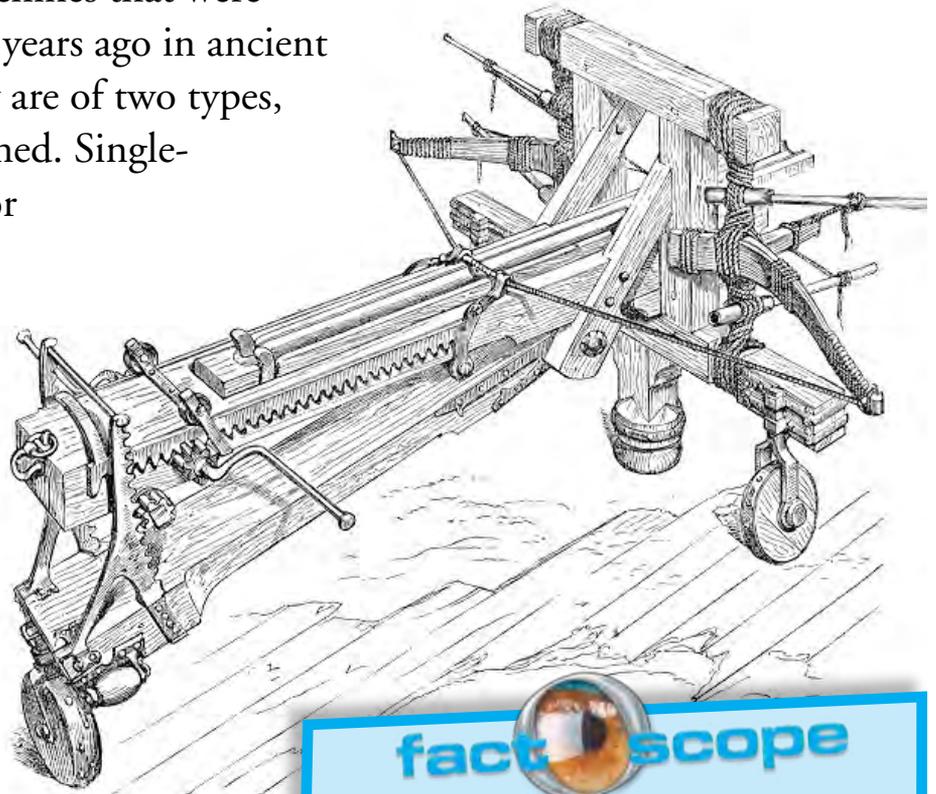
Shadoof in War

During the Middle Ages, armies laying siege on forts used a shadoof-like device for lifting soldiers over fortress walls.

Catapult



Catapults are hurling machines that were invented around 2,400 years ago in ancient Greece by Archimedes. They are of two types, single-armed and double-armed. Single-armed catapults were used for hurling objects like large stones. Double-armed catapults, also called ballista, were used for shooting arrows. The Romans improved upon the catapult by adding wheels to make them mobile.

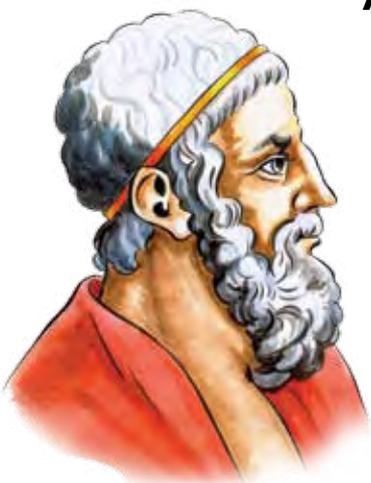


What is a Catapult?

Any machine that hurls an object can be considered a catapult. But the term is generally understood to mean medieval siege weapons.

Assembling

Catapults were usually assembled at the site of a siege. Armies carried few pieces of a catapult with them because wood was easily available.



fact scope

- Catapults are siege engines.
- Catapults use an arm to hurl a projectile a great distance.
- Catapults work on the physical concept of storage and release of energy required to propel a projectile.
- In Europe, the first catapults appeared in later Greek times around 400 BCE–300 BCE.
- Alexander the Great introduced the idea of using catapults to provide cover on the battlefield in addition to using them during sieges.
- Catapult projectiles included both arrows and stones.
- During medieval times, catapults and related siege machines were the first weapons used for biological warfare.



Trebuchet

Trebuchets are similar to catapults but more powerful. They were used to hurl huge boulders at incredible speed and were mostly used as a demolition weapon during medieval times. It is believed that the Chinese invented the trebuchet in the 5th century BCE.

fact scope

- In England, siege weapons, including the trebuchet were known as the "Ingenium" from the Latin word *ingenium* meaning "ingenious device."
- A medieval trebuchet was similar to a catapult or stave sling.
- A medieval trebuchet used a huge counterweight that swung a long arm.
- Trebuchets could reduce castles, fortresses, and cities to rubble.
- A very large force was applied to the shorter end of the arm. The load was placed on the longer end of the arm with the fulcrum in the middle.
- The arm of the trebuchet could measure over 59 feet in length
- Trebuchet missiles were heavy lead weights or a pivoting ballast box, filled with earth, sand, or stones.



Name

The word "trebuchet" is derived from the Old French word *trebucher* meaning "to throw over."

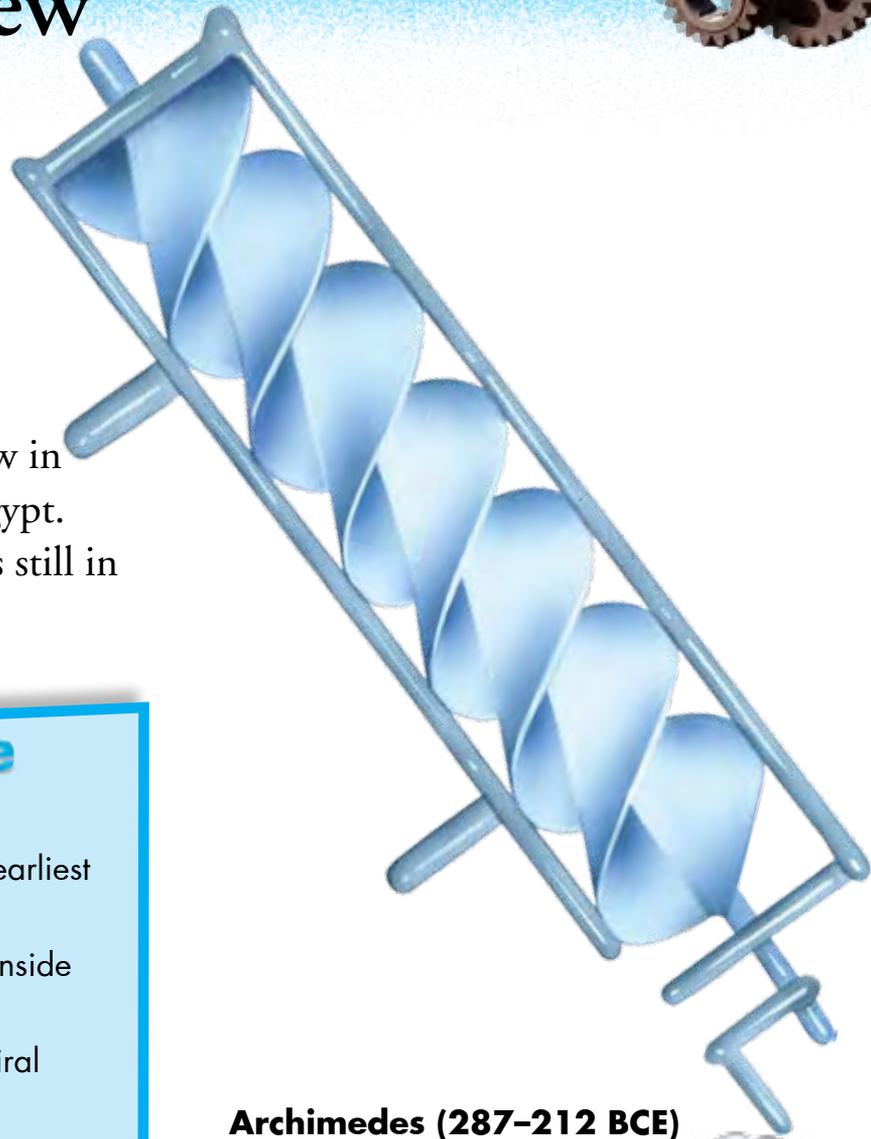
Trebuchet History

The first trebuchet was the traction trebuchet. It is believed to be an ancient war engine, which was invented in China. Many believe that the trebuchet may have been developed from the stave sling.

Archimedes Screw



An Archimedes screw is a machine for raising water from a lower to a higher level. It ranges in size from .2 inches to about 13 feet. The great mathematician Archimedes of Syracuse invented the hydraulic screw in the 3rd century BCE on a visit to Egypt. Surprisingly, the Archimedes screw is still in use today.

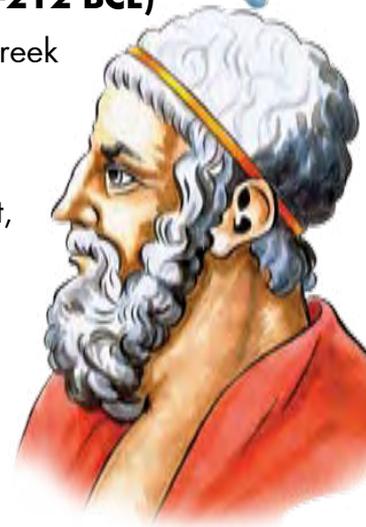


fact scope

- The Archimedes screw is one of the earliest kinds of pumps.
- The Archimedes screw is a cylinder inside which a continuous screw, extending the length of the cylinder, forms a spiral chamber.
- By placing the lower end of the screw in water and revolving the screw, water is raised to the top.
- The principle of the Archimedes screw is applied in machines used for drainage, irrigation, and in some types of high-speed tools.
- The Archimedes screw can also be used for handling light, loose materials such as grain, sand, and ashes.
- The inclination of the cylinder is such that at the next revolution the water is raised above the next thread, while the lowest thread scoops up another quantity.
- Successive revolutions of the Archimedes screw raises the water, thread by thread, until it emerges at the top of the cylinder.

Archimedes (287–212 BCE)

Archimedes was a Greek mathematician, astronomer, philosopher, physicist, and engineer. He is best known for his invention of the lever and pulley.

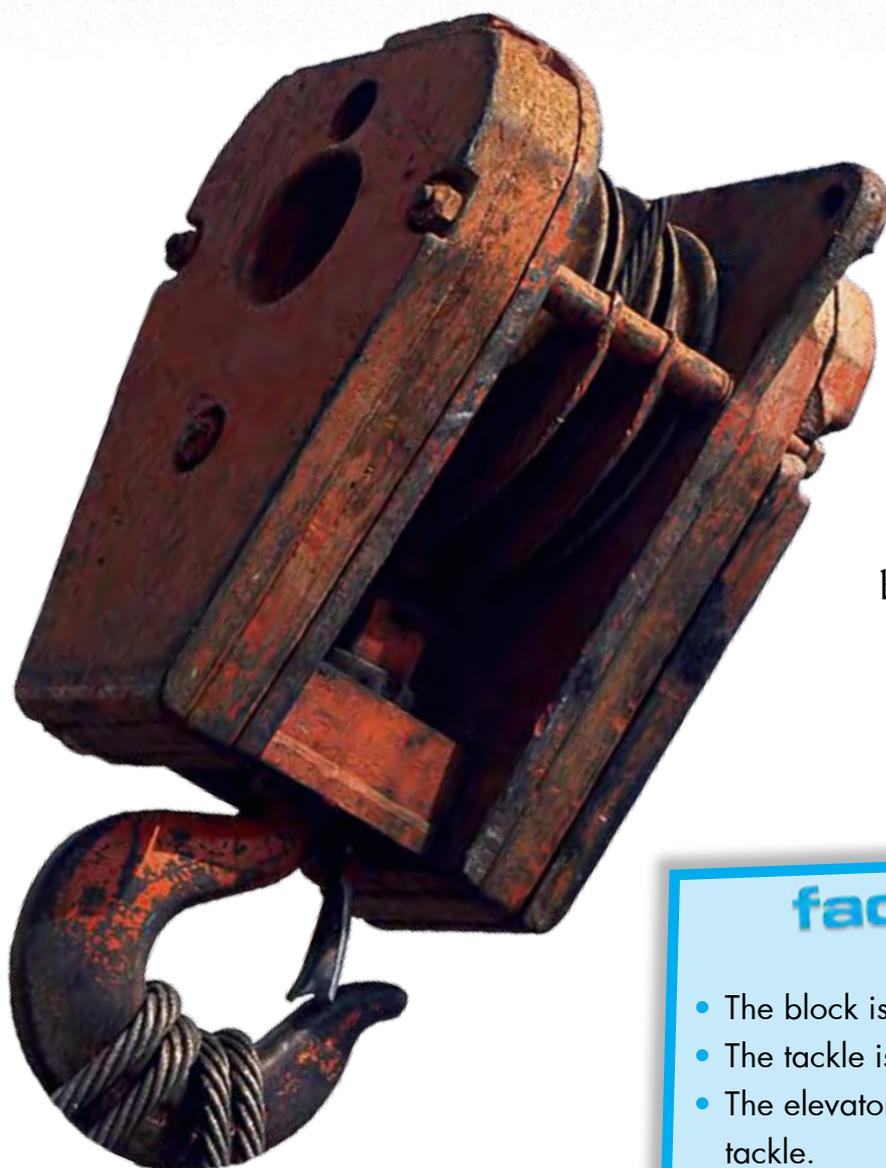


Scooping Water

The lowest portion of the Archimedes screw is slightly inclined and dipped into water. On turning the screw, a small quantity of water is scooped up and pushed to the next rung.



Block and Tackle



Block and tackle is a mechanism used for lifting weights. It is a system of two or more pulleys with a rope interweaved between. It is used to lift heavy loads mostly in ships, boats, cranes, and elevators. Archimedes invented the block and tackle pulley.

fact scope

- The block is the whole assembly of pulleys.
- The tackle is the rope.
- The elevator is an example of a block and tackle.
- The block and tackle pulley are used where motorized aids are usually not available, and the task must be performed manually.
- The mechanical advantage of a block and tackle is equal to the number of lines running between the two blocks.
- Archimedes created the ship-shaker using the block and tackle.
- Using the ship-shaker, a man could pull an entire ship on one rope, including the crew and cargo.
- A more complicated block and tackle system involves several simple blocks and tackles.

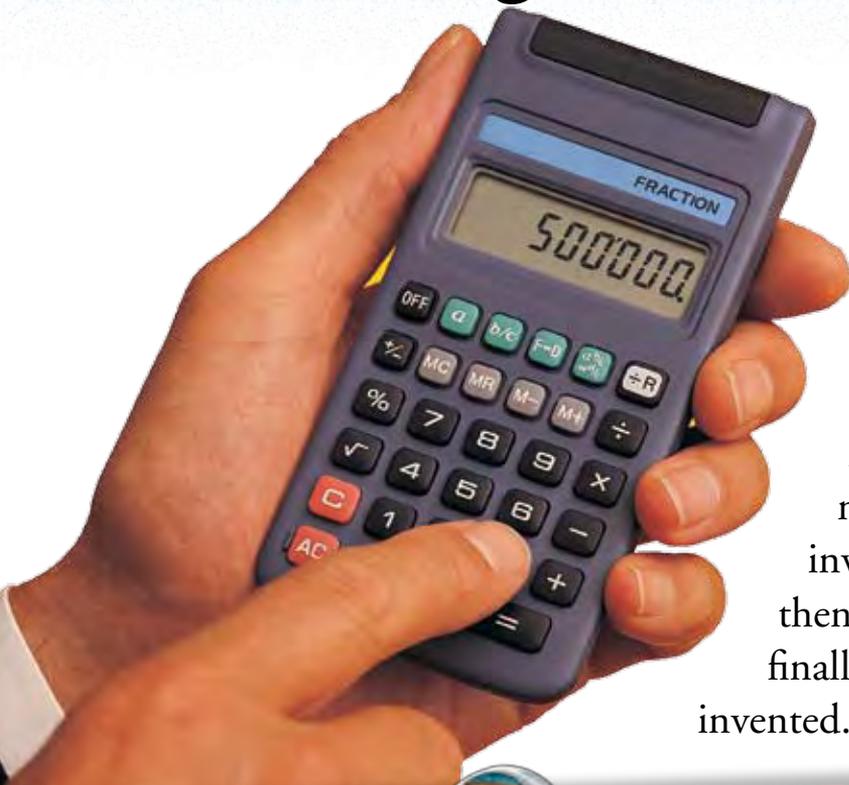
Arrangement

The block and tackle pulley is usually arranged as a set of fixed pulleys. These are then mounted on a single axle, and another set is left to move.

Advantage

A tackle with two fixed and two moving pulleys has four lines going between the pulleys. This gives it a mechanical advantage of four, meaning the block and tackle can lift weights four times heavier than would be otherwise possible.

Calculating Machine



The earliest calculating machines were the abacus, slide rule, and logarithms. The abacus is used to do math problems. It is made of beads that slide on wires, mounted on a wooden frame. It is still in use in many parts of the world. The first mechanical calculating machine was invented by Blaise Pascal in 1642. Since then electro-mechanical calculators and finally electronic computers have been invented.

fact scope

- In 1600 John Napier invented Napier's bones for multiplication, based on the ancient numerical scheme known as the Arabian lattice.
- In 1622 William Oughtred invented the circular slide rule.
- In 1623 Willhelm Schickard invented the calculating clock, a mechanical calculator.
- Charles de Colmar invented the Arithmometer in 1820.
- In 1853 the world's first printing calculator called the Scheutz Difference Engine was invented by the father and son duo of George and Edvard Scheutz.
- In 1872 Frank Baldwin invented the pin-wheel calculator.
- The world's first direct multiplication machine was built by Raymond Verea in 1878.
- The first practical adding-listing machine called the Burroughs Registering Accountant was introduced in 1892.

Thomas Fowler Ternary Calculator

In 1838 Thomas Fowler a creative inventor and banker from England developed a system of arithmetic calculations based in binary and ternary tables.

William S. Burroughs (1855–1898)

William Burroughs invented the Burroughs Registering Accountant. It was an adding and listing machine with a full keyboard. He received a patent for his invention in 1888.



Sewing Machine

Sewing machines are mechanical machines that are used for stitching clothes, leather, and other fabrics. Most believe that American Elias Howe invented the sewing machine. Howe, however, only invented a machine that used a process known as “lockstitch mechanism.” It was Charles Wiesenthal, a German inventor who invented the first sewing device. Another American, Isaac Singer made sewing machines popular and a household necessity.



fact scope

- In 1818 an American churchman, John Adams Doge and his partner John Knowles, produced a crude sewing device.
- The French tailor, Barthelemy Thimonnier, invented the first functional sewing machine in 1830.
- In 1834 Walter Hunt built America’s first sewing machine.
- In 1842 the American John Greenough produced a sewing machine in which the needle passed completely through the cloth.
- In 1844 Englishman John Fisher invented a machine, which was essentially a working sewing machine.
- Isaac Singer invented the first practical, commercially successful sewing machine.
- By 1863 the Singer machine had become America’s most popular sewing machine.

The Song of the Shirt

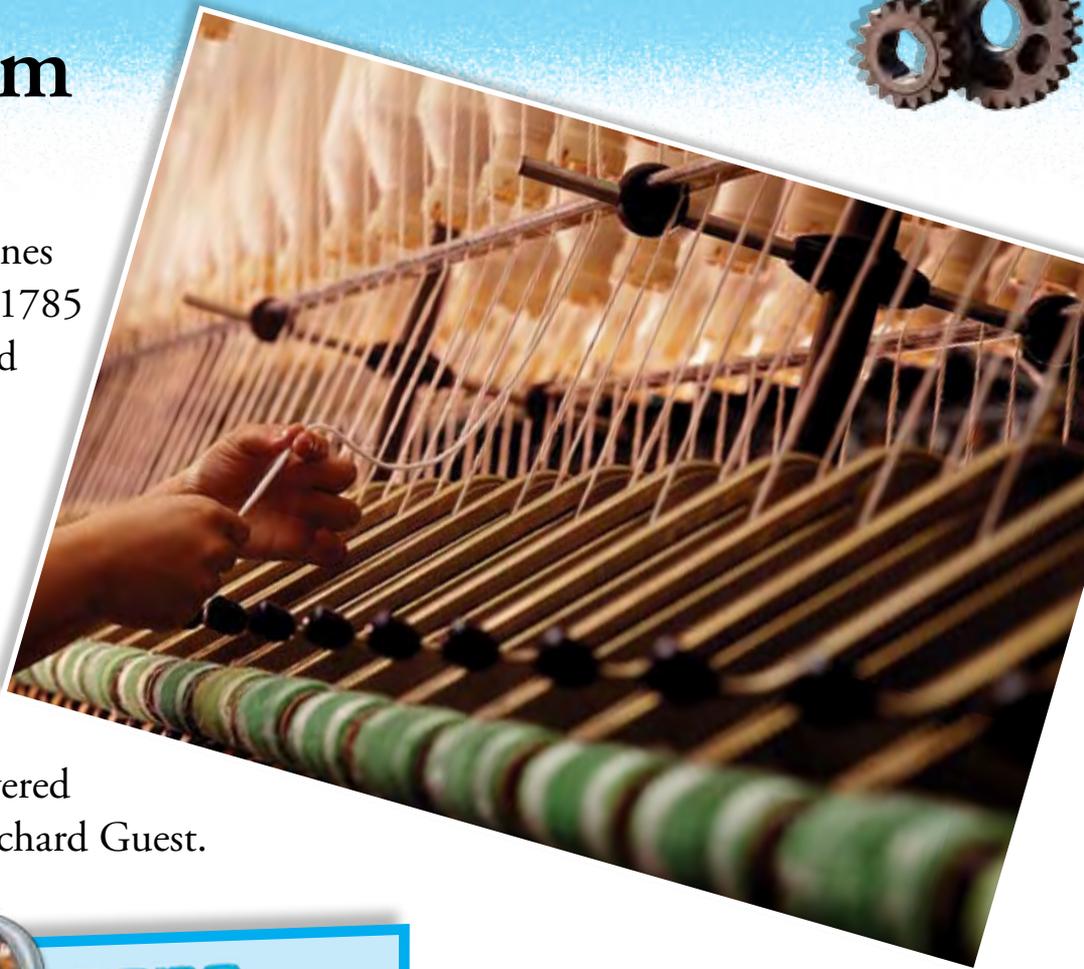
To attract attention to his sewing machine, Singer would croon “The Song of the Shirt” at county fairs and circuses, while a pretty woman demonstrated the ease of his new machine.

Isaac Singer (1811–1875)

In 1873 Isaac Singer established his sewing machine factory on Newark Bay. The factory was built on a 32-acre plot and once had a workforce of six thousand, the largest in the world at that time. The I. M. Singer & Co. was also the first American multinational company.

Power Loom

The power loom is a machine that combines thread to make cloth. In 1785 English inventor Edmund Cartwright invented the mechanical power loom. Cartwright's invention paved the way for large scale production of cloth, and weaving became an industry. In the 1830s the steam-powered loom was invented by Richard Guest.



fact scope

- Before the invention of the power loom, cloth was made by handloom weavers.
- The early power looms relied on waterpower. Therefore, power loom workshops needed to be located near a source of running water.
- Modern looms are of two types, those with a shuttle and those without it.
- In 1804 Joseph Marie Jacquard invented an attachment that could weave any design on a power loom.
- There are basically three kinds of shuttleless looms.
 - a) The dummy shuttle contains no weft but moves through the shed depositing a trail of yarn.
 - b) A second type, the newest of looms, makes use of jets of air or water to force the weft through the shed.
 - c) A third kind called the rapier type, widely used in carpet weaving, uses steel rods to move the weft into the shed.

The fundamental parts of all looms are

- Warp beam
- Cylinder
- Heddles
- Harness
- Reed
- Breastbeam
- Cloth beam
- Shuttle, if it is not a shuttleless loom.

Power Loom

The power loom was one of the key inventions of the Industrial Revolution. By early 19th century, advanced steam engines enabled power looms to be installed anywhere.



Nylon



Nylon is a manmade synthetic material usually used for making clothes. It is an extremely strong, synthetic fiber. Nylon was invented by a chemist, Dr. Wallace Carothers, at the Du Pont Company in 1935. Du Pont named this fiber "nylon."

fact scope

Nylon Products

Nylon is used in a variety of products, including fabrics, surgical sutures, threads, insulators, mosquito nets, gears, bearings, rope, and tire cords.



Creation

Nylon is created when a condensation reaction occurs between amino acids, dibasic acids, and diamines.

- Du Pont did not register nylon as a trademark, choosing to allow the word to enter the American vocabulary as a synonym for stockings.
- Nylon is considered to be the first engineered thermoplastic.
- Carothers the inventor of nylon was looking to develop a synthetic fiber, which led him to experiment with polymerization.
- Carothers used a machine called a molecular still with which he was able to make longer molecules than had been made before.
- Carothers observed that many of the fibers could be pulled out several times their length after they were cooled. This resulted in a much longer and more elastic fiber.
- Synthetic thermoplastic materials are characterized by strength, elasticity, resistance to abrasion and chemicals, low moisture absorbency, and capacity to be permanently set by heat.

Bicycle



Bicycles are vehicles with two or three wheels. They are moved by foot pedals and do not have an engine. Bicycles are the principal mode of transportation in many countries. The early bicycle was invented in 1790 by a Frenchman named Comte Mede de Sivrac.



fact scope

- The earliest bicycle was a wooden scooter-like contraption called a celerifere.
- The celerifere was invented by Comte Mede de Sivrac of France in 1790.
- The draisienne invented in 1816 by Baron Karl Sauerbrun of Germany had two same-size wheels and the rider sat between the two wheels.
- A French father and son team of carriage-makers, Pierre and Ernest Michaux, invented an improved bicycle in the 1860s.
- Many early bicycles had huge front wheels because it was thought that the bigger the wheel, the faster you could go.
- The earliest tires were wooden, metal tires were an improvement, and solid rubber tires were added later.

The First Pedal-Driven Bicycle

Scotland's Kirkpatrick Macmillan, a blacksmith from Dumfriesshire, Scotland, built the first pedal-driven bicycle in 1839. He never patented his cycle and his idea did not get popular among the locals.

Inexpensive Machine

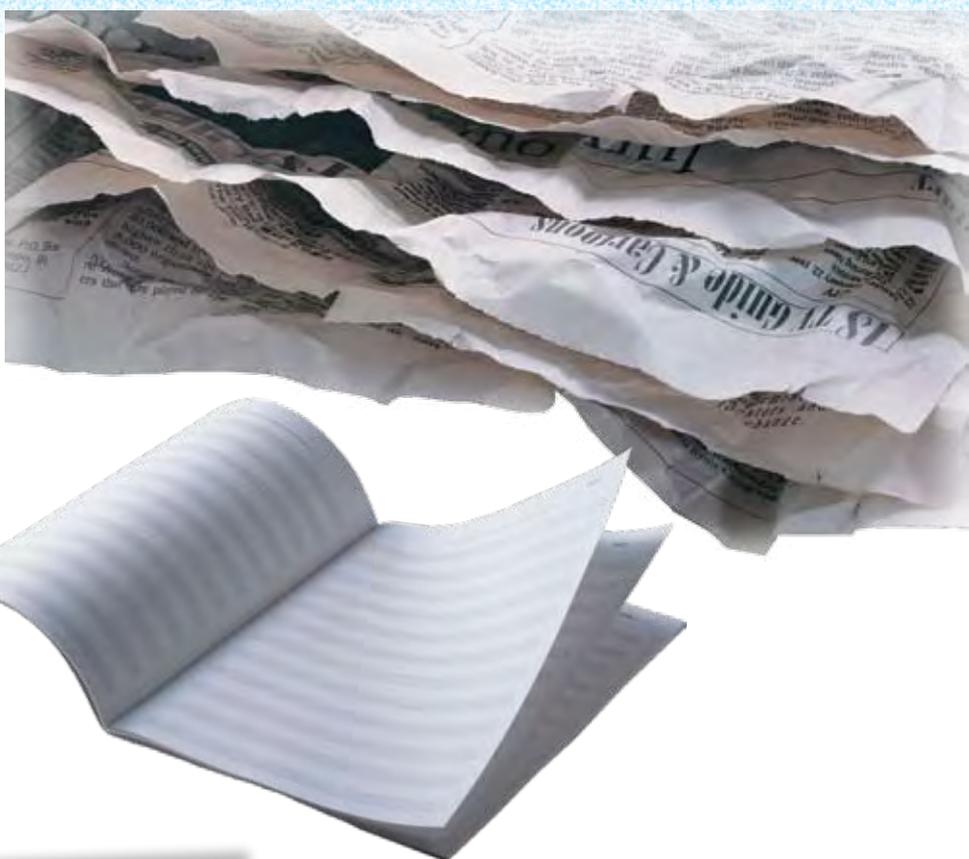
The bicycle was initially an amusement machine for the upper classes. However, it soon became a popular means of transportation for millions of people throughout the world.



Paper

Paper is made of fibrous materials, rags, and wood pulp. Fibrous plants like rice, cotton, hemp, and linen are also used to make paper.

The first paper was made in ancient China by a man named Ts'ai Lun. The ancient Egyptians also used paper that they made from the papyrus plant.



fact scope

- The word "paper" is derived from the papyrus plant.
- Papyrus is a grass-like aquatic plant native to the Nile Valley of Egypt.
- Paper is the most widely used product around the world.
- Almost 5,000 years ago, in ancient Egypt, the papyrus plant was processed and used as paper.
- Papyrus paper was made from thin sheets of papyrus pith that were soaked in water, pressed together with the grains at right angles, and then dried. The sticky sap of the plant made the thin sheets stick together, forming a sturdy writing surface.
- Paper is made by grinding plant material into a pulp, forming it into thin sheets, and drying it.
- Early Chinese paper was made from the bark of the mulberry tree and other plant fibers.

Ts'ai Lun

Ts'ai Lun invented paper in China. He mixed the inner bark of a mulberry tree and bamboo fibers with water. He then pounded it into a mixture and poured it onto a flat piece of coarsely woven cloth for the water to drain out. Once dry, he discovered that he had made paper.

Spread of Papermaking

The knowledge of papermaking was used in China before word was passed along to Korea, Samarkand, Baghdad, and Damascus.

Printing Press



The printing press is a machine used for making many identical copies of a document. Different types of printing machines and methods have been developed over the years. Printing is an integral part of the print media and the publishing industry. Modern methods of printing such as digital printing, laser printing, and screen-printing, have taken over the old techniques such as engraving.

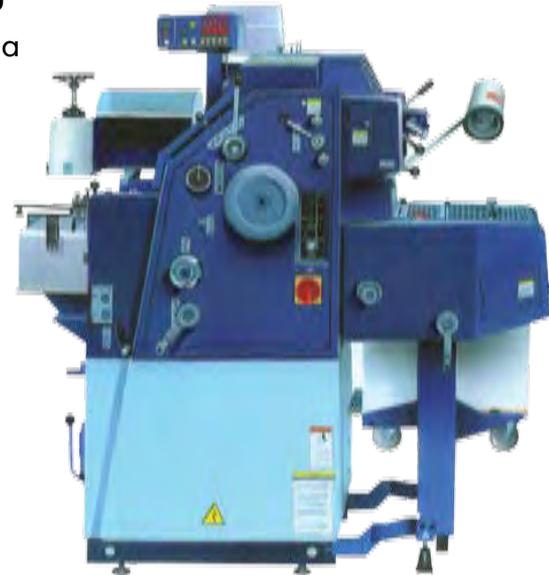


fact scope

- The earliest dated printed book known is the *Diamond Sutra* was printed in China in 868 CE.
- One of the earliest newspapers was the Roman *Acta Diurna* by Julius Caesar.
- The first printing press with movable type was invented in 1450 by Johannes Gutenberg.
- Gutenberg's invention revolutionized printing, making it simpler and more affordable.
- Gutenberg produced dyes for easily producing individual pieces of metal type that could be made, assembled, and later re-used.
- Gutenberg's press could print a page every three minutes.

Offset Printing

Offset printing is a popular printing method and is used to produce large volumes of high quality printing. It was developed in 1875 in England.



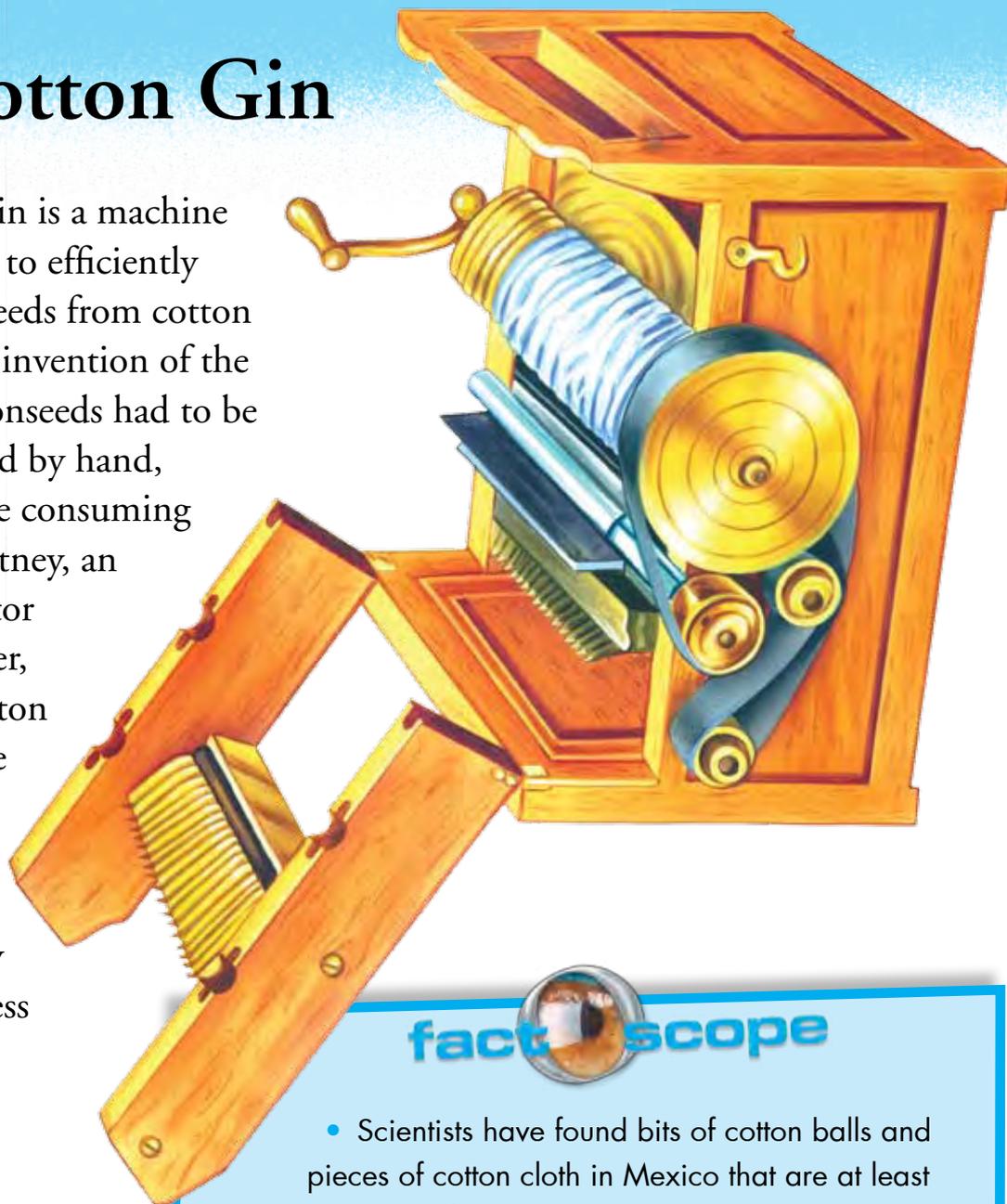
Lithography

Alois Senefelder of Germany invented lithography in 1798. It is a method of printing on smooth surfaces.



Cotton Gin

The cotton gin is a machine that is used to efficiently separate cottonseeds from cotton yarn. Before the invention of the cotton gin, cottonseeds had to be carefully removed by hand, which was a time consuming process. Eli Whitney, an American inventor and manufacturer, invented the cotton gin in 1793. The invention of the cotton gin made cotton-growing a highly profitable business in the southern United States.



fact scope

- Scientists have found bits of cotton balls and pieces of cotton cloth in Mexico that are at least 7,000 years old.
- In the Indus River Valley, cotton was grown, spun, and woven into cloth around 3000 BCE.
- When Columbus discovered America in 1492, he found cotton growing in the Bahamas.
- Cotton was first spun by machinery in England in 1730.
- Rayon was the first man-made fiber.
- Levi Strauss invented the fabric called denim used in blue jeans.
- American inventor Sally Fox invented colored cotton fiber in 1982 in Davis, California.
- The first synthetics were made in the 1920s and 30s.
- Swiss chemist, Georges Audemars, invented the first crude artificial silk around 1855.

Polyesters

Polyesters are fibers made of synthetic polymers. It is a manmade fiber.

Rayon

Rayon is made from wood or cotton pulp and was first known as artificial silk.

Magnetic Compass



The magnetic compass is an instrument used to find directions. It has a magnetic needle that always points north. The compass is usually a circular instrument with the four cardinal directions of north, south, east, and west marked out on its face. The magnetic compass is one of the four great Chinese inventions.



fact scope

- An early form of the compass was probably first made in China during the Qin dynasty (221–206 BCE).
- During the 10th century, the idea of the magnetic compass had been brought to Europe, probably from China.
- Columbus used a magnetic compass on his first trans-Atlantic trip.
- Simple compasses were used in the Mediterranean as early as the 12th century.
- In 1745 Gorwin Knight, an English inventor, developed a way of magnetizing steel.
- Gorwin Knight's new and improved compass was called the Knight compass.
- The mariner's compass was invented in Europe around 1300.
- A compass dial is a small pocket compass with a sundial.

First Use of Compass

Zheng He (1371–1435), from the Yunnan province in China, was the first person to have used the magnetic compass. He used it as a navigational aid during seven ocean voyages between 1405 and 1433.

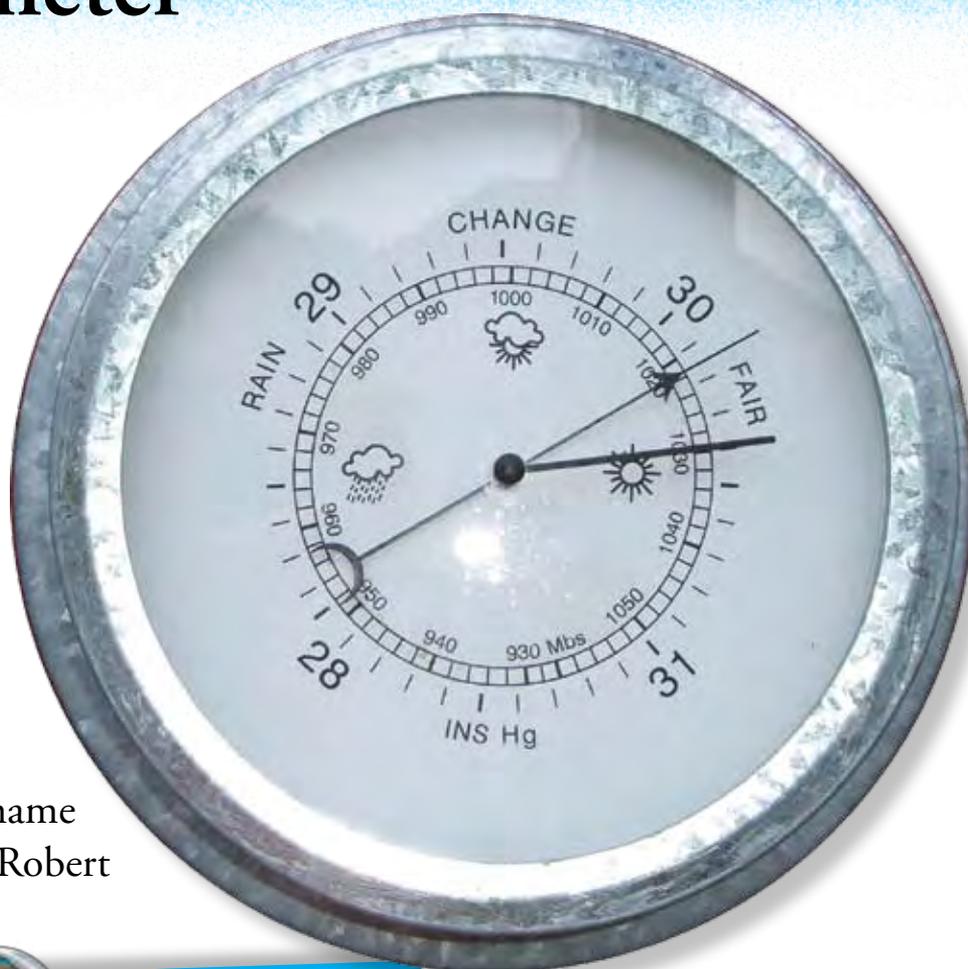
Sailor's Compass

Flavio Gioja, an Italian marine pilot, is sometimes credited with perfecting the sailor's compass. He enclosed the needle in a little box with a glass cover.



Barometer

The barometer is an instrument that is used to measure atmospheric pressure. The most common type of barometer is the mercury barometer. The aneroid barometer is another type of barometer. It was invented by the Italian scientist Evangelista Torricelli in 1643. The name barometer was given by Robert Boyle in 1665.



fact scope

- Torricelli did not call his invention a barometer. Boyle did that in 1665.
- The name barometer has its roots in the Greek word *baros* meaning "weight."
- A storm is generally anticipated when the barometer is falling rapidly.
- When the barometer is rising, fair weather may usually be expected.
- Water based barometers are also called storm glass or Goethe thermometer.
- A barometer is commonly used for weather prediction.
- While the barometer stands above 30 inches, the air must be very dry, or very cold, or perhaps both, and no rain may be expected.
- When the barometer stands very low, there will not be much rain, though the weather may not be fine either.

Evangelista Torricelli

Evangelista Torricelli was born on October 15, 1608, in Faenza, Italy, and died October 22, 1647, in Florence, Italy. He was a physicist and mathematician. In 1641 Evangelista Torricelli moved to Florence to assist the astronomer Galileo.

Galileo's Suggestion

Galileo suggested that Evangelista Torricelli use mercury in his vacuum experiments. Torricelli filled a four-foot long glass tube with mercury and inverted the tube into a dish. This led to the invention of the barometer.

Cup Anemometer



The cup anemometer is an instrument used to measure wind speed. It consists of three or four cups fixed at the end of horizontal arms and mounted on a vertical axis. The wind rotates the cups and the rate of rotation is used to measure wind speed. It was invented around 1845 by Thomas Romney Robinson, an Irish astronomer and physicist.



fact scope

- Robert Hooke, an English physicist, is often mistakenly considered the inventor of the first anemometer.
- The term anemometer is derived from the Greek word *anemos* meaning "wind."
- The anemoscope is an ancient device for measuring or predicting wind direction or weather.
- A weather vane is a device for indicating wind direction.
- A windsock is a device for measuring wind speed and direction.
- On April 12, 1934, an anemometer recorded a wind gust of 230 mph on the summit of Mount Washington, in New Hampshire.

Anemometers Classes

Anemometers may be divided into two classes: those that measure the velocity of the wind and those that measure the pressure of the wind.

First Anemometer

The first anemometer was a disc that was placed perpendicular to the wind. The Italian architect Leon Battista Alberti invented it in 1450.

Other Types of Anemometers Include:

- Propeller anemometers
- Pitot-tube anemometers
- Hot-wire or hot-film anemometers
- Sonic anemometers



Steel

Steel is a hard, tough metal widely used in construction. It is an alloy of iron with small percentages of carbon. Sometimes, metals such as manganese, nickel, and chromium are added to steel to make it rust-free and hard. British inventor and metallurgist Sir Henry Bessemer developed the first process for the mass-production of steel.



Global Crude Steel Production

2005	1 129 Metric tons*	2001	850 Metric tons
2004	1 067 Metric tons	2000	848 Metric tons
2003	969 Metric tons	1997	799 Metric tons
2002	904 Metric tons	1995	752 Metric tons



fact scope

- The oldest evidence of hardened steel is a knife found in Cyprus, dated to 1100 BCE.
- Steel has more carbon than wrought iron but less than cast iron.
- Over 66% of total global steel production is dependent on coal.
- 70% of the steel used in automobile production today did not exist 10 years ago.
- Steel companies have developed ultra-light steel for cars.
- 15% of modern commercial aircrafts are made from specially developed steel.

Top Ten Steel Producers

China	384.7 tons	349 Metric tons
Japan	124.56 tons	113 Metric tons
USA	103.62 tons	94 Metric tons
Russia	72.75 tons	66 Metric tons
South Korea	52.91 tons	48 Metric tons
Germany	49.6 tons	45 Metric tons
India	41.88 tons	38 Metric tons
Ukraine	40.78 tons	37 Metric tons
Brazil	35.27 tons	32 Metric tons
Italy	31.96 tons	29 Metric tons

Stainless Steel

Harry Brearley invented stainless steel. He was the son of a steel melter and was born in the year 1871 in Sheffield, UK.

Kelly to Bessemer

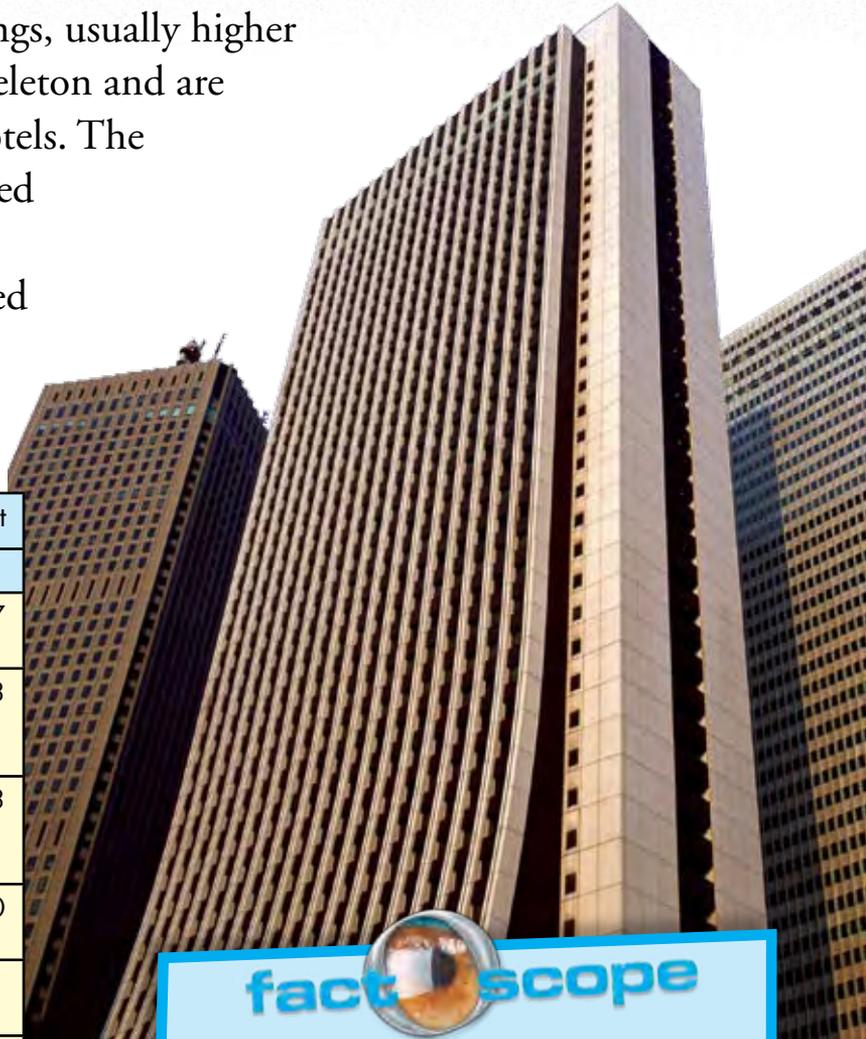
American, William Kelly, held a patent for a method of steel production known as the pneumatic process of steel making. Bankruptcy forced Kelly to sell his patent to Bessemer, who had been working on a similar process for making steel.

* One metric ton equals 2,204.6 pounds

Skyscrapers



Skyscrapers are multi-storied buildings, usually higher than 500 feet. They have a steel skeleton and are generally used as office buildings or hotels. The term skyscraper originated in the United States in the late 1880s to describe tall buildings. The first building to be called a skyscraper was the 1885 built Home Insurance Building in Chicago.



Rank	Building, city	Year	Stories	Height
				feet
1.	Taipei 101, Taipei, Taiwan	2004	101	1,667
2.	Petronas Tower 1, Kuala Lumpur, Malaysia	1998	88	1,483
3.	Petronas Tower 2, Kuala Lumpur, Malaysia	1998	88	1,483
4.	Sears Tower, Chicago	1974	110	1,450
5.	Jin Mao Building, Shanghai	1999	88	1,381
6.	Two International Finance Centre, Hong Kong	2003	88	1,362
7.	CITIC Plaza, Guangzhou, China	1996	80	1,283
8.	Shun Hing Square, Shenzhen, China	1996	69	1,260
9.	Empire State Building, New York	1931	102	1,250
10.	Central Plaza, Hong Kong	1992	78	1,227

Nine-Storied Skyscraper

The Home Insurance Building was only nine stories when it was called a skyscraper. It was erected at the northeast corner of LaSalle and Adams streets in Chicago. Nine stories and one basement were completed in 1885. Two more stories were added in 1891.

fact scope

- The height of a skyscraper is measured from the sidewalk level of the main entrance to the structural top of the building.
- The Eiffel Tower was the tallest building in the world when it was completed in 1889.
- The Empire State Building is designed to be a lightning rod.
- New York's Citicorp Center, built in 1977, was the first U.S. skyscraper to contain a tuned mass damper in order to control the building's sway.
- On a clear day, you can see four states from the top of Chicago's Sears Tower: Illinois, Indiana, Wisconsin, and Michigan.



Escalator and Elevator

Escalators and elevators are transportation machines. Escalators are moving stairways that carry people over short distances. American inventor Jesse W. Reno invented the escalator in 1891. Elevators are lifting machines that consist of either a platform or cage that transports people from one floor to another in a building. In 1853 American inventor Elisha Otis invented the elevator, fitted with a safety device.



fact scope

- In 1846 Sir William Armstrong introduced the hydraulic crane.
- In the early 1870s hydraulic machines began to replace the steam-powered elevators.
- Electric elevators came into use toward the end of the 19th century.
- The German inventor Werner von Siemens built the first electric elevator in 1880.
- Moving walkways are often used in airports and metro stations.
- The speed of a moving walkway is usually 1.8 mph.
- Montparnasse station in Paris has a high-speed walkway that moves at 5.5 mph.
- In 1892 Charles A. Wheeler patented ideas for the first practical moving staircase, though it was never built.
- The world's fastest passenger elevator with a speed of 3,313 feet/minute is installed in the Taipei 101 tower in Taiwan.

Two Types of Moving Walkways

Pallet type: a continuous series of flat metal plates blend together to form a walkway.

Moving belt: built with mesh metal belts or rubber walking surfaces over metal rollers.



Battery

The battery is a device that produces electricity. It consists of a group of individual electrical cells arranged together. Batteries convert chemical energy into electrical energy. Batteries are used to power many devices including cell phones and electric cars. Italian physics professor, Alessandro Volta, invented the electric battery in 1800.



fact scope

- Benjamin Franklin first coined the term "battery."
- The first battery-like discovery occurred in 1786 by Count Luigi Galvani, an Italian anatomist.
- In 1839 William Robert Grove developed the first fuel cell, which produced electricity by combining hydrogen and oxygen.
- In 1859 French inventor, Gaston Plante, developed the first practical rechargeable battery.
- In 1881 Carl Gassner invented the first commercially successful dry cell battery.
- In 1898 Conrad Hubert created the first flashlight; he called it an electric hand torch.

Cell

A battery is a device that has two electrodes, an anode (positive end) and a cathode (negative end). An electrical pathway runs between these two electrodes, passing through a chemical called an electrolyte. This unit is called a cell.

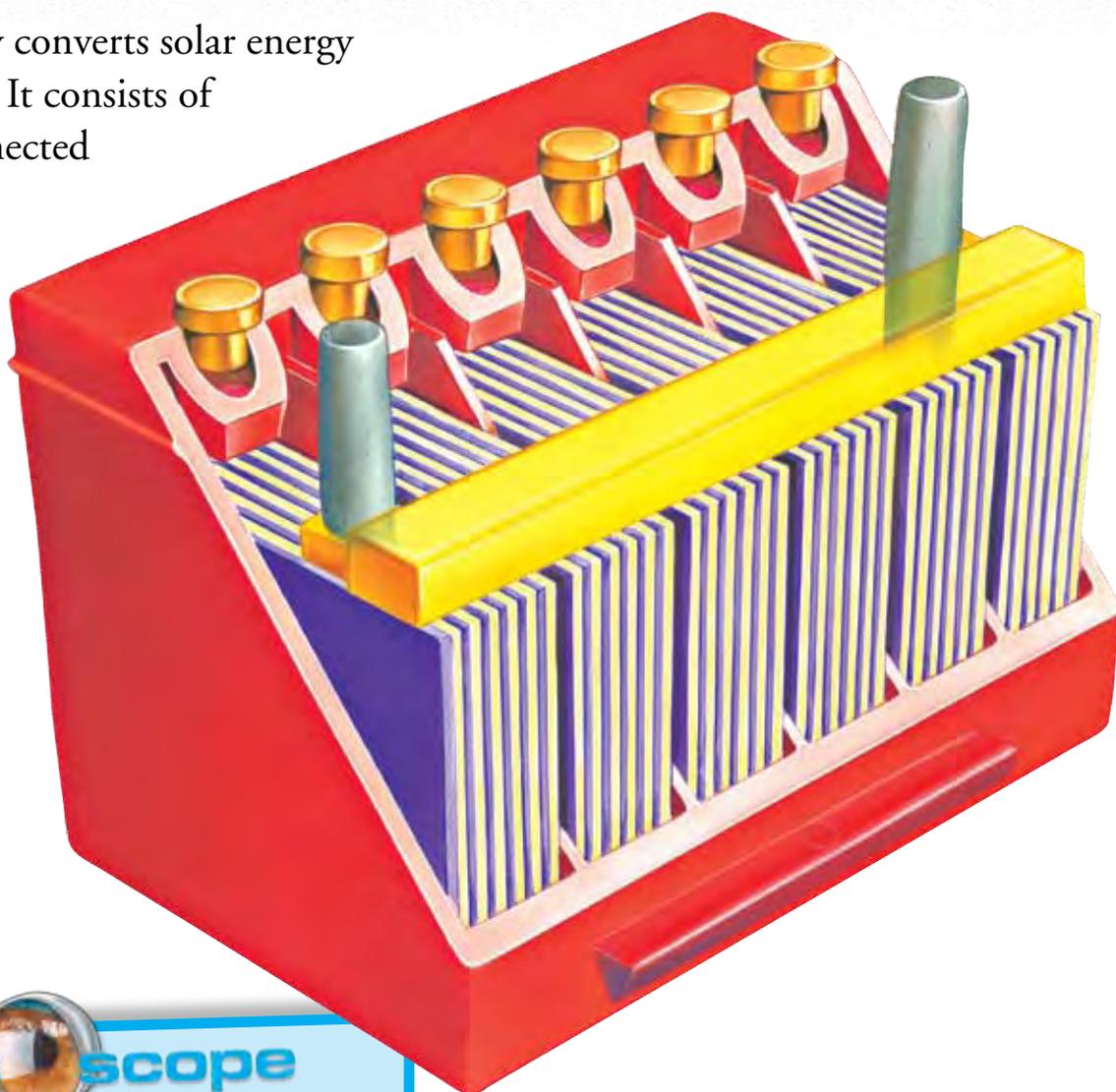
Many Uses

Batteries are used to power hundreds of devices and are also used to make the spark that starts a gasoline engine.



Solar Battery

The solar battery converts solar energy into electricity. It consists of a large array of connected solar cells. A typical solar cell uses semiconductors made from silicon. Gerald Pearson, Calvin Fuller, and Daryl Chapin invented the first solar battery at Bell Laboratories in 1954.



fact scope

- A solar cell can use a maximum of about 25 percent solar energy.
- The sun produces about 1,000 watts of energy per square foot on a sunny day.
- In 1839 Alexandre Edmond Becquerel observed the photoelectric effect.
- In 1883 Charles Fritts developed a solar cell using selenium on a thin layer of gold.
- In 1888 Edward Weston received patent number US389124 and US389125 for the solar cell.
- In 1902 Philipp von Lenard observed the variation in electron energy with light frequency.

Photoelectric Effect

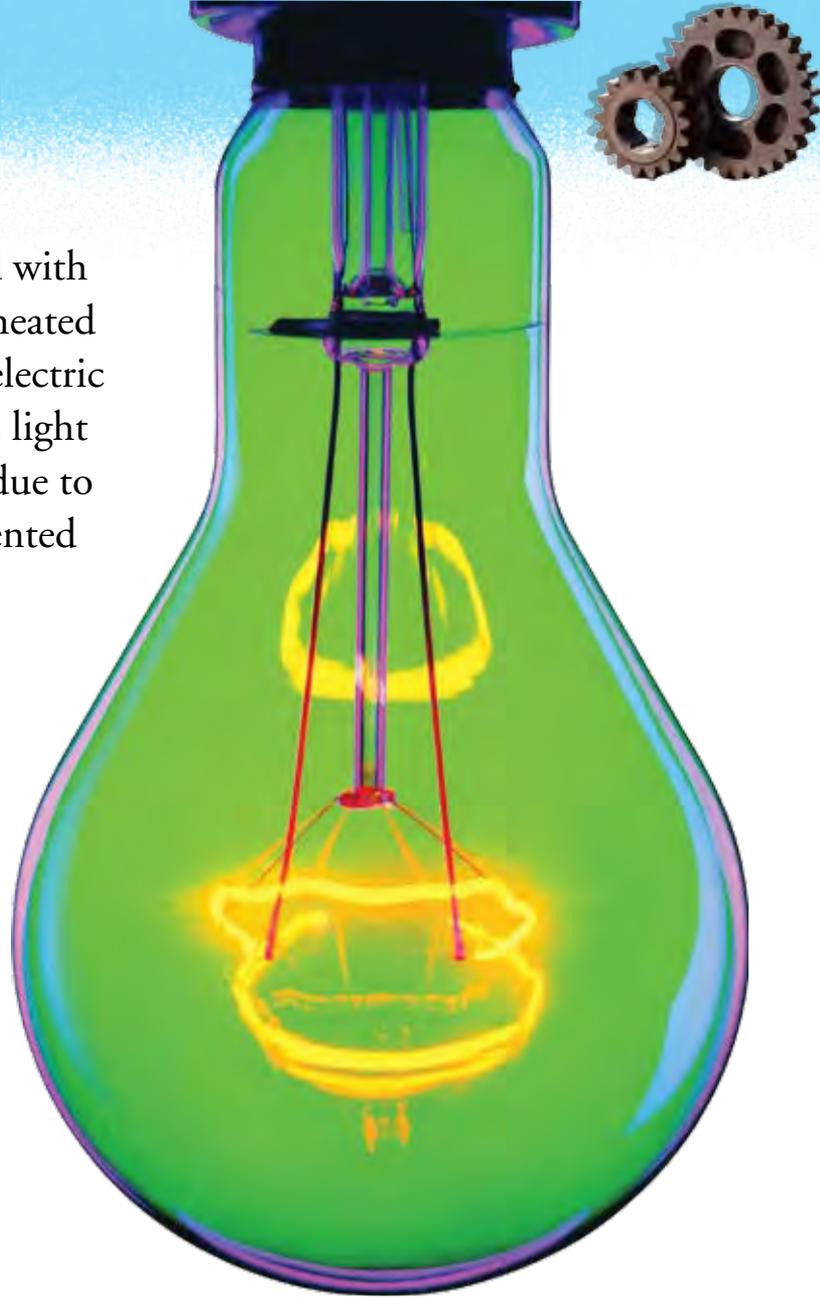
In 1904 Albert Einstein published a paper on the photoelectric effect. In 1916 Robert Millikan conducted experiments and proved the photoelectric effect.

Solar Cell

In 1954 AT&T exhibited the first solar cells in Murray Hill, New Jersey. These cells had about 6% efficiency.

Electric Bulb

The electric bulb is a glass bulb, fitted with a wire filament, which glows when heated by electricity. The wire filament used in electric bulbs is usually tungsten. The bulb emits light when electric current heats the filament due to incandescence. Thomas Alva Edison invented the first practical electric bulb in 1879. This bulb could emit light for about 40 hours.



fact scope

- In 1809 Humphry Davy, an English chemist, invented the first electric light.
- In 1820 Warren De la Rue used a platinum filament in an evacuated tube. It proved too costly.
- In 1854 a German watchmaker named Henricg Globel invented the first true light bulb.
- In 1875 Herman Sprengel invented the mercury vacuum pump making it possible to develop a practical electric light bulb.
- In 1875 Henry Woodward and Matthew Evans patented a light bulb.
- In 1878 Sir Joseph Wilson Swan, an English physicist, was the first person to invent a practical and longer-lasting electric light bulb that could burn for 13.5 hours.

Early Attempts

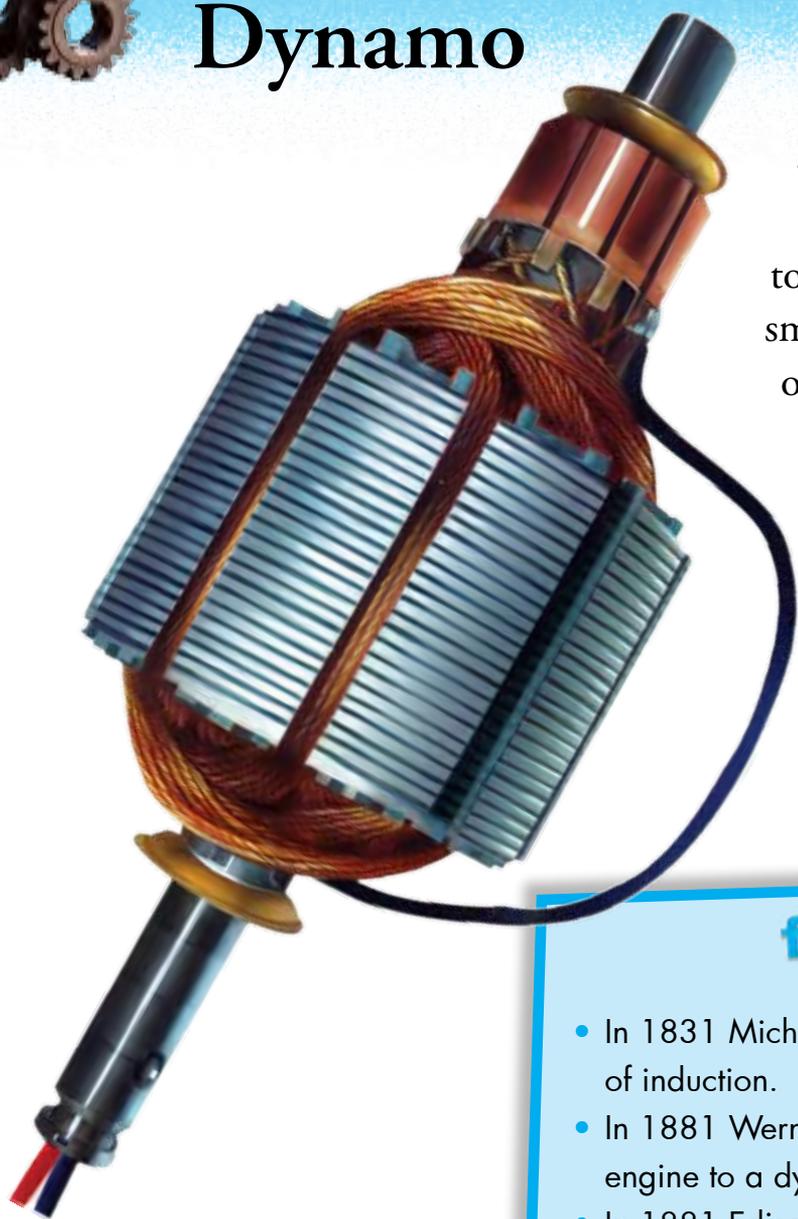
Many scientists and inventors worked to develop a cheap and durable incandescent light bulb. William Robert Göbel, a German scientist, made one of the first practical bulbs in 1854, but it was not very efficient.

Tungsten Filaments

Another Russian scientist and engineer, Alexander Nikolayevich Lodygin, made filament lamps with metallic filaments in the 1870s. He is believed to be the first person to have used the tungsten filaments.



Dynamo



The dynamo is a machine that converts mechanical energy to electrical energy. It is actually a small generator. It consists of a coil or armature, which rotates between the poles of an electromagnet. This rotation causes electric current to flow in the coil.

fact scope

- In 1831 Michael Faraday demonstrated the principle of induction.
- In 1881 Werner von Siemens connected a steam engine to a dynamo.
- In 1881 Edison displayed a 300 horse power steam-driven dynamo at the Paris Exhibition.
- In 1882 a 1,000 horsepower steam-driven dynamo was installed by Siemens in the West Berlin Power Station in Germany.
- Hippolyte Pixii, a French instrument maker, built the first dynamo based on Faraday's principles in 1832.
- In 1827 Anyos Jedlik was the first to give the concept of using two electromagnets opposite to each other instead of a permanent magnet to induce the magnetic field.
- The first commercial power plants became operational in Paris in the 1870s.
- Thomas Edison's main continuous current dynamo was nicknamed the "long-legged Mary-Ann."
- Faraday died in August 1867.

Discovery

In 1830 Joseph Henry discovered the principles of the dynamo.

Universal Use of Electric Currents

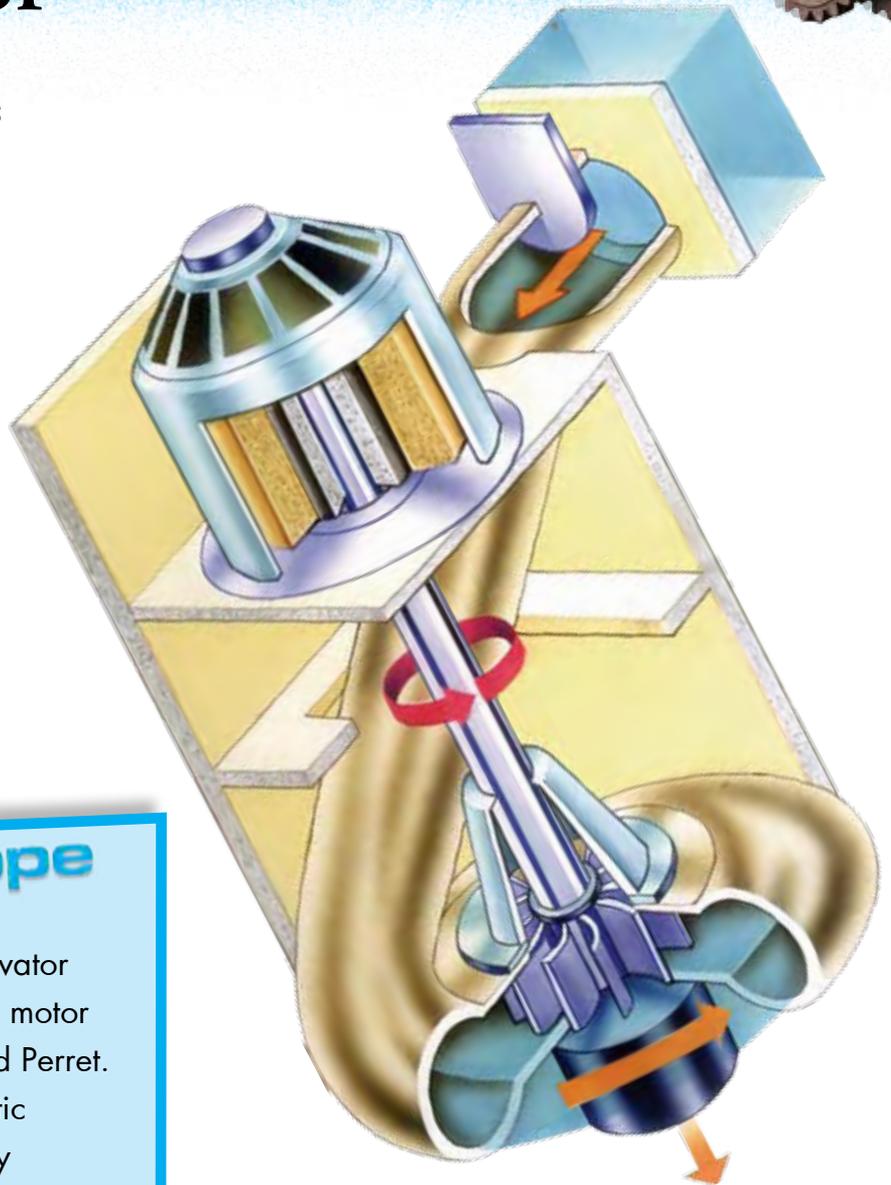
In 1867 Werner von Siemens developed the dynamo for generating alternating current. It paved the way for the universal use of heavy electrical current.

Electric Motor

The electric motor converts electricity to mechanical motion. Most electric motors work by electromagnetism. Electric motors evolved from the work of Michael Faraday and Joseph Henry in the early 19th century. They are used in numerous household appliances like electric fans, remote-controlled toys, and in many other devices.

fact scope

- The first American electric elevator was provided with an electric motor manufactured by Frank Alvord Perret.
- One of the first electromagnetic rotary motors was invented by Michael Faraday in 1821.
- Nikola Tesla received the U.S. Patent for the electric motor in December 1889.
- Michail Osipovich Dolivo-Dobrovolsky invented a three-phase cage-rotor in 1890.
- A linear motor is essentially an electric motor that produces a linear force.
- Maglev trains began to use the linear motor.
- In 1988 engineers at the University of California, Berkeley, built the first operating micromotor.



Tesla's Motor

In 1882 Nikola Tesla pioneered the use of the rotary field of force to operate machines. His motors initiated what is known as the Second Industrial Revolution.

DC Motor

Zenobe Gramme accidentally discovered the modern DC motor. In 1873 he connected a spinning dynamo to a second similar unit, driving it as a motor. It became the first industrially useful electric motor in history.

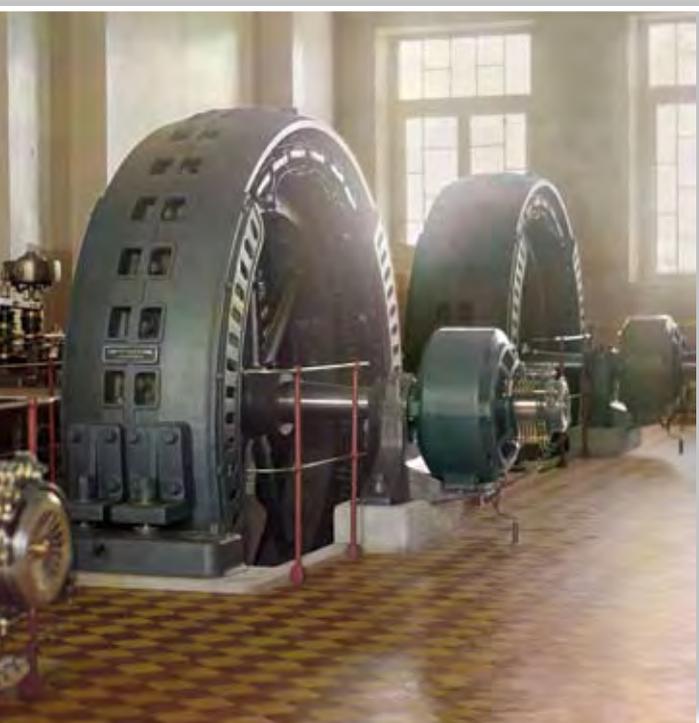
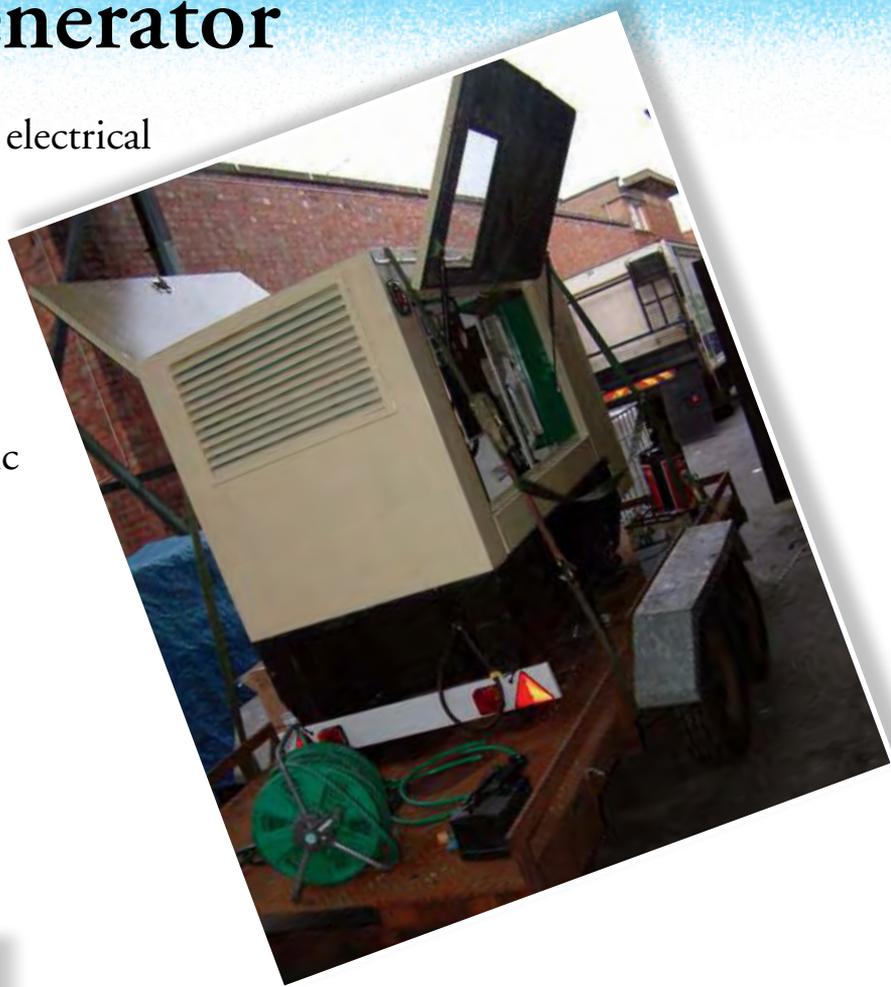


Electric Generator

The electrical generator produces electrical energy from mechanical energy. It uses electromagnetic induction to generate electricity and the process is called electricity generation. In 1831–1832 Michael Faraday built the first electromagnetic generator called the Faraday disc.

Spinning Copper Wires

Electric generators are essentially very large quantities of copper wire spinning around inside very large magnets, at very high speeds.



Commercial Electric Generator

Commercial electric generators can be quite large. They can be over 19.5 feet in diameter, 49.2 feet long, and weigh over 55 tons.

fact scope

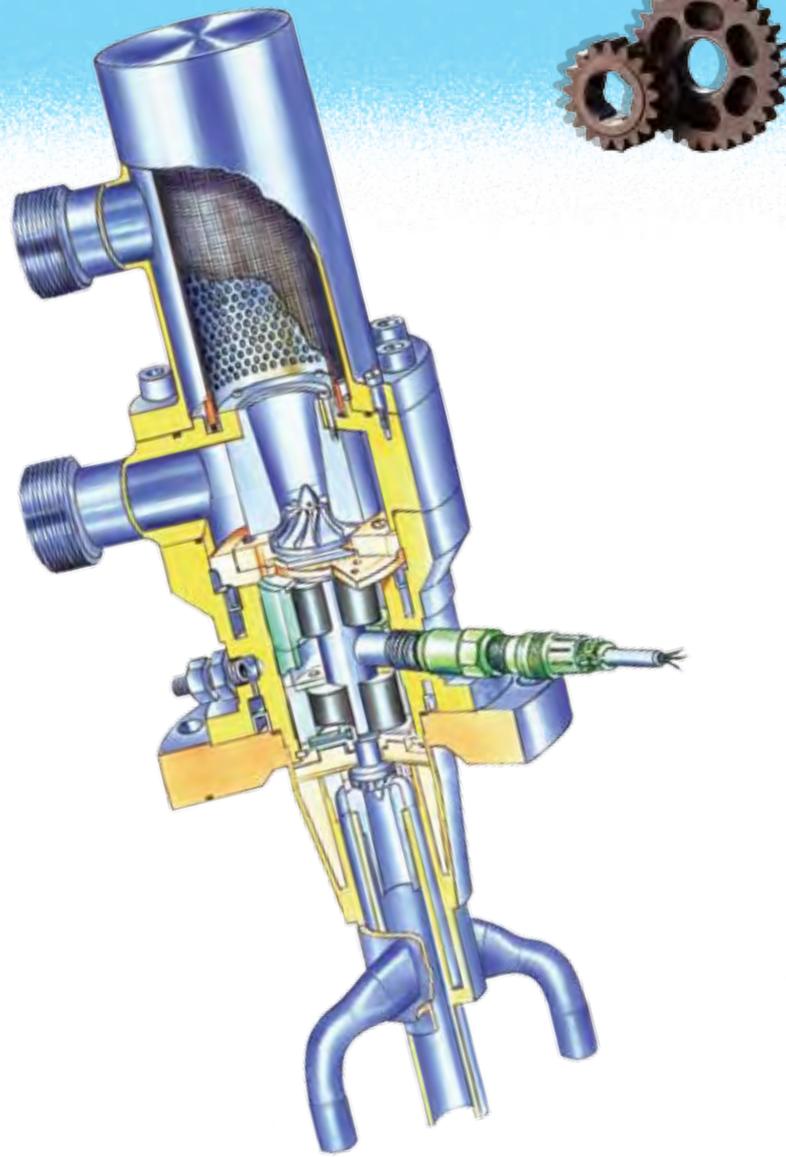
- In commercial electric generators, the copper coils are called the armature.
- The armature spins at 3,600 revolutions per minute.
- All electricity produced is the same, regardless of how it is produced.
- In 1832 Hippolyte Pixii built an early form of alternating current electrical generator.
- Bicycle lights are powered by some of the smallest generators.
- Genset is the combination of an electrical generator and an engine mounted together to form a single piece of equipment.
- Large gensets use various fuel types such as diesel, natural gas, and propane to operate.

Turbine

A turbine is an engine that uses rotational power to produce energy. It is fitted with blades attached to a central shaft. The rotation of the blades by moving fluids (liquid or gas) creates mechanical motion that is converted to other forms of energy. In 1824 French engineer Claude Bourdin coined the term *turbine*.

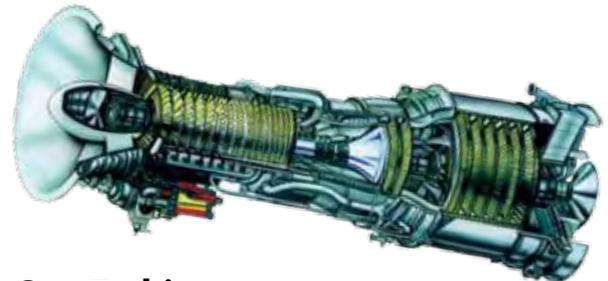
fact scope

- Wind machines were used for grinding grain in Persia as early as 200 BCE.
- The development of the modern water turbines began around 1820.
- A water wheel used for grinding wheat was built in 1744 in India.
- Steam turbines are used for the generation of electricity in thermal power plants.
- In 1872 Dr. F. Stolze designed the first true gas turbine engine.
- A wind turbine is a machine that converts the kinetic energy of the wind into mechanical energy.
- The highest located wind turbine is at 7,546 feet on the Gütisch mountain near Andermatt, Switzerland.
- A turboexpander is a turbine used as sources of refrigeration in industrial processes.
- Water turbines, developed in the 19th century, were widely used for industrial power.



Turbine

The term "turbine" comes from the Latin word *turbinis*. Claude Burdin coined the name during an 1828 engineering competition.



Gas Turbines

Gas turbines are also known as combustion turbines. They are used to power aircraft, trains, ships, electrical generators, and even tanks.



Steam Engine

Steam engines are machines that convert the heat energy of steam into mechanical force. These engines are used in running pumps, turbines, locomotive trains, and ships. In 1765 James Watt, a Scottish inventor and mechanical engineer, improved upon the Newcomen engine. He made a steam engine, which had a separate condenser.



fact scope

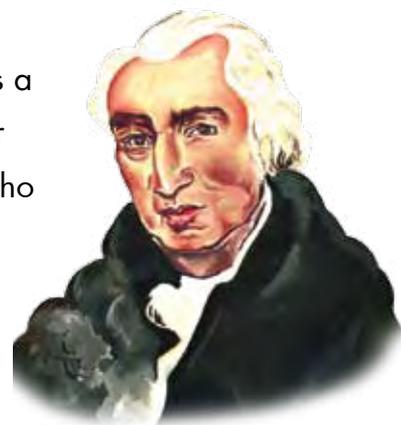
- The first recorded steam device, the aeolipile, was invented by Hero of Alexandria, a Greek, in the 1st century CE.
- Around 1680 French physicists Denis Papin and Gottfried Leibniz invented the world's first-ever pressure cooker. It was a steam digester to soften bones.
- Sir Samuel Morland built a number of steam-engine pumps for King Louis XIV of France in the 1680s.
- Thomas Savery was an English military engineer and inventor, who in 1698 patented the first crude steam engine, based on Denis Papin's pressure cooker of 1679.
- The atmospheric engine invented by Thomas Newcomen in 1712, was the first practical device to use steam power to produce mechanical work.

Cornish Engine

The Cornish engine, built by Richard Trevithick in 1834, is a high-pressure steam engine developed in Cornwall, England, for pumping water from a tin mine.

James Watt

James Watt was a Scottish inventor and engineer who made several improvements to the steam engine.



Electroplating

Electroplating is the process of coating a metal surface by means of electrolysis. Electroplating coats a thin layer of copper, nickel, chromium, gold, silver, or rhodium on the base metal surface. Electroplating provides protection against corrosion and improves the appearance of the materials. Italian chemist Luigi V. Brugnatelli invented modern electrochemistry in 1805.

Electrodeposition

Electrodeposition is the process used in electroplating.



Electropolishing

Electropolishing is the reverse of electroplating. This process polishes a metal surface by removing any amount of material.



fact scope

- John Wright of England discovered that potassium cyanide was a suitable electrolyte for gold and silver electroplating.
- George Elkington and Henry Elkington were awarded the first patents for electroplating in 1840.
- Steel bumpers become more corrosion-resistant when they have been electroplated first with nickel and then chromium.
- Steel bolts that have been electroplated with a coating of zinc or cadmium tend to last much longer.
- Copper wires are electroplated with silver to increase its conductivity.
- Chrome plating is a finishing treatment, which gives a mirror-like finish to items such as metal furniture frames.
- Low voltage separable connectors used in computers and other electronic devices are plated with gold.



Food Preservation



Food preservation is the process of treating food to prevent spoilage. Food deteriorates mostly because of bacteria and fungi. Food preservation techniques prevent or significantly slow down the growth of bacteria in food. Various preservation techniques include canning, freezing, drying, adding salts, pickling, irradiation, and vacuum packing.

Method	Effect on Microbial Growth or Survival
Chilling	Retards growth.
Freezing	Reduction of water activity to prevent growth.
Drying, curing, and conserving	Reduction in water activity; delays or prevents growth.
Vacuum and oxygen free packaging	Delays growth of facultative anaerobes.
Carbon dioxide enriched packaging	Specific inhibition of some micro-organisms.
Sugar preservation	High sucrose concentration makes most microbial survival difficult.
Ethanol preservation	Steeping or cooking in Ethanol produces toxic inhibition of microbes.
Addition of preservatives	Inhibition of specific groups of micro-organisms.
Pasteurization	Sufficient to inactivate target micro-organisms to the desired extent.
Food irradiation	Delivery of ionizing radiation.
Pascalization or application of high hydrostatic pressure	Pressure-inactivation of vegetative bacteria, yeasts and molds.

Drying

Drying is one of the oldest methods of food preservation. It reduces water activity, which is sufficient to delay or prevent bacterial growth.

Smoking

Meat smoking uses a combination of heat to dry the meat without cooking it. It uses aromatic hydrocarbons to preserve the meat.

Microwave Oven



The microwave oven is an oven that uses microwaves to cook or heat food. Percy Spencer, an American engineer working with the Raytheon Company, invented the first microwave oven while working with the magnetron. The magnetron is a device that produces microwave radiation. In 1946 he found microwaves could be used to cook food fast. In 1947 the first commercial oven was sold by the Raytheon Company.



Japan and US

In 1976 more cooking was done with microwave ovens in Japanese homes (17%) than in American homes (4%).



Radarange

The first commercial microwave oven was called a Radarange. The name was the winning entry in an employee contest.

fact scope

- The first microwave oven was 5.25 feet tall, weighed 750 pounds and cost about \$5,000.
- The first microwave oven produced about three times the amount of radiation than ovens today.
- In 1975 for the first time, sales of microwave ovens exceeded that of gas ranges.
- In 1976 the microwave oven reached nearly 60%, or about 52 million U.S. households.
- In 1978 the world's first over-the-range microwave oven was introduced.
- In 1984 General Electric (GE) introduced microwave ovens that could fit under a kitchen wall cabinet.
- GE invented a microwave oven that could recognize voice commands.
- By 2003 GE invented full-size ovens that could cook food up to five times faster than conventional ovens.



Refrigerator



The refrigerator is an electric machine that helps to preserve food. It uses artificial refrigeration to chill food and check bacterial growth. William Cullen at the University of Glasgow demonstrated the first known artificial refrigeration in the mid 1700s. Karl von Linde built the first practical and portable compressor refrigeration machine in Munich in 1873.

fact scope

- Before the refrigerator, people used icehouses to store food.
- In 1805 Oliver Evans designed the first refrigeration machine that used vapor instead of liquid.
- In 1856 James Harrison introduced vapor-compression refrigeration in the meat packing industries.
- Marcel Audiffren of France received U.S. patents for his idea of a refrigerating machine for cooling and preserving foods at home.
- In 1876 Carl von Linden patented the process of liquifying gas, which became the basic refrigeration technology.
- In 1923 Frigidaire introduced the first self-contained refrigeration unit.
- The first refrigerator to be widely used was the Monitor-Top made by General Electric in 1927.
- The introduction of freon expanded the refrigerator market in the 1930s.

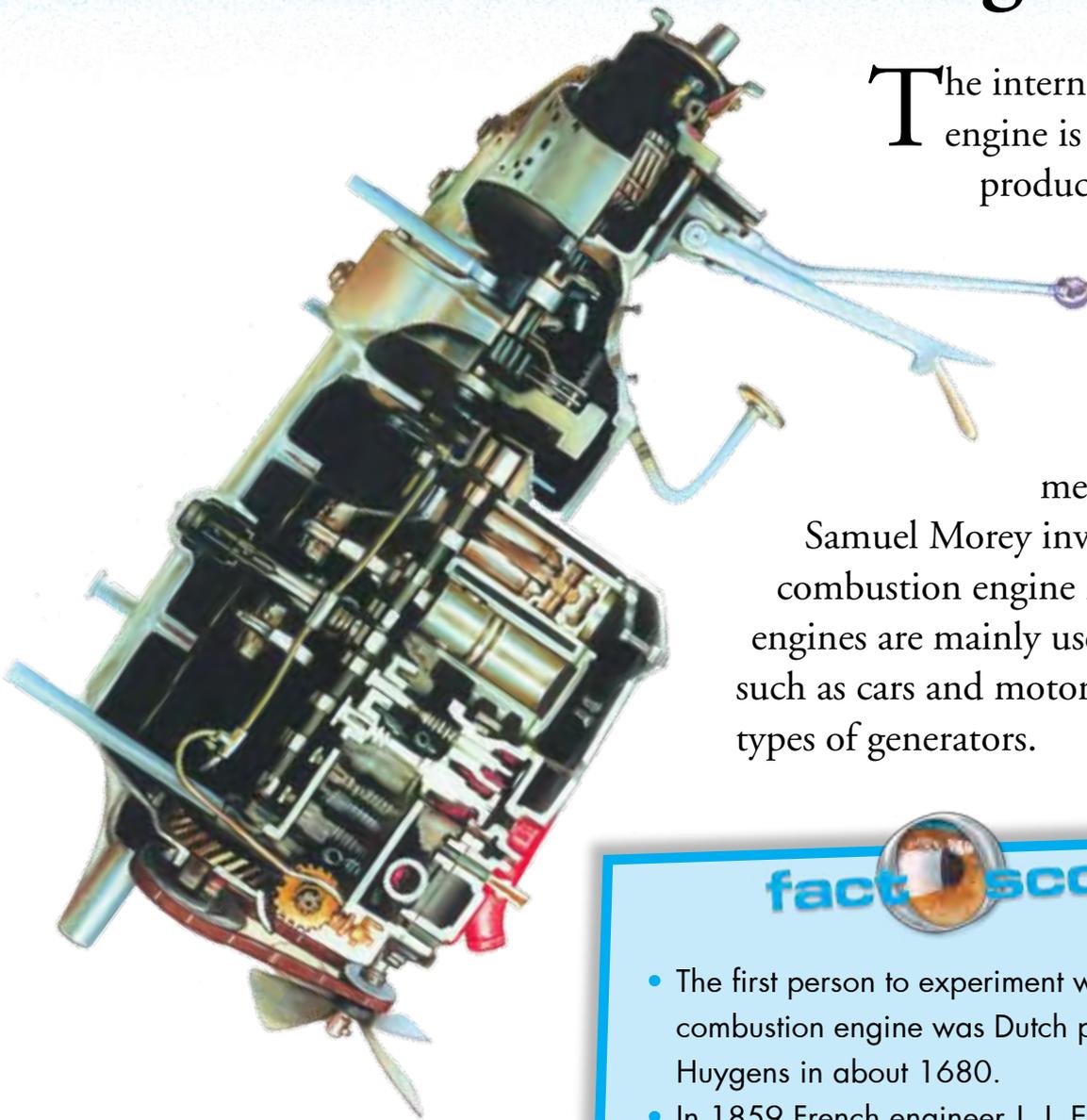
Refrigerator Capacity

The capacity of a refrigerator is measured in liters in Europe and in cubic feet in the United States.

Temperature Settings

The ideal temperature settings for the refrigerator compartment are 36° to 46° F and 0° F for the freezer.

Internal Combustion Engine



The internal combustion engine is an engine that produces heat energy internally by the combustion of fuels. The heat energy is then used to derive mechanical power.

Samuel Morey invented the internal combustion engine in 1826. These engines are mainly used in automobiles, such as cars and motorcycles and several types of generators.

George Brayton

In 1873 George Brayton, an American engineer, developed a two-stroke kerosene engine. It was too large and too slow and failed commercially.

Benz Motorwagen

The first automobile powered by an internal combustion engine was the Benz Motorwagen, built in 1885. Karl Benz patented it on January 29, 1886.

fact scope

- The first person to experiment with an internal-combustion engine was Dutch physicist Christian Huygens in about 1680.
- In 1859 French engineer J. J. Etienne Lenoir built a double-acting, spark-ignition engine.
- In 1862 Alphonse Beau de Rochas, a French scientist, patented a four-stroke engine.
- In 1878 Nikolaus A. Otto built a successful four-stroke engine that became famous as the "Otto cycle."
- In 1878 Sir Dougald Clerk built the first successful two-stroke engine.
- In 1891 Joseph Day simplified Clerk's two-stroke engine. It is still in use today.
- In 1867 Nicholas August Otto developed an improved internal combustion engine.
- In 1885 Gottlieb Daimler constructed the first prototype of the modern gasoline engine.



External Combustion Engine



An external combustion engine is an engine that produces heat energy externally by the combustion of fuels. The heat is then used to derive mechanical power.

The heat produced by the external combustion engine heats a working fluid, such as water. Steam engines and Stirling cycle engines are examples of external combustion engines.

fact scope

- The Stirling engine is an external combustion engine.
- The Stirling engine was invented by Scottish clergyman Rev. Robert Stirling in 1816.
- The Stirling engine works by the repeated heating and cooling of a sealed amount of working gas, usually air, hydrogen, or helium.
- Stirling engines are of three distinct types: alpha Stirling, beta Stirling, and gamma Stirling.
- The English inventor Sir George Cayley is known to have devised air engines around 1807.
- Los Alamos National Laboratory has developed an Acoustic Stirling Heat Engine, which converts heat into intense acoustic power.
- Stirling engines operate at relatively low pressure and thus are much safer than typical steam engines.
- Stirling engines start easily and run more efficiently in cold weather.

Stirling Cycle

The Stirling cycle consists of four thermodynamic processes: compression, heat-addition, isothermal expansion, and heat-removal.

Stirling Engine and Electricity

Stirling engines are used as an economical source of electrical power often utilizing a heat source from an industrial process.

Automobiles

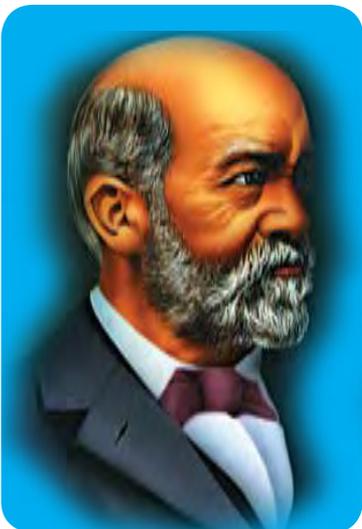


Automobiles are vehicles that are usually powered by gasoline. Automobiles are self-propelled road vehicles that run with the help of an engine, which is usually an internal combustion engine. Nicolas Joseph Cugnot a French engineer invented the automobile in 1769. Different types of automobiles include cars, vans, buses, and trucks.



First Modern Automobile

In 1887 Gottlieb Daimler built a four-wheel vehicle using his internal combustion engine. This vehicle is considered the first modern automobile.



Bertha Benz

Bertha Benz, wife of Karl Benz drove a Benz automobile for 66 miles in 1888. This historic drive is celebrated as an annual holiday in Germany with vintage car rallies.

fact scope

- Cugnot's vehicle could move at a maximum speed of 2.5 mph.
- On August 21, 1879, George Baldwin filed for the first U.S. patent for an automobile.
- The first gasoline pump was installed in Fort Wayne, Indiana, on September 5, 1885.
- Henry Ford built his first automobile in Michigan in 1886.
- The first motor vehicle accident happened in 1771 when Nicolas Cugnot drove his vehicle into a stone wall.
- Robert Anderson of Scotland invented the first electric vehicle between 1832 and 1839.
- In 1873 the first safe and practical oil engine was developed by American engineer, George Brayton.



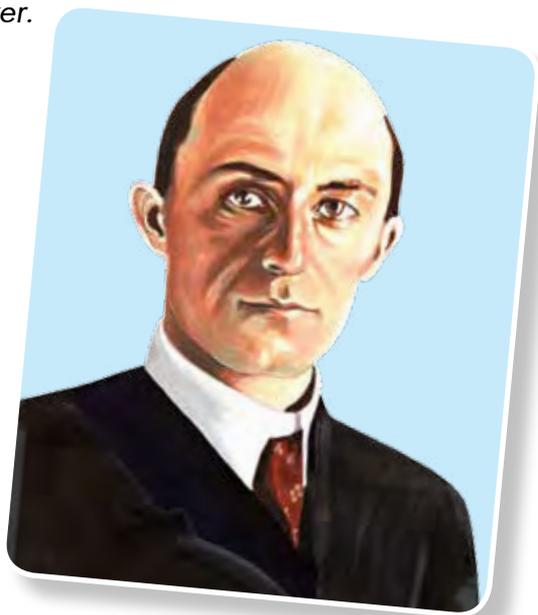
Airplanes

Airplanes are machines that can fly in the air. They have two fixed wings, fuselage or body, control surfaces, landing gear, an engine, and propellers. The wings of the airplane help it to push through the air. Control surfaces control it in the air, while the landing gear allows it to land. Americans brothers Wilbur and Orville Wright invented the airplane in 1903.



Conquering the Sky

On December 17, 1903, the Wright Brothers created history. They became the first to fly a controlled, powered, and heavier-than-air aircraft. The aircraft was known as the *1903 Flyer*.



Men Cannot Fly in 1000 years

Wilbur Wright once commented, "Not within a thousand years would man ever fly."

fact scope

- First powered flight in history by Wilbur and Orville Wright in 1903.
- In 1905 the world's first practical airplane, the *1903 Flyer*, was introduced by the Wright Brothers.
- 1925–1926 saw the introduction of a new generation of lightweight, air-cooled, radial engines that made bigger and faster planes possible.
- On May 21, 1927, Charles Lindbergh flew nonstop across the Atlantic, traveling 3,599 miles from New York to Paris in a Ryan monoplane.
- The first modern commercial airliner was a 10-passenger monoplane introduced by Boeing in 1933.
- Pan American inaugurated the first transpacific mail service between San Francisco and Manila, on November 22, 1935.
- In 1937 jet engines made their first test runs.
- U.S. Air Force pilot Captain Charles "Chuck" Yeager broke the sound barrier on a Bell X-1 on October 14, 1947.

Radio

Devices that send and receive radio waves are called radios. Radio waves travel thousands of miles through the air to transmit data, voice, and video. Radio can broadcast both live and recorded programs. It is one of the more popular means of entertainment. Italian inventor, Guglielmo Marconi, invented a machine that could send and receive radio waves.



fact scope

- German physicist Heinrich Hertz first discovered Radio Waves.
- In 1894 Marconi first experimented with Hertzian Waves.
- In 1895 Marconi sent his first wireless radio transmission at Pontecchio, Italy.
- The first radio transmission were three dots denoting the letter "S."
- In 1896 Marconi while in London, performed his first official experiment from the terrace of the post office to the Salisbury plain.
- Marconi was granted the world's first patent for the radio.
- In 1897 Marconi's signals reached 3, 5, 9, 18, and 62 miles.
- In July 1897 Marconi formed the Wireless Telegraph Trading Signal Co. Ltd.
- In 1898 the first wireless telegraphy was used for journalism for the Daily Express.

First Radio Broadcast

In 1906 Reginald Fessenden broadcast the first program of speech and music transmitted by radio.



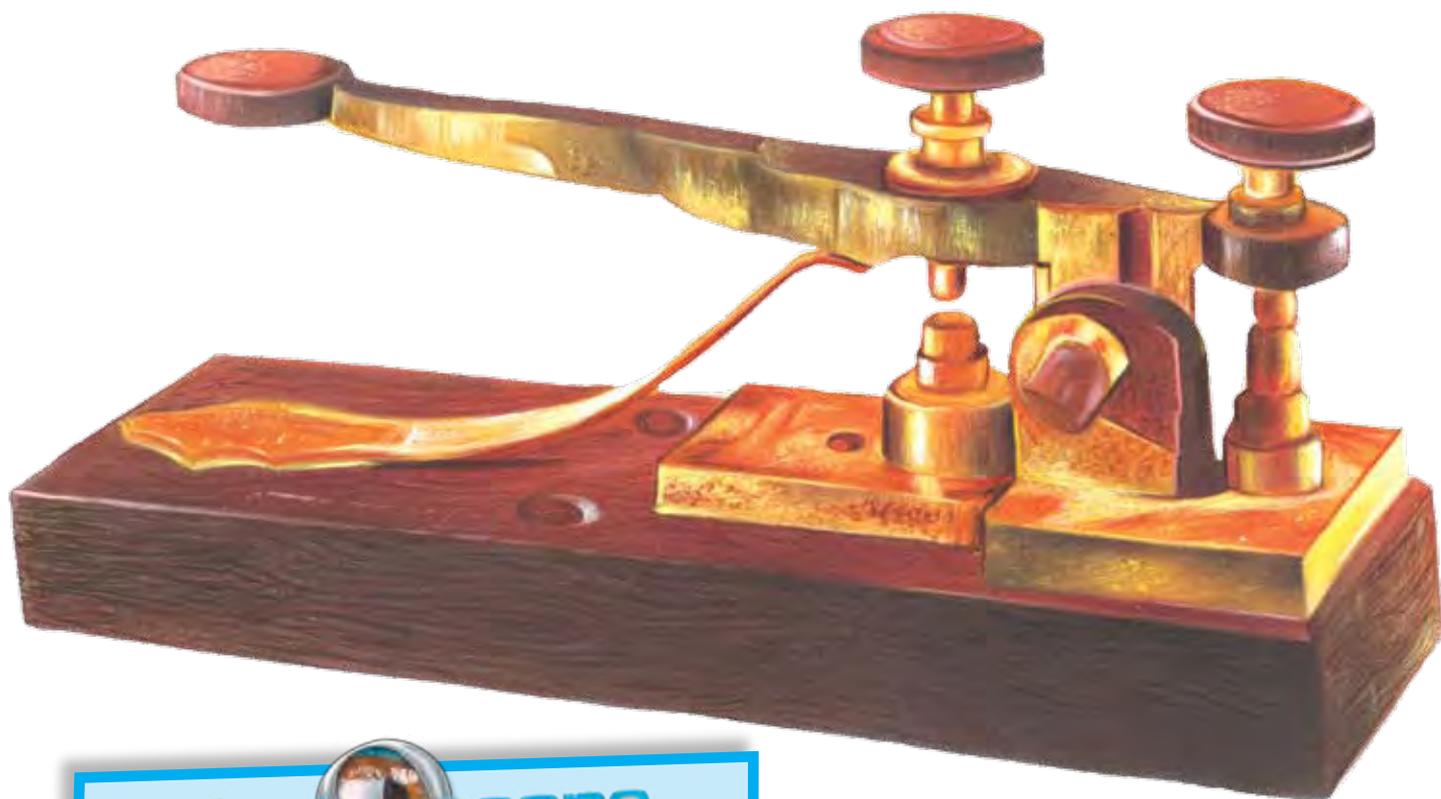
Guglielmo Marconi (1874–1937)

Marconi was an Italian electrical engineer who invented the wireless telegraph. In 1909 he was awarded the Nobel Prize for Physics.



Telegraph

The telegraph is a machine that transmits signals over long distances. These signals represent written messages, numbers, and coded letters. These days, however, telegraphy is being replaced by the quicker and more reliable method of fax and e-mail. In 1835 American inventor, Samuel Morse, invented the telegraph.



fact scope

- Samuel Soemmering sent the first telegraph message in Bavaria, Germany, in 1809.
- In 1828 American Harrison Dyar sent electrical sparks that burned dots and dashes on chemically treated paper.
- In 1831 Joseph Henry invented the first electric telegraph.
- In 1835 Samuel Morse invented Morse code.
- The United States Congress funded a telegraph line between Baltimore, Maryland, and Washington, D.C., in 1838.

Communication Revolution

By 1865 the telegraph had become the greatest means of communication ever. Over 83,000 miles of wire in the USA alone was dedicated to telegraph. At the same time development of the telephone began.

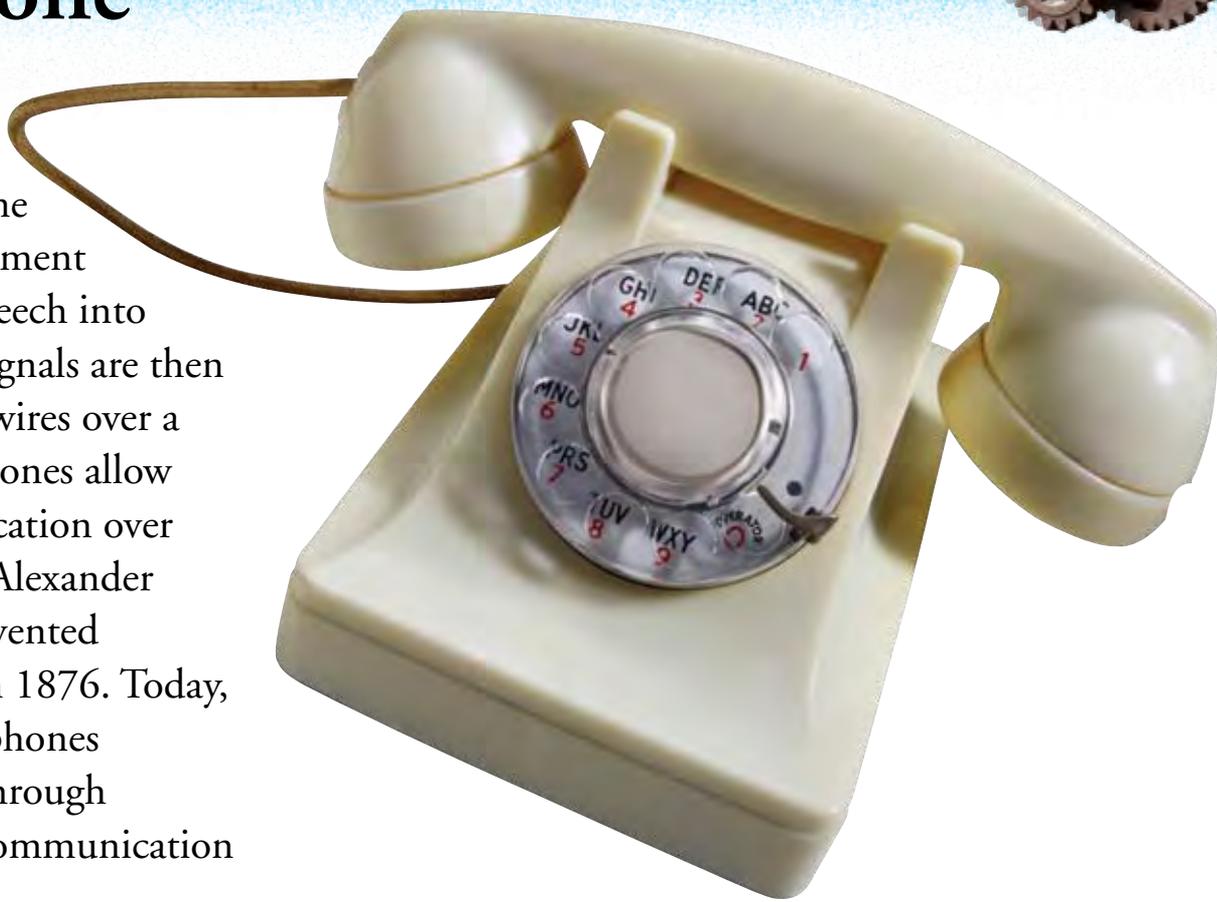
Speed

In 1848 it took around ten weeks to send a message from London to Bombay and get a reply. By 1874 it could be done in four minutes.

Telephone



The telephone is an instrument that converts speech into signals. These signals are then transmitted by wires over a distance. Telephones allow voice communication over long distances. Alexander Graham Bell invented the telephone in 1876. Today, millions of telephones are connected through a complex telecommunication network.



Bell Telephone Company

Alexander Bell established the Bell Telephone Company in 1877.

Das Telephon

Johann Reis, a German scientist, constructed some of the earliest forms of telephones. He made a device called *das Telephon* or the telephone in 1860.

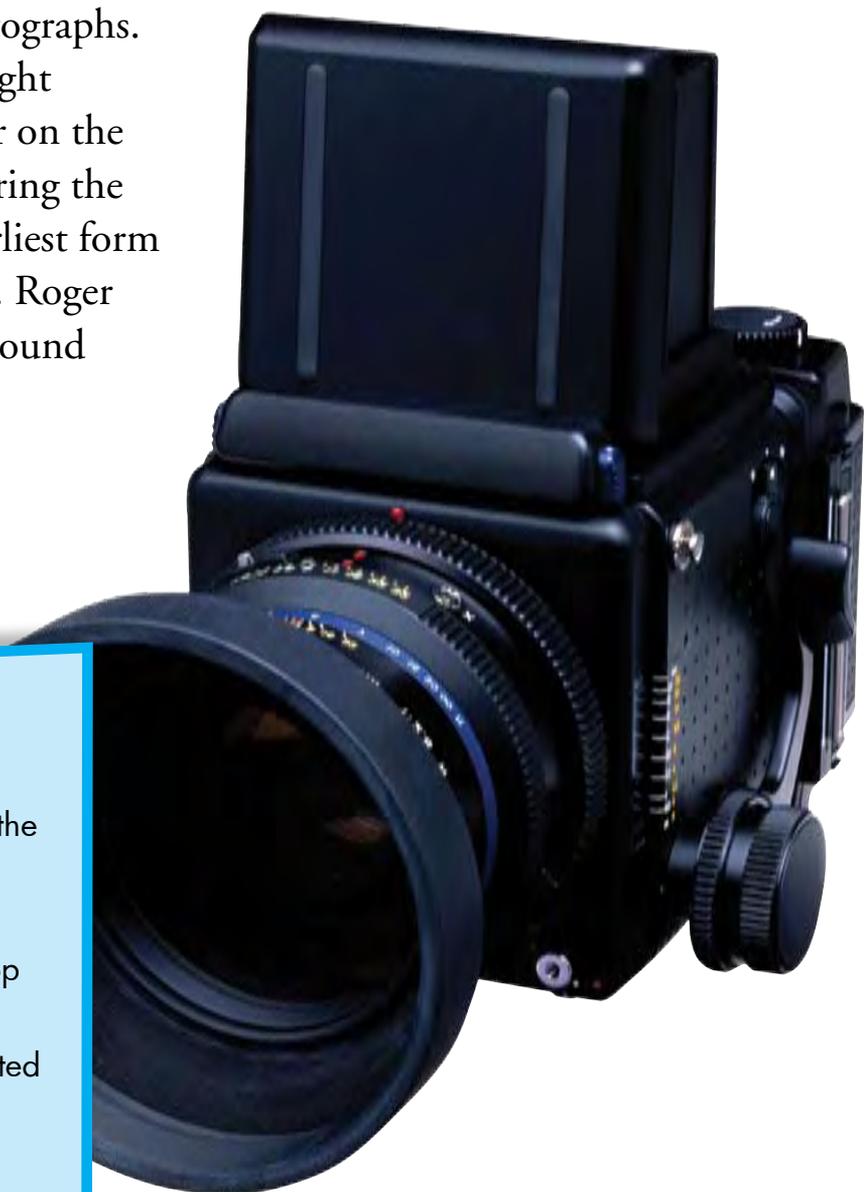
fact scope

- Optical fibers can carry 100,000 telephone calls at the same time.
- The first person to have a home telephone was Edwin T. Holmes of Boston.
- Antonio Meucci demonstrated a device to people in Havana in 1849 and in New York in 1854. This device was later called a telephone.
- The first regular telephone exchange was established in 1878 in New Haven, Connecticut.
- In 1884 long distance connections were made between Boston, Massachusetts, and New York City.



Camera

Cameras are devices that take photographs. Cameras have lenses that focus light from an object onto films. The shutter on the lens controls the amount of light entering the camera and exposing the film. The earliest form of the camera was the camera obscura. Roger Bacon invented the camera obscura around the year 1300 to study solar eclipses.



fact scope

- In 1888 George Eastman introduced the Kodak Camera.
- In 1947 Dr. Edwin H. Land invented the Polaroid camera that could develop photographs in sixty seconds.
- In the 1960s Dr. Edwin H. Land invented the color Polaroid camera.
- In 1685 Johann Zahn built the first practical portable camera.
- In 1850 Frederick Scott Archer reduced exposure time dramatically by developing the collodion wet plate process.
- The most popular 35 mm movie cameras in use today are Arriflex, Moviecam, and Panavision models.
- In 1843 the first advertisement with a photograph was made in Philadelphia.
- In 1927 General Electric invented the modern flash bulb used in cameras.

First Photograph

A French inventor named Joseph Nicéphore Niépce produced the first photograph in 1826.

Disposable Camera

The disposable camera is a camera that can be used only once. It was invented jointly by Kodak and Fujifilm in the mid-1980s.

Fountain Pen



Fountain pens are writing instruments. Fountain pens carry their own supply of ink. Ink is filled with the help of a dropper. Most modern fountain pens have a disposable cartridge or a removable ink reservoir. Lewis Waterman invented the first practical fountain pen in 1884.



Conklin Crescent-Filler

Roy Conklin invented the Conklin crescent-filler in 1897. It was the first successful self-filling pen that used a flexible rubber ink sac.

Parker 51

The Parker 51, made in 1941, is one of the best fountain pens ever made. It was named because the research and development was completed in Parker's 51st year.

fact scope

- The first pens were bamboo tubes cut into cylindrical shapes.
- The Sultan of Egypt used the earliest form of a reservoir pen in 953 CE.
- In 1636 Daniel Schwenter described a pen made from two quills in his *Delicia Physic-Mathematicae*.
- Quill pens were made from the shaft of a bird's feather, most often a goose.
- George Stafford Parker founded the Parker Pen Company in Janesville, Wisconsin, in 1891.
- The Conklin crescent-fillers were the first mass-produced self-filling pen.
- William B. Purvis, an African American, is credited with inventing the ink-feeding tube in 1890.
- Romanian Petrace Poenaru invented the fountain pen as a student in Paris.



Television

Televisions broadcast moving pictures and sounds. Televisions have antennas that receive these radio waves. These radio waves are then changed into moving pictures and sounds by the television. Television stations record pictures and sounds and convert them into radio waves. On October 2, 1925, Scottish John Logie Baird transmitted the first television pictures.



fact scope

- On January 23, 1926, John Logie Baird gave the world's first public demonstration of a mechanical television apparatus.
- In 1927 Philo Farnsworth filed for a patent on the first complete electronic television system.
- In 1929 Vladimir Zworykin demonstrated the first practical electronic system for television.
- In 1929 John Baird opened the first TV studio.
- 600 million people watched the first TV transmission from the Moon on July 20, 1969.
- In 1939 television was first introduced to the public in the World's Fair in New York City.
- On April 9, 1927, the first long distance use of TV was conducted between Washington, D.C., and New York City.

TV Transmission

The BBC (British Broadcasting Corporation) began regular TV transmissions in 1930. Charles Jenkins broadcast the first TV commercial in the same year.

Cable Television

In 1948 cable television was introduced in Pennsylvania. It was originally meant to bring television to rural areas.

Thermometer

The thermometer is a device that measures temperature. They are usually filled with a liquid that expands when heated and contracts when cooled. This way the liquid column in the thermometer rises or dips depending on the temperature. Galileo Galilei invented the thermometer in 1593.



fact scope

- Thermometers are calibrated in standard temperature units such as Fahrenheit or Celsius.
- Sealed thermometers did not come into existence until about 1650.
- English physician, Sir Thomas Allbutt, invented the first medical thermometer used for taking the temperature of a person in 1867.
- German physicist, Gabriel Fahrenheit, proposed the Fahrenheit scale in 1724.
- Swedish astronomer, Anders Celsius, devised the Celsius scale used in thermometers in 1742.
- Galileo Galilei's thermometer consisted of water in a glass bulb. The water moved up and down the bulb as the temperature changed.
- The optical pyrometer is used to measure temperatures of solid objects at temperatures above 1292° F.
- David Phillips invented the infrared ear thermometer in 1984.
- Various thermistors made of oxides of nickel, manganese, or cobalt are used to sense temperatures between -51° and 302° F.



Modern

Thermometers

German physicist, Gabriel Fahrenheit, invented the modern alcohol and mercury thermometers.

Ear Thermometer

Theodore Hannes Benzinger invented the ear thermometer. Dr. Jacob Fraden invented the world's best-selling ear thermometer, the Thermoscan® Human Ear Thermometer.



Stethoscope



The stethoscope is a medical instrument. It transmits low-volume sounds of the heart, lungs, and intestine to the ear of the listener. The stethoscope aids in diagnosing certain diseases and conditions. René Laennec invented the stethoscope in France in 1816.

Stethoscope

The word stethoscope is derived from the Greek word *stethos*, which means chest.

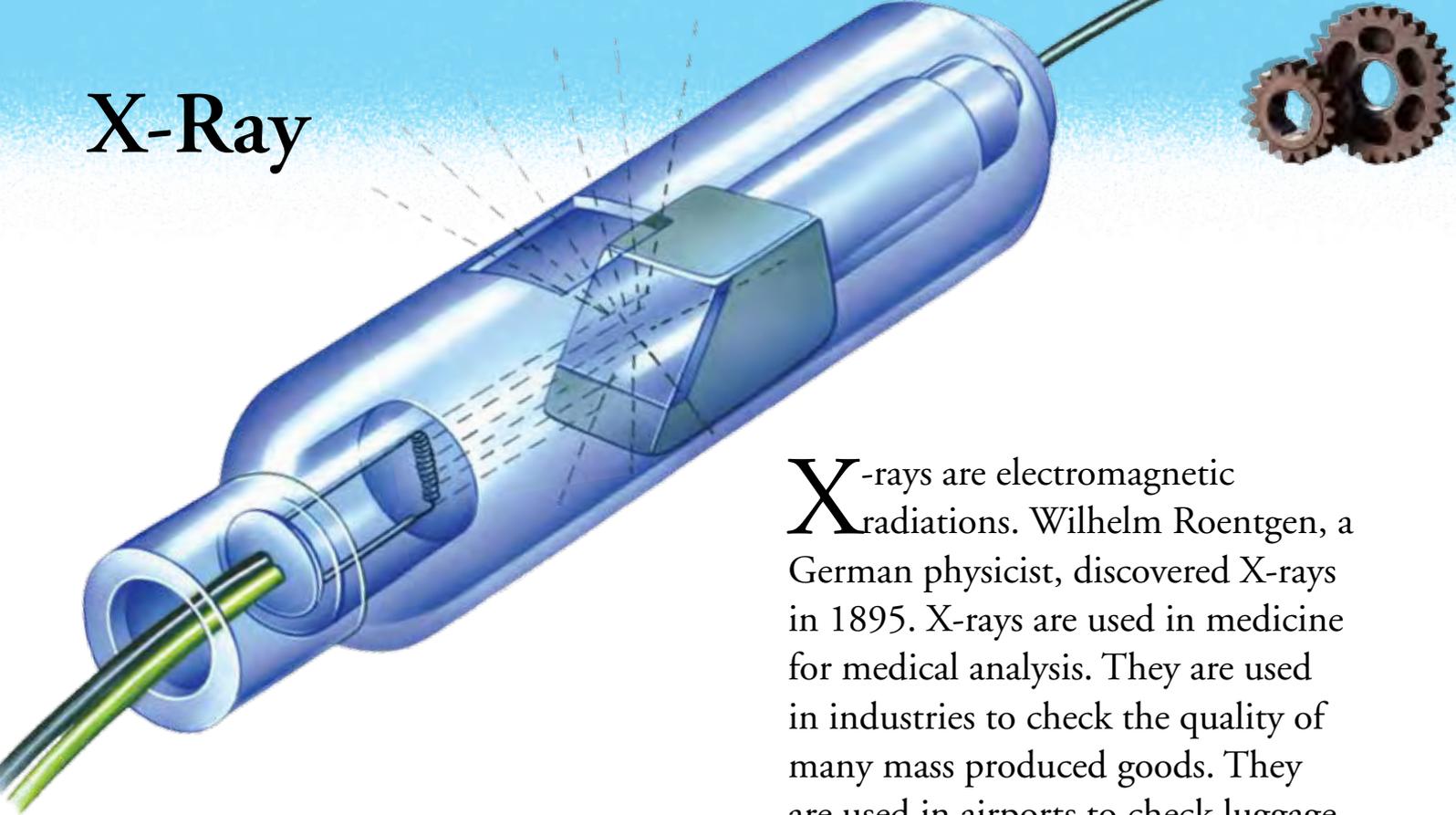
Types of Stethoscopes

There are two types of stethoscopes: acoustic and electronic. Acoustic stethoscopes use a chest-piece to listen to sounds. Electronic stethoscopes convert acoustic sound waves to electrical signals, which are then amplified and processed for optimal listening.

fact scope

- The two-sided stethoscope was invented by Rappaport and Sprague in the early part of the 20th century.
- In 1851 Arthur Leared invented the binaural stethoscope.
- In 1852 George Cammann perfected the binaural stethoscope for commercial production.
- By 1873 the differential stethoscope was invented by Scott Alison.
- A Harvard Medical School professor, Dr. Littmann, invented the modern light stethoscope in the 1960s.
- A normal heart sounds like “lub-dub.”
- Abnormal lung sounds include crackles, wheezes, and friction rubs.
- Friction rubs are sounds that can be heard when there is an infection in the lungs.
- Wheezes are whistling noises and are heard in the case of airway diseases like bronchitis.
- Crackles are sounds indicating the evidence of fluid in the lungs.

X-Ray



X-rays are electromagnetic radiations. Wilhelm Roentgen, a German physicist, discovered X-rays in 1895. X-rays are used in medicine for medical analysis. They are used in industries to check the quality of many mass produced goods. They are used in airports to check luggage. Scientists and archaeologists also use X-rays to examine materials.

X-ray Microscope

The X-ray microscope is an instrument that produces images of very small objects using X-rays. It was first developed by Kirkpatrick and Baez in 1948.



CAT Scanning

CAT scanning is a method of taking X-ray images using computers. It produces three-dimensional images of the body.

fact scope

- In April 1887 Nikola Tesla began to investigate X-rays using high voltages and vacuum tubes.
- The first X-ray photograph was of Mrs. Roentgen's hand. The photograph exposed her wedding ring and her bones.
- X-ray photographs are known as radiographs or skiagraphs.
- X-rays blacken the photographic plate where they penetrate the body parts. The plate is white where the X-rays are blocked.
- Swedish physicist, Karl Manne Georg Siegbahn, discovered that X-rays are refracted like light rays when they pass through prisms.



Radium



Radium is an alkaline metal that is highly radioactive. Radium emits three kinds of radiation: alpha particles, beta particles, and gamma rays. It is found in minute amounts in uranium ores. It is the heaviest of all alkaline earth metals. Marie Curie and her husband Pierre discovered radium in 1898.

fact scope

- Henri Becquerel discovered radioactivity in 1896.
- Ernest Rutherford discovered alpha and beta radiation.
- James Chadwick discovered neutron as a product in 1932.
- Hans Bethe and C. Critchfield made the first complete analysis of the proton-proton reaction.
- In December 1938 Otto Hahn, Fritz Strassman, and Lise Meitner demonstrated nuclear fission.
- In December 1942 Fermi demonstrated a nuclear chain reaction at the University of Chicago.
- On August 6, 1945, an atomic bomb was dropped on Hiroshima, Japan.

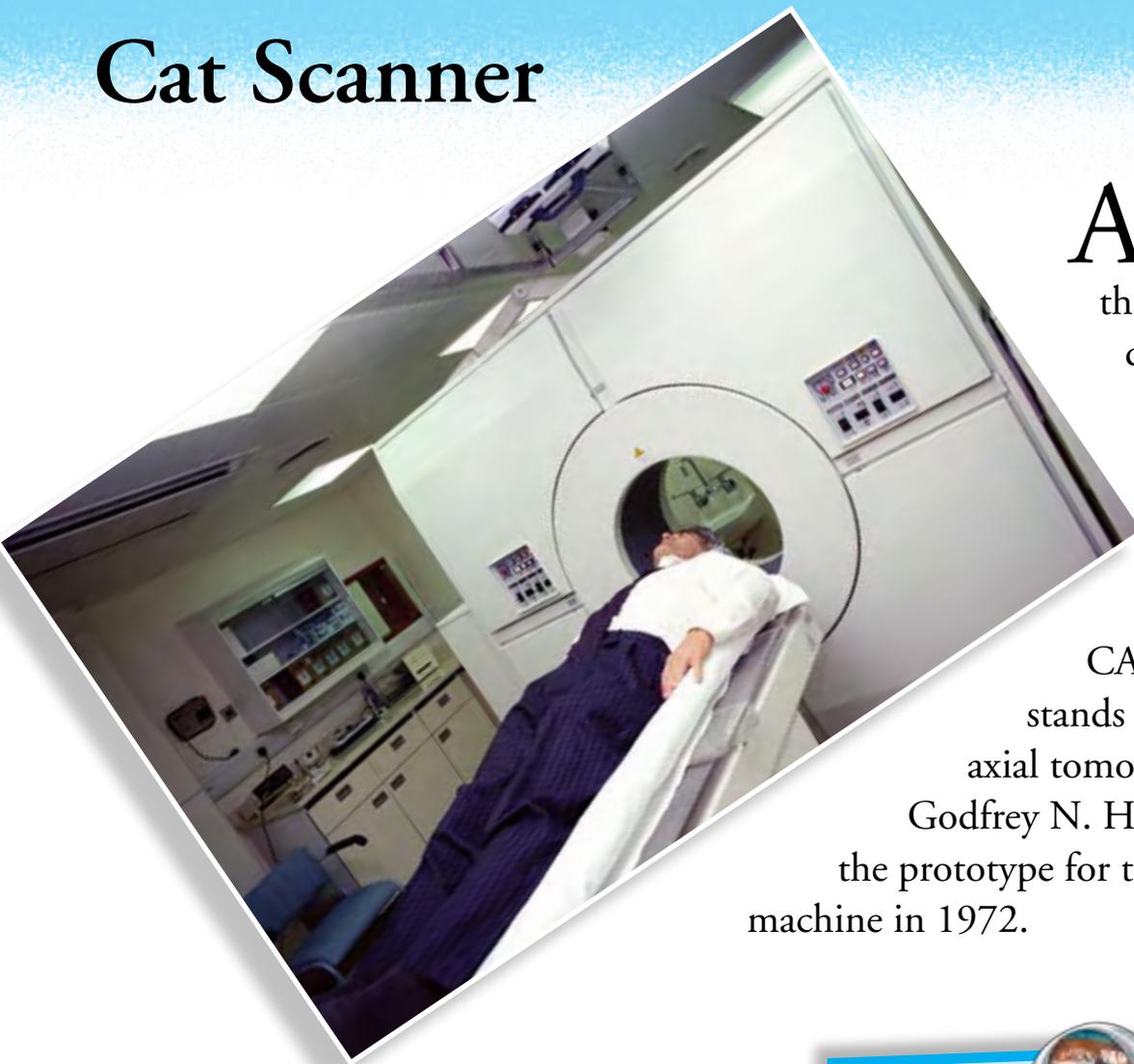
First Atomic Laboratory

In November 1942 the first atomic laboratory was set up in Los Alamos, New Mexico. Robert Oppenheimer was chosen as the director.

First Atomic Bomb

On July 16, 1945, the first atomic bomb was exploded by the United States in Alamogordo, New Mexico.

Cat Scanner



A CAT scanner is a medical machine that produces three-dimensional images of the body. It uses X-rays and more than 300 to 600 detectors to produce images.

CAT scan or CT scan stands for computerized axial tomography. Sir Godfrey N. Hounsfield built the prototype for the first CAT scan machine in 1972.

Tomography

The word tomography is derived from the Greek words, *tomos* (slice) and *graphia* (describing).

Metal Testing

CT or computed tomography is also used in other fields such as nondestructive materials testing.



fact scope

- CT imaging can show several types of tissue—lung, bone, soft tissue, and blood vessels—with great clarity.
- The first production X-ray CT machine, called the EMI scanner, was limited to making tomographic sections of the brain.
- The first X-ray CT machine was installed in Atkinson Morley's Hospital in Wimbledon, England.
- The first CT system that could make images of any part of the body was the ACTA scanner designed by Robert S. Ledley, DDS at Georgetown University.



Lasers



Laser is the acronym for Light Amplification by Stimulated Emission of Radiation. Laser devices can amplify light and emit very high-energy light beams. Laser is useful in surgical operations, scientific research, military, and telecommunications. American physicist, Theodore Harold Maiman, invented the world's first laser in 1960.

Name

Gordon Gould, an American physicist, coined the word "laser."

First Laser

Theodore Maiman used a synthetic ruby rod to build the first working laser. The rod was silvered at both ends to reflect light. The laser got the energy from a flash lamp.

fact scope

- Laserdisc is an optical disc that is used to store video images.
- The first gas laser was built by Ali Javan, a physicist at the Massachusetts Institute of Technology in 1960.
- In 1961 a laser was used for the first time to destroy a human patient's retinal tumor.
- In 1962 General Electric, IBM, and MIT's Lincoln Laboratory simultaneously developed a gallium arsenide laser that is now used in CD players, DVD players, and laser printers.
- In 1974 bar-coded products were introduced in America. The codes were read using laser technology.

Dynamite



Dynamite is a powerful high explosive. It is called high explosive because it is more powerful than gunpowder. Dynamite has many uses in construction, mining, and demolition. Swedish chemist and engineer Alfred Nobel invented dynamite in 1867.



fact scope

- Dynamite is made from nitroglycerin.
- Italian chemist Ascanio Sobrero first invented nitroglycerin in 1846.
- In 1865 the Nobel Company built the first factory that made nitroglycerin and later dynamite.
- In 1866 Alfred Nobel discovered that mixing nitroglycerin with silica would turn the liquid into a paste, called dynamite.
- Albert Nobel received U.S. patent number 78317 for his dynamite.
- For several decades, the biggest producer of dynamite in the world was the Republic of South Africa.
- Dynamite is dangerous to manufacture.

Dynamite Stick

Dynamite is usually sold in the form of a stick. It is usually about 8 inches long and .75 inches in diameter.

Name

The word dynamite comes from the Greek word *dunamis*, meaning power.

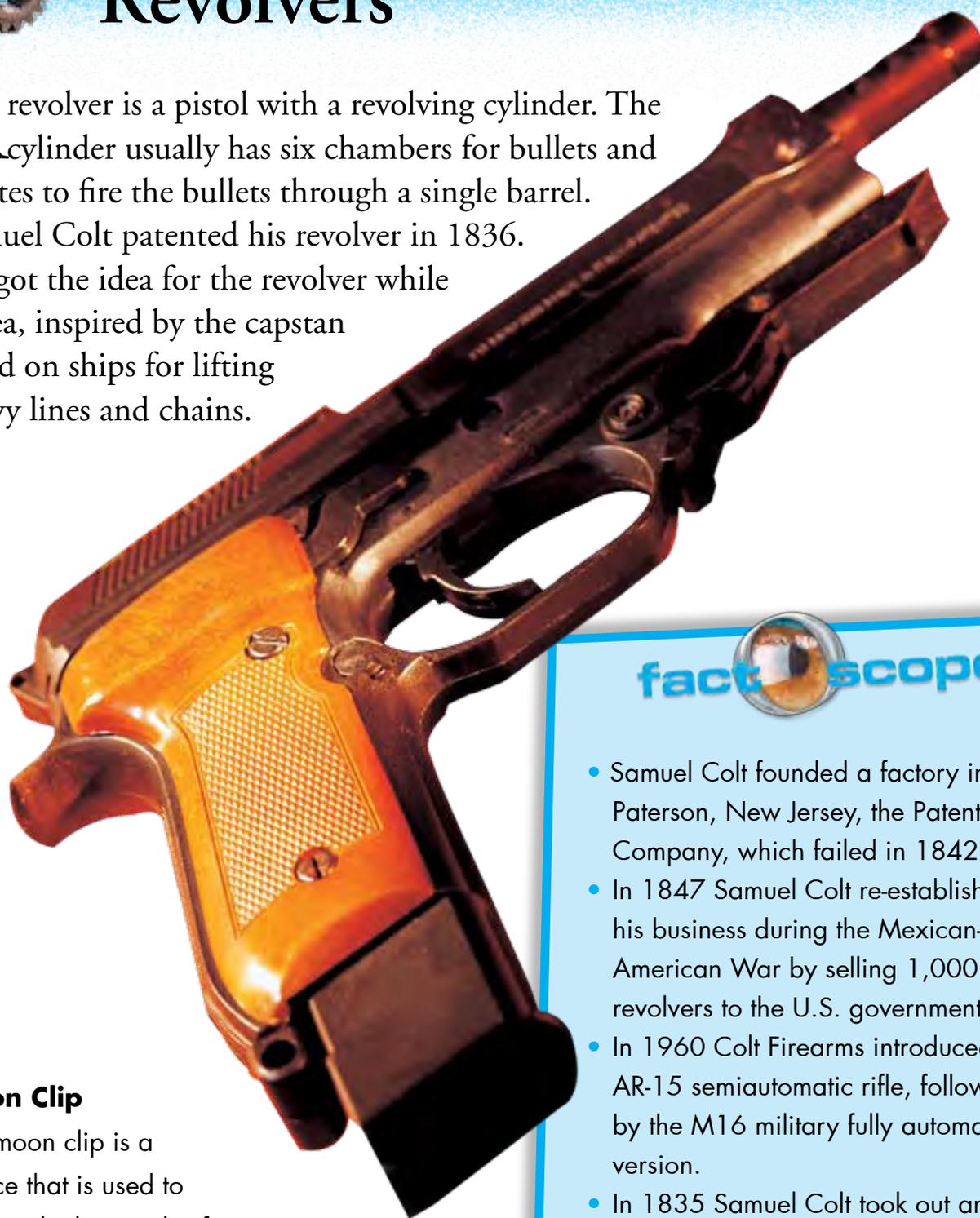


Revolvers

A revolver is a pistol with a revolving cylinder. The cylinder usually has six chambers for bullets and rotates to fire the bullets through a single barrel.

Samuel Colt patented his revolver in 1836.

He got the idea for the revolver while at sea, inspired by the capstan fitted on ships for lifting heavy lines and chains.



fact scope

- Samuel Colt founded a factory in Paterson, New Jersey, the Patent Arms Company, which failed in 1842.
- In 1847 Samuel Colt re-established his business during the Mexican-American War by selling 1,000 revolvers to the U.S. government.
- In 1960 Colt Firearms introduced the AR-15 semiautomatic rifle, followed by the M16 military fully automatic version.
- In 1835 Samuel Colt took out an English patent for his single-barrelled pistol and rifle.
- The swing-out cylinder is the most common method of loading and unloading a revolver.
- The Webley Fosbery automatic revolver was the first automatic revolver to be marketed in 1901.

Moon Clip

The moon clip is a device that is used to store multiple rounds of ammunition in a revolver.

Caliber

The caliber of a revolver is the measurement of the inside diameter of its barrel in inches or sometimes in millimeters.

Guided Missile



Guided missiles are rocket-propelled missiles that can be controlled during flight. The path of the missile is controlled either by radio signals or by internal devices. These missiles are very deadly because they can even chase and destroy a moving target such as an airplane. During World War II, Germany developed the first guided missiles used in combat.

fact scope

- Anti-Tank Guided Missiles are guided missiles developed primarily to hit and destroy armored tanks.
- The Kettering Bug was the first cruise missile developed in 1917 by the USA.
- Laser guidance is a technique of guiding a missile to its target by means of a laser beam.
- Fire-and-forget is a third-generation method of missile guidance in which the user has to simply fire the missile and then can forget about it. It will still correctly strike the target.
- Staring Array Missile Guidance System uses sensors, usually infrared light sensing, to guide a missile.
 - Terrain Contour Matching is a navigation system used to increase the accuracy of a missile by using an on-board map of the terrain.

Ballistic Missile

Ballistic missiles are guided only during the powered phase of their flight.

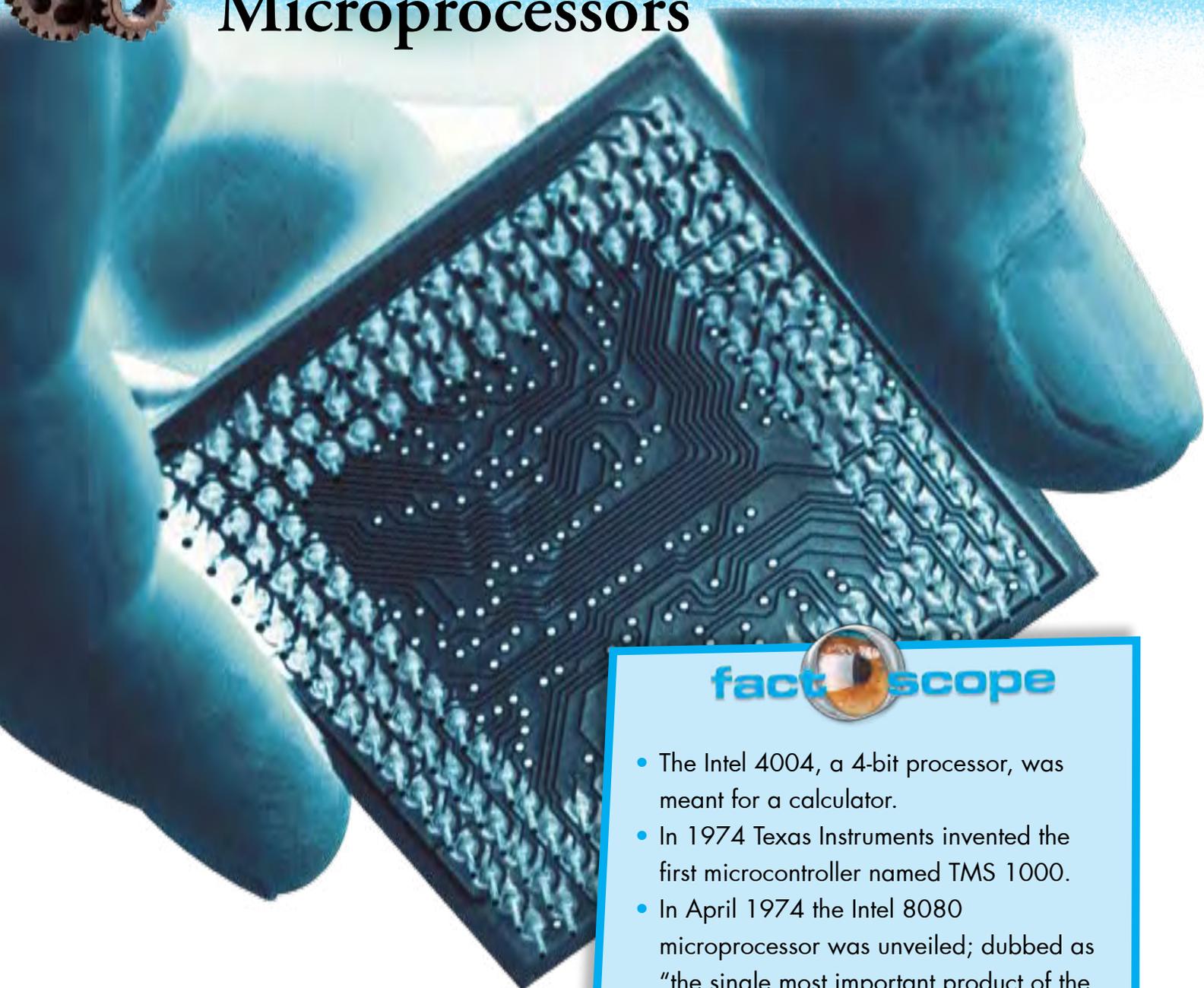
Cruise Missile

Cruise missiles are guided missiles that are designed to carry a conventional or nuclear warhead. They can hit their targets hundreds of miles away with deadly accuracy.





Microprocessors



fact scope

- The Intel 4004, a 4-bit processor, was meant for a calculator.
- In 1974 Texas Instruments invented the first microcontroller named TMS 1000.
- In April 1974 the Intel 8080 microprocessor was unveiled; dubbed as "the single most important product of the 20th century."

Microprocessors are electronic circuits that can perform arithmetic calculations and control programs with great accuracy. It is often referred to as a logic chip or master chip. It acts as an engine of the computer. The world's first single chip microprocessor, Intel 4004, was introduced by Intel Corporation in 1971.

TMS 1000

The TMS 1000 was a 4-bit processor and the first microprocessor to include enough RAM and space for a program ROM.

Pioneer

On September 12, 1958, Jack Kilby of Texas Instruments demonstrated the world's first integrated circuit. It was about .5 inches long and thinner than a toothpick.

Computer



A computer is a machine that stores and manipulates data. Computers use a set of instructions called a program to perform mathematical and logical operations. Computers need software and hardware to accomplish different tasks. Hardware consists of the electronic parts, while programs are a part of software. Charles Babbage, an English computer scientist, designed the first mechanical computers in 1822.



fact scope



- The Z1 computer, the first freely programmable computer, was invented by Konrad Zuse in 1936.
- The Mark I computer, designed by Howard Aiken and Grace Hopper in 1944, was 55 feet long, 8 feet high and weighed around 11,023 pounds.
- The ENIAC 1 computer, built in 1946 for the US military, was the first general purpose electronic computer.
- In 1958 Jack Kilby and Robert Noyce invented the Integrated Circuit.
- In 1962 Steve Russell from MIT invented the first computer game called Spacewar Computer Game.
- In 1964 Douglas Engelbart invented the computer mouse.

Transistors

In 1947 William Shockley, John Bardeen, and Walter Brattain built the first practical transistor at Bell Labs. All the second generation of computers used transistors.

Computer Language

Computer language is a language or set of commands used to develop software for computers.



Optical Fiber



Optical fibers are thin filaments of glass that are used as communication cables. They use light beams to transmit audio, video, and data. They work on the principle of total internal reflection. They have enormous data carrying capacity at low-cost. In 1930 Heinrich Lamm, a German student, became the first person to use optical fibers to carry an image.

fact scope

- In 1961 researchers Elias Snitzer and Will Hicks demonstrated a laser beam directed through a thin glass fiber.
- In 1966 Charles Kao and George Hockham demonstrated that optical fiber can transmit laser signals.
- In 1970 scientists Donald Keck, Peter Schultz, and Robert Maurer reported the creation of optical fibers that meet the standards set by Kao and Hockham.
- In 1973 John MacChesney and Paul O'Connor at Bell Laboratories developed an ultra-transparent glass that can be mass-produced into low-loss optical fiber.
- In 1977 telephone companies began fiber optic trials.

Skeptical Scientists

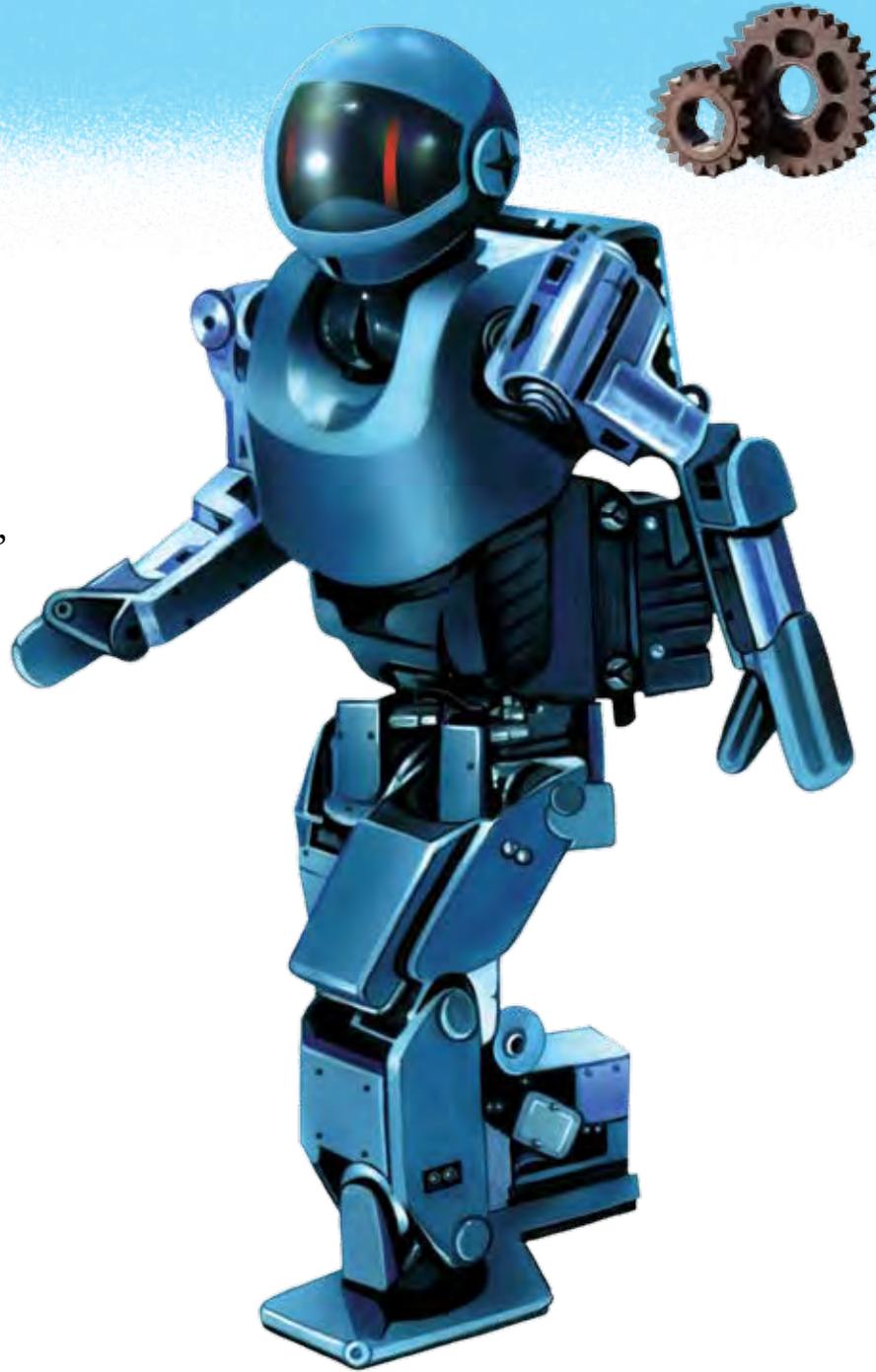
When Snitzer and Hicks gave their demonstration, most scientists believed that optical fibers were unsuitable for communications across long distances.

Heterostructures

In 1963 Physicist Herbert Kroemer proposed the idea of heterostructures. These heterostructures are used in cell phones and other electronic devices.

Robots

Robots are devices that perform complex tasks using artificial intelligence. They are either pre-programmed or work under human supervision. Robots are used in different industries such as medicine, manufacturing, entertainment, and household. Grey Walter at Bristol University, England, created the first electronic autonomous robots in 1948.



fact scope

- In 400 BCE philosopher and mathematician Archytas of Tarentum built a wooden dove that could flap its wings and fly.
- In 1543 John Dee from England created a wooden beetle that could fly.
- In 1949 British robotics pioneer William Grey Walter created autonomous machines that could mimic life-like behavior.
- In 1954 George Devol and Joe Engleberger created the world's first industrial robots.
- In 1966 Shakey, the world's first mobile robot that could reason with its surroundings, was built by Stanford Research Institute.

Artificial Intelligence

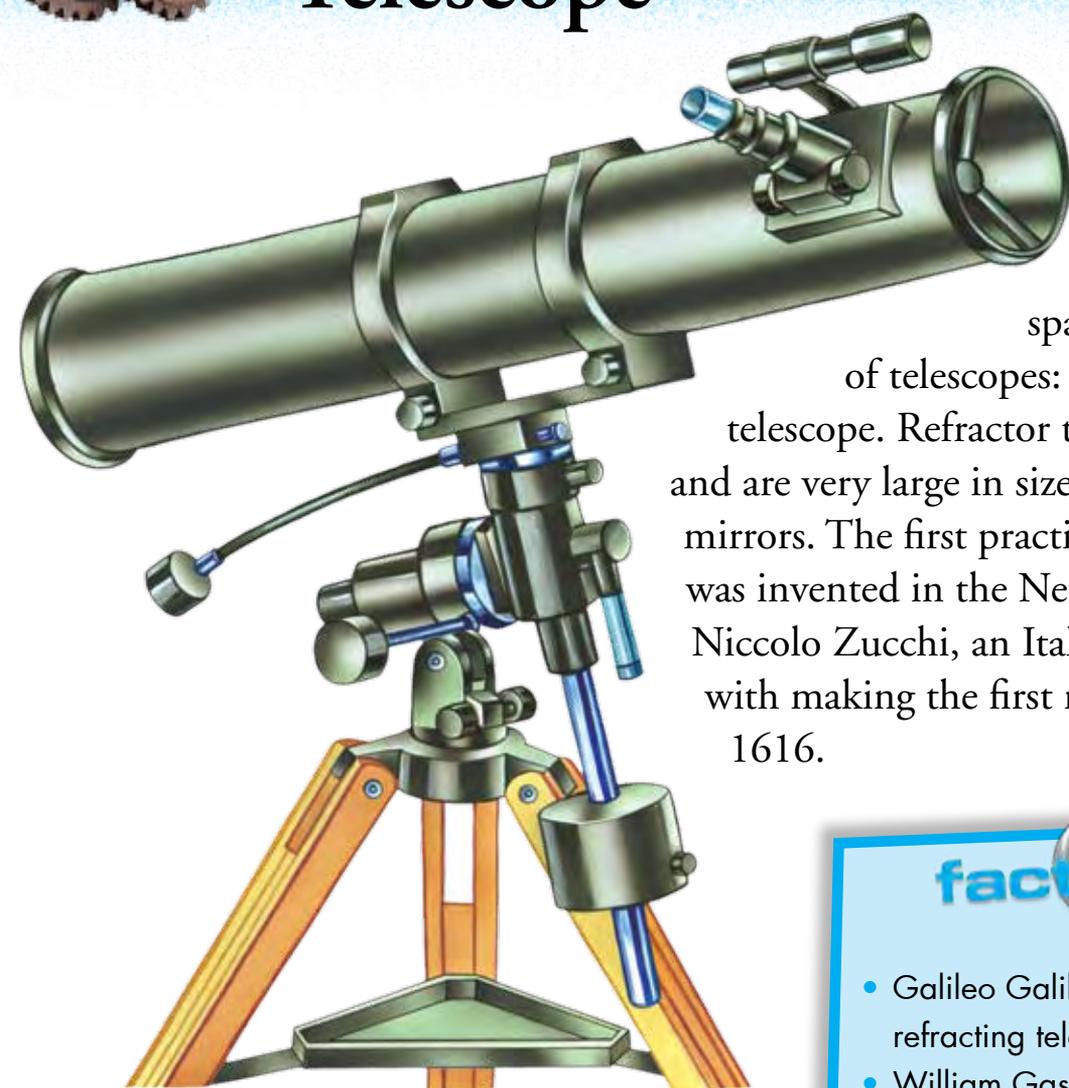
In 1956 Marvin Minsky and John McCarthy organized a conference of robotics and machine research in Dartmouth, Massachusetts. The phrase "artificial intelligence" was coined in the conference.

Iron Fly

German scholar Johann Müller is believed to have invented robots. He built an iron fly and an artificial eagle, which supposedly could fly.



Telescope



The telescope is an astronomical device that is used to see distant objects in space. There are two types of telescopes: the refractor and reflector telescope. Refractor telescopes use lenses only and are very large in size. Reflector telescopes use mirrors. The first practical refracting telescope was invented in the Netherlands about 1608. Niccolo Zucchi, an Italian monk, is credited with making the first reflector telescope in 1616.

First Refracting Telescopes

Hans Lippershey, Zacharias Janssen, and Jacob Adriaanszoon are credited with the invention of the first refracting telescope.

Many Moons

Until 1610 humans knew of only the moon. However, when Galileo Galilei discovered the four main moons of Jupiter, humans realized that there were many moons in the solar system. Today we know of 162 moons orbiting the eight major planets.

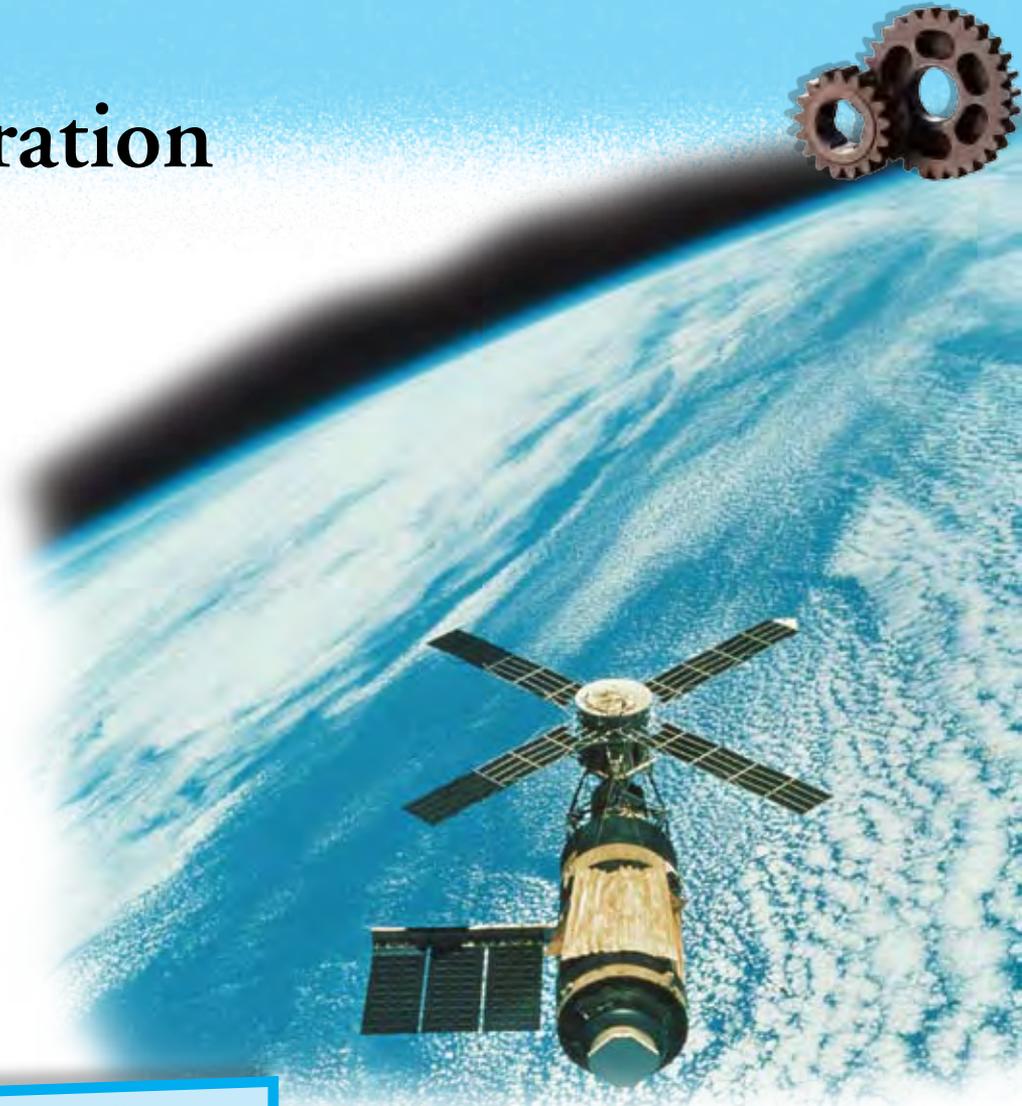
fact scope

- Galileo Galilei built his first optical refracting telescope in 1609.
- William Gascoigne invented the telescope cross hairs in 1641.
- James Gregory proposed an optical reflecting telescope in 1661.
- In 1668 Isaac Newton constructed the first optical reflecting telescope.
- Laurent Cassegrain designed the Cassegrain telescope in 1672.
- Chester Moor Hall invented the achromatic lens refracting telescope in 1733.
- William Herschel finished a 4 foot optical reflecting telescope, located in Slough, England, in 1789.
- In 1897 Alvan Clark finished the Yerkes 40-inch optical refracting telescope, located in Williams Bay, Wisconsin.

Space Exploration



Space exploration began with the launch of the artificial satellite *Sputnik 1* in 1957 by the former Soviet Union. Since then many satellites, spacecrafts, and space shuttles have been launched. Men have landed on the Moon and walked in space. Space stations have been built where astronauts stay and work for months together.



fact scope



- On October 4, 1957, *Sputnik 1* became the first manmade object to orbit Earth. It remained in orbit until January 4, 1958.
- The first living thing launched in space was a dog, Laika, on November 3, 1957.
- On January 2, 1959, the former Soviet Union launched *Luna 1*, the first manmade satellite to orbit the Sun.
- *Tiros 1*, was the first successful weather satellite launched by the US in 1960.
- On April 12, 1961, the former Soviet Union launched *Vostok* carrying Cosmonaut Yuri A. Gagarin, the first man in space. He orbited Earth once.
- On May 5, 1961, Alan B. Shepard Jr. became the first US astronaut in space aboard *Mercury Freedom 7*.

John Glenn

On February 20, 1962, John Herschel Glenn Jr. became the first American to complete an orbit of Earth. He orbited Earth three times.

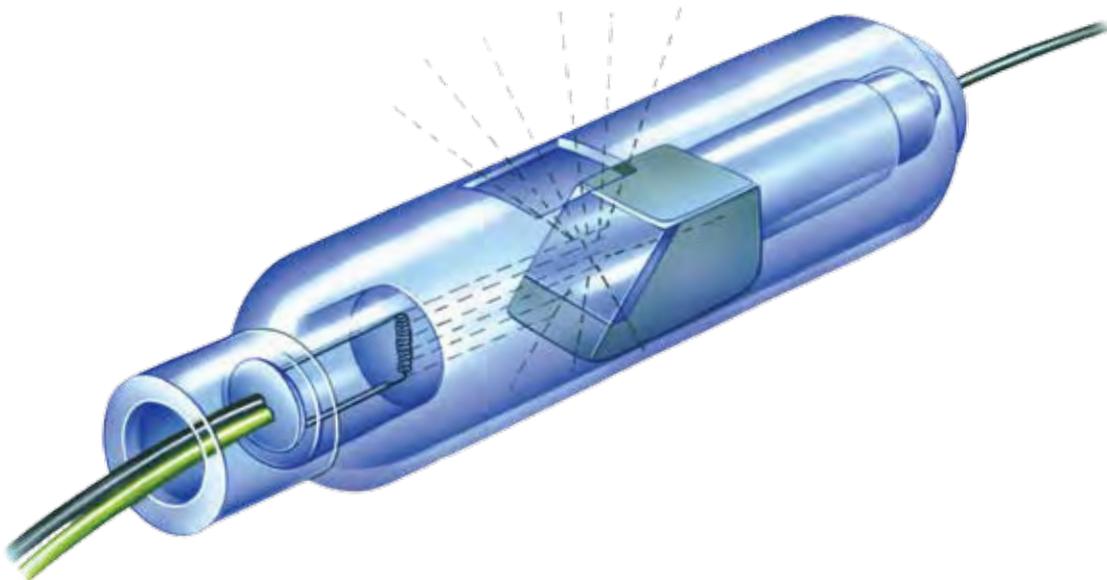
NASA

NASA (National Aeronautics and Space Administration) was founded on October 1, 1958, with its headquarters in Washington, D.C.



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