The Seed Drill
Jethro Tull

Tull was born in Basildon, Berkshire, England. He became sick with a pulmonary disorder, and as he went in a search for a cure he travelled Europe seeking more knowledge of agriculture. Influenced by the early Age of Enlightenment, he is considered to be one of the early proponents of a scientific (and especially empirical) approach to agriculture. He helped transform agricultural practices by inventing or improving numerous implements.

Tull did not exactly invent the seed drill, a device for sowing seeds effectively, but he only refined the invention in 1701 while living in Crowmarsh Gifford. At the time his workers did not like the idea because they thought they were going to lose their jobs.

A seed drill is a device for planting seeds in the soil. Before the introduction of the seed drill, the common practice was to "broadcast" seeds by hand. Besides being wasteful, broadcasting was very imprecise and led to a poor distribution of seeds, leading to low productivity.
The seed drill allows farmers to sow seeds in well-spaced rows at specific depths at a specific seed rate; each tube creates a hole of a specific depth, drops in a seed, and covers it over. Prior to this farmers simply cast seeds on the ground, by hand, for them to grow where they landed (broadcasting).

This invention gave farmers much greater control over the depth that the seed was planted and the ability to cover the seeds without back-tracking. This greater control meant that seeds germinated consistently and in good soil. The result was an increased rate of germination, and a much-improved crop yield (up to eight times).

A further important consideration was weed control: in the days before selective herbicide, drilling afforded the ability to hoe the crop during the course of the growing season. Weeding by hand is laborious and poor weeding limits yield.

Tull also advocated the use of horses over oxen, invented a horse-drawn hoe for clearing weeds, and made changes to the design of the plough which are still visible in modern versions. His interest in ploughing derived from his interest in weed control, and his belief that fertilizing was unnecessary, on the basis that nutrients locked up in soil could be released through pulverization. Although he was incorrect in his belief that plants obtained nourishment exclusively from such nutrients, he was aware that horse manure carried weed seeds, and hoped to avoid using it as fertilizer by pulverizing the soil to enhance the availability of plant nutrients.

Tull's inventions were sometimes considered controversial and were not widely adopted for many years. However, on the whole he introduced innovations which contributed to the foundation of productive modern agriculture.

Tull published his famous book, The New Horse-Houghing Husbandry, c.1731, with the sub-title "an Essay on the Principles of Tillage and Nutrition"

Tull died in Shalbourne, Berkshire (now Wiltshire), and is buried in the garden of St Bartholomew's house, Lower Basildon, Berkshire.

The Steam Engine

Thomas Newcomen and James Watt

A steam engine is a heat engine that performs mechanical work using steam as its working fluid. The basic concept is that coal heats up water, and the steam is channeled into a small area. The pressure that the steam creates causes turbines, or blades, to spin circularly. The power of the turbines is harnessed by an engine.

Steam engines have a long history, going back almost two thousand years. Early devices were not practical power producers, but more advanced designs became a major source of mechanical power during the industrial revolution. Modern steam turbines generate about half of the electric power in the world.

The first commercially-successful engine did not appear until 1712. The atmospheric engine, invented by Thomas Newcomen, paved the way for the Industrial Revolution. Newcomen's engine was relatively inefficient, and in most cases was only used for pumping water. It was mainly employed for draining mine workings at depths that had previously been impossible, but also for providing a reusable water supply for driving waterwheels at factories sited away from a suitable 'head'.

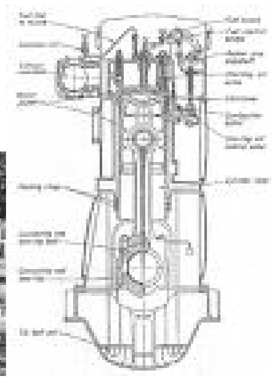
The next major step occurred when James Watt developed an improved version of Newcomen's engine. Watt's engine used 75% less coal than Newcomen's, and was hence much cheaper to run. Watt proceeded to develop his engine further, modifying it to be suitable for driving factory machinery. This enabled factories to be sited away from rivers, and further accelerated the pace of the Industrial Revolution.

Around 1800, Richard Trevithick introduced engines using high-pressure steam. These were much more powerful than previous engines and could be made small enough for transport applications. Thereafter, technological developments and improvements in manufacturing techniques (partly brought about by the adoption of the steam engine as a power source) resulted in the design of more efficient engines that could be smaller, faster, or more powerful, depending on the intended application.

Steam engines remained the dominant source of power well into the 20th century. In the 20th century electric and internal combustion engines replaced steam engines in many industries.

Gottlieb Daimler

The automobile

Gottlieb Wilhelm Daimler (March 17, 1834 - March 6, 1900) was an engineer, industrial designer and industrialist, born in what is now Germany. He was a pioneer of internal-combustion engines and automobile development.

Daimler and his lifelong business partner Wilhelm Maybach were two inventors whose dream was to create small, high speed engines to be mounted in any kind of locomotion device. They designed in 1885 a precursor of the modern gasoline powered engine which they subsequently fitted to a two-wheeler, considered the first motorcycle and, in the next year, to a stagecoach, and a boat. They are renowned as the designers of this Grandfather Clock engine.

Daimler and Maybach spent long hours debating how best to fuel engines, and turned to a byproduct of petroleum. The main distillates of petroleum at the time were lubricating oil, kerosene (burned as lamp fuel), and benzine, which up to then was used mainly as a cleaner and was sold in pharmacies.

In 1885, they created a carburetor which mixed gasoline with air allowing its use as fuel. In the same year Daimler and Maybach assembled a larger version of their engine, still relatively compact. It was called the Standuhr (Grandfather Clock), because Daimler thought it resembled an old pendulum clock.

In November 1885, Daimler installed a smaller version of this engine in a wooden bicycle, creating the first motorcycle. It was named the "riding car" (Reitwagen).

Maybach rode it for two miles alongside the river Neckar, from Cannstatt to Untertürkheim, reaching 7 miles per hour in speed.

On March 8, 1886, Daimler and Maybach secretly brought a stagecoach made by Wilhelm Wafter into the house, telling the neighbors it was a birthday gift for Mrs. Daimler. Maybach supervised the installation of a larger version of the Grandfather Clock engine into this stagecoach and it became the first four-wheeled vehicle to reach 10 miles per hour. The engine power was transmitted by a set of belts.

Driven by Daimler's desire to use the engine as many ways as possible,[12] Daimler and Maybach also used their engine in other types of transport including:

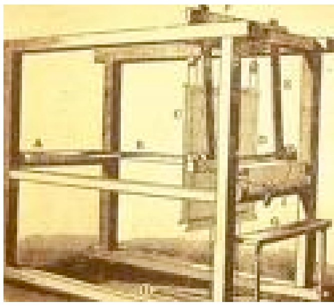
- on water (1887), by mounting it in a 4.5 meters long boat and achieving a speed of 6 knots (about 6 miles per hour). Boat engines would become Daimler's main product for several years. The first customers expressed fear the petrol engine could explode, so Daimler hid the engine with a ceramic cover and told them it was "Oil-Electrical".
- street-cars and trolleys.
- in the air in Daimler's balloon, usually regarded as the first airship, where it replaced old fashioned hand-operated-engines. With the new engine, Daimler successfully flew over Seelberg on August 10, 1888.

Engine sales increased, mostly for boat use. In 1889, Daimler and Maybach built their first automobile that did not involve adapting a horse-drawn carriage with their engine, but which was somewhat influenced by bicycle designs. There was no production in Germany, but it was licensed to be built in France and presented to the public in Paris in October 1889 by both engineers.

The same year, Daimler's wife, Emma Kunz, died. Soon after, Daimler sold his business to the Benz automobile corporation. Daimler said that after the death or his wife, he had to reason to continue living. He died shortly thereafter.

John Kay

The Flying Shuttle



The flying shuttle was developed by John Kay (1704 - 1764). In 1733 he invented one of the key developments in weaving that helped fuel the Industrial Revolution.

When weaving on a loom, the shuttle carries the weft yarn across the loom through the shed formed by the raised warp threads to form the fabric. When weaving was performed on a handloom, the width of cloth that could be woven was restricted by the reach of the weaver, and required the use of two hands. Two weavers were needed to operate larger looms. The fly shuttle enabled the weaver to propel the shuttle through a wider strip of cloth with a single hand, and allowed the other hand to perform the combing to compact the cloth. This speeded the process and thus increased production.

With increased speed and production, the demand for yarn rose, and thus this early invention spurred the textile industry in Great Britain. Initially, demand outstripped supply, and weavers were put into competition for the limited supply of yarn. The technology was seen as a threat because of this, and Kay's innovation led to machine wreckers attacking his property. Kay also suffered because his invention was used by others without his getting any royalties.

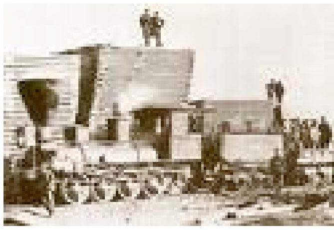
The fly shuttle principle was the predominant means for weft insertion employed by powered looms until the middle of the twentieth century. Modern industrial looms, driven by the desire for greater weft insertion rates, have employed systems which carry the weft yarn across the width of the fabric from one side only, using many small light projectiles or positively driven rapiers instead of the heavier shuttle. There are now looms which use jets of air or water to carry the warp yarn across the fabric width for use with suitable yarn types delivering even greater rates of weft insertion.

The production of cotton yarn was generally insufficient to keep up with the demand for hand-loom weavers, so his invention was not appreciated by weavers who thought it would steal their jobs; consequently he was persecuted and his constructions were damaged or destroyed. He fled England to France to try and sell his invention in that market, but he failed there as well and died from being poor.

Although he received little credit for his invention during his lifetime, he has been recognized posthumously for his contributions. He is depicted in several English murals and has many streets and towns named for him. His sons continued working in the industrial textile business, and experienced a moderate amount of success.

The Railroad

George Stephenson

George Stephenson (9 June 1781 – 12 August 1848) was an English civil engineer and mechanical engineer who built the first public railway line in the world to use steam locomotives and is known as the "Father of Railways". The Victorians considered him a great example of diligent application and thirst for improvement, with self-help advocate Samuel Smiles particularly praising his achievements.

In 1813, William Hedley and Timothy Hackworth designed a locomotive (nicknamed the Puffing Billy) for use on the tramway between Stockton and Darlington. Puffing Billy featured piston rods extending upwards to pivoting beams, connected in turn by rods to a crankshaft beneath the frames, which in turn drove the gears attached to the wheels. This meant that the wheels were coupled, allowing better traction. A year later, George Stephenson improved on that design with his first locomotive Blücher, which was the first locomotive to use single-flanged wheels.

That design convinced the backers of the proposed Stockton and Darlington Railway to appoint Stephenson as engineer for the line in 1821. While traffic was originally intended to be horse-drawn, Stephenson carried out a fresh survey of the route to allow steam haulage. The Act was subsequently amended to allow the usage of steam locomotives, and also to allow passengers to be carried on the railway. The 25-mile (40 km) long route opened on 27 September 1825, and with the aid of Stephenson's Locomotion No 1, was the first locomotive-hauled public railway in the world.

The first public railways were built as local rail links operated by small private railway companies. With increasing rapidity, more and more lines were built, often with scant regard for their potential for traffic, until the vast majority of towns and villages had a rail connection, and sometimes two or three. Over the course of the 19th and early 20th centuries, most of these independent railways amalgamated or were bought by competitors until only a handful of larger companies remained.

The period also saw a steady increase in government involvement, especially in safety matters. The 1840 "Act for Regulating Railways" empowered the Board of Trade to appoint railway inspectors. The Railway Inspectorate was established in 1840, to enquire into the causes of accidents and recommend ways of avoiding them. As early as 1844 a bill had been put before Parliament suggesting the state purchase of the railways; this was not adopted. It did, however, lead to the introduction of minimum standards for the construction of carriages and the compulsory provision of 3rd class accommodation for passengers - so-called "Parliamentary trains".

Steamboat

Robert Fulton

The French inventor Denis Papin, after inventing the steam digester, a type of pressure cooker, built a model of a piston steam engine, the first of its kind in 1690. He continued to work on steam engines for the next fifteen years. In 1704, he also constructed a ship powered by his steam engine. The engine was mechanically linked to paddles. This would then make him the first to construct a steam boat. However, his steamboat was irregular and unsafe. Over the next 100 years, many people would attempt to make an engine powered steamboat, and most failed with disastrous results. At best, the steam engines died and the boats had to be towed in; at worst, the boilers exploded or the boats sank, killing most passengers.

Robert Fulton visited Britain and France, where he built and tested an experimental steamboat on the River Seine in 1803. Before returning to the United States he ordered a Boulton and Watt steam engine, and on return built what he called the North River Steamboat. In 1807, she began a regular passenger service between New York City and Albany, New York, a 150 miles distance, which was a commercial success. She could make the trip in 32 hours. In 1808, John and James Winans built "Vermont" in Burlington, Vermont, the second steamboat to operate commercially.The experience of both vessels showed the new system of propulsion waspotentially profitable, and as a result its application to the more open waters of the Great Lakes was next considered.

Steamboats on major American rivers soon followed Fulton's success. In 1811 the first in a continuous (still in commercial passenger operation as of 2007) line of river steamboats left the dock at Pittsburgh down the Ohio River and on to New Orleans. Mark Twain, in his Life on the Mississippi, described much of the operation of these vessels. For most of the 19th century and part of the early 20th century, trade on the Mississippi River would be dominated by paddle-wheel steamboats.

The cartoon Steamboat Willie introduced steamboat pilot Mickey Mouse to the public.

A number of other steamers were built around the turn of the century, in part due to the growing fish industry and the gold rush.

Sternwheelers were an instrumental transportation. They were used on most of the navigable waterways at one time or another, generally being replaced by the expansion of railroads and road access.

The simplicity of these indispensable to pioneer communities that were otherwise virtually cut off from the outside world. They could nose up almost anywhere along a riverbank to pick up or drop off passengers and freight. Sternwheelers would also prove vital to the construction of the railroads that would eventually replace them, and were used to haul supplies, track and other materials to construction camps.

Steel and the Bessemer Process

Henry Bessemer

The Bessemer process was the first inexpensive industrial process for the mass-production of steel from molten pig iron. The process is named after its inventor, Henry Bessemer, who took out a patent on the process in 1855. In order to give the steel the desired properties, other substances could be added to the molten steel when conversion was complete, such as strong or powerful alloys.

Steel had previously been produced in very small quantities through labor intensive practices. This made steel very expensive and inaccessible to many people. Steel is an important and useful alloy because it is extremely strong and durable. Steel is often used to construct bridges, buildings, heavy machinery and trains.

This process for making steel was first improved in the 1700s with the introduction of Benjamin Huntsman's crucible steel-making technique, which added an additional three hours firing time and required additional large quantities of coke. This produced higher quality crucible steel but also increased the cost.

The Bessemer process reduced to about half an hour the time needed to make steel of this quality while requiring only the coke needed to melt the pig iron initially.

The Bessemer process revolutionized steel manufacture by decreasing its cost, and greatly increasing the scale and speed, while also decreasing the labor requirements. Prior to its introduction, steel was far too expensive to make bridges or the framework for buildings and wrought iron had been used throughout the Industrial Revolution. After its introduction, steel and wrought iron became similarly priced, and most manufacturers turned to steel

The key principle is removal of impurities from the iron by oxidation with air being blown through the molten iron. The oxidation also raises the temperature of the iron mass and keeps it molten.

The process is carried on in a large ovoid steel container lined with clay or dolomite called the Bessemer converter. \ At the top of the converter is an opening, usually tilted to the side relative to the body of the vessel, through which the iron is introduced and the finished product removed. The bottom is perforated with a number of channels called tuyères through which air is forced into the converter. The converter is pivoted so that it can be rotated to receive the charge, turned upright during conversion, and then rotated again for pouring out the molten steel at the end. This produces high quality steel in a small amount of time using a small amount of raw materials.

Alfred Nobel

Dynamite

Alfred studied chemistry and devoted himself to the study of explosives, and especially to the safe manufacture and use of nitroglycerine. Several explosions occurred at their family-owned factory in Heleneborg; one disastrous one killed Alfred's younger brother Emil and several other workers in 1864.

Nobel found that when nitroglycerin was incorporated in an absorbent inert substance like kieselguhr (diatomaceous earth) it became safer and more convenient to handle, and this mixture he patented in 1867 as dynamite. Nobel demonstrated his explosive for the first time that year, at a quarry in Redhill, Surrey, England.

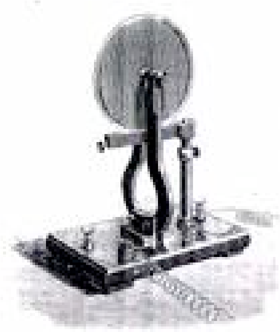
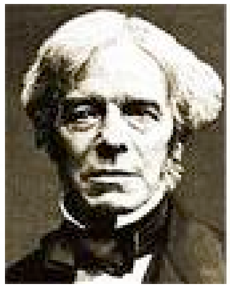
Nobel later on combined nitroglycerin with another explosive, gun-cotton, and obtained a transparent, jelly-like substance, which was a more powerful explosive than dynamite. Gelignite, or blasting gelatin as it was branded, was patented in 1876, and was followed by a host of similar combinations, modified by the addition of potassium nitrate and various other substances.

The invention of dynamite aided industrialism in many ways. Dynamite provided a new and efficient way for miners to break apart rocks and mountains to reach important natural resources like coal or iron. Dynamite was also useful in city planning and construction.

Alfred Nobel grew to be very wealthy with no family or descendents. The foundations of the Nobel Prize were laid in 1895 when Alfred Nobel wrote his last will, leaving much of his wealth for its establishment. Since 1901, the prize has honored men and women for outstanding achievements in physics, chemistry, medicine, literature, and for work in peace. There is no prize for math, it is rumored, because a mathematician ended up marrying Nobel’s one true love, and he did not want his prize to be awarded to him nor any of his descendants. Alfred Nobel is buried in Norra begravningsplatsen in Stockholm, Sweden.

Electric Motor

Michael Faraday

Michael Faraday (September 22, 1791–August 25, 1867) was an English chemist and who contributed to the fields of electromagnetism and electrochemistry, and effectively “invented electricity.”

Faraday studied the magneticfield around a conductor carrying a DC electric current, and established the basis for the magnetic field concept in physics. His inventions of electromagnetic rotary devices formed the foundation of electric motor technology, and it was largely due to his efforts that electricity became viable for use in technology. As a chemist, Faraday discovered benzene, investigated chlorine, invented an early form of the bunsen burner and the system of oxidation numbers, and popularized terminology such as anode, cathode, electrode, and ion.

Although Faraday received little formal education and knew little of higher mathematics, such as calculus, he was one of the most influential scientists in history. Some historians of science refer to him as the best experimentalist in the history of science. Faraday's greatest work was probably with electricity and magnetism. In 1821, soon after the Danish physicist and chemist, Hans Christian Ørsted discovered the phenomenon of electromagnetism, Faraday went on to build two devices to produce what he called electromagnetic rotation: a continuous circular motion from the circular magnetic force around a wire and a wire extending into a pool of mercury with a magnet placed inside would rotate around the magnet if supplied with current from a chemical battery. These experiments and inventions form the foundation of modern electromagnetic technology.

Faraday's breakthrough came when he wrapped two insulated coils of wire around an iron ring, and found that upon passing a current through one coil, a momentary current was induced in the other coil.[3] This phenomenon is known as mutual induction. The iron ring-coil apparatus is still on display at the Royal Institution. In subsequent experiments he found that if he moved a magnet through a loop of wire, an electric current flowed in the wire. The current also flowed if the loop was moved over a stationary magnet. His demonstrations established that a changing magnetic field produces an electric field. This relation was mathematically modelled by Faraday's law, which subsequently became one of the four Maxwell equations, which forms the foundation for electricity.

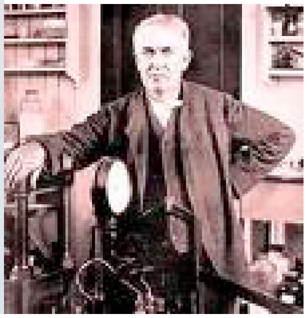
Faraday later used the principle to construct the electric dynamo, the ancestor of modern power generators. In 1839 he completed a series of experiments aimed at investigating the fundamental nature of electricity. Faraday used "static", batteries, and "animal electricity" to produce the phenomena of electrostatic attraction, electrolysis, magnetism, etc. He concluded that, contrary to scientific opinion of the time, the divisions between the various "kinds" of electricity were not really different. Faraday instead proposed that only a single "electricity" exists, and the changing values of quantity and intensity (voltage and charge) would produce different groups of phenomena.

Near the end of his career Faraday proposed that electromagnetic forces extended into the empty space around the conductor. This idea was rejected by his fellow scientists, and Faraday did not live to see this idea eventually accepted.

Electricity, the electric motor, generators and batteries completely revolutionized society. Equipment could be powered, factories could run without the use of their own factories or coal-powered engines, and energy could be stored for later use. Electricity also paved the way for the development of many other inventions, such as the light bulb, radio waves, electric motors and modern ventilation.

The Light Bulb

Thomas Edison



Thomas Edison began his career as an inventor in Newark, New Jersey, with the automatic repeater and his other improved telegraphic devices, but the invention which first gained him fame was the phonograph in 1877. A phonograph is the first device used to record sound, and the predecessor to record players, tapes and CDs.

This accomplishment was so unexpected by the public at large as to appear almost magical. Edison became known as "The Wizard of Menlo Park," New Jersey, where he lived. His first phonograph recorded on tinfoil around a grooved cylinder and had poor sound quality. The tinfoil recordings could only be replayed a few times. Later inventers improved upon the phonograph and the music industry was born.

Edison was more interested in practical uses of electricity, and devoted a lot of research into the development of incandescent electric lamps, better known as the light bulb.

Edison began serious research into developing a practical incandescent lamp in 1878. Edison filed his first patent application for "Improvement In Electric Lights" on October

14, 1878. The most difficult part of the invention was determining which fiber should be placed inside the bulb and burnt to produce light. After many experiments with platinum and other metal filaments, Edison returned to a carbon filament. The first successful test was on October 22, 1879, and the light bulb lasted 13.5 hours. Edison continued to improve this design and by Nov 4, 1879, filed for a U.S. patent for an electric lamp using "a carbon filament or strip coiled and connected ... to platina contact wires."

Several months after the patent was granted that Edison and his team discovered that a carbonized bamboo filament could last over 1200 hours, and this became the most commonly used fiber inside of a light bulb.

The availability of electric light was extremely revolutionary. Prior to electric lights, people relied on daylight, candles, and expensive kerosene lamps to provide lighting. Lighting was especially important inside factories where little window were available to allow natural light. Electric light also extended the working day for many industrial factories. No longer were the working hours constrained to the hours where natural light was available; many factories began to work 24 hours a day.

Germ Theory

Louis Pasteur

Louis Pasteur (December 27, 1822 – September 28, 1895) was a French chemist and microbiologist best known for his remarkable breakthroughs in the causes and prevention of disease. His experiments supported the germ theory of disease, also reducing mortality from fever, and he created the first vaccine for rabies. He was best known to the general public for inventing a method to stop milk and wine from causing sickness - this process came to be called pasteurization. Louis demonstrated that microbacteria can grow from a liquid such as milk or wine, causing sickness.

Germ theory is the concept that all sicknesses are caused by bacteria and viruses that are transmittable through the air. Germ theory also explains that infections are caused by the exposure of a wound to bacteria. Prior to Pasteur, doctors assumed that infections and bacteria were caused by internal illnesses, and little attention was paid to hygiene. People did not wash their hands or instruments, and hospitals did not change bedsheets or clean materials that were used by multiple patients.

While Pasteur was not the first to propose germ theory, he developed it and conducted experiments that clearly indicated its correctness and managed to convince most of Europe it was true. Today he is often regarded as the father of germ theory and bacteriology.

Pasteur's research also showed that some microorganisms contaminated fermenting beverages. With this established, he invented a process in which liquids such as milk were heated to kill most bacteria and molds already present within them. He completed the first test on April 20, 1862. This process was soon afterwards known as pasteurization, and is now required for nearly all milk, juice, and alcoholic beverages sold in the US.

Beverage contamination led Pasteur to conclude that microorganisms infected animals and humans as well. He proposed preventing the entry of microorganisms into the human body, leading Joseph Lister to develop antiseptic methods in surgery.

Pasteur’s research revolutionized medicine, and formed the foundation for modern medicine. Hygeine became an important factor in life, and people paid attention to their cleanliness and washed more frequently. Cities took the time and spent the money to establish sewer and sanitation systems to reduce people’s contact with bacteria and germs. This greatly reduced disease and deaths, and as a result, the population skyrocketed.

Antiseptics

Joseph Lister

Joseph Lister (5 April 1827 – 10 February 1912) was an English surgeon who promoted the idea of sterile surgery while working at the Glasgow Royal Infirmary. He successfully introduced carbolic acid (phenol) to sterilize surgical instruments and to clean wounds.

At the time the usual explanation for wound infection was that the exposed tissues were damaged by chemicals in the air or via a stinking "miasma" in the air. The sick wards actually smelled bad, not due to a "miasma" but due to the rotting of wounds. Hospital wards were occasionally aired out at midday, but Florence Nightingale's doctrine of fresh air was still seen as science fiction.

Facilities for washing hands or the patient's wounds did not exist and it was even considered unnecessary for the surgeon to wash his hands before he saw a patient.

Lister became aware of a paper published by the French chemist Louis Pasteur which showed that rotting and fermentation could occur without any oxygen if micro-organisms were present. Lister confirmed this with his own experiments. If micro-organisms were causing gangrene, the problem was how to get rid of them. Pasteur suggested three methods: filter, heat, or expose them to chemical solutions. The first two were inappropriate in a human wound, so Lister experimented with the third.

Carbolic acid (phenol) had been in use as a means of deodorizing sewage, and Lister thought that it might be useful in removing bacteria from wounds. Lister tested the results of spraying instruments, the surgical incisions, and dressings with a solution of it. Lister found that carbolic acid solution swabbed on wounds markedly reduced the incidence of gangrene and subsequently published a series of articles on the Antiseptic Principle of the Practice of Surgery.

He also made surgeons wear clean gloves and wash their hands before and after operations with 5% carbolic acid solutions. Instruments were also washed in the same solution and assistants sprayed the solution in the operating theatre. He also decided that surgeons must stop using porous materials, like wood, in the construction of their medical instruments, because wood would absorb bacteria and be difficult to clean.

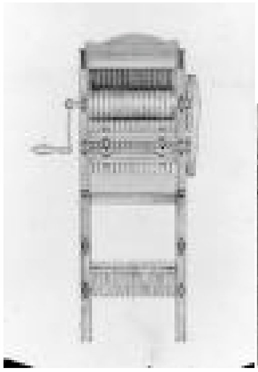
Lister next became Professor of Surgery at the University of Edinburgh, and continued to develop improved methods of antisepsis. His fame had spread by then and audiences of 400 often came to hear him lecture.

As the germ theory of disease became more widely accepted, it was realized that infection could be better avoided by preventing bacteria from getting into wounds in the first place. This led to the rise of sterile surgery. Some consider Lister "the father of modern antisepsis."

In 1879 Listerine mouthwash was named after him for his work in antisepsis. Also named in his honor is the bacterial family called Listeria.

Lister moved from Scotland to King's College Hospital, in London, and became the second man in England to operate on a brain tumor. He also developed a method of repairing kneecaps with metal wire and improved the technique of amputations. His discoveries were greatly praised and he was made Baron Lister of Lyme Regis and became one of the twelve original members of the Order of Merit.

Eli Whitney
The Cotton Gin

A Cotton Gin is a machine that quickly and easily separates the cotton fibers from the seedpods and the sometimes sticky seeds, a job previously done by workers. These seeds are either used again to grow more cotton or, if badly damaged, are disposed of. It uses a combination of a wire screen and small wire hooks to pull the cotton through the screen, while brushes continuously remove the loose cotton lint to prevent jams. The term "gin" is an abbreviation for engine, and means "machine".

The modern cotton gin was created by the American inventor Eli Whitney in 1792 to mechanize the cleaning of cotton. The invention was granted a patent on March 14, 1794.

The immediate effect of the Gin was to cause a massive growth in the production of cotton in the American South. Whereas cotton had formerly required considerable labor to clean and separate the fiber from the seeds, the cotton gin revolutionized the process. The wholesale price of cotton plummeted as output increased dramatically.

Large areas of land on American states such as Mississippi were cleared and planted with cotton to meet increasing demand. An unfortunate by-product of the cotton gin was the expansion of slavery through the region, as laborers were needed to plant and harvest cotton -- not the most pleasant tasks in the Southern heat. Many of the plantations of the American South were built on cotton fortunes, which could not have occurred without the cotton gin's invention.

Raw cotton was sold cheaply and sent to textile factories in England and the Northeastern United States. Previously, cotton fabric was very expensive and woven by hand in cottage industries. The greater production of raw cotton helped to influence the development of textile factories, which were able to mass produce fabrics and other textiles. These textile factories became notorious for unsafe working conditions, child labor and long hours.

Samuel More

The Telegraph

A telegraph is a machine for transmitting and receiving messages over long distances. The word telegraph alone now generally refers to an electrical telegraph.

A telegraph message sent by a telegraph operator (or telegrapher) using Morse code was known as a telegram or cablegram. Before long distance telephone services were readily available or affordable, telegram services were very popular. Telegrams were often used to confirm business dealings and, unlike email, telegrams were commonly used to create binding legal documents for business dealings.

The telegraph was first developed by Sameul Morse. Morse also developed a code of taps that could be used to communicate words through a wire.

On a sea voyage in 1832, Morse developed the concept of a single wire telegraph. He knew that messages could be sent over short distances of wire, but wanted to make communication possible over large distances.

Morse encountered the problem of getting a telegraphic signal to carry over more than a few hundred yards of wire. His breakthrough came from the insights his friend Professor Gale. With Gale's help, Morse soon was able to send a message through ten miles of wire. This was the great breakthrough Morse had been seeking. Morse and Gale were soon joined by a young enthusiastic man, Alfred Vail, who had excellent skills, insights and money. Morse's telegraph now began to be developed very rapidly. He set about working with the US government to establish the rights to form a telegraph company and to set up the infrastucture.

In May 1845 the Magnetic Telegraph Company was formed in order to radiate telegraph lines from New York City towards Philadelphia, Boston, Buffalo, New York and the Mississippi.

Morse and his partners spend most of the rest of their lives traveling the world and introducing telegraphy to other countries. He successfully set up a telegraph infrastructure in all the countries of Europe, as well as the Ottoman Empire and parts of Latin America.

The Morse telegraphic apparatus was officially adopted as the standard for European telegraphy in 1851. Telegraphs continued as a common means of communication all the way through the 1950s, when long-distance telephone communication became possible and reasonably priced.

The Telephone

Alexander Graham Bell


Alexander Graham Bell (3 March 1847 – 2 August 1922) was an eminent scientist, inventor and innovator who is widely credited with the invention of the telephone.

His father, grandfather and brother had all been associated with work on elocution and speech, and both his mother and wife were deaf, profoundly influencing Bell's life's work. His research on hearing and speech further led him to experiment with hearing devices that eventually culminated in Bell being awarded the first U.S. patent for the invention of the telephone in 1876. In reflection, Bell considered his most famous invention an intrusion on his real work as a scientist and refused to have a telephone in his study. Upon Bell's death, all telephones throughout the United States "stilled their ringing for a silent minute in tribute to the man whose yearning to communicate made them possible."

The first telephones were quite different than the telephones of the 20th century. Individuals or businesses would lease telephone services from a company, but could not just “plug the phone into the wall”
Early telephones were locally powered, using either a dynamic transmitter or by the powering of a transmitter with a local battery. One of the jobs of outside plant personnel was to visit each telephone periodically to inspect the battery. During the 20th century, "common battery" operation came to dominate, powered by "talk

battery" from the telephone exchange over the same wires that carried the voice signals.

Early telephones used a single wire for the subscriber's line. The earliest dynamic telephones also had only one opening for sound, and the user alternately listened and spoke (rather, shouted) into the same hole. Sometimes the instruments were operated in pairs at each end, making conversation more convenient but were more expensive.Telephones instead were leased in pairs to the subscriber, who had to arrange telegraph contractors to construct a line between them, for example between his home and his shop.

Users who wanted the ability to speak to several different locations would need to obtain and set up three or four pairs of telephones.

Western Union, already using telegraph exchanges, quickly extended the principle to its telephones in New York City and San Francisco, and Bell was not slow in appreciating the potential.

Eventually, cities began to establish telephone wire access for each house in their community. Telephone providers had centers with operators. Individuals would call the operator and tell the operator where he was calling. Then the operator would literally connect the wires between the two telephones and a call would be made.

The modern “dial telephone” was not established until the 1950s. Telephone communication revolutionized communication because it provided people with access to immediate communication across large distances. Telegrams sometimes caused miscommunications, and required operators skilled in Morse code. The telephone allowed for a common person to be able to communicate. This helped to develop trade across long distances, facilitated long distance travel (such as railroad travel) and generally improved communication and news.

The Radio

Marconi

In 1896, Marconi was awarded the British patent for radio. In 1897 he established the world's first radio station on the Isle of Wight, England. Early uses were sending telegraphic messages using Morse code between ships and land. One of the most memorable uses of marine telegraphy was during the sinking of the RMS Titanic in 1912, including communications between operators on the sinking ship and nearby vessels, and communications to shore stations listing the survivors.

Radio was used to pass on orders and communications between armies and navies on both sides in World War I; Germany used radio communications for diplomatic messages once it discovered that its submarine cables had been tapped by the British. The United States passed on President Woodrow Wilson's Fourteen Points to Germany via radio during the war. Broadcasting began from San Jose in 1909.

During his early years, Marconi had an interest in science and electricity. One of the scientific developments during this era came from Heinrich Hertz, who, beginning in 1888, demonstrated that one could produce and detect electromagnetic radiation—now generally known as "radio waves."

Marconi began to conduct experiments, building much of his own equipment in the attic of his home at the Villa Griffone in Pontecchio, Italy. His goal was to use radio waves to create a practical system of "wireless telegraphy"—i.e. the transmission of telegraph messages without connecting wires as used by the electric telegraph. This was not a new idea—numerous investigators had been exploring wireless telegraph technologies for over 50 years, but none had been successful.

At first, Marconi could only signal over limited distances. In the summer of 1895 he moved his experimentation outdoors. After increasing the length of the transmitter and receiver antennas, and arranging them vertically, and positioning the antenna so that it touched the ground, the range increased significantly. Soon he was able to transmit signals over a hill, a distance of approximately 0.9 miles. By this point he concluded that with additional funding and research, a device could become capable of spanning greater distances and would prove valuable both commercially and militarily.

In early 1896 at the age of 21, Marconi traveled to England to seek support for his work. While there, he gained the interest and support of the British government. A series of demonstrations for the British government followed—by March, 1897, Marconi had transmitted Morse code signals over a distance of about 4 miles. On 13 May 1897, Marconi sent the first ever wireless communication over open sea at a distance of about 4 miles. The message read "Are you ready?" Marconi then discovered by strengthened the capability of the radio receiver, he could send a message over a distance of about 10 miles.

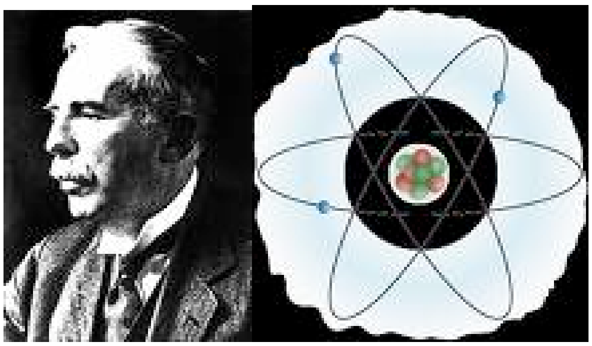
Marconi became famous in Europe, and gave many demonstrations and lectures to the general public. He was hired by most of the governments of Europe to set up radio communications, usually for military purposes. Over the years, the technology improved. Marconi sent a signal over the English Channel in 1899, and the fall of 1899, live radio broadcasting of sporting events began, with the New York International yacht race.

Radio communication revolutionized communication technology because it became a quick and easy way for individuals to communicate to a wide audience. The audience only needed to purchase a radio-wave receiver, known today simply as a “radio.” These radio-wave receivers are portable and do not require advanced technical knowledge.

Radio was used for purposes of secret communication (on special radio waves), news broadcasting, sending emergency messages, entertainment and business interactions.

Dalton

Atomic Theory



In chemistry and physics, atomic theory is a theory of the nature of matter, which states that matter is composed of units called atoms. It began as a philosophical concept in ancient Greece and India and entered the scientific mainstream in the early 19th century when discoveries in the field of chemistry showed that matter did indeed behave as if it were made up of particles.

In the early years of the 19th century, John Dalton developed his atomic theory in which he proposed that each chemical element is composed of atoms of a single, unique type, and that though they are both immutable and indestructible, they can combine to form more complex structures (chemical compounds). How precisely Dalton arrived at his theory is not entirely clear, but nonetheless it allowed him to explain various new discoveries in chemistry that he and his contemporaries made.

Dalton also believed atomic theory could explain why water absorbed different gases in different proportions: for example, he found that water absorbed carbon dioxide far better than it absorbed nitrogen. Dalton hypothesized this was due to the differences in mass and complexity of the gases' respective particles.

In 1803 Dalton presented his theories in a paper. This paper was published in 1805, but he did not discuss there exactly how he obtained his information. The method was first revealed in 1807 by his acquaintance Thomas Thomson, in the third edition of Thomson's textbook, A System of Chemistry. Finally, Dalton published a full account in his own textbook, A New System of Chemical Philosophy, 1808 and 1810.

Atomic theory became the basis for the study of physics, chemistry, microbiology and many other scientific fields. Atomic theory was instrumental in the development of achievements like chemical production, the production of gas, advanced engines and electricity, and medicine.

Atomic theory was a revolutionary idea because it suggested that all matter is composed of the same type of particles, but arranged in a different way. This scientific development completely changed the way experts view the universe.