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HISTORICAL DEVLOPMENT OF MODERN CHEMISTRY

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ABSTRACT

The words ‘’Chemistry” and “Alchemy” have been derived from “Khem”, an ancient name for Egypt. The history of chemistry represents a time span from ancient history to the present. By 1000 BC, civilizations used technologies that would eventually form the basis to the various branches of chemistry. Many chemists lived long ago, so what happened a long time ago is history. Chemistry analyzes the composition of different substances, their physical and chemical properties and the specific conditions under which they combine with other substances. The practical applications of Chemistry affect every aspect of civilization. By performing experiments and recording the results, alchemists set the stage for modern chemistry. Both alchemy and chemistry are concerned with matter and its transformations, chemists are seen as applying scientific method to their work. Alchemy was that branch of Chemistry which studied the hidden sprit of the elements. The history of chemistry is intertwined with the history of thermodynamics, especially through the work of Willard Gibbs. The idea of a drug appears from the ancient Indian Vedas from before 1000BC. The Chinese Alchemy believed that there were five elements, wood, fire, earth, metal and water, and these were linked to five colors, five directions and to five metals, gold, silver, leads, copper and iron. As a result, every Chinese alchemical technique involved repeating stages five times. Around 420 BC, Empedocles stated that all matter is made up of four elemental substances - earth, fire, air and water. Aristotle (384-323 BC) developed the idea of properties of the elements, saying different types of matter depend on a specific balance of the qualities of hot, cold, wet, and dry. In 1789 a French chemist Antoine-Laurent de Lavoisier established the Law of Conservation of Mass, which is also called "Lavoisier's Law and is called "father of modern chemistry. John Dalton in 1803 proposed that matter is composed of indivisible smallest particle called atom.

INTRODUCTION

The earliest record of man's interest in chemistry was approximately 3,000 B.C, in the Fertile Crescent. At that time, chemistry was more an art than a science. Tablets record the first known chemists as women who manufactured perfumes from various substances. Ancient Egyptians produced certain compounds such as those used in mummification. By 1000 B.C, chemical arts included the smelting of metals and the making of drugs, dyes, iron, and bronze. Chemistry, a branch of physical science, is the study of the composition, structure, properties and change of matter. Chemistry is chiefly concerned with atoms. There were four prehistoric times in the development of chemistry-beginning of the Christian era known as black magic (1700-300BC), beginning of the Christian era-end of the 17th century known as alchemy period, end of the 17th century to mid 19th century known as traditional chemistry and mid 19th century to present known as modern chemistry.Ancient Egyptians pioneered the art of synthetic chemistry up to 4,000 years ago. By 1000 BC ancient civilizations were using technologies that formed the basis of various branches of chemistry. Many groups of people contributed to these developments--among them were ancient Egyptians, Greeks, Hebrews, Chinese and Indians. The historical development from ancient periods are summaries in the table-1.

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Alchemy and Modern Chemistry

Alchemy is defined by the Hermetic quest for the philosopher's stone, the study of which is steeped in symbolic mysticism, and differs greatly from modern science. The alchemy that eventually developed into chemistry, and is often referred to as a protoscience.

Table 1. Historical development of ancient Chemistry

Time Intervals	Specific Periods	Historical work
Prehistoric Times - Beginning of the Christian Era (Black Magic)	1700 BC--300 BC	Known metals were recorded. Democritus proclaims the atom to be the simplest unit of matter. All matter was composed of atoms. Aristotle declares the existence of only four elements: fire, air, water and earth. All matter is made up of these four elements and matter had four properties: hot, cold, dry and wet.
Beginning of the Christian Era - End of 17th Century (Alchemy)	300 BC -300 AD, 13th - 15th Century , 1520- End of 17th Century	Alchemists attempted to transmute cheap metals to gold. The substance used for this conversion was called the Philosopher's Stone. Alchemists not only wanted to convert metals to gold, but they also wanted to find a chemical concoction that would enable people to live longer and cure all ailments. This elixir of life never happened either.
End of 17th Century - Mid 19th Century (Traditional Chemistry)	1700's--1803	Johann J. Beecher believed in a substance called phlogiston. Charles Coulomb discovered that given two particles separated by a certain distance, the force of attraction or repulsion is directly proportional to the product of the two charges and is inversely proportional to the distance between the two charges. Joseph Priestley heated calx of mercury, collected the colorless gas and called the gas "dephlogisticated air". Antoine Lavoisier renamed the "dephlogisticated air" oxygen who is now called the "Father of Modern Chemistry". John Dalton publishes his Atomic Theory which states that all matter is composed of atoms, which are small and indivisible.
Mid 19th Century - Present (Modern Chemistry *or* 20th Century Chemistry)	1854--1940's	Heinrich Geissler creates the first vacuum tube. Eugene Goldstein discovered positive particles by using a tube filled with hydrogen gas. Wilhelm Roentgen accidentally discovered x-rays while researching the glow produced by cathode rays. J.J. Thomson discovered electron and was awarded Nobel Prize1906 in physics. Marie Curie discovered uranium and thorium within pitchblend. Robert Millikan discovered the mass of an electron. Ernest Rutherford discovered alpha, beta and gamma rays and proposed atomic model.

The Chinese alchemists, who also developed methods for manipulating minerals and altering the state of substances. They were obsessed with creating gold but, rather than creating gold for wealth, their obsession was with creating gold of the utmost purity for creating an elixir of life and a way to achieve immortality. Cleopatra the Alchemist described furnaces and has been credited with the invention of the alembic. Chinese alchemy was based in the fundamentals of Taoism. Taoism is based around the idea of opposing forces, the Yin and the Yang. Yin is the female, passive element, and Yang is the male, active element. Adding extra any substances rich in Yang would confer life and longevity. Pure gold was seen as a substance containing a lot of Yang, but a mineral known as cinnabar was seen as best of all. The overriding influence on Chinese alchemy was the number 5, a mystical number in China. The Chinese believed that there were five elements, wood, fire, earth, metal and water, and these were linked to five colors, five directions (the center counts as a direction) and to five metals, gold, silver, leads, copper and iron. As a result, every Chinese alchemical technique involved repeating stages five times. By performing experiments and recording the results, alchemists set the stage for modern chemistry.Though Greeks are shown as wise people who had spectacular achievements in science, Muslims are portrayed as alchemists and transmitters of Greek "wisdom", and Western scientists are shown as the real founders of chemistry, the truth is actually the opposite. In the Arab world, the Muslims were translating the works of the ancient Greeks into Arabic and were experimenting with scientific ideas. Their experiments led to sophisticated medical practices that were far superior to the barbaric medicine practiced in Europe at that time. Thomas Aquinas read the works of the Muslims and learned of their ideas of faith and reason. This thinking led to the Renaissance in Europe ("Islam: Empire of Faith"). Muslims also discovered many elements with their specific weights. Al-Jabr discovered 19 elements along with their specific weights.

They distinguished between metals and alloys, noting that alloys were only mixtures and not true elements. Evidence is found in the fact that the word alkali originated from the Arabic word al-kili. The earliest practical knowledge of chemistry was concerned with metallurgy, pottery, and dyes. The Greek philosopher thought that matter is composed of four elemental substances such as earth, fire, air and water. The first chemical reaction used in a controlled manner was fire that could transform one substance into another producing heat and light. They formulate the first basic idea of element and compound during the period 500-300 B.C. Aristotle (384-323 BC) developed the idea of properties of the elements, saying different types of matter depend on a specific balance of the qualities of hot, cold, wet, and dry. Influenced by Aristotle's ideas, alchemists explored the idea that there might be a substance which could be found or made in the laboratory that would transmute cheap metals to gold. This substance became known as the Philosopher's Stone. It was Antoine Lavoisier (1743-1794) a brilliant Frenchman renamed "dephlogisticated air" to oxygen and realized that oxygen was the part of air that combines with substances as they burn. Because of his work, Lavoisier is known as the Father of Modern Chemistry. Greek atomism dates back to the Greek philosopher Democritus, who declared that matter is composed of indivisible and indestructible atoms around 380 BC. Leucippus also declared that atoms were the most indivisible part of matter. This coincided with a similar declaration by Indian philosopher Kanada in his Vaisheshika sutras around the same time period. Electron discovered by J. J. Thomson in 1897 , Proton discovered by Rutherford's in 1920 and neutron discovered by James Chadwick in 1932. After the discovery of electron, proton and neutron, it was proved that atom is divisible and consists of these fundamental particles. Georg Agricola (1494–1555), His work describes the highly developed and complex processes of mining metal ores, metal extraction and metallurgy of the time and so he has **b**een

described as the "father of metallurgy". English chemist Robert Boyle (1627–1691) is considered to have refined the modern scientific method for alchemy and to have separated chemistry further from alchemy and therefore He was one of the founders of modern chemistry. He is best known for Boyle's law, which he presented in 1662, this law describes the inversely proportional relationship between the pressure and volume of a gas, if the temperature is kept constant within a closed system. In 1702, German chemist Georg Stahl coined the name "phlogiston" for the substance believed to be released in the process of burning. In 1754, Scottish chemist Joseph Black isolated carbon dioxide, which he called "fixed air". In 1766, English chemist Henry Cavendish isolated hydrogen, which he called "inflammable air". In 1773, Swedish chemist Carl Wilhelm Scheele discovered oxygen, which he called "fire air. In 1774, English chemist Joseph Priestley independently isolated oxygen in its gaseous state, calling it "dephlogisticated air. Humphry Davy, the discover of several alkali and alkaline earth metals in1807 and also contributes to the discoveries of the elemental nature of chlorine and iodine.

In 1808 Amedeo Avogadro postulated that, under controlled conditions of temperature and pressure, equal volumes of gases contain an equal number of molecules. This is known as Avogadro's law. In 1840, Germain Hess proposed Hess's law - the law of conservation of energy. In 1848, William Thomson, 1st Baron Kelvin (commonly known as Lord Kelvin) established the concept of absolute zero, the temperature at which all molecular motion ceases. In 1856, Sir William Henry Perkin synthesize quinine, the anti-malaria drug, from coal tar. In 1871 a Russian chemist Dmitri Mendeleev's development of the first modern periodic table, or the periodic classification of the elements. German engineer Carl von Linde's developed a methyl ether refrigerator (1874) and an ammonia refrigerator (1876) by using modern technology. Marie Skłodowska-Curie was a Polish-born French physicist and chemist who is famous for her pioneering research on radioactivity. She and her husband discovered a radioactive element in 1898 and got Nobel Prize for Chemistry in 1911. New Zealand-born chemist and physicist Ernest Rutherford is considered to be "the father of nuclear physics." Rutherford is best known for devising the names alpha, beta, and gamma radiation. Ernest Rutherford, discoverer of the nucleus and considered the father of nuclear physics.

In 1913, Niels Bohr, a Danish physicist, introduced the concepts of quantum mechanics to atomic structure by proposing the Bohr model of the atom, where electrons exist only in strictly defined circular orbits around the nucleus similar to rungs on a ladder. In 1902, Gilbert N. Lewis, the namesake of the Lewis structure, the discoverer of the covalent bond, and creator of the concept of electron pairs. In 1924, French quantum physicist Louis de Broglie proposed wave–particle duality. In 1953 James Watson and Francis Crick deduced the double helical structure of DNA. In 1970, John Pople developed the Gaussian program greatly easing computational chemistry calculations. In 1985, Harold Kroto, Robert Curl and Richard Smalley discovered fullerenes, a class of large carbon molecules superficially resembling the geodesic dome designed by architect R. Buckminster Fuller. In 1991, Sumio Iijima develop nanotechnology.

Conclusions

Both alchemist and chemist were successively brought today's modern chemistry from early stages. Chemistry plays a vital role in everyday life. It develops medicine for man, animal and plants and hence improving human activity.

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