International Year of Chemistry - The History of Chemistry

International Year of Chemistry 2011 - What is Chemistry should be the first question asked when it comes to discuss such a celebration. The word "chemistry", or at least its translation into German language "Chemie", comes from the newer Greek word χημεία. The word stands for the "foundry" of metals.

The Greek word in turn may come from the Arabian word "al-kīmiyá" which is often translated to "philosopher's stone", but in Europe the word Alchemie was used synonymous for foundry. Other sources trace the word back to "kemi" the koptic or ancient Egypt word for "dark soil" what is also the ancient Egypt word for the Nile delta area.

No matter how one traces back the word "chemistry", one comes to a close connection with metal production, molding and alloying. And what is at least partially the same in chemistry is the mixing and heating of soil, arch and minerals to get a material with particular characteristics.

A main difference between man and other mammals is that we don't use our forelimbs for locomotion. To reach the maximum benefit from these free limbs our cortex developed enormously, enabling us to design and to use better tools.

With the use of fire around 700,000 BC, already Homo erectus used chemistry to change the characteristics of matter. This demonstrates that chemistry is and always was central to the human evolution and maybe was the first milestone in incarnation of mankind itself.

Already the origin of the word "chemistry" demonstrates that the production of metals was one of the most important topics in chemistry over some millennia. Around 7,500 BC man started melting copper and other native metals like gold and silver from arches. Another few thousand years later the first alloys appeared, with bronze alloyed from copper and tin. At ~6500 BC another chemical technique using soil entered the scene, the manufacturing of ceramics.
From ca. 4000 BC on, man used native iron from meteorites for decorating cultic weapons. Beginning ~3000 BC smelted iron can be found in Mesopotamia. Most likely this material was a very rare side product of bronze production.

Between 1800 and 1500 BC smelted iron occurred also in India and China, but for a very long time the material was extremely rare.

~1600 BC the Hittites were the first one to develop a method for smelting iron effectively. A few centuries long this knowledge, and the fact that the developers keep the knowledge a secret, supported the strong position of the Hittite culture in the near east. ~1200 BC neighboring cultures also learned the smelting process and the technique spread fast throughout Europe and Asia, thereby eliminating the economic and cultural predominance of the Hittites.

Already ~ 4000 BC in Egypt a wide variety of chemical techniques were frequently used. Beside developments in metallurgy, "wet" chemical techniques like making pottery and glazes, extraction methods for pigments, drugs etc., biochemistry techniques like fermentation, tanning leather, rendering fat into soap e.g. were developed.

The Greek atomism dating back to ~440 BC tried to replace superstition with knowledge by describing matter as being formed from atoms, which are undividable and very tiny particles. Roman philosophers like Lucretius (De rerum naturea "the nature of things", 50 BC) further developed this concept.

Pliny the Elder (23 - 79 AD) described most of the so far developed separation techniques in Naturalis Historia, the very first scientific encyclopedia that collected over 20,000 facts from 2000 books written by 100 selected authors.
With the dawn of the early medieval, scientific thinking was eliminated in Europe and scientific development and knowledge in general was damned by the Catholic Church. Meanwhile, in the near east the scientific "seed" flourished and lead to a period of prosperity, the so called "islamic golden age". During this area the modern scientific methodology was developed and Alhazen and Jābir ibn Hayyān (Geber) revolutionized chemistry based on Aristotle's concepts. The House of Wisdom (Bait al-Hikma), Al-Andalus and Alexandria became the world leading institutions where scientists of all religious and ethnic backgrounds worked together. Besides technical advances in processes and apparatus, the Arabic scientists developed and improved the production and purification of substances such as alcohols, acids, and gunpowder, which were not available to the Europeans.

In Europe, beginning with the medieval, Alchemy became more and more an empiric art. (Al-) - Chemists learned and reported that a particular material was the result of the mixing of defined masses of different substances and particular treatments. But why something happened was neither taught nor learned - the outcome was god given.

In the early 16th century Paracelsus (1493 - 1541) was one of the people who changed chemistry from an empiric art towards an experimental science by fighting hard against the common sense of doctors and pharmacists. Medicine in this time was mainly influenced by the belief that four humors were responsible for man's health. These four humors (black bile, yellow bile, phlegm, and blood) needed to be in balance in a particular person otherwise he or she got ill. This theory can be traced back to Hippocrates (ca. 460 BC - ca. 370 BC) and Galen of Pergamon (199 BC - 129 BC). Paracelsus hardly fought against this theory and especially the tendency of contemporary medicals to keep the empiric knowledge concealed from the major part of the European society for example by using Latin language.

Initiated by Paracelsus, chemistry changed slowly into an experimental science, used by a much larger part of the society then ever before, making this change fundamental for the dawn of the Age of Enlightenment.

A century later in 1661, Robert Boyle hypotheses in "The sceptical Chymyst" that matter consists of atoms and clusters of atoms in motion. He assumed that every phenomenon in the universe is a result of the behavior, motion and collision of particles. He demanded that all theories must be proved experimentally before they can be regarded as true.

Another century later, Antoine Lavoisier (1743 - 1794) found and described oxygen and hydrogen, he was involved in the development of metric systems and he listed
all elements known until then. In 1803, John Dalton presented his atomic theory and 1869 Dmitri Mendeleev published the periodic table of the elements. Rutherford's, Bohr's, Planck's and Heisenberg's work at the end of the 19th century and the beginning of the 20th century clarified important aspects of matter. Marie and Pierre Curie discovered radioactive matter.

Chemistry is the understanding, the definition and the description of the structure and behavior of matter, the matter that surrounds us and the matter we are consisting off. It is neither good nor bad; it is our history, our life and our future.

Authors

Dr. Arne Kusserow