Islamic Alchemy

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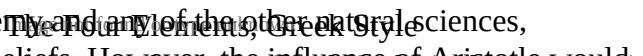
The History of Chemistry

After the contribution of the Ancient Greek philosophers to the history of chemistry, the knowledge passed into the domain of the Islam scholars.


The Four Elements, Greek Style (Public Domain)

The Greeks did not yet make any distinctions between alchemy and any of the other natural sciences, wrapping it together with their philosophical and religious beliefs. However, the influence of Aristotle would still shape the history of chemistry, and the Islamic scholars preserved his knowledge and added their own observations to it.

The Islamic scholars certainly refined Ancient Greek alchemy and the foundations of the first separation of chemistry as a separate discipline were apparent, although it is probably too early to call it 'proto-chemistry.' They based their alchemy upon the Aristotelian idea of four elements and attempted to integrate them with their beliefs in Allah and their studies into psychology, medicine and physics. Islamic alchemists attempted, as many before and since, to find a Grand Universal Theory that described the whole of perfect creation, governed by elegant laws.

The History of Chemistry - the Greek Influence

The Islamic scholars, whilst still holding to the principles of Aristotle and attempting to transmute base metals into gold and find the elixir of life, were the first scientists to attempt to quantify the process and use the scientific method proposed by such scholars as Ibn Sina and Al Haytham. In addition to using the underlying framework of Greek alchemy, they added knowledge from China and India, developing novel ideas and making discoveries that would become common knowledge to chemists once the esoterica and the

dogma were discredited. However, many European scholars believed that the Islamic Alchemists merely translated the original Greek ideas without adding anything new, which discredited the novel discoveries made by the Islamic scholars.

In the new and exciting field of Islamic alchemy, two great names stand out as the pioneers of the discipline, scholars whose work formed the basis of chemistry and filtered into Europe by osmosis. This was despite the attempts of the Renaissance scholars to ignore it in favor of Greek alchemy and elegant beliefs, perhaps hindered by the inability of the Europeans to understand Arabic. Jabbir Ibn Hayyan was the first Islamic scholar to delve deeply into Islamic alchemy and to present theories. Al Rhazes took this further, and added empirical methods, in the first steps towards developing chemistry as a separate discipline.

Jabbir Ibn-Hayyan - Geber, the Father of Islamic Alchemy

Jabir ibn Hayyan

Writing any history of chemistry including the Islamic world is difficult, simply because many of the greatest Islamic scholars were polymaths, often making great advances in philosophy, theology, medicine and a whole range of scientific disciplines.

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Alchemist Jabir ibn Hayyan, from a 15th c. European portrait of "Geber", Codici Arabi urbinati 1166, Biblioteca Medicea Laurenziana, Florence (Public Domain)

During this period, where scientific endeavor was only just beginning and there were few distinctions between the various sciences, great minds such as Ibn Hayyan, known in the west as Geber, could prosper. However, amongst his range of other achievements, he is best known as the Father of Islamic Alchemy, writing many great works that were passed over by later European scholars and only rediscovered much later in the history of chemistry.

Like the Greek philosophers, Geber made no attempt to separate the concepts of Islamic alchemy from other disciplines, looking at them within the confines of natural science, medicine and theology, drawing upon Greek ideas of balance and perfection. He certainly performed work in attempting the holy grail of transmuting base metals into gold, and he also tried to discover the secrets to an elixir of life, perhaps even creating life from components.

His major work looked at the nature of metals, trying to establish exactly what gave them their different properties. Like the Greeks, Geber made few distinctions between life and non-life, seeing minerals as a part of creation, in some ways a ‘genus’ with similar qualities. Therefore, the distinctions between them were fine and transmutation was possible with the correct elixir. Likewise, he believed that distinctions between animals, or between plants, were equally fine and that the alchemist, given the correct elixir, would be able to transform animals from one species into another, perhaps even creating new species.

Jabir took the Aristotelian ideas of the four elements of heat, cold, dryness and wetness and also believed that they were combined to make every other substance. This became the basis of his theory of metals and he proposed that all metals were made of sulphur and mercury, the ‘intermediate’ stages between the elements and metals. Gold was the perfect combination of sulphur and mercury, but other metals were contaminated by impurities, with copper, silver’ lead and the other known metals resulting from this. In Jabir’s Islamic alchemy, the task was to restore the impurity by removing the impurities from the metal and ending up with gold.

However, Geber did make many contributions to the applied side of Islamic alchemy and documented some of the advances he made in areas such as refining metals, fabricating and using dyes and inks, and contributions to glassmaking. He found out a way to use iron pyrites to make gold ink for manuscripts, which was much cheaper than actual gold for the intricate illuminated manuscripts of the time.

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Aqua regia - used to clean graduated cylinders - Discovered by Geber (Public Domain)

He wrote how to create and purify acids: nitric, hydrochloric and sulphuric, as well as the mixture of sulfuric and nitric acids, known as Aqua Regia, that can even dissolve gold. He described the methods used for extracting and preparing alum, antimony, lead acetate and mercury oxide. He wrote extensively about the use of varnishes to waterproof leather and metals. He also looked at organic acids, aware of how to concentrate acetic and citric acids.

The methods that he used for his experiments are familiar to any modern chemist and he documented methods of sublimation, evaporation, filtration, calcinations and crystallisation. It is believed that Geber laid down the framework for conducting, recording and repeating chemistry experiments, a sign of the increasing use of a proto-scientific method amongst Islamic scholars.

Islamic Alchemy - Al Razi

Al Rhases followed on from Jabbir, incorporating many of the same ideas and using much the same terminology, even using the same titles for his books as the earlier scholar. This is unusual for such a freethinker as Al-Rhazes, and hints at a connection between the two ands shows that there is little doubt that Al Rhazes admired and respected Geber. However, there were many distinctions and refinements made by Al Rhazes as he moved Islamic alchemy into another direction. These subtle, yet important distinctions are the reason why Geber is often referred to as the father of Alchemy whilst Al Rhazes is known as the father of Chemistry.

Al Rhazes wrote a number of treatises that became known to western science, the most important of which became known as Liber Secretorum Bubacaris, in the western world, and was regarded as a foundation work for centuries. The difference between the Islamic alchemy of Al Razi and that of the earlier scholar was that Rhases started the process of disconnecting the science and empiricism from archaic formulas and numerology, in an attempt to study physical processes outside the confines of divine will.

The works contained detailed descriptions of the methodology and the equipment used during experiments. His discussions of metals and other substances were discussed outside of the confines of relating them to spirituality and theology.

Whilst Rhases still incorporated many of the overall concepts and the archaic and esoteric language of earlier alchemists, he studied substances and compounds in isolation and divined their natures, rather than trying to fit them into elegant theories and sweeping generalizations.

This included trying to fit the substances into groups and classifications according to their properties. In his book, Sirr al-asrar book, he listed the ingredients as follows.

1. Earthly Substances:
2. The Spirits: Mercury, sulphur, arsenic sulphate, ammonia
3. The Bodies: Gold, silver, copper, iron, lead, tin
4. The Stones: Iron pyrites, iron oxide, zinc oxide, malachite, turquoise, arsenic oxide, lead sulphate, gypsum, glass
5. The Vitriols: Black, alum, green, red, yellow, white
6. Borax
7. The Salts
8. Vegetable Substances:
    - Rarely used and believed to be the domain of physicians
9. Animal Substances:
    - Hair, brain, bile, blood, milk, urine, eggs, horn, shell

In addition, Razi pointed out that many other substances could be derived from these basics, including lead oxide, verdigris, caustic soda, copper oxide, cinnabar (mercury (II) sulphide), and zinc oxide. These he believed were derived substances,

Alembic – Invented by Geber

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Alembic - Invented by Geber (Creative Commons) [1]

Razi was meticulous in his documentation, and listed the apparatus that he used for his research. Again, most of these, such as crucibles, alembics and a range of distillation equipment as well as various furnaces and smelting equipment. Certainly, His 'Book of Secrets' bears a remarkable resemblance to a modern laboratory manual in the way it lays out and collates the data.

Islamic Alchemy and the Decline of the Islamic Age

Whilst Jabir and Al-Razi were the two great names in the history of Islamic alchemy and two great contributors to the history of chemistry, other Islamic scholars also added to the annals. In later years, the Islamic Age was in decline and the European Renaissance was beginning as the balance of power began to pass from the East into the West.

However, these later Islamic scholars, whilst perhaps not making the same contributions to the methodology as their forebears, or making the same level of discovery, certainly deserve a mention in the history of chemistry. Their work preserved the writings of Jabir and Razi and ensured that they filtered into Europe, from Andalusia and Byzantium.

Abu'l-Qasim of Iraq

Abu'l-Qasim published work during the 13th Century and his books are a fine example of the changes occurring as the balance of power began to shift, almost imperceptibly, from the Islamic world to a Europe emerging from the Dark Ages and displaying the first glimmerings of the Renaissance. Great minds, such as Roger Bacon and Robert Grosseteste, were heavily influenced by Classical texts obtained from Byzantium as the Crusades enveloped the Eastern Mediterranean, but an increasing amount of material travelled from Andalusia.

Whilst Qasim made very little original contribution to the history of Islamic alchemy, he often quoted his more illustrious forebears and ensured that their knowledge could be passed on to the Europeans. In terms of theory, his work starts to show the decline of Islamic alchemy as he appeared to ignore many of the ideas of Jabir and returned to a more Classical view.

Aidamir Al-Jildaki (?-1342)

Al-Jildaki, another Islamic scholar living in Cairo, is one of the most important contributors to Islamic alchemy and to the history of chemistry as a whole. Whilst it would be a leap to class him as a skilled alchemist or theoretician, as an archivist he was meticulous and unbiased. In his works, he tended to quote earlier minds, such as Jabir and Razi, ensuring that large extracts of their work were available to later chemists.

Al-Tughra'i (1063-1120)

Sadly, very little of the works of Al-Tughra'i survive, otherwise there is a chance that he might have been placed alongside Jabir and Razi. Certainly, later scholars praised his work highly, especially as a theorist, and he certainly passed on much of the European knowledge of Ancient alchemy.

Islamic Alchemy Shaping the Future of the History of Chemistry

There is little doubt that the work of Islamic scholars provided the framework for the development of

chemistry. They ensured that knowledge from Greece, Egypt, India, and further afield was preserved for the later European scholars and underpinned the development of the proto-scientific approach to alchemy that would be adopted by the Renaissance scholars.

The Islamic alchemists applied a rudimentary scientific method [2] to alchemy and began to quantify and classify compounds and elements, even if they made many incorrect assumptions about the theory. The Islamic alchemists also began the process of dividing organic and inorganic chemistry; in their study of ammonia, they recognized that ammonium salts occurring naturally, as ammonium chloride, were different from those obtained from the distillation of animal by-products, such as hair, which gives ammonium carbonate.

Certainly, the contribution of the Islamic scholars to the history of chemistry was notable, but they also made some incorrect assumptions that would be replicated by later scientists. For example, the Islamic alchemists believed that sulphur and mercury were the base of every metal and that mixing them in the correct proportions would allow alchemists to create any metal.

Despite the inaccuracies, the History of chemistry owes much to Islamic alchemy and the work of Jabir and Razi. Their work was kept alight, and they ensured that the flame of knowledge would pass into the European history of chemistry.

Links
[1] http://en.wikipedia.org/wiki/User:Jeremiah
[2] https://m.explorable.com/what-is-the-scientific-method