Alchemy and chemistry in the medieval Islamic world

Alchemy and chemistry in Islam refers to the study of both traditional alchemy and early practical chemistry (the early chemical investigation of nature in general) by scholars in the medieval Islamic world. The word *alchemy* was derived from the Arabic word كيمياء or *kīmiyā'*.[1][2] and may ultimately derive from the ancient Egyptian word *kemi*, meaning black.[2]

After the fall of the Western Roman Empire, the focus of alchemical development moved to the Caliphate and the Islamic civilization. Much more is known about Islamic alchemy as it was better documented; most of the earlier writings that have come down through the years were preserved as Arabic translations.[3]

Ibn Umail describes a statue of a sage holding the tablet of ancient alchemical knowledge. Illustration from a transcript of Muhammed ibn Umail al-Tamimi's book *Al-mâ' al-waraqî* (The Silvery Water), Islamic miniature probably from Baghdad, 608H/1211.

Contents

Definition and relationship with medieval western sciences

In considering Islamic sciences as a distinct, local practice, it is important to define words such as "Arabic," "Islamic," "alchemy," and "chemistry." In order to gain a better grasp on the concepts discussed in this article, it is important to come to an understanding of what these terms mean historically. This may also help to clear up any misconceptions regarding the possible differences between alchemy and early chemistry in the context of medieval times. As A.I. Sabra writes in his article entitled, "Situating Arabic Science: Location versus Essence," "the term Arabic (or Islamic) science denotes the scientific activities of individuals who lived in a region that roughly extended chronologically from the eighth century A.D. to the beginning of the modern era, and geographically from the Iberian Peninsula and North Africa to the Indus valley and from southern Arabia to the Caspian Sea - that is, the region covered for most of that period by what we call Islamic civilization, and in which the results of

the activities referred to were for the most part expressed in the Arabic language."[4] This definition of Arabic science provides a sense that there are many distinguishing factors to contrast with science of the Western hemisphere regarding physical location, culture, and language, though there are also several similarities in the goals pursued by scientists of the Middle Ages, and in the origins of thinking from which both were derived.

Lawrence Principe describes the relationship between alchemy and chemistry in his article entitled, "Alchemy Restored," in which he states, "The search for metallic transmutation — what we call "alchemy" but that is more accurately termed "Chrysopoeia" — was ordinarily viewed in the late seventeenth century as synonymous with or as a subset of chemistry." [5] He therefore proposes that the early spelling of chemistry as "chymistry" refers to a unified science including both alchemy and early chemistry. Principe goes on to argue that, "[a]ll their chymical activities were unified by a common focus on the analysis, synthesis, transformation, and production of material substances."[5] Therefore, there is not a defined contrast between the two fields until the early 18th century.[5] Though Principe's discussion is centered on the Western practice of alchemy and chemistry, this argument is supported in the context of Islamic science as well when considering the similarity in methodology and Aristotelian inspirations, as noted in other sections of this article. This distinction between alchemy and early chemistry is one that lies predominately in semantics, though with an understanding of previous uses of the words, we can better understand the historical lack of distinct connotations regarding the terms despite their altered connotations in modern contexts.

The transmission of these sciences throughout the Eastern and Western hemispheres is also important to understand when distinguishing the sciences of both regions. The beginnings of cultural, religious, and scientific diffusion of information between the Western and Eastern societies began with the successful conquests of Alexander the Great (334-323 B.C). By establishing territory throughout the East, Alexander the Great allowed greater communication between the two hemispheres that would continue throughout history. A thousand years later, those Asian territories conquered by Alexander the Great, such as Iraq and Iran, became a center of religious movements with a focus on Christianity, Manicheism, and Zoroastrianism, which all involve sacred texts as a basis, thus encouraging literacy, scholarship, and the spread of ideas.[6] Aristotelian logic was soon included in the curriculum a center for higher education in Nisibis, located east of the Persian border, and was used to enhance the philosophical discussion of theology taking place at the time.[7] The Qur'an, the holy book of Islam, became an important source of "theology, morality, law, and cosmology," in what Lindberg describes as "the centerpiece of Islamic education." After the death of Muhammed in 632, Islam was extended throughout the Arabian peninsula, Byzantium, Persia, Syria, Egypt, and Israel by means of military conquest, solidifying the region as a predominately Muslim one.[8] While the expansion of the Islamic empire was an important factor in diminishing political barriers between such areas, there was still a wide range of religions, beliefs, and philosophies that could move freely and be translated throughout the regions. This development made way for contributions to be made on behalf of the East towards the Western conception of sciences such as alchemy.

While this transmission of information and practices allowed for the further development of the field, and though both were inspired by Aristotelian logic and Hellenic philosophies, as well as by mystical aspects[9] it is also important to note that cultural and religious boundaries remained. The mystical and religious elements discussed previously in the article distinguished Islamic alchemy from that of its Western counterpart, given that the West had predominately Christian ideals on which to base their beliefs and results, while the Islamic tradition differed greatly. While the motives differed in some ways, as did the calculations, the practice and development of alchemy and chemistry was similar given the contemporaneous nature of the fields and the ability with which scientists could transmit their beliefs.

Contributions of Islamic alchemists to mystical alchemy

Marie-Louise von Franz describes in her introduction to Ibn Umails "Book of the Explanation of the Symbols — Kitāb Ḥall ar-Rumūz" the contributions of Islamic alchemy as follows: In the 7th to 8th century, Islamic scholars were mainly concerned with translating ancient Hermetic-Gnostic texts without changing them. Gradually they began "'confronting' their content with the Islamic religion" and began "to think independently and experiment themselves in the realm of alchemy". Thus they added "an emphasis on the monotheistic outlook" (tawḥīd) and more and more creating a synopsis of the diverse antique traditions. Thus

unifying their meaning, the Islamic scholars arrived at the idea, that the secret and aim of alchemy were the achievement of "*one* inner psychic experience, namely the God-image" and that stone, water, prima materia etc. were "all aspects of the inner mystery through which the alchemist unites with the transcendent God". Secondly, they added "a passionate feeling tone" by using much more a poetic language than the antique Hermetists did, also giving "a greater emphasis on the coniunctio motif", i.e. images of the union of male and female, sun and moon, king and queen etc.[10] "The mystical masters of Islam understood alchemy as a transformative process of the alchemist's psyche. The fire which promoted this transformation was the love of God."[11]

Alchemists and works

Khālid ibn Yazīd

According to the bibliographer Ibn al-Nadīm, the first Muslim alchemist was Khālid ibn Yazīd, who is said to have studied alchemy under the Christian Marianos of Alexandria. The historicity of this story is not clear; according to M. Ullmann, it is a legend.[12][13] According to Ibn al-Nadīm and Ḥajjī Khalīfa, he is the author of the alchemical works *Kitāb al-kharazāt* (*The Book of Pearls*), *Kitāb al-ṣaḥīfa al-kabīr* (*The Big Book of the Roll*), *Kitāb al-ṣaḥīfa al-saghīr* (*The Small Book of the Roll*), *Kitāb Waṣīyatihi ilā bnihi fī-ṣ-ṣanʿa* (*The Book of his Testament to his Son about the Craft*), and *Firdaws al-ḥikma* (*The Paradise of Wisdom*), but again, these works may be pseudepigraphical.[14][13][12]

Jābir ibn Ḥayyān

Jābir ibn Ḥayyān (Persian: جابرحیان, Arabic: جابر بن حیان, Latin Geberus; usually rendered in English as Geber) may have been born in 721 or 722, in Persian city of Tus, Iran, and have been the son of Ḥayyān, a druggist from the tribe of al-Azd who originally lived in Kufa. When young Jābir studied in Arabia under Ḥarbī al-Ḥimyarī. Later, he lived in Kufa, and eventually became a court alchemist for Hārūn al-Rashīd, in Baghdad. Jābir was friendly with the Barmecides and became caught up in their disgrace in 803. As a result, he returned to Kufa. According to some sources, he died in Tus in 815.

15th century European impression of "Geber"

A large corpus of works is ascribed to Jābir, so large that it's difficult to believe he wrote them all himself. According to the theory of Paul Kraus, many of these works should be ascribed to later Ismaili authors. It includes the following groups of works: *The One Hundred and Twelve Books*; *The Seventy Books*; *The Ten Books of Rectifications*; and *The Books of the Balances*. This article will not distinguish between Jābir and the authors of works attributed to him.[15]

Abū Bakr al-Rāzī

Abū Bakr ibn Zakariyā' al-Rāzī (Latin: Rhazes), born around 864 in Rayy, was mainly known as a Persian physician. He wrote a number of alchemical works, including the *Sirr al-asrār* (Latin: *Secretum secretorum;* English: *Secret of Secrets*.)[16][17]

Ibn Umayl

Muḥammad ibn Umayl al-Tamīmī was a 10th-century alchemist of the symbolic-mystical branch. One of his surviving works is *Kitāb al-māʿ al-waraqī wa-l-arḍ al-najmiyya* (*The Book on Silvery Water and Starry Earth*). This work is a commentary on his poem, the *Risālat al-shams ilā al-hilāl* (*The Epistle of the Sun to the Crescent Moon*) and contains numerous quotations from ancient authors.[18] Ibn Umayl had important influence on medieval Western (Latin) alchemy,[19] where his work is found under

different names, mainly as Senior or as Zadith.[20] His "Silvery Water" e.g. was reprinted as "The Chemical Tables of Senior Zadith" in the collection of alchemical texts: Theatrum Chemicum, and commented upon by Pseudo Aquinas in Aurora Consurgens. They both also give his (modified) image of the sage holding a chemical table (see image above).[21]

Al-Tughrai

Al-Tughrai was an 11th–12th century Persian physician.[22] whose work the*Masabih al-hikma wa-mafatih al-rahma* (The Lanterns of Wisdom and the Keys of Mercy) is one of the earliest works of material sciences.

Al-Jildaki

Al-Jildaki who was a Persian alchemist urged in his book the need for experimental chemistry and mentioned many experiments *Kanz al-ikhtisas fi ma'rifat al-khawas by Abu 'l-Qasim Aydamir al-Jildaki*.

Alchemical and chemical theory

Jābir analyzed each Aristotelian element in terms of Aristotle's four basic qualities of *hotness*, *coldness*, *dryness*, and *moistness*. For example, fire is a substance that is hot and dry, as shown in the table.[23][24][25] According to Jābir, in each metal two of these qualities were interior and two were exterior. For example, lead was externally cold and dry but internally hot and moist; gold, on the other hand, was externally hot and moist but internally cold and dry. He believed that metals were formed in the Earth by fusion of sulfur (giving the hot and dry qualities) with mercury (giving the cold and moist.) These elements, mercury and sulfur, should be thought of as not the ordinary elements but ideal, hypothetical substances. Which metal is formed depends on the purity of the mercury and sulfur and the proportion in which they come together.[23] The later alchemist al-Rāzī followed Jābir's mercury-sulfur theory, but added a third, salty, component.[26]

Elemental scheme used by Jābir[23]

	Hot	**Cold**
Dry	Fire	Earth
Moist	Air	Water

Thus, Jābir theorized, by rearranging the qualities of one metal, a different metal would result.[27] By this reasoning, the search for the philosopher's stone was introduced to Western alchemy.[28][29] Jābir developed an elaborate numerology whereby the root letters of a substance's name in Arabic, when treated with various transformations, held correspondences to the element's physical properties.[23]

Processes and equipment

Al-Rāzī mentions the following chemical processes: distillation, calcination, solution, evaporation, crystallization, sublimation, filtration, amalgamation, and ceration (a process for making solids pasty or fusible.)[30] Some of these operations (calcination, solution, filtration, crystallization, sublimation and distillation) are also known to have been practiced by pre-Islamic Alexandrian alchemists.[31]

In his *Secretum secretorum*, Al-Rāzī mentions the following equipment:[32]

- Tools for melting substances (*li-tadhwīb*): hearth (*kūr*), bellows (*minfākh* or *ziqq*), crucible (*bawtaqa*), the *būt bar būt* (in Arabic, from Persian) or *botus barbatus* (in Latin), ladle (*mighrafa* or *milʿaqa*), tongs (*māsik* or *kalbatān*), scissors (*miqṭaʿ*), hammer (*mukassir*), file (*mibrad*).
- Tools for the preparation of drugs (*li-tadbīr al-ʿaqāqīr*): cucurbit and still with evacuation tube (*qarʿ* or *anbīq dhū khatm*), receiving matras (*qābila*), blind still (without evacuation tube) (*al-anbīq al-aʿmā*), aludel (*al-uthāl*), goblets (*qadaḥ*), flasks (*qārūra*, plural *quwārīr*), rosewater flasks (*mā' wardiyya*), cauldron (*marjal* or *tanjīr*), earthenware pots varnished on the inside with their lids (*qudūr* and *makabbāt*), water bath or sand bath (*qidr*), oven (*al-tannūr* in Arabic, *athanor* in Latin), small cylindirical oven for heating aludel (*mustawqid*), funnels, sieves, filters, etc.

See also

- Chinese alchemy
- Islamic science

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Further reading

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External links

- "How Greek Science Passed to the Arabs" (http://www.aina.org/books/hgsptta.htm) by De Lacy O'Leary