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The most Famous Chemistry Scientists in the Islamic East During the Third and Fourth Centuries of the Islamic Hijri Calendar (AH)

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Abstract

Chemistry refers to the scientific study of the properties, composition, and structure of matter, as well as the changes that occur in the structure and composition of matter, and the associated energy changes.Chemistry has become a legitimate science thanks to the efforts of the Arabs, their scientific inclination, and their inclination towards research, scrutiny, and experimentation.It was a common practice among Arabs to observe, examine, and utilize mathematical sciences, employing methods of measurement and acquiring new information. They did not rely solely on observation in mechanics, instruments, and optics. Instead, they resorted to experimentation, observation, examination, and inference using the tools and machines available to them. This approach paved the way for the inception of chemistry and led them to invent filtration, distillation, and lifting weights. Additionally, it prompted them to utilize balance in chemistry, distinguishing them from others.Arabs were the pioneers in establishing the practical science of chemistry and uncovering some of its significant components, such as sulfuric acid, nitric acid, and alcohol. They were the first to employ these substances in medical treatments, pioneering the publication of pharmaceutical compositions and mineral preparations. The Arabs made significant contributions to chemistry that led Westerners to consider it an Arab science.Arabs had a notable influence on chemistry by categorizing known chemical substances into four basic divisions during their time: mineral substances, plant substances, animal substances, and derived substances.Arabs utilized this science in medicine, industries, drug manufacturing, pharmaceutical composition, and mineral purification.It can be said that Arabs had a significant impact in shaping a chemical school that left a profound influence in the West. This would not have been possible without the transformative efforts of Jabir ibn Hayyan and similar figures, who revolutionized the field by establishing chemistry based on experimentation, observation, and inference.

Keywords: *Chemistry, Arabs, Science*

1. Chemistry in the Islamic Orient

The term "al-kimiya" or alchemy: alchemists believed that it transforms metals and turns them into gold or silver. Alchemy or "al-kimiya" in ancient times: It is a science aimed at transforming some metals into others, particularly transforming them into gold using alchemy (and alchemy: the philosopher's stone or a remedy for all diseases) (Maalouf, 2008, p. 706). Researchers have not reached a consensus on the origin and derivation of the word "chemistry." It has been suggested that the term "chemistry" is derived from the ancient Egyptian word (Chem) or) Kmt), which was used by the Pharaohs to refer to their land, meaning "black earth," indicating its fertility (Moore, 1939, p. 3). Perhaps it may have been derived from the Greek word

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(Chuma), meaning "molten metal," or in the sense of melting or molding (Arnold, 1972, p. 468). Alternatively, it could be derived from the Hebrew word (Kim Yeh), meaning "from God Almighty" (Haji Khalifa, p. 270). Some suggest that it originated from the Arabic word (quantitative), meaning to conceal or hide, or from the Persian word (Ki mia), meaning "to come by way of exclusion" (Al-Badri, 1968, p. 47). It has also been suggested that "chemistry" may be derived from the Hebrew word (Shaman), meaning mystery or secrecy, or that it is derived from the word (شم - Chem), referring to black earth or burning. The word evolved during the Ptolemaic era to become (Chemis) or (Chymes), indicating the craft for which the Egyptians were renowned (Al-Shukri, 1979, p. 20). The ancient Chinese defined chemistry as "a distinct discipline dedicated to constructing a chemical structure of natural phenomena, producing materials with specific demands at that time, such as prolonging and preserving life, extracting gold and silver, chemistry in medicine, chemical technology directly, and through philosophy and social thought indirectly" (Seifen, p. 611).

For others, the word "chemistry" may have come from the Greek (Khymeia), meaning fusion, referring to the art of melting gold and silver (Rashed, 1997, p. 1091). Argue that chemistry is derived from (kymy), meaning to cover or conceal, and chemistry is known just like alchemy: which is the name of a craft. It is said that its origin is non-Arabic, not Arabic (Ibn Sida, 1421 AH/2000, p. 3934). Ibn Khaldun also defined chemistry as the science that investigates the substances used in the production of gold and silver through industrial processes and explains the procedures leading to that.

They examine all components after knowing their compositions and potentials, hoping to find the material ready for that even from animal bones, feathers, eggs, as well as minerals. Then they explain the processes by which these substances are transformed from potentiality to actuality, such as dissolving bodies into their natural components by escalation and distillation and freezing the solvent from them by solidification. They claim that through these industries, they produce a natural body they call the elixir (Ibn Khaldun, 1984, p. 504). It is stated that the science of chemistry is "a science known for its methods of extracting properties from mineral gems and especially bringing new properties to them" (Haji Khalifa, p. 1526). There are several synonyms for the word "chemistry" in ancient references. Among them are chemistry, alchemy, chimia, craft, science of craft, science of stone, science of management, science of balance, craft of chemistry, craft of elixir, divine craft, concealed stone, the greatest concealed secret, philosopher's stone (Al-Qattan, p. 1). It is necessary to clarify a matter, that the term "Shem" or "Shim" or "Shimi" was used to refer to craftsmanship, and it has a story behind this designation: "The word is traced back to Ham, the son of the prophet Noah (peace be upon him). Ham hid the tablet from his father Noah when they boarded the ship during the flood. He gifted it to his son Mizraim, who brought it to the land where they settled, which was named after him 'Egypt'. He entrusted it to those who clandestinely practiced artisanry, namely the spiritualists and priests. The tablet contained the secrets of craftsmanship and other matters of knowledge" (Al-Shukri, p. 19).

The Origins of Chemistry

The emergence of chemistry is considered a result of human attempts to manufacture gold and interpret its existence. This metal has captivated human attention since ancient times due to its brilliance and vibrant color. Some researchers believe that it was known even before the discovery of copper, which dates to around 5000 BCE (Perst, 1992, p. 44). Subsequently, the discovery of other metals such as silver, lead, and bronze occurred in various times and places.

The use of metals by humans' dates back to around 3400 BCE in both the Nile Valley and Mesopotamia (Partington, J.R.: A Short History of Chemistry, London: 1937, p. 2). Chemistry, alchemy, or alchemical philosophy is a blend of deceit, magic, and esoteric philosophy. Its popularity grew from the beginning of Christianity until the 18th century AD. Alchemists attempted to transmute base metals into silver and gold. Chemistry or alchemy was studied in China and India before the birth of Jesus Christ. However, it evolved as a principal system in Egypt over the following three hundred years (Al-Qattan, pp. 1-2). The durability of gold quality led people to believe in the possibility of discovering the secret of longevity or even immortality, provided they discovered how to make gold from base materials. The Chinese believed that consuming food in golden dishes prolongs life. Chemistry (alchemy) was associated with many religious beliefs. It is believed that the methods of making gold were symbolically linked to death, decay, and renewal, as chemistry was intricately linked to astrology. Some people believed that the sun represented gold, the moon represented silver, Mars represented iron, Venus represented copper, Jupiter represented tin, Saturn represented lead, and Mercury represented mercury (Al-Qattan, p. 2).

Alchemy and the Legend of the Elixir

Gold and silver have been considered precious metals since ancient times, being rare and highly valuable metals. Therefore, they have been termed as 'Precious Metals.' On the other hand, other more common and less esteemed metals, which are more susceptible to heat, moisture, and rust over time, such as copper, lead, iron, and tin, have been referred to as 'Base Metals' (Burr, pp. 8-9).

The Influence of Astrology on Chemistry

Astrology originated and evolved in Mesopotamia, gradually becoming a sophisticated art during the 6th and 5th centuries BCE (the time of the Chaldeans). Since the time of the Babylonians, it has been associated with predicting the future and events occurring on Earth (Dulaurent: Mesopotamia - The Civilization of Babylon and Assyria, translated by Maroun Al Khouri, Dar Al-Rawae, Beirut: 1971, p. 181). They regarded the five known wandering planets (Mercury, Venus, Mars, Jupiter, Saturn) as the forces that govern the events of the world and the destinies of humans. Their five main gods represented these planets (Perst, p. 233).

The Fusion of Chemistry with Magical Claims and Mysterious Philosophical Ideas

The Interweaving of Chemistry with Magical Claims and Mysterious Philosophical Ideas: Chemistry has been influenced since early times by the ideas of Pythagoras, the Greek philosopher of the 6th century BCE, who formed a philosophical-religious bond primarily based on the sanctity of numbers and the belief that the origin and existence of the world lie within them. Some professions closely related to chemistry have been influenced by magical claims (Moore, pp. 6-7).

The Interconnection of Chemistry with Religion

The blending of chemistry with religion is considered part of chemistry's inclination towards symbolism and mystery. The precise nature of this close connection between them appears complex and unclear. Practitioners in the field attributed their craft to a legendary figure known

as Hermes of Babylon. Some Arab historians distinguished between three Hermetic figures: the first Hermes, said to be the prophet Idris, whose name appeared in the Torah as Enoch; the second Hermes, or Hermes of Babylon, to whom Ibn al-Nadim attributed thirteen books on alchemy; and the third Hermes, characterized by wisdom, prophecy, and grace, to whom several books on astrology, magic, chemistry, and other subjects were attributed (See: Ibn al-Nadim, "Al-Fihrist", p. 418; Ibn Jalljal, Abu Dawud Sulaiman ibn Hasan al-Andalusi). Layers of Physicians and Sages, by Fuad Said, published by the French Scientific Institute, Cairo, 1955, pp. 5-10; Al-Qifti, Jamal al-Din Abu al-Hasan Ali ibn al-Qadi al-Ashraf Yusuf (d. 646 AH): "Kitab Akhbar al-Ulama' bi-Akhbar al-Hukama'," published by Maktabat al-Mutanabbi, Cairo, n.d., pp. 1-7, 346-350; Ibn Abi Usaybi'ah, Mu'afah al-Din Abu al-Abbas Ahmad ibn al-Qasim ibn Khalifah ibn Yunus al-Sa'di al-Khazraji (d. 668 AH): "Uyun al-Anba' fi Tabaqat al-Atibba'," published by Dar al-Kutub, Beirut, 1376 AH, vol. 1, p. 32. "They also refer to Hermes as the Triangular Wisdom or Grace, and thus alchemy is referred to as the Hermetic craft" (Al-Khaldi, 1953, p. 13).

They claimed that Pythagoras (sixth century BC) acquired alchemy from Hermes and spread it among people. Gradually, alchemy became surrounded by an aura of sanctity, and it was termed "Divine Craft" because, according to their claim, it was sent down by God to His prophets. Later, with the spread of Christianity, some practitioners of alchemy began to associate the transformation process closely with the idea of the soul's completion seeking material salvation and eternal salvation (Dumézil, 1962, p. 260). Thus, chemistry entered a strange phase of its evolution: for the transformation to occur, the alchemist had to supplicate with prayers and sacrifices, recite prayers and rosaries, engage in meditation and fasting, seeking closeness to God so that the experiment would succeed (Ibn al-Nadim, 1971, p. 424).

If the operation failed, it was not due to errors in the experiment but rather due to the practitioner's shortcomings. "He must be a believer with absolute faith in God, adorned with noble and virtuous ethics, free from greed or avarice, living a life of asceticism and contemplation, free from any impurity or debauchery." Some might have forgotten certain invocations or erred in some religious chants, or failed to fulfill the obligations of asceticism, renunciation, and worship. This interaction and amalgamation between the philosophy of religion (theology) on one side and practical chemistry on the other, with their intertwined complexity, made alchemical literature a massive speculative work, not easily understood (Edinburgh: 1957: p. 152).

3. The Transmission of Chemistry to the Arabs

After Muslims triumphed over the Persian and Byzantine empires and consolidated their rule, they turned their attention to science and education. They began collecting books on medicine, wisdom, philosophy, chemistry, mathematics, and other scientific fields, initiating a wide-scale translation movement to transfer this knowledge into Arabic for utilization. Translation was conducted either directly from Greek or through Syriac into Arabic. The channels through which Greek chemistry entered Arabic were particularly notable in Alexandria and generally in renowned cultural centers of that era, such as Haran in Iraq, Nisibis, and Edessa in Syria, and Gundeshapur in southwestern Iran (Edinburgh: 1957: p.65).

Arabic chemistry was indeed influenced by Greek and Syriac chemistry. However, the sciences of Greece and Syria in this field were not valuable because they relied on hypotheses and intellectual analyses (Al-Hallou, 1996, p. 60).

It has been mentioned that Arabic chemistry was imbued with alchemy, just as their astronomy was infused with the art of astrology. However, the amalgamation of established science with imagination did not prevent Arabs from making important discoveries. The knowledge transferred from Greece to the Arabs in chemistry was weak, and the Greeks were not aware of the significant compounds discovered by the Arabs, such as alcohol, sulfuric acid, nitric acid, and aqua regia, among others. The Arabs discovered fundamental principles of chemistry, such as distillation (Lubon, 1384 AH/1964, pp. 474-475). The Arabs emerged onto the stage of chemical (alchemy) history in the seventh century AD, marking a long journey for chemistry. Their first encounter with this chemistry was in Egypt, particularly in Alexandria, where traditions trace back many centuries before the Christian era (Rashid, p. 1103). The craft reached the Arabs through the Alexandrians when Khalid ibn Yazid ibn Muawiya (d. 85 AH / 704 CE) imported some Arabic-speaking Copts, such as Mariano and Stefaunus al-Alexandri, and requested from them the translation of the craft sciences into Arabic. Khalid ibn Yazid learned this craft with the aim of transmuting base metals into gold, making him the first to transfer and practice chemistry. Therefore, Khalid ibn Yazid is considered the pioneering figure of chemistry in Arabic (Ibn al-Nadim, p. 303). He is attributed with several authored works in the craft, including "The Beads," "The Great Scroll," "The Small Scroll," and "His Testament to His Son in the Craft." His most famous work is "The Paradise of Wisdom," consisting of 2315 verses in poetic form (Ibn al-Nadim, 1968, p. 224). Historians mention that Imam Ja'far al-Sadiq, the son of Imam Muhammad al-Baqir (peace be upon them), was born in 80 AH (700 CE) and passed away in 148 AH (765 CE). He was the second Arab to engage in chemistry. He authored works on the craft of chemistry, alchemy, and astrology, including a book consisting of a thousand pages containing the letters of Ja'far al-Sadiq (peace be upon him), totaling five hundred letters (Ibn Khallikan, pp. 224-226).

It is also reported that among the compilations of Imam Ja'far al-Sadiq (peace be upon him) are "The Comprehensive Division of Vision in Jafr" and "The Book of Jafr" (Hajji Khalifa, p. 1531).

He is also credited with abundant compilations comprising instructions and books concerning verses from the Quran, which were used as talismans and for divination (Rashid, p. 1104).

In any case, Khalid ibn Yazid, and Imam Ja'far al-Sadiq (peace be upon him) are considered the guiding lights that illuminated the path of research and experimentation for Jabir ibn Hayyan, Abu Bakr al-Razi, and others (Hamoud, 1999, p. 60). Khalid ibn Yazid's direction of the Arab community towards the science of chemistry, followed by Imam Ja'far al-Sadiq's (peace be upon him) interest in this field, elevated chemistry to a prestigious position among the realms of knowledge and scholarship. Consequently, people embraced the study and practice of chemistry, including scholars and philosophers, with Jabir ibn Hayyan, considered the founder of chemistry among the Arabs, leading the way (Fahad, 1408 AH/1988, p. 152).

Jabir's father, Hayyan ibn Abdullah al-Azdi, worked as a perfumer in Kufa and traveled from one place to another until he reached Tous, a city in Khorasan and one of the villages near Bukhara, during the days of Uthman ibn Affan's reign (Yaqut al-Hamawi, 1977, pp. 49-50; al-Qazwini, p. 111). We mentioned that Imam Ja'far al-Sadiq (peace be upon him) was the second to delve into the science of chemistry. It appears that Jabir ibn Hayyan's association with Imam Ja'far al-Sadiq (peace be upon him), his close attachment to him, and his profound respect for his master, along with his exposure to the chemistry practiced, instilled in him a love for this science. He delved deeper into its study, revisiting the teachings of Khalid ibn Yazid and the translations of books from Alexandrian scholars and others, swiftly emerging as the first Arab

to establish the foundations of a new science and elevate it to the ranks of esteemed disciplines (al-Shukri, p. 30).

Historians differ regarding the number of books authored by Jabir ibn Hayyan. Ibn al-Nadim listed two indices of his works, one large and the other small, providing varying numbers of his books, treatises, and articles, citing 228 books, one hundred treatises, and twenty-four articles (Ibn al-Nadim, pp. 513-514). It is also mentioned that Jabir's books numbered around 232 (Haji Khalifa, pp. 1534-1535). However, the consensus is that Jabir ibn Hayyan authored approximately 112 books, not necessarily confined to chemistry but covering diverse topics such as medicine, pharmacology, poisons, language, rhetoric, talismans, alchemy, and the production of elixirs, among others (al-Shukri, p. 153). Many of Jabir ibn Hayyan's books have been translated into Latin, French, Italian, German, and English, becoming important references in the study of chemistry. Some of his famous works in chemistry include "Book of Great Properties," "Mercy," "Balances," "Harmony," "Poisons," "The Hidden Secret," "Stones," "Divine Science," "Extraction of Potential into Action," "Isagoge" (Parts I, II, and III), "The Pure," "Correspondence and Similarity," "Exposition," and "Elements" (al-Shukri, pp. 1105-1107).

As for his achievements, Jabir ibn Hayyan attended to a wide array of accomplishments (Mahmoud, 1950, p. 100; Bidawi, 1978, pp. 14-16; al-Qattan, pp. 9-10; Rashid, pp. 475-477):

1. Sulfuric acid was named "oil of vitriol" or "dissolving oil."
2. Nitric acid, hydrochloric acid, and the mixture of both resulted in a solution that dissolves gold, known as "aqua regia" or "royal water" today.
3. Caustic soda, which prepared sodium and potassium carbonate.
4. White lead, meaning basic lead carbonate.
5. Cinnabar, referring to mercuric sulfide.

6. Jabir studied the properties of mercury and prepared numerous amalgams from it. Among the metallic amalgams, there was a mineral resembling silver, either in the form of large crystals, large masses, or semi-liquid silver-white lumps. As for the gold amalgam, it consisted of small metallic pebbles resembling white pebbles, easily crumbled, and may appear as white-to-yellowish prisms, one-third gold, and two-thirds mercury.

8. He identified the qualitative test for copper ions by observing that copper compounds impart a blue color to the flame.
9. He is credited with the preparation of alcohol, acetic acid, and citric acid in their pure forms.
10. He studied poisons and explained in his book "Poisons" the types of poisons, their properties, and their effects on the body. He classified them into:

a. Animal poisons such as snake venom and scorpion venom.
b. Plant poisons such as opium, morphine, strychnine (with the toxic substance quinine), hemlock, which contains the toxic substance solanine.
c. Mineral poisons such as arsenic, mercury, cyanide, and sulfur.

11. He categorized and explained the best laboratory devices and instruments, such as furnaces and ovens, and modified the temperature to suit the experiment.

Undoubtedly, Jabir ibn Hayyan is recognized as the first philosopher and scientist who elevated chemistry to a lofty science. He distinguished between "knowledge" and "craftsmanship". He engaged in chemistry as a science on one hand and practiced it as a craft, specifically in the transmutation of gold, on the other hand. (Source: Al-Shukri, "Chemistry Among the Arabs", p. 46).

4. The Most Famous Scientists of the Islamic East in Chemistry

As previously mentioned in the preceding topics, the first Muslims Arabs to engage in chemistry were Khalid ibn Yazid, Imam Ja'far al-Sadiq (peace be upon him), and Jabir ibn Hayyan. It was imperative for us to mention these pioneering Muslim Arab chemists who provided significant contributions to the world in this field. Jabir, in particular, left scientific legacies and greatly contributed to demonstrating the benefits of chemistry, transforming it into an applied science in industry and medicine. Arab philosophers and scientists who came after Jabir turned their attention to chemistry. Therefore, we will discuss some of the renowned pioneers of chemistry in the Islamic East after Jabir.

1- Ali bin Muhammad al-Hasani al-Khorasani (d. 305 AH/917 AD)

He was a chemist from Khorasan who traveled between countries. Among his works are the book "Al-Usul fi al-Sibghah" (Principles of Dyeing), the book "Al-Hajar al-Tahir" (The Pure Stone), the book "Al-Shi'r wa al-Dam" (Poetry and Blood), and the book "Risalat al-Yatim" (The Orphan's Treatise). (Al-Baghdadi, 1947, p. 676; Kahhala, 1960, p. 194).

2- Al-Husayn ibn Mansur al-Hallaj (died 309 AH / 921 CE)

He was believed to be from Khorasan, specifically from Nishapur, while others claimed he was from Marw. He had some knowledge of chemistry, and authored works such as "Taseen: The Eternal, The Great Gems and The Illuminated Olive Tree," "Modern and Eternal Letters and Universal Names," "The Extended Shadow, Poured Water, and Eternal Life," "The Bearer of Light, Life, and Spirits," and "Red Sulfur." (Ibn al-Nadim, pp. 241-242).

3- Abu Bakr Muhammad bin Zakaria Al-Razi (d. 313 AH / 925 AD)

Born and raised in Rey, a city renowned for its abundance of fruits and blessings, located approximately 160 farsakhs from Nishapur, Razi was a prominent figure in medicine, chemistry, and philosophy. Rey is a remarkable city, characterized by its intricately adorned brick structures polished with azure, nestled beside a mountain overseeing it, near Damavand, Tabaristan, Qumis, and Jurjan. Razi, known to Europeans as Rhazes, was deeply passionate about intellectual sciences, literature, poetry, and music from a young age, as noted by Ibn Khallikan. He was a renowned philosopher who emphasized the importance of natural sciences, urging scholars to study them and adhere to logical laws. He believed that neglecting these sciences would hinder scholars' progress (Jundi, pp. 211-224). Al-Razi aspired to acquire knowledge of all known sciences and arts, mastering and excelling in many of them. Chemistry was one of the sciences he dedicated considerable time and effort to, conducting numerous chemical experiments. He regarded chemistry as essential for philosophers, stating, "I do not consider someone a philosopher unless they are proficient in the art of chemistry." Al-Razi emphasized the importance of chemical knowledge, believing that a person cannot be called a philosopher unless they possess expertise in chemistry, as it enables them to be self-sufficient and indispensable to others in their knowledge and circumstances. He drew many of his chemical theories from Jabir ibn Hayyan, often citing him in his works on chemistry (Ibn Abi Usaybi'ah, pp. 419-420). It is likely that Al-Razi drew from the books attributed to Jabir ibn Hayyan, which were produced by the brethren of Purity, also known as the Secret Society. The influence of these books can be traced throughout the history of European chemistry (Eberly, 1959, pp. 404-405).

Al-Razi may have been influenced by what he read in the books of Jabir ibn Hayyan and believed, like him, that all substances are composed of only four elements: earth, water, air, and

fire. He added a third component, salt, considering it one of the essential elements in the composition of substances. This perspective led to the idea of transmutation, where one metal could potentially be transformed into another (Abdul Baqi, pp. 412-413).

In reality, Al-Razi's interest in chemistry stemmed from his pursuit of the philosopher's stone (the elixir), which was believed to transform base metals into gold and silver. However, realizing the impracticality of achieving this goal, he turned his attention to the field of medicine, seeing in it the potential to fulfill his aspirations for wealth (Abdul Baqi, p. 413). Ibn Abi Usaybi'a reported: "Some physicians told me that Al-Razi had sold gold alloys to a group of Romans, who took them back to their country. Several years later, they found that the color of the alloys had changed significantly, realizing their deception. They returned them to him, and he was obliged to refund them." Regardless of the veracity of this account, it clearly indicates Al-Razi's involvement in the craft of alchemy, as he understood its essence. He authored numerous books on this subject, including a volume containing twelve books (Ibn al-Nadim, pp. 356-359; Al-Qifti, p. 179). Additionally, he added seven books on the same subject (Ibn Abi Usaybi'a, p. 422).

One of the most important of these books is "The Secret of Secrets," considered one of Al-Razi's most significant works in wisdom. It gained popularity among practitioners and remained the only book on alchemy by Al-Razi that has not been lost. It also garnered widespread fame in Europe, where it was translated into German by Ruska and commented upon. This book illustrates Al-Razi's inclination toward the scientific aspect of chemistry and his preference for conducting experiments himself (Al-Ta'i, pp. 113-114). Additionally, in his book "Al-Tartib," Al-Razi discussed the arrangement of work for experimenters, presented the claims of artisans, and explained the sentences contained in Jabir ibn Hayyan's book titled "Al-Rahmah" (Haji Khalfah, p. 1403).

Al-Razi benefited from his chemical experiments to understand a large number of chemical compounds and various methods of chemical processes that are still used today. He classified chemical substances into four basic categories based on the properties of natural compounds: terrestrial, mineral, vegetal, and animal substances and derivatives. Each category encompasses several types, further divided into multiple substances (Al-Ta'i, pp. 153-154). Al-Razi's classification of chemical substances into vegetal and animal categories remains steadfast in modern science (Arnold, 1978, p. 466).

4- Abu Nasr Muhammad bin Tarkhan Al-Farabi (d. 339 AH / 950 AD)

Al-Farabi was born in the city of Farab, which is located in the province of Transoxiana, near the borders of Turkish lands, farther than Shash, and close to Balasaghun. It is also a district of Sughd. A group of virtuous individuals and scholars are associated with it (Yaqut al-Hamawi, p. 433). He moved to Baghdad with his father, where he studied the Arabic language. Later, he moved to Aleppo and entered the court of Saif al-Dawlah al-Hamdani. Al-Farabi became renowned for his knowledge of various languages, philosophy, and logic. He was described as the "philosopher of the Muslims" and the one closest to Aristotle's philosophy, earning him the title of "the Second Teacher." He wrote extensively on philosophy and logic, with one of his most famous works being "The Opinions of the People of the Virtuous City," a philosophical book that encompasses his views on theology, human psychology, ethics, logic, education, politics, and more (Al-Qifti, 2000, p. 11).

Al-Farabi was a skilled musician, credited with the discovery of the instrument known as the "qanun." He was also the first to categorize the sciences, with his book "Enumeration of the

Sciences" serving as the nucleus for structuring the circles of knowledge in the world (Al-Shukri, p. 60).

Undoubtedly, Al-Farabi is recognized as the primary interpreter of Aristotle's theories and philosophy in all its aspects. He rationalized Aristotle's theory of the four elements and the possibility of transforming metals. It appears that he was deeply influenced by this theory, and perhaps the idea of transformation or alchemy was central to his beliefs, or rather to Aristotle himself. He authored a book titled "An Essay on the Necessity of Chemistry and Refutation of Its Detractors" (Ibn al-Nadim, p. 382).

Al-Farabi stated in his writings about minerals that the seven malleable metals (those capable of being hammered into sheets and drawn into wires) including gold, silver, lead, tin, copper, iron, and mercury, are of one type. Their differences lie in their qualities such as humidity, softness, hardness, and color (Al-Shukri, pp. 60-61).

Among his works are: "The Book of Demonstration," "The Minor Analytics," "The Middle Book," "The Book of Argumentation," "The Little Abridged Book," "The Big Abridged Book," "The Book of Proof's Conditions," "The Book of Stars," "The Book of Unity and Oneness," along with "The Book of Views of the Noble City," "Enumeration of the Sciences," "The Book of Writing," "Refutation of Ibn al-Nahwi," "A Book on the Art of Debate," "Refutation of Rawandi," "Introduction to Logic," "The Book of Metrics," "Summary of the Book of Vows," "A Book on the Intellect," "Refutation of Galen," "Explanation of Aristotle's Demonstration," and "A Book on Essence" (Al-Qifti, p. 157).

5- Abu Al-Rayhan Muhammad bin Ahmed Al-Biruni (d. 440 AH / 1051 AD)

He was born in the year 362 AH / 973 CE in a suburb of Khwarazm. Khwarazm is part of the region of Khurasan, and its major city is called "Ghilan" or "Qila," sometimes referred to as the city of Khwarazm. Samarkand and Khwarazm are disconnected areas of Khurasan and beyond the river. It is known for its abundant trees, predominantly mulberry trees, and is famous for its abundance of grapes. Its winters are very cold, surrounded by flowing sands, inhabited by a mixture of Turks and Turkmen. See: Yaqut al-Hamawi, pp. 395-398; Al-Hamiri, pp. 224-225; Ibn Abdul-Hakam al-Baghdadi, p. 487. Al-Biruni is named after Birun; Al-Biruni learned Arabic and Persian from Abu Nasr Mansur ibn Ali ibn Iraq, was favored by Sultan Mansur ibn Nuh al-Samani, and was admitted to his court in Bukhara, where he gained access to the treasure trove of books and their contents. (Al-Biruni, 1955, p. 8). Al-Biruni is considered one of the most renowned Muslim scholars and philosophers in mathematics, engineering, astronomy, and geography, with numerous books written in these fields. Al-Biruni relied on his personal experiments in his research, thereby emphasizing the principle of experimentation in scientific inquiry. (Al-Shukri, p. 71; Al-Fandi, 1968, p. 192).

Al-Biruni studied herbal plants and medicinal drugs, authoring the book "Al-Saidana," which is considered one of the foundational texts in the comprehensive Arab revival of medical and chemical pharmacology. He also researched metals, discussing metals and gemstones, their formation, locations, and extraction methods. In this field of knowledge, he authored "An Article on the Relationship between Phases" and "The Famous Book on the Knowledge of Jewels." (Nasr, Sayyid Husayn, 1978, pp. 190-193; Al-Damurdash, Ahmed Saeed, 1980, p. 4; Fahd, pp. 158-159).

Al-Biruni discussed the chemical and physical properties of mercury, including its specific gravity and its reaction with sulfur. He provided an excellent chemical description of gold, mentioning its names in various languages: in Greek, it is called Khersun; in Syriac, it is called

Dhahab; in Hindi, it is called Soren; in Turkish, it is called Tan; in Persian, it is called Zar; and in Arabic, it is known as Dhahab al-Nudar. (Al-Shukri, p. 74). The discussion elaborates on silver, including its names, compositions, attributes, and mining processes, alongside its specific weight. Additionally, copper is mentioned, detailing its compositions, mining methods, and its propensity to rust in vinegar. Iron and its various types, properties, mining processes, as well as the production of iron alloys and steel, are also described. Lead is also addressed, explaining its mining process, noting its specific melting in dedicated soil and metallic stones, thus contributing to its decreased market value (Meille, 1962, pp. 196-198; Al-Qatati, p. 11).

Al-Biruni rejected the concept of transmutation of metals, advocating the futility of alchemy. He posited that all human-made metallic substances are inferior to those produced by nature. He contested the views held by chemists, stating that the value of their gold creations in dreams exceeds that of the actual metal due to its innate purity and strength (Al-Halaw and Jaber, pp. 130-137; Al-Qatati, p. 11).

Al-Biruni advocated for the unity of scientific direction between the Islamic and Western worlds, emphasizing the importance of recognizing the common human and scientific foundations across nations in a unified global realm (Al-Shukri, p. 78).

6- Abu Ali Al-Hussein Ibn Abdullah Ibn Sina (d. 428 AH / 1037 AD)

Born in 370 AH / 980 CE in a village near Bukhara, which is one of the greatest cities of Transoxiana, Ibn Sina's life began in a region abundant with orchards and fruits. Bukhara boasts extensive markets and spacious squares, with most of its markets located within these squares (Yaqut al-Hamawi, pp. 353-356; Al-Hamiri, pp. 82-84; Al-Baghdadi, p. 169; Al-Qazwini, p. 509). As the capital of Khurasan, Ibn Sina studied under Abu Bakr al-Khwarizmi, mastering the Quran, and excelling in the fundamentals of religion, literature, mathematics, algebra, and logic (Fahd, pp. 158-159).

Ibn Sina left a significant scientific legacy, with over a hundred works to his credit, ranging from concise treatises to comprehensive volumes, highlighting his broad knowledge and prolific output across various fields of learning and sciences. He is renowned as one of the most eminent Muslim scholars, earning the epithet "The Master Sheikh," a title bestowed upon the greatest philosophers and scientists (Al-Shukri, pp. 63-64).

While Ibn Sina did not write a specific book on chemistry, his contributions to the field include important research, opinions, and theories. For instance, in his discourse on chemistry found in the section on natural sciences in his book "Al-Shifa," Ibn Sina definitively refuted the transmutation of gold, a stance that contradicted the views of his contemporaries and predecessors among the philosophers and scientists (Rashid, pp. 1120-1122). This represents an addition to Ibn Sina's achievements in the field of herbal medicine and medicinal drugs. He conducted thorough studies on these substances from therapeutic perspectives and extracted chemical medicines from their natural sources. Ibn Sina's works in medicinal drugs formed a solid foundation for the establishment of the science of pharmacology. This science, as widely recognized, stands as one of the most important subjects in both chemistry and medicine alike (Al-Shukri, pp. 66-67; Fahd, pp. 158-159).

7- Nasir Khusraw Al-Isbahani Al-Qabadbani Al-Maruzi (d. 450 AH)

He is among the authors in the field of chemistry, and the title of his book is "The Greatest Masterpiece in Wisdom." Additionally, he is a scientist in chemistry and is considered one of the contributors in jurisprudence and hadith studies (Al-Shukri, pp. 82-83).

8- Muayyid al-Din Hussein bin Ali al-Asbahani, known as al-Tughra'i (d. 515 AH/1121 AD)

He was born in the year 453 Hijri and was attributed to the one who writes the "Tughra" - which is the inscription written at the top of decrees above the Basmala with a clear pen, containing the name of the king who issued the decree. It is a distorted Arabic word for "Tughra." He served as the minister to Sultan Mas'ud bin Muhammad al-Saljuqi (Rashid, p. 1115).

Al-Tughra'i was a creative poet and a skillful writer, with experience in chemistry. However, he only worked on it theoretically, focusing his efforts on alchemy. He wasted his wealth, time, and life in this attempt, ultimately failing. He lamented himself, and others mourned him (Rashid, p. 1115).

In the field of chemistry, he authored works such as "Structures of Light in Alchemy," "Compendium of Secrets," "The Secret of Wisdom," "The Radiant Essence in the Art of Alchemy," "The Keys of Mercy and Lamps of Wisdom in Chemistry," "The Truths of References in Chemistry," and "Response to Ibn Sina in Chemistry" (Haji Khalifa, p. 143; Al-Khwansari, 1971, p. 223; Kahhala, p. 70). Al-Tughra'i was a creative poet, renowned for his famous collection of poetry. He expressed poetry about chemistry and its pursuit, particularly in the matter of alchemy (theoretical rather than practical). For instance, he said:

"I discovered the secrets of creation entirely,
Knowledge illuminated the dark animal for me.

I inherited from Hermes his wisdom's secret,
Still hidden in the unseen, a mystery believed.

I possessed the key to treasures with wisdom,
Revealing to me the enigmatic hidden secret."

From his poetry, it is evident that he did not achieve his goal in chemistry, nor did he accomplish what he had hoped for, as indicated in his verse:

"The authenticity of my opinion preserved me from deviation,
The adornment of merit adorned me in times of adversity" (Al-Shukri, pp. 83-85).

9- Izz al-Din Aydimir bin Ali al-Jaldaki (d. 743 AH/1341 AD)

He is undoubtedly the most significant representative of late Arabic chemistry. He compiled the statements of Arab and Muslim scientists and philosophers, organizing them effectively. His work on chemistry was during the peak of the Islamic Arab Renaissance.

He held important views in chemistry, asserting that chemical substances only react with each other in specific proportions, which is the key principle of the Law of Constant Proportions in chemical combination. He also succeeded in separating gold from silver using nitric acid, which dissolves silver while leaving gold intact.

Al-Jaldaki authored several books, including "Al-Taqrīb fī Asrār al-Tarkīb fī al-Kīmiyā" (Approximation of the Secrets of Composition in Chemistry) and "Nihāyat al-Talab" (The End of Seeking). These two books contain theories, research, and practical experiments of early scientists, making them important references in the study of chemistry among Arabs. He authored other books, including "Al-Badr al-Munir fi Khawas al-Iksir" (The Illuminating Full Moon on the Properties of the Elixir) and "Al-Bur al-Munir fi Yanbu' al-Iksir" (The Luminous

Land in the Source of the Elixir), along with the book "Al-Misbah fi 'Ilm al-Miftah" (The Lamp in the Science of the Key), which summarizes his works. Additionally, he wrote the book "Al-Burhan fi Asrar 'Ilm al-Mizan" (The Proof of the Secrets of the Science of Balance), a comprehensive work that discusses numerous principles in natural science. He delved into the concept of the seven bodies (i.e., metals) and elucidated the books "Al-Ajsad" and "Kitab al-Mawazin" by Jabir ibn Hayyan.

It is mentioned that al-Jaldaki is renowned not only among Western and Muslim scientists but also among chemists in general. He showed remarkable dedication to reading and analyzing works on chemistry, using them to construct his scientific path in the field of chemistry. This approach is known as the Arabic and Islamic chemistry ethics. Al-Jaldaki conducted scientific experiments in the field of chemistry, primarily analytical in nature. Nonetheless, he is recognized by modern scientists for his significant contributions to the field.

4. Conclusion

The article draws several conclusions, as follows:

Alchemy, or alchemy, is a mixture of deception, magic, and esoteric philosophy. It gained popularity from the early Christian era until the eighteenth-century AD. Alchemists attempted to transmute base metals into silver and gold and sought to discover the elixir of life, a substance believed to cure diseases. However, they ultimately failed in their endeavours. Nonetheless, their efforts in preparing and studying chemical substances contributed to the development of the science of chemistry.

These alchemists were charlatans, while others were genuine scientists. Their focus was more philosophical than chemical; they believed that mastering the transmutation of base metals into gold would unlock other secrets. They considered gold as the perfect metal due to its beauty and resistance to corrosion.

Alchemy was studied in China and India before the birth of Christ but evolved as a major system in Egypt over the following three hundred years. Greek-speaking scholars in Alexandria used alchemy to explain how Egyptian craftsmen crafted objects. Greek-Egyptian alchemy spread from Syria and Persia to the Arabs, who played a crucial role in transitioning from alchemy to chemistry at the end of the third century AH (tenth century AD). It later spread to Western Europe during the twelfth and thirteenth centuries AD.

Alchemy derived its theories about matter from ancient Greeks, believing that all matter consisted of a single formless substance. They also believed that this substance constituted the four elements: earth, air, fire, and water, which combined through heat, cold, wetness, or dryness.

The origins of chemistry date back to ancient times, with conflicting accounts of its birthplace. It is said to have begun in the third century BC. Ancient civilizations such as China and India considered chemical processing (altering substances with chemical fluids) a skill and expertise. This knowledge and proficiency spread westward to the Persian and ancient Egyptian empires.

Artisanry reached the Arabs through the Alexandrians when Khalid ibn Yazid ibn Mu'awiya brought some Arabic-speaking Copts, such as Mariano, Shimon, and Istifan al-Iskandari, and requested them to transfer the knowledge of craftsmanship into Arabic. Khalid ibn Yazid learned this craft with the aim of transmuting base metals into gold, making him the first to introduce and engage in alchemy.

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