his *Mīzān al-Ḥikmah*, written in 618/1221 and considered among the masterpieces of the Middle Ages. In this work al-Khāzini discussed mechanics, hydrostatics, and physics in a masterly way. He gave tables of specific gravities of liquid substances (on the lines adopted by al-Bīrūni) and detailed studies of the theory of gravitation (universal force directed towards the then considered centre of the universe, i.e., the centre of the earth); weight and buoyancy of air; rise of water in capillary tubes; aerometric measurement of densities and the temperature of liquids; theory of the lever; levelling by balance; and measurement of time.

The Muslims took keen interst in clocks to find out the correct times for prayers. Their artisans acquired great mastery in this work, as may be judged from Hārūn al-Rashid's presenting Charlemagne with a water-clock in 192/807.

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Chapter LXV

CHEMISTRY

Alexandrian Alchemy.—With the advent of Islam, the Arab tribes, many of them still nomadic, were united into one nation. Their conflicts with the neighbouring peoples which used to end as skirmishes bringing immediate defeat on the scattered tribes, now changed into regular wars often crowning them with success. What that meant can be realized from the fact that within a hundred years of the Prophet's death, which occurred in 11/632, Islam had spread from Spain in the West to Sind in the East. As an advancing nation the Arabs came in contact with different races, and when Egypt was conquered, during the regime of the Caliph 'Umar, in 21/641, they came to know the Hellenized Egyptian culture as it then existed. Its centre was Alexandria, founded by Alexander in 332 B.C. Very soon it became an emporium of international trade attracting merchants from all over the world. Above all, the Greeks had migrated there in numbers, giving rise to a mixed culture of Egyptian and Greek origin. The Egyptians used idols in their temples and chapels, preferring those of bronze, particularly when they were gilded. The artisans of Alexandria excelled in this craft, and the manufacture of gilded bronze statues apparently became a lucrative industry. From gilding bronze

some of the artisans began to dream of making gold itself and devoted their main attention to achieve this end. Thus arose alchemy, not found before either in Egypt or in Greece. It was existing when the Arabs acquired Egypt and was one of the elements of Alexandrian culture which diffused into Arabian civilization. There are several treatises and even books which suggest that Greek science, which flourished between 300 B.C. and 200 A.D., subsequently passed on to the Arabs who functioned as its intermediate preservers delivering it to Europeans during the Middle Ages. Such is the accepted origin of alchemy.

It now becomes necessary to offer a brief sketch of alchemy as it was founded at Alexandria. The oldest existing manuscript on alchemy is not prior to about 391/1000. But it is supposed to be a copy of a work originally written in about 100 A.D. During this early period alchemy was a semi-secret science pursued by a few obscure persons. As Taylor[1] says, "although the earlier alchemists wrote in Greek, they were not Greeks, but in all probability Egyptians or Jews. They were not Christians." And what did they call their art? This knotty problem is conspicuous by its absence in Taylor's book. When Wilson[2] came to review it, he supplied the missing information on "the derivation of the Greek name of the art." "The word unmistakably goes back to the craft of the foundryman and metal-worker. First, there is the Greek verb *cheo* (χέω), to melt and pour, as in the casting of a bronze statue, then its derivative *chuma*, an ingot of cast metal, and finally from this another derivative *chumeia*, the art of preparing metal ingots. This in time became a technical term for the artificial preparation of the precious metals, but at first, as in Zosimus, about 300 A.D., it acquired a qualifying phrase, the *chumeia* of silver or gold. Before the Arabic period, however, *chumeia* could stand alone to denote the art of transmutation. Also before Arabic times, about 81/700 or earlier, it seems to have been confused with *chemia*, apparently a Greek derivative of the Egyptian word *chem*, meaning black. The reasons are obscure but the fact of the confusion is hardly to be questioned. Later, the Arabs took over both spellings, *chumeia* and *chemia*, prefixed their own definite article *al*, and handed the word on to the Europeans in about the sixth/twelfth century." Thus *kīmiya* is the Arabicized form of the dual word *chumeia/chemia*.

The Greek and Arabic Terms Compared.—Now it is even more important to know what the Arabs received under the name *kīmiya* from the Greek-speaking alchemists—to know what the word *chemeia* signifies and how the Arabic word *kīmiya* compares with it in meaning. Gildemeister[3] explains that "*kīmiya* with the Arabs primarily is not an abstraction (or the science of alchemy) but the name of a substance, of an agent, by which transmutation of metals is brought about, thus of the Philosophers' Stone, or rather of

[1] F. Sherwood Taylor, *The Alchemists*, 1951, p. 28.
[2] J. W. Wilson, "Review of Taylor's *The Alchemists*," *Brn. Hist. Med.*, 1951, Vol. XXV, No. 397.
[3] J. Gildemeister, "Alchymie," *Z.D.M.G.*, 1876, Vol. XXX, No. 534.

preparations made out of it. It is thus a synonym of *iksīr* which likewise signifies a transforming agent. By contrast *chumeia* is never used by the Greeks in any other sense than transmutation of metals."[4] There are two synonyms in Greek, *chemeia* and *chumeia*. Gildemeister refers to the use only of the latter, apparently taking it as identical with the former. In Arabic there are two terms *kīmiya* and *iksīr*, the latter not being represented in Greek literature. In fact, *iksīr* occurs far more in Arabic than the word *kīmiya*. *Iksīr* or *al-iksīr* has been Europeanized into elixir which has come to mean as an agent for prolonging life. According to Taylor,[5] "the alchemy of China was primarily concerned with the prolonging of life"; he adds[6] in this connection that "it is very probable that the Arab alchemists received some information about it. It is certainly notable that the idea of the elixir as a medicine prolonging life was present amongst the Arabs and not known to their Greek-speaking predecessors." P. Kraus[7] published a voluminous work on Jābir. Its reviewer[8] correctly noticed that "as to the origin of all those theories, Kraus maintains that not much of Jābir's alchemy can be traced to the extant fragments of Greek alchemistic literature, and that there are certain features in his alchemistic knowledge which are definitely unknown in classical antiquity." There has prevailed so much prejudice in favour of Greek that even the word "elixir," absent in Greek and therefore inconceivable as a loan-word in Arabic, has been given a Greek root. *Iksīr* has accordingly been said to have come from the Greek word *ksiron*, meaning dry, and has been made to connote dry powder, while elixir means essence, spirit, or fluid. How the Arabs coined their word from Greek cannot be explained. All this tends to show that the primary source of Arab alchemy lies somewhere away from Alexandria.

The Urge to Pursue Alchemy.—There were two types of seekers after longevity. First, the ascetic who was his own grocer, cook, and doctor and to whom infirmity of old age meant lingering death. The second was represented by a prince who had wealth and power and desired long life, only to enjoy his possessions fully. Though for different reasons, the Sufis, the nearest to ascetics, also indulged in alchemy. In fact, Wiedemann[9] remarks that "the study of alchemy has had one undesirable result inasmuch as the representatives of the mystic movement in Islam studied alchemy, e.g., ibn al-'Arabi." This, however, was expected, and the converse is also true, for about the master of alchemy, Jurji[10] states that "later tradition makes Jābir

[4] *Ibid.*, p. 538.
[5] F. Sherwood Taylor, *op. cit.*, p. 68.
[6] *Ibid.*, p. 71.
[7] P. Kraus, "Jābir ibn Ḥayyān," *Memoires del' Inst. Egypte*, Cairo, 1945, Vols. XLIV and LXV.
[8] *J. A. Or. Soc.*, Vol. LXV, 1945, pp. 68–70.
[9] E. Wiedemann, "al-Kīmiya," *Encycl. of Islam*, Vol. II, p. 1010.
[10] E. J. Jurji, *Illumination in Islamic Mysticism*, 1938.

ibn Ḥayyān the first Sufi." Kraus[11] explains how Jābir, the alchemist, became interested in Sufism. He writes, "Alchemy is never practised by Jābir for the object of accumulating wealth and acquiring the power of gold. Its real mission is to bring about salvation." And how was this possible? He continues to say that "Salvation in the Manichaean sense means to oppose in all spheres of life the fatal mixture of light and darkness and to free the light from dark particles. The Manichaean natural history, especially alchemy, aims at the great work of salvation."

Let us now turn to the wealthy and the worldly class. According to Martin,[12] "Emperor Ts'in-She-Hwang (B.C. 220), the builder of the great wall of China, is the earliest historical sovereign who became a votary of alchemy." There are a few more Chinese emperors who believed in alchemy; a couple of them had to pay with their lives for trying alchemical drugs. In the life of Chingiz Khān it is stated that he sent for a Taoist priest all the way from China to Central Asia, where he was encamped, to discuss if life could be prolonged for ever.

Khālid, the Umayyad Prince (40–85/660–704).—There is a sub-class among the well-to-do who would like to enjoy as sport the transmutation of a base metal into gold. Such a motive on the part of a young prince can be easily imagined and one such prince appears to have been Khālid, son of the Caliph Yazīd I and grandson of Mu'āwiyah. In the Arabic literature on alchemy, compiled about 377/987 by the famous bookseller al-Nadīm, it is stated, as translated by Fuck,[13] that "Khālid was the first Muslim for whom medical, astronomical, and *(al)chemical* writings were translated into Arabic . . . ." He wrote a number of treatises and books. Al-Nadīm also saw the following four of his books: (1) *The Book of Amulets*, (2) *The Great Book of the Scroll*, (3) *The Small Book of the Scroll*, and (4) *The Book of the Testament to His Son on the Art.*

Introduction of Alexandrian Alchemy.—When Khālid wanted to learn alchemy at Damascus, his capital, he sent for a teacher from Alexandria, a Christian monk named Marianos, a pupil of another alchemist, also of Alexandria, named Stephanos, who lived in the reign of the Byzantine Emperor Herkleios I (610–641 A.D.). That the best available teacher of alchemy at the time was a monk is in full harmony with what has been said of alchemy and of Sufis here. A monograph of over fifty pages has been devoted to Khālid by Professor Ruska,[14] the famous German historian of alchemy.

The Oldest Alchemy and How it Reached the Muslim World.—A series of

[11] P. Kraus, "Islamic Dogmatic Theology and Manichaeism," *al-Urwa*, Bombay, 1 : 34, 1947.
[12] W. A. P. Martin, "Alchemy in China," *Hanlin Papers* 1880, p. 234.
[13] J. W. Fuck, "The Arabic Literature on Alchemy according to al-Nadīm," *Ambix*, 1951, Vol. IV, No. 81.
[14] J. Ruska, *Arabische Alchemisten, I, Chalid Ibn Yazid Ibn Muawiya*, Heidelberg, 1924.

authors have established that alchemy is indigenous to China. Among the older writers may be mentioned Martin,[15] while the best historical evidence has been offered by Dubs.[16] From China alchemy reached Alexandria by the sea-route. In South China, the name of the dynasty that built the Great Wall is pronounced Ts'in, which became *Tseen*, the Arabic name for China. Likewise, the South Chinese term, *kim-iya*, Gold-making Juice, became the loan-word *kīmiya*, upon which Schneider[17] has published the most recent communication. It is probable that the word *kīmiya*, instead of having been borrowed direct from the Chinese, was taken over from Arabic into Greek, being Hellenized there as *chemeia*. This is how it was written, but very probably its pronunciation was similar to that of *kīmiya*. The pre-Islamic Arabs, bringing silk from South China, all along the sea-route, also imported Taoism and alchemy as the cults of immortality. To the pagan mind alchemy made a special appeal and this explains how it came to be imported. Some of the Arab alchemists of the type of what we call fakirs must have settled at Alexandria where it gradually spread mainly among monks and other ascetics. We have just seen that even centuries afterwards this character did not change for it was the monks who brought Alexandrian alchemy to Damascus.

Another way in which Chinese alchemy reached the Islamic world was *via* land-route. In Christianity one church tried to suppress another; and a community, speaking Syriac and calling themselves Nestorians, sought protection from outside and established an academy at Jundi-Shāpūr, in South-West Persia. The Nestorians migrated even up to China so that there must have been contact between the Nestorians of China and those of Persia. As an impact of Christianity upon Zoroastrianism there resulted the religion of Māni. The Manichaeans with their philosophy of dualism were close to the alchemists as they also believed in a similar doctrine. Briefly, Nestorian and Manichaean Persia was in intimate contact with China and was responsible for a fresh influx of Chinese alchemy. The Jundi-Shāpūr academy was by no means dead during the reign of Hārūn al-Rashīd to which period Jābir also belonged. When Kraus and others notice that there was much in Jābir that was not found in Greek alchemy we have to turn to Chinese influence in Persia at that time.

The Beginning of Classical Islamic Alchemy.—The Umayyads ruling from Damascus had become very unpopular. There were plots to replace them by the 'Abbāsid dynasty. Such agents were active as far east as the province of Khurāsān in Persia. One such emissary was Jābir's father, Ḥayyān, a druggist by profession. Jābir was born at Ṭūs, in Khurāsān, about 104/722, during the family's sojourn in Persia. When Jābir was a mere boy, Ḥayyān was arrested for his activity and had to pay with his life. Khurāsān being the

[15] W. A. P. Martin, *op. cit.*, p. 234.
[16] H. H. Dubs, "The Beginnings of Alchemy," *Isis*, Vol. XXXVIII, p. 62.
[17] W. Schneider, "Über den Ursprung des Wortes 'Chemie'," *Pharm. Ind.*, Vol. XXI, p. 79.

border province was a centre of foreign cultures like Mahayana Buddhism and other schools of mysticism. It may be pointed out in this connection that it was again at Ṭūs, in Khurāsān, where Imām Ghazāli, one of the great Muslim mystics, was born. Above all, we find in Jābir one of the first persons to be formally called a Sufi and the first among Muslims to be recognized as the master of alchemy. Both alchemy and Sufism appear to come from the same source and to have long remained together. Some of those who have written upon the history of Sufism have noticed that in its early stages it flourished only where Neo-Platonism was found. Likewise, writers on the history of alchemy have also observed its earlier co-existence with Neo-Platonism. While Sufism and Neo-Platonism can be directly and easily connected with each other, as pertaining to the same system of thought, it requires inquiring into what alchemy originally was in order to admit that alchemy did not develop from one craft to another, from gilding to gold-making, but was a kind of applied mysticism. The Sufis wanted immortality in the next world by spiritual exercises; the alchemists wanted it by virtue of drugs in this world. This motive at once becomes evident by a study of Chinese alchemy which represents its earliest phase. Instead of associating Islamic alchemy with Alexandrian Neo-Platonism it is more fruitful to connect it with Manichaeism and with schools of mysticism influenced by Chinese mysticism. Khurāsān, rather than Egypt, was the centre from where Islamic alchemy got its real initiation. Between Khālid ibn Yazīd and Jābir bin Ḥayyān was a period of seventy-five years. Historically, the political power shifted from Damascus to Baghdād. At this latter centre the so-called Persian influence, but really Chinese-Manichaean doctrines, rapidly promoted Islamic alchemy. Those who compare Greek alchemy with that of Jābir notice an obvious difference between the two. If comparison is made between the doctrines and achievements of Muslim alchemists with those of China, the difference is very much less. In so far as even the alchemy of Alexandria is Chinese, though a degenerated form of it, it still has features enough for it to stand comparison with that of China. With Jābir begins a school of alchemy much nearer to its original source, with its centre at Ṭūs, instead of at Alexandria. The first feature to be noticed here is that the ideal seems to be not to make gold but to prepare panacean drugs. Jābir's reputation as a physician grew after the services he had rendered at the Court of Hārūn al-Rashīd. His alchemical writings on the contrary were misunderstood even by a savant like ibn Khaldūn[18] who remarked that they read like puzzles. The effect of the chemical mysticism, which was alchemy, was demonstrated in the form of life-saving *iksīrs*; the theory of applied mysticism was obtained from other systems of mysticism, such as Sufism and Manichaeism. The existing literature shows that alchemy proposed to make gold only and this seems to be true of Greek alchemy. The Arab alchemists, like the original Chinese masters, worked upon

[18] Ibn Khaldun, *The Muqaddimah*, tr. F. Rosenthal, Vol. III, 1958.

their preparations for making everything everlasting. When the omnipotent substance, *iksīr* or *kīmiya*, was applied to a base metal it became rust-proof and fire-proof, which meant it changed into gold. The same agent could also convert an ordinary stone into a permanent diamond. These features are not revealed in treatises on the history of alchemy and must be clearly pointed out.

Imām Ja'far al-Ṣādiq (81–148/700–765).—It will now be apparent how Jābir would venerate a master of mysticism like Imām Ja'far al-Ṣādiq, the sixth Imām, who lived like an internee at Baghdād. Of all the Imāms he was the greatest mystic. He was deeply interested in alchemy and even composed treatises on the subject. Importance is attached to him here mainly because Jābir speaks of him as a Master and also because of the fact that alchemy and Sufism both aim at immortality. Since Jābir was both a Sufi and an alchemist, he could have received initiation from the Imām at least as a mystic. Ruska[19] has edited a treatise attributed to the Imām and discussed his position in the history of alchemy, devoting an introduction of sixty pages to the problem.

Jābir ibn Ḥayyan (104–200/722–815).—Our knowledge of Jābir's life is very sketchy. He was born at Ṭūs, in Khurāsān, about 104/722. He became an orphan while yet a boy and was brought up in the tribe of his father, Azd, which lived in South Arabia. Then we suddenly find him as a man of middle age active as a physician at the Court of Hārūn al-Rashīd and as a companion of Imām Ja'far al-Ṣādiq. His special patrons were Hārūn's viziers, the Barmakids, who really introduced him to the Court. When the Barmakids fell into disfavour in 188/803, Jābir, then over eighty years old, returned to Kūfah where he used to live before coming to Baghdād. The early life of the man, say from twenty to thirty-five, must have been spent in the pursuit of alchemy probably at Ṭūs. If he had merely been born there he would have hardly been called al-Ṭūsi. Another designation of his, al-Sufi, also sets us inquiring as to where he acquired proficiency in this field. With Ṭūs as a common centre for both Sufism and alchemy, the search is reduced to the minimum. When he left Baghdād immediately for Kūfah, as an old bachelor, he could have hardly found people with whom he was familiar. Without relatives and surviving friends his life must have been that of a stranger and he must have migrated from Kūfah to Ṭūs where Sufism and alchemy were very much at home. According to one source, he died at Ṭūs, in 200/815, which appears most probable, at the ripe age of ninety-three.

Two centuries after his death some houses in a part of Kūfah where Jābir used to live were demolished. The house which he used to occupy was found to contain a mortar of solid gold weighing two pounds and a half which went to the royal treasury of the time. This archaeological finding

[19] J. Ruska, *Arabische Alchemisten, II, Gafar Alsadiq*, Heidelberg, 1924.

gives much reality to the personality of Jābir with his many-sided features. Those who have been prejudiced in favour of Greek culture have nourished myths such as given by Thompson,[20] who writes that "Jābir is said to have been either a native of Mesopotamia or a Greek who afterwards embraced Mohammadanism." The fact that this theory originated from Suidas, who lived in the fifth/eleventh century, and continued to appear as late as 1351/1932, when Thompson published his book, indicates the persistence of prejudice in favour of the Greek origin of alchemy.

The existing literature on the history of alchemy seems to be devoted mainly to textual criticism rather than to the subject proper. Hence, as late as 1353/1934 Hopkins[21] recorded that "the fundamental work of fact-finding has been so difficult and time-consuming that no real history of alchemy has yet appeared." The same judgment continued to be repeated, when Taylor[22] wrote in 1371/1951 that "it may at once be said that alchemy still remains an unsolved problem." And both these remarks apply even more forcibly to Muslim alchemy. We have not been told as yet what the Muslim alchemists were after and particularly what was meant by *kīmiya* and *iksīr*; whether they were identical or whether there was a subtle difference between them. What the Europeans of the Medieval Ages got as alchemy was the system developed by the Arabs immediately before them so that observations upon the alchemy of any of these two apply to either. "Paracelsus taught," as worded by Thompson,[23] "that the object of alchemy was not to make gold, but to prepare medicines." He is the founder in Europe of iatro-chemistry, but it is being maintained here that this has always been the character of alchemy and is best illustrated by the popularity Jābir enjoyed among his contemporaries. The fact that Jābir could indulge in the use of a golden mortar and yet live the life of a vegetarian, bachelor, and a Sufi-ascetic shows how he was not concerned with the making of gold as a source of wealth. The other observation is from Liebig. Chickashige[24] writes, in this connection, that "the long history of alchemy clearly shows, as Liebig remarked, that alchemy was never anything else than *chemistry* proper to its own generation." If instead of "chemistry" and "iatro-chemistry" as above we use the more familiar and precise term, pharmaceutical chemistry, then both Liebig and Paracelsus would be expressing the same idea. Here again, Jābir's career fully confirms the remarks of Parcelsus and Liebig.

Among those who spared no energy to study the writings of Jābir may be mentioned the late Dr. Holmyard. He observes that "Jābir ibn Ḥayyān has many claims to be considered the first to whom the title of chemist may

[20] C. J. S. Thompson, *The Lure and Romance of Alchemy*, 1932, p. 59.
[21] A. J. Hopkins, *Alchemy, Child of Greek Philosophy*, 1934, p. v.
[22] F. Sherwood Taylor, *op. cit.*, p. 16.
[23] C. J. S. Thompson, *op. cit.*, p. 168.
[24] Masumi Chikashige, *Alchemy and Other Chemical Achievements of the Ancient Orient*, 1936, p. 1.

legitimately be applied."[25] Hopkins[26] is even more eloquent in his tribute when he states that "... if all that has been deduced from the writings of Geber (the Europeanized name of Jābir) is true, he was one of the greatest single constructive influences in science, particularly in the science of metals, that the world has ever seen. Perhaps he should be ranked with Lavoisier for instituting a great revolution in the attitude of the educated people of his time towards the study of chemistry, especially in their attitude towards experiments. Whereas, since the days of Aristotle, to soil one's hands with labour has been considered, except in Egypt, despicable and proper only for slaves, it is related that Geber had some success in teaching his friends at Court that laboratory methods are necessary and the only foundation for exact and reasonable science." Respect to practical work which Jābir must have preached is confirmed by the converse having continued to exist even afterwards. Fuck[27] explains that "al-Nadīm had no high opinion of Alchemy or of its adepts. Of a contemporary alchemist who was credited with having been successful, he tells us that he never found him otherwise than in straitened circumstances and *dirty* by reason of the chemical work he was in the habit of doing." We can now appreciate the wealth of praise due to Jābir. Hopkins rightly showers praises upon Jābir, the Master, who infused into his people a spirit for experimentation which raised the status of Muslim alchemists so much above others that later historians, like Schneider,[28] could admit that "it is certain that no other people have pursued alchemy with so much persistent zeal as the Arabs." The special urge on the part of the Arabs to devote to alchemy would be apparent from what follows.

Kīmiya.—Man's earlier medicines came from the plant world; herbalism was then the system of medicine. From this developed the notion that herbs could even make man immortal. The Aryans idealized the *soma* plant, the Iranians called it *homa*; the Chinese believed in the mushroom *chih*; and the Hebrews in the *tree of life*. Late in this period must be reckoned the belief in a gold-making-plant juice or *kim-iya* in the Hakka dialect of South China, the original of the Arabic term *kī-miya*.[29]

How Kīmiya worked.—The ancient religion of man was animism. Every substance, including trees and stones, was believed to have a body and a soul, and to be alive potentially. The soul was a highly refined matter, like a perfume, and it came from the sun. It was more of energy than matter, like light, which, according to some physicists, has a corpuscular nature. The soul in turn was an emanation of the cosmic positive energy, called *yang*, in Chinese, meaning light, while in the universe there was also negative

[25] E. J. Holmyard, "Islam and Chemistry," *Islamic World*, Lahore, 1928, Vol. VI, p. 116.
[26] A. J. Hopkins, *op. cit.*, p. 137.
[27] J. W. Fuck, *op. cit.*, p. 84.
[28] K. C. Schneider, *Geschichte der Alchemie*, reprinted, 1959, p. 82.
[29] W. Schneider, *op. cit.*, p. 79.

energy, called *yin*, meaning darkness. Matter was frozen *yin* energy, and it was difficult to convert matter into energy. Matter and spirit could form only a temporary union or mixture. But if matter received the impact of an energizing principle it was changed into reactive negative energy which would then unite with the positive energy, and the result would be a real compound or a permanent union. Even a drop of the gold-making juice was taken to be bubbling with *yang* energy so that if a coin of copper was heated with it its ineffective soul was expelled and the material body or copper was transformed into negative energy, and it combined with the soul or positive energy from the plant juice to make the resultant gold. Here the donor is exceptionally rich in *yang* energy and the ultimate transmutation of metal is due to it. Further, the donor belongs to the plant world. In countries like China and India, with their rich flora, alchemists did depend upon fresh herbs for the transformations they wished to bring about. This being denied to an alchemist like Jābir, he exploited mainly, if not entirely, minerals and metals instead; hence the importance given to inorganic raw materials and metals in the works of Arabian alchemists. Instead of *kīmiya*, inorganic preparations called *iksīrs* were used.

Rūḥ.—It is necessary to describe how the minds of the alchemists worked in preparing a simple substance such as *rūḥ* (soul, spirit, or essence). Every substance, they must have felt, has a soul which remains like a tenant temporarily in the substance, the container of the soul. On heating the soul can be made to leave the body; on distilling the soul can be recovered more or less concentrated in the distillate. Thus a rose gives out its soul or *rūḥ*. The flower is now a dead body and the soul is its perfume or essence. When such an essence or *rūḥ* is taken as a drug it temporarily strengthens the body of the user, like blood-transfusion or an injection of glucose. The donor here gives only one of the two elements; the material body, the flower, is discarded. When the soul of the flower is introduced into the body of another receiver it is like the temporary transmigration of the soul which must repeat at every stage if the soul is not to disappear in space.

Iksīr.—Transmigration implies that the soul and the body do not come from the same source, the two are not permanently united, the balance between the positive energy contained in the foreign soul and the potentially negative energy existing in its present container is not ideal. All that is required is to convert the body into negative energy and reunite with it the soul previously separated from it. This is a regular art. For example, take common salt. It does not sublime. Now, if re-crystallized and mixed with alcohol, just as roses were mixed with water, and the mixture distilled, the essence of common salt evaporates along with the volatile vehicle, alcohol. The distillate is added again to the residual salt in the distilling vessel and the process of rectification is continued. A stage comes when all the salt becomes fluid, leaving no solid residue. This is the *iksīr* of common salt. The body, the material vehicle, has by now been converted into reactive energy,

negative in character, and its soul, as the positive energy, has combined with it into an inseparable whole. Salt is a mixture of a material body, or of *potential* negative energy, and a soul, the positive energy. Its *iksīr* contains a permanent union or compound of positive energy coming from the soul and *reactive* negative energy or the transformed material body. Technically, two processes were most necessary: distillation in the first instance, to isolate the soul, the essence, or the positive element, and calcination, to purify the material vehicle, in order to convert the potential energy into the reactive negative element. Melting of metals is a very minor operation. In the case of an active gold-making plant juice, calcining of copper is limited to gentle heating. In the case of *iksīr* of common salt no separate calcining is necessary, repeated distillation incorporates it. It is clear by now that *rūḥ* or spirit contains one element only, the positive. *Iksīr* contains two, the positive element and the negative one. Each of them belongs to the same substance and as such must necessarily contain enough quanta of both to balance like exact opposites or rather like exact supplements. When *iksīr* results, the substance becomes a spirituous preparation, sublimable, volatile, atomized, or potentized. Now being all energy, it represents a permanent union, inseparable for ever. When taken as a drug it makes the patient like itself, tending to become permanent. Naturally, according to the original substance, the total energy content in different cases differs and *iksīrs* also vary in their pharmacological properties. In any case an *iksīr* is stronger than the spirit or *rūḥ*. Whereas *kīmiya* is a natural substance, *iksīr* is an artificial one. To meddle with the gold-making juice in any way would be to destroy its virtues, whereas *iksīrs* can be produced only by chemical processes, above all by distillation and calcination.

Because substances like common salt are made to distil along with alcohol, such heterogeneous mixtures as contained alcohol were probably called "elixirs" by European alchemists of the Middle Ages. It will be apparent why Jābir talked mostly, if not solely, of *iksīr* and not of *kīmiya*, its synonym. How *iksīr* has been made to come from the Greek word, *kseron*, merely meaning dry, cannot be explained. By constitution *iksīr* was taken to be the purified body with its soul returned to it. It was a revived body and a returned soul, where the two, on becoming identical, represented a third substance. The picture was essentially the same as that of man after resurrection. The soul would return to the dead body which would revive and henceforward remain immortal. But the revived person would be a regular mutation, his body feeling neither thirst nor hunger. He would be like a spirit or ghost with a body no longer composed of matter. *Iksīr* represents such a substance, material to look at but in fact become energy, and, what is important, also a donor of energy.

Whatever the substance *iksīr* may have been, its uses mainly decide its virtues. Jābir prepared *iksīrs* from one substance after another and as an indefatigable worker could not avoid studying the properties of inorganic acids into which he tried to dissolve his metals to purify them, instead of

melting them alone or along with other metals. In India the metals were never purified by the use of inorganic acids but mainly by calcining them with boiled extracts of herbs. In order to have substitute a plant extracts or organic acids Jābir prepared inorganic acids not for their own sake but for making *iksīrs*. His experiments spread over a wide range of substances. The preparations resulting from them must have maintained Jābir's enthusiasm and made him a master. Holmyard,[30] a chemist and an author of standard text-books on chemistry, after a careful study of Jābir, rightly states that "like painting which reached its highest pitch of perfection while still in its infancy, Islamic alchemy never surpassed the level it attained with one of its exponents, Jābir ibn Ḥayyān." We can represent him as a noble soul, seeing diseases all over, finding no herbs to treat them with, and so taking with a vengeance to minerals as the only source of supplying remedies. Enthusiasm born under such circumstances, incorporating the personality of the worker and the poverty of the country reacting upon it, resulted in the achievement with which the world today remembers the name of Jābir. Those who do not know what *iksīrs* mean, certainly not mere powders, cannot imagine the deep urge for or high aim in making them. At every stage we have to remember that Jābir was an ascetic-bachelor and a mystic-Sufi; acquisition of wealth or making of bullion gold could never have been his motive. In the absence of the right perspective much energy has been wasted in trying to separate historical data from Jābirian legends. What is still required is to isolate alchemy proper from Jābir's writings. Writers on alchemy, rather on Alexandrian alchemy, have rightly attached full importance to the early record of the word *chemeia*. Likewise, in dealing with the history of Muslim contribution to alchemy we feel that the introduction of the word *iksīr* played an even more significant role. Jābir apparently used it for the first time and demonstrated its claims. Paracelsus is credited with having founded iatro-chemistry or having taught that the real aim of alchemy was to prepare medicines and not to make gold. Jābir would have been surprised to hear that alchemy was anything but that, and his *iksīrs* anything but highly potent, we may say, omnipotent and multipurpose drugs. Kraus[31] has translated from Arabic into German a text revealing what *iksīr* can prove to be; an extract from it has also been rendered into English by Holmyard.[32] Hārūn al-Rashīd's ministers belonged to the Barmakid family. One of them, Yaḥya, was much devoted to a lady in his harem. She fell ill. The case ultimately became so hopeless that Jābir was sent for. The report[33] as coming from Jābir himself maintains: "I had a certain *elixir* with me, so I gave her a draught of two grains of it in three ounces of vinegar and honey and in less than half an hour she was as well as ever. And Yaḥya fell at my

[30] E. J. Holmyard, *Alchemy*, Pelican Book Series, 1957, p. 116.
[31] P. Kraus, "Studies zu Jābir ibn Ḥayyān," *Isis*, Vol. XV, p. 22.
[32] E. J. Holmyard, *Alchemy*, p. 70.
[33] *Ibid.*

feet and kissed them, but I said, 'Do not do so, O my brother!' And he asked about the uses of the *elixir* and I gave him the remainder of it and explained how it was employed, whereupon he applied himself to the study of science and persevered in it until he knew many things." Having demonstrated such a dramatic achievement it is impossible for any sane person to have found interest in making gold instead. Jābir's alchemy consisted only in preparing *iksīrs* or wonder-drugs which were more precious than gold.

The Philosophers' Stone (Ḥajr Mukarram).—The preparation which marks the zenith of alchemical achievement is the Benevolent Stone *(ḥajr mukarram)*. The alchemists called themselves philosophers or *Ḥakīms* as opposed to physicians or *ṭabībs*. The Alchemists' Stone was correctly paraphrased as the Philosophers' Stone. This is the genesis of the term. In the historical survey of the chemical arts of China by Li,[34] we read that "*Chin-tan*, an alchemical term in Chinese, first appearing in *Pao-p'u tzu* (a work composed about 317–332 A.D.), comes to refer to a *drug* or *elixir* which was prepared by the alchemists for prolonging life and transmuting metals. It reminds us of the Philosophers' Stone because this was considered to have the same effect as *Chin-tan*. . . . The language of the ancient alchemists is very hard to understand [a confession recalling the judgment of ibn Khaldūn upon Jābir]. It is supposed that *Chin-tan* may have consisted of mercury, sulphur, lead, etc., a compound or mixture prepared in accordance with a theory not unlike that of Jābir, who supposed that every metal contained mercury and sulphur." The admission seems to be to the effect that the theory, that metals are composed of mercury and sulphur, did exist in China but in a vague form. Taking the simpler notion first, with Jābir all metals including gold were composed of mercury and sulphur. Davis[35] states that, "for the Chinese alchemists, positive *yang* was lead instead of sulphur; negative *yin* was mercury." Jābir died in about 184/800. The Chinese alchemist, Chang Po-tuan,[36] living later in 373–475/983–1082, still maintained the ancient Chinese theory that "our fellow workers must be able to recognize true *lead* and *mercury*." It is, therefore, clear that Jābir borrowed a theory as known to the Chinese but improved upon it, keeping mercury as the one element and changing the other from lead to sulphur.

The surprising feature of the Sulphur/Mercury theory about the origin of metals is that it has not been challenged by experimenters who have melted metals, calcined them, and even sublimated at least arsenic and mercury compounds. That they should have believed that iron consisted of sulphur and mercury, and that even gold consisted of the same elements, has received no explanation so far. The primitive man accepted blood as the life-giving principle

[34] Li Ch'iao-p'ing, *The Chemical Arts of Old China*, 1948, p. 16.

[35] T. L. Davis, "The Chinese Beginnings of Alchemy," *Endeavour*, Vol. II, pp. 154–57.

[36] Chang Po-tuan, "Essay on the Understanding of the Truth," tr. T. L. Davis and Chao Yun-ts'ung, *Proc. Am. Aca. Arts & Sci.*, 1939, Vol. LXXIII, p. 104.

and further believed that its red pigment was the real agent. Thus redness was taken to be the active principle so that any red substance could generate blood. Of all red substances cinnabar was the nearest approach to blood in colour. When it was established by actual synthesis that cinnabar consists of mercury and sulphur, its elements came to be considered to be the elements of all metals. Animism assumed that even metals were living things, having a soul as well as a body. When negative energy freezes it becomes matter and the body of the metal consists of it. The soul is represented by the positive element, one which is sublimable so that it can permeate the material body. Lead is not volatile, sulphur is; hence the Lead/Mercury theory was essentially defective and the justification of the Sulphur/Mercury modification. Further, lead and mercury do not produce a red compound, while sulphur and mercury do. But if Jābir's theory is a modification of a previous Chinese theory, how is it that in its original form it accepted lead and mercury as the elements of metals? What was required as the end-product was redness, and theorizing depended upon this result. Lead heated by itself oxidizes in the air to red lead or minium. Likewise, mercuric oxide is obtained as red, orange, or yellow powder, consisting of minute crystals. Thus, the Chinese theory was, indeed, properly conceived, but it failed to include a spirituous element like sulphur, while lead obviously was not.

Alchemy as a philosophical system is based on a dualism, postulating that everything consists of two elements, of light (*yang* in Chinese) and darkness *(yin)*. When the metals were ascribed their constitution, sulphur and mercury came to be taken respectively as positive *(yang)* and negative *(yin)* elements. And the realistic basis of this theory, as has been explained, came from the actual knowledge of what constituted cinnabar and the identification of cinnabar with blood. When the cosmic forces, *yang* and *yin*, are in perfect balance, it means *yin* exists as a negative creative energy and not as frozen matter, while *yang* naturally always remains spirituous; the result of their union is like that of two substances, identical in nature but oppositely charged, like positive and negative electricity. The resultant is everlasting. Pure sulphur and pure mercury are imagined to be existing as energy, even though they may not appear to be so, and their resultant, when ideal or when the two are perfectly balanced, means an everlasting union, which is gold. According to another tenet of animism, like makes like; gold, the everlasting metal, as a drug makes the consumer also immortal. Gold remaining in mines for millions of years loses this property of donation, its negative element, mercury, having become less spirituous or more material; hence gold, as a drug, must be freshly prepared. Better still it must be in a stage prior to its becoming gold, so to say, in a nascent stage when it is the *iksīr* of gold, a ferment-like substance which will convert any metal into gold. This is the Philosophers' Stone, converting matter into energy, energizing the material or the negative element until it comes to the same level as its positive or spirituous element.

We, thus, see that *rūḥ* or spirit consists of only the positive element, the

soul; and *iksīr* consists of two elements, the positive element and the purified material element sublimated into reactive negative energy. Philosophers' Stone is double *iksīr*; it consists of sulphur as a substance, which has a body and a soul (or failing sulphur, its substitute, say lead), and mercury as a substance, likewise with two elements of its own, its body and soul. In all, there are two purified bodies and two souls returned to their respective bodies. The question now arises that if there are four elements compounded to form a fifth substance, why not another which is double that of the Philosophers' Stone. There are only four cosmic elements—heat, cold, dryness, and humidity. The body and soul of sulphur and the body and soul of mercury represent all these four cosmic elements; hence, between themselves, mercury and sulphur fully represent the cosmic force, the highest imaginable.

We have seen that Islamic alchemy was almost non-existent at Damascus. Baghdād produced its first two masters without whom there would perhaps have been no alchemy in the Islamic world. If alchemy at Damascus meant an importation from Alexandria, alchemy at Baghdād was an importation from Khurāsān, which in turn was really an importation from China. Now two substances used by Jābir reveal the alchemy which he borrowed and upon which he improved. Ammonium chloride has played a very important role in alchemical preparations to which Stapleton[37] devotes a special monograph. From Holmyard[38] we learn that Jābir's "is one of the earliest Arabic mentions of sal-ammoniac which for a time was imported from inner Asia. Jābir, however, knew how to prepare it from organic matter." Inner Asia is a vague term which makes it difficult for the reader to locate the actual source of the product. However, Stapleton[39] explains that the Arabic word, *nushādar*, for sal-ammoniac, is a loan word-from Chinese. The origin of the product is thereby assured.

Another substance Jābir used is what he named *khār sīni*. Holmyard[40] comments, "Muslim writers say that it was used in China to make mirrors. According to Laufer, it was an alloy composed of copper, zinc, and nickel, known as *pai-t'ung* in Chinese, or white-copper." *Khār* is salt and a loan-word in Arabic. It cannot be made to express any metal or alloy. An alloy comparable with *pai-t'ung* is called *bidri* in India, consisting of copper, lead, and zinc in the ratios of 1 : 1 : 16. To give it a dark surface, sodium sulphate is used. A similar salt may be used for giving a metallic white surface to a different alloy of copper and zinc. In fact, it is easier to give it a metallic shine than to make it dull black. This salt of Chinese origin further points to the source of Jābir's alchemy.

[37] H. E. Stapleton, "Salammoniac, A Study in Primitive Chemistry," *Mem. As. Soc. Bengal*, Vol. I, No. 2, p. 41.
[38] E. J. Holmyard, *Alchemy*, Pelican Book Series, 1957, p. 78.
[39] H. E. Stapleton, *op. cit.*, p. 41.
[40] E. J. Holmyard, "Islam and Chemistry," *Islamic World*, Lahore, 1928, Vol. VI, p. 78.

Jābir being a mystic incorporates numerology into his alchemy, a fact discussed by some writers, above all by Stapleton.[41] According to him, the square with the nine cells was found as a motif near Nineveh as early as 4000 B.C. But in China also from at least the seventh century B.C., if not actually from the eleventh century B.C., the nine rooms of the square of the Imperial Temple had assigned to them the first nine numbers arranged in the actual order of these numbers in the simplest Magic Square. Even Jābir's numerology can thus be safely classed as Chinese in origin.

The Emerald Table of Hermes.—Among Jābir's writings, Holmyard first discovered in 1342/1923 the Arabic original of the famous Latin work bearing the above name. It deals with the phenomenon of change in nature, a typical Taoist idea, couched in phrases like those used in the following quotation from it: "That which is above is like that which is below and that which is below is like that which is above." Such mystical statements are more decorative than illustrative in any other context.

Turba Philosophorum.—A Latin work of this title was very popular with European alchemists. It contained many names which were cited by Jābir in one of his books. On that account Ruska, in 1352/1933, proved that there should be an Arabic original of the *Turba* and this was confirmed by Stapleton by indicating that a fourth/tenth-century authority, ibn 'Umail (see later) quoted passages from it. Plessner having studied the problem exhaustively says, as quoted by Holmyard,[42] that "it is the three-fold result of the cosmological discussion, the Qur'ānic Creator-God, the unified world, the four elements (heat, cold, dryness, and humidity) that gives the discussion its clear direction towards the chief subject of the *Turba*, alchemy." From the contents of the two classical works of medieval alchemy, the *Turba* and the *Emerald Table*, incorporated in Jābir's writings, the reputation he enjoyed in the Middle Ages can be easily visualized.

Al-Rāzi (c. 251–313/865–925).—Engaged as he was in preparing elixirs, Jābir was called upon as a consultant to use them when ordinary drugs had proved ineffective. On the contrary, abu Bakr Muḥammad ibn Zakarīya al-Rāzi, an account of whose philosophy has been given in Volume I (Chapter XXII) of the present work, was a physician by profession. At the age of thirty he went to Baghdād, where the achievements of Jābir must have been narrated almost as miracles. Al-Rāzi could not but have been inspired by the tradition existing at Baghdād in favour of Jābir's elixirs. At Baghdād he decided to become a physician. As a Muslim alchemist he comes next only to Jābir. His fame in the medical world became so high that he was consulted when a hospital at Baghdād was being extended and ultimately became its chief physician. Holmyard unwittingly remarks that "like the majority of physicians of medieval times, Rāzi was led to the study

[41] H. E. Stapleton, "Probable Sources of the Numbers on Which Jabrian Alchemy was Based," *Arch. Int. Hist. Sci.*, Vol. XXII, p. 59.
[42] E. J. Holmyard, *Alchemy*, p. 83.

of alchemy." In fact, alchemy has been nothing else but pharmaceutical chemistry and the physicians of those times had to prepare their own medicines. When Rāzi decided to become a physician he was probably attracted by the reports about elixirs. In other words, he became an alchemist first and a physician afterwards. Among his writings only one book dealing with alchemy has reached us. It is entitled "The Book of the Secret of Secrets" translated into German by Ruska.[43] "Stapleton," says Holmyard,[44] "places Rāzi on an intellectual level with Gallileo and Boyle." There is an illuminating article on al-Rāzi and alchemy by Heym,[45] where we read[46] that "bodies are composed of invisible elements and of empty space that lay between them. These atoms were eternal and possessed a certain size." The statement reminds us of the modern explanation of the structure of crystals. Rāzi accepted Jābir's Sulphur-Mercury theory of the constitution of metals but Heym says that "in the same way the attribute of salinity enters into Rāzī's scheme." He comments at the same time that "without doubt it is here [with Rāzi] that the origin of the popular conceptions of alchemy with its three elements—mercury, salt, and sulphur—can be found which reappears later in Europe and plays such an important part in the history of Western alchemy." Without mentioning Rāzī's name, Thompson[47] writes, "This Sulphur-Mercury doctrine was accepted by most alchemists until about the twelfth century, when the theory was extended by the addition of a third elementary principle, to which the name "salt" was given. It was believed to be a basic principle which gave solidity and resistance to fire. Mercury was considered to be the connecting link between the spirit and the body, and the element on which depended blood and life." The source of the Sulphur-Mercury-Salt theory not mentioned in Thompson is revealed by Redgrove,[48] who writes that "Isaac Hollandus appears to be the earliest known writer who makes mention (c. 1063/1652) of the famous Sulphur-Mercury-Salt theory." Thompson places the theory in the twelfth century; Redgrove makes it seventeenth century; while Rāzi, the real author of it, lived in the third/ninth century. An explanation can also be offered as to how an alchemist of Holland came to be credited as the propounder of this modified theory. Heym writes that "in Europe throughout the Middle Ages until the seventeenth century, Rāzī's works on medicine were still part of the curriculum at Dutch Universities."

It has been casually indicated that alchemy as a system of thought is based on dualism which characterizes Manichaeism and which was at its best in China. At any rate, al-Rāzi was so much influenced by dualism that Heym says, "al-Rāzi was also called a Manichaean," though he gives a different

[43] J. Ruska, *Al-Rāzī's Buch Geheimnis der Geheimnisse*, Berlin, 1937.
[44] E. J. Holmyard, "Islam and Chemistry," *Islamic World*, Lahore, 1928, Vol. VI, p. 87.
[45] G. Heym, "Al-Rāzi and Alchemy," *Ambix*, 1938.
[46] *Ibid.*, Vol. I, p. 184.
[47] C. J. S. Thompson, *op. cit.*, p. 69.
[48] H. S. Redgrove, *Alchemy, Ancient and Modern*, 1922, p. 54.

explanation for this appellation of his. Where Rāzi continued the tradition of Jābir, which rightly made an appeal to the judgment of Hopkins, was his love for practical work. Heym states that "even though al-Rāzi in his alchemy was not strictly empirical in our sense of the word, his great work mentioned above is a book of experiments; it is a book of practical alchemy. . . . There it can be said that al-Rāzi is the creator of a new alchemy for he seems to be the first to have transformed theoretical alchemy into a new strictly scientific system. Or, to be more definite, al-Rāzi transformed alchemy for the first time into a new and strictly scientific system." To a practising physician and to one who was not a mystic like Jābir, it was practical phase of alchemy, which was inorganic pharmaceutical chemistry of the age, that naturally appealed most.

Ibn Sīna (370–428/980–1037.)—Europeans in the Middle Ages had Latinized the names Jābir into Geber and Rāzi into Rhasis or Rhazes, and these easily passed on as those of their own masters in science and medicine. The greatest medical authority of the Muslim world was abu 'Ali Sīna whose name was likewise adapted as Avicenna. Muslim physicians call him the Shaikh, meaning the Prince of Physicians. His career shows nothing revolutionary like that of Rāzi. He studied medicine in the routine way and became proficient enough to treat patients even by the age of sixteen. Being a genius he was called by one prince after another from Bukhāra to Iran and served them even as a vizier. Enjoying Court life in every sense of the word, luxury above all, he could have hardly found time to experiment as a pharmacist. In his classic entitled the "Canon of Medicine," some seven hundred and fifty drugs are mentioned, but they are all simples or individual drugs, vegetable, animal, and mineral in origin. None of them are of the class of high potency or synthetic inorganic chemicals, or *iksīrs*. In his writings alchemy is discussed but critically. As a physician he did not use any *iksīr*; it is out of question that he could have believed in a substance changing base metals into gold.

Ibn 'Umail (250–300/864–912).—In a short contribution on the subject such as this we have to be strict in selecting the representatives of Islamic alchemy. In doing so we have dealt with authors whose works were translated into Latin during the Middle Ages. These are, so to say, the masters who served as progenitors of European alchemy. Now, Davis[49] has tried to prove by the common contents and even the common illustrations of the works on the subject that the alchemy of medieval Europe is almost identical with that of China. To connect European alchemy with that of the Chinese, it becomes necessary to place Islamic alchemy as the real connecting link between the two. It would at once explain a continuity of thought and give a complete sketch of the evolution of alchemy. As depicted at present, there seem to be at least two different systems of alchemy isolated and unconnected. For this reason we wish to mention one more author whose work was translated into Latin and printed in 1032/1622. He is ibn 'Umail.

[49] T. L. Davis, *op. cit.*, p. 154.

Stapleton[50] and his colleagues have edited 'Umail's three Arabic texts and also the Latin translation in 1032/1622, along with copious notes which together make the presentation a model of scholarship. When we compare 'Umail's treatise with an original European work on alchemy, *Splendor Solis*, a classic in itself, by Solomon Trismosin,[51] composed about 990/1582, we get the impression that the contents and even the style of presentation are the same in both the works. The influence of alchemical literature in Arabic on medieval European writers becomes thereby quite evident.

Our present contribution will serve its purpose better if we indulge in offering in modern phraseology what these alchemists were actually after. It is a problem of science to explain how one form of energy is converted into another, e.g., heat into light. Likewise, a far greater problem, but of the same category, is to explain how matter changes into energy and *vice versa*. Ibn 'Umail, like a typical alchemist, expresses this as follows: "Turn bodies into non-bodies and non-bodies into bodies." *Iksīr* was the energizing principle which could sublimate matter into energy. This was with regard to technique only. The aim was to energize the human body to make it immortal. When the soul is strengthened and the body merely reconditioned and not thoroughly purified, life is only prolonged. The agent that purifies the human body can purify the body of a base metal as well. With a purified body man mutates into an *immortal* being capable of flying about in the air, as Davis[52] has clearly emphasized. With the purified body a base metal mutates into an *everlasting* form which is gold. Alchemical improvement ended in the permanency of form. Thus, the active agent behaved in one and the same way, converting impure body into sublime energy, resulting in man's immortality and in the synthesis of gold. This is what ibn 'Umail actually meant.

Jildaki (d. 762/1360).—The last authority we propose mentioning here is Jildaki. One of his works, "End of Search," has been the subject of detailed study by Dr. M. Taslīmi of Teheran—a study which was accepted as a thesis for Doctorate by London University in 1954. Unfortunately, the thesis has not yet been published. But Holmyard[53] summarizes it by saying, "That there is a great deal of similarity between the ideas contained in the quotations of Jābir given in the 'End of Search' and those found in the Latin works of Geber but the correspondence is not sufficiently close to establish a definite affiliation." Our problem has been to find how, from author to author, alchemy has actually progressed. After al-Rāzi or at the most after 'Umail we find repetition of what had been said before in different words and with other

[50] H. E. Stapleton and others, "Three Arabic Treatises on Alchemy by Muḥammad Bin 'Umail," *Mem. Asia Soc. Bengal*, Vol. XII, No. 1.

[51] E. J. Holmyard, "Alchemy in Medieval Islam," *Endeavour*, 1955, Vol. XIV, p. 117.

[52] T. L. Davis, *op. cit.*, p. 154.

[53] E. J. Holmyard, "Alchemy in Medieval Islam," *Endeavour*, 1955, Vol. XIV, p. 117.

illustrations. No wonder that Holmyard justly observes that "after Jildaki there is no outstanding figure in Muslim alchemy."

Alchemy in Other Islamic Countries.—No writer to our knowledge has spoken of alchemy by Muslims outside the schools of Damascus and Baghdād. What about the impact of local schools of alchemy upon Muslims living in India, Burma, Indonesia, and elsewhere? Dr. Maung Htin Aung,[54] Vice-Chancellor of Rangoon University, speaks as follows: "Some members (of the Burmese Science) association may (be) also (among those who) consider the Burmese alchemist to be a charlatan and an impostor. But I will plead with you to spare him a sigh. Of all the religious cults that existed in Burma before the advent of Buddhism, alchemy was the noblest. Like modern science, Burmese alchemy aimed at the conquest of nature, and discovering for suffering humanity a way to preserve the human body in its vigour and beauty." Jābrian alchemy was certainly that and it is impossible to think that any two systems incorporating such ideas did not fuse.

[54] Maung Htin Aung, "Burmese Alchemy Beliefs," *J. Burmese Res. Soc.*, Vol. XXXVI, Part 2, p. 91.

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Chapter LXVI

NATURAL HISTORY

A

Inasmuch as the sciences studied in any traditional civilization, that is, one based upon a divine revelation, depend upon the metaphysical and religious bases of that civilization, Muslim sciences have always echoed and reflected the central Islamic doctrine of unity *(tauḥīd)*. Just as the Islamic religious and moral sciences have begun from and returned to the idea of divine unity, the natural sciences have tried to discover the interrelation of all created beings. It is a general feature of all medieval cosmological sciences[1] that they seek to express the "unicity of all that exists." Especially in the Muslim natural sciences this goal has been central, and the idea of the unicity of nature and the interrelatedness of all parts of the universe has remained as a complement to and necessary consequence of the oneness of the Creator.

Since the most legitimate and meaningful way of studying a science is with respect to its ultimate aim and from the point of view of those who have cultivated it, we shall best understand the Muslim sciences if we keep in mind that their primary aim, unlike that of the modern natural sciences which are only analytical and quantitative, has been to arrive at the unity lying behind the veil of multiplicity of natural forms by a synthetic and qualitative study of nature.[2]

This search for unity is clearly manifested in a general science like natural history. As studied by the Muslims, natural history covers a large number of fields and includes not only such subjects as geology, botany, zoology,

[1] By cosmological sciences we mean all sciences dealing with the cosmos, including the natural sciences. The traditional sciences should, properly speaking, be divided into the metaphysical, dealing with God and supracosmic realities, and the cosmological, dealing with beings in the cosmos. See T. Burckhardt, "Nature de la perspective cosmologique," *Etudies Traditionelles*, Vol. XLIX, 1948, pp. 216–19.

[2] See Seyyed Hossein Nasr, introduction to the section on "Muslim Sciences" in the *Mentor Foundations of Scientific Thought*, Vol. II, Signet Books, New York, (in press). In his famous *'Ajā'ib al-Makẖlūqāt* (The Wonders of Creation), abu Yaḥya Zakarīya al-Qazwīni writes that the presence of divine wisdom in every atom of the universe and in all forms of multiplicity is itself a proof of divine unity, and quotes the famous verse "*wa fi kull-i shai'in lahu āyātun ta'dullu 'ala annahu wāḥidun*" (that His sign exists in all things is a proof of His unity).