

ORIGIN AND TRADITION OF ALCHEMY

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The paper presents a comparative account of the 'Origin and Tradition of Alchemy' in different countries with particular reference to India. It is shown that alchemy had an independent origin in Alexandria, China and India, though there must have been an exchange of ideas among these countries in course of time. The Arabian alchemy, though basically Greek in origin, was also influenced in certain aspects by the ideas derived from the Chinese and Indian traditions in this field. Alchemy in India had a continuous evolutionary growth starting from the early Vedic Age down to the end of the sixteenth century. Indian alchemy was, however, tinged and urged by spiritual aspirations, transmutation or gold-making being a later phase of its development during the Tāntric period.

INTRODUCTION

In the present paper it is proposed to discuss how the same ideas and practices relating to alchemy arose and grew in different countries and influenced each other in course of time. Incidentally, this may as well serve as one of the many illustrations in the *History of Science* that human minds, though differing widely in race, creed and cult, often think alike. There are a number of excellent books and review-articles on alchemy written by Western scholars, but very few of them have taken any notice of the Indian contribution to this field. Most of these scholars—there are, however, a few exceptions—labour under the impression that in the ancient world the Greeks held the monopoly of all original thought and wisdom, particularly in natural philosophy, and that the people of other countries derived and borrowed their ideas from the Greeks. They are reluctant to attribute any independent power of thinking to any other people even in the face of evidence for chronological priority. A few review-articles on Indian alchemy have been published by some Indian authors, but these again with rare exceptions are mostly coloured by national pride, besides suffering from lack of precision, and from chronological confusion. It is, therefore, considered necessary in the interest of *History of Science* that an authentic, just and unbiased account of Indian alchemy, with a discussion of its characteristic features in comparison with those of other countries, be presented to the workers interested in this field.

AIMS AND IDEAS OF ALCHEMY AND ITS CHARACTERISTIC FEATURES

In all chief centres of civilization the art or science, as one may call it, of alchemy was cultivated by some groups of persons from a very early age to

almost the middle of the eighteenth century; but the period of its maximum activity might be said to lie between A.D. 800 and the middle of the seventeenth century. It claimed among its adherents people from every walk of life, from the highest to the humblest, from the most enlightened to the least cultivated, from the deeply religious to the grossly superstitious, and from the purely speculative to the merely practical. But what is most important, alchemy led to the growth of modern chemistry and contributed in no small measure to the development of medicine. Strictly speaking however, alchemy, like astrology, is a primeval science or pseudo-science. For, it reversed the method of science by trying to realize a faith by laboratory experiments. It is well known that there were two aspects of alchemy, inextricably mingled together. They may be termed: (i) *physical* and (ii) *metaphysical* or *mystical*. Holmyard¹ calls them *exoteric* and *esoteric* respectively.

The physical aspect of alchemy is concerned with the experimental study of the transmutation of base metals into gold or silver, and with the preparation of a drug of immortality. The transmuting agent was named *aliksir* (elixir) by the Arabian alchemists and *tincture* or *philosophers' stone* by the European alchemists. The notion of philosophers' stone might, however, be traced to the Chinese alchemists in the early Christian era.

The metaphysical aspect of alchemy aimed at the transformation of man from his sinful nature to a perfect being which means the salvation of his soul or the attainment of immortality in the present life. Transmutation of metals was viewed as symbolic of the transformation of man. The alchemy was thus characterized by a dual objective, viz. the perfection of metal and the perfection of man. Of all metals, gold was regarded as the perfect metal because of its bright yellow colour which did not tarnish by fire or other agents easily. Alchemy thus came to be associated with the philosophical, theological and mystical ideas, as well as with astrology, occultism, signs, symbols, allegories, etc., for keeping the knowledge secret and confined to its adepts.

It will, therefore, not be far from the truth to state that alchemy had its origin in religious mysticism and spiritual aspirations of man. In fact, in almost all the countries where it flourished, it was initiated by some religious sect or associated with some religious cult; for example, *Taoism* in China, *Sufism* in Arabia and *Tāntric* cult in India. Even in Greco-Alexandrian centres of learning, alchemical ideas and practices were first cultivated by the adherents of a mystic cult, derived from the Egyptian priesthood in the beginning of the Christian era.

Jung² in an article on 'The Idea of Redemption in Alchemy' has discussed the significance of the metaphysical or mystical aspect of alchemy from a psychological standpoint. He emphasizes the fact that it is almost hopeless to find any order in the confounding chaos of substances and procedures described in alchemical texts, which appear more or less unintelligible and senseless

to modern readers. According to Jung, in alchemy 'we are called upon to deal, not with chemical experimentation as such, but with something resembling psychic processes expressed in pseudo-chemical language'. Jung defines alchemistic processes as 'a chemical research into which there entered an admixture of unconscious psychic material by the way of projection. For this reason the alchemistic texts frequently emphasize the psychological prerequisites for the work. The contents that come into consideration are those that suit themselves to projection upon the unknown chemical substances. Because of the impersonal nature of matter, it was the collective archetypes that were projected; and as first and foremost, as the collective spiritual life of those centuries dictated, it was the image of the spirit imprisoned in the darkness of the world'. As a matter of fact, alchemists ascribed a body and a spirit (soul) to all matter, living and non-living; and described the processes like calcination, sublimation, distillation and combination of two bodies as symbolic of transmigration of souls or resurrection of bodies after death. A characteristic feature of alchemistic philosophy was adoption of a dualistic doctrine of 'opposites' or 'two contrary principles' as a derivative of the monistic concept of the theory of cosmogony developed in all ancient centres of civilization. This doctrine viewed all things as resulting from the combination or interaction of two contrary principles, distinguished as positive and negative, or male and female, or active and passive. This is best illustrated by the conception of *Yang* and *Yin* in China; *Puruṣa* and *Prakṛti*, as well as of *Śiva* and *Śakti*, in India; of spirit (soul) and body in India, Alexandria, Arabia and Europe.

Alchemy, though a precursor of modern chemistry, was really a by-path, or misdirected course, followed by chemistry in the early days of civilization under the influence of philosophical and religious mysticism prevailing at the time. For, the origin of chemistry may be traced to as early a date as near about 4000 B.C. The ancient Egyptians of the pre-dynastic and dynastic periods and the people of Mesopotamia as also the Cretans of the fourth millennium B.C. showed a considerable skill in various practical arts like making of pottery (glazed and unglazed), glazes, and glass, extraction of metals and metal-working and preparation of alloys. Dyeing with natural colouring matters was also known to the Egyptians and Hittites in the second millennium B.C.³ Similar achievements have been recorded in favour of the Indus Valley people during the third and second millennium, B.C.⁴ The knowledge acquired by these ancient people was purely empirical, based exclusively on experience about the properties of substances, without any theoretical background. But chemistry could not progress along this practical and fruitful line for long, owing to the impact of alchemistic philosophy and practices just before the Christian era; and it merged itself into the latter. Nevertheless,

the alchemists succeeded in making many physically useful discoveries in spite of their attempts at achieving what was physically impossible.

ORIGIN OF THE NAMES (CHEMISTRY AND ALCHEMY)

It is well known that chemical operations, as well as alchemistic notions and practices, were current long before the names, *chemistry* and *alchemy*, came into vogue. Origin of chemistry, as stated above, may be traced to the dawn of human civilization with the development of practical arts. In the case of alchemical practices also, an Assyrian Tablet of 700 B.C. has been found to refer to the making of silver.

In the writings of the Greek authors of the fourth century A.D. the word *chemeia* was found to occur for the first time, to designate the art of metal-working, especially the possible change of base metals into silver and gold. The word was possibly derived from the Greek *chemi*, meaning black. On the basis of this meaning, different uses have been made of the word *chemi* :

(I) as the Greek name for Egypt, referring to the black soil of the Nile valley;

(II) as a certain blackening process, frequently mentioned in the alchemistic texts, preliminary to the whitening or yellowing of silver or gold;

(III) in the sense of dark or hidden to indicate a black, hidden or divine art by which the ancients named what was later known as alchemy.

The name alchemy arose when the Arabs prefixed their definite article *al* to the Greek word *chemi* at a later date and made it *al-chemi* (alchemy). In the beginning it signified chemistry in general, but in course of time it assumed its specific connotation of gold-making or making a drug of immortality (elixir of life).

Mythologically, origin of alchemy may be traced to the Egyptian god Thoth (Greek, Hermes Trismegistus), whence the name Hermetic Art has arisen. There are writings (probably of the third century A.D.), assigned to him, which include Platonic and Stoic philosophy besides astrology and alchemy. Of these, mention may be made of the famous *Emerald Table of Hermes* in Arabic translation. Egypt is therefore regarded as the original home of both chemistry and alchemy.

Some authors,^{5, 6, 7} on the basis of chronological, etymological and other evidence, hold the view that alchemy had its origin in China, and some also believe that even the name chemistry was derived from the Hakka term *kim-mi* and the Cantonese term *kim-mai*, signifying 'gone astray in search of gold' or 'secret of gold'. It is further suggested that these terms are the origins of derivatives like the Greek *chemeia*, the French *chimie* and the Arabian *al-chemi*. So far as alchemy relates to the search for elixir or drug of immortality it is presumably correct to state that it had its origin in China; but with the stock of information available till now the same cannot

be asserted in respect of the other phase of alchemy, dealing with the transmutation of base metals into silver and gold. It would perhaps be more correct to state that alchemy in this phase had an indigenous and contemporaneous growth both in China and Alexandria, though there might have been an exchange of information between the two in course of time through Persia and Mesopotamia, particularly after the rise of the Islam. At the present state of our knowledge we shall not be justified to seek a genetic relationship between the Chinese and Alexandrian alchemy. Holmyard⁸ and Sherwood Taylor⁹ have discussed this point at some length. They have also come to a similar conclusion. Regarding the growth of chemistry there can be little doubt that it had its origin in ancient Egypt, though the name itself might have a different origin at a later date.

ALCHEMY IN GREECE OR HELLENISTIC EGYPT

Neither in classical Greek science, nor in Greek philosophy, one finds any reference to alchemical ideas or practices. The same also holds good for descriptions of practical art of ancient Egypt, recorded in fragmentary forms in numerous papyri recovered from the tombs. For instance, the papyri of Leyden and Stockholm¹⁰ give a rather detailed account of metallurgical operations, preparation of alloys, tinting of metals with dyes, lacquering and varnishing of metals, and even coating the surface of one metal with a superficial layer of another in a more or less rational way resembling almost that of our present time, free from symbolism and all rhetorical, allegorical and mystical expressions, so characteristic of alchemistic writings. They made no mention of any possible transmutation of metals. Hopkins¹¹ has rightly observed that alchemy in Greece was a product of the impact of Greek philosophy on Egyptian craftsmanship. This is also borne out by historical consideration of the origin of Greek alchemy. During the fifth and fourth centuries B.C. Greek physicians and thinkers travelled to the Eastern centres of learning in Persia and Mesopotamia and became acquainted with the ideas of astrology, astronomy and other philosophical sciences cultivated there at the time. They also met there the visiting scholars from India, Central Asia and China, whose ideas on the subjects thus became known to them. All these materials were brought back to Greece and incorporated into the imposing body of the Greek thought by great philosophers like Plato, Aristotle and others. Then, after the foundation of the city of Alexandria in Egypt by Alexander the Great, that city became the centre of Greek learning with its temple of Serapis and the famous museum and library. It became the meeting-place of Eastern, Western and ancient Egyptian crafts and practices because of its attraction as a thriving port. Various branches of studies were developed at this centre and the Alexandrian school was associated with many illustrious names in the early history of science. The

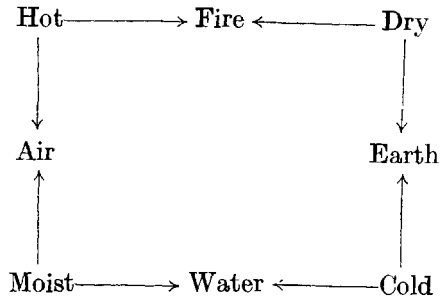
Egyptian craftsmen, too, applied their skill in practical art in decorating the temple of Serapis and the deities therein with alloys prepared to imitate gold and silver in colour. This admixture of Greek and Eastern philosophical thought with astrology, mysticism, magic and the knowledge of practical art served as a suitable breeding-ground for alchemical ideas and practices at Alexandria.

Then, between the first and the third century A.D., there arose at Alexandria a mysterious cult, derived mainly from the Egyptian priesthood. The followers of this cult cultivated with great secrecy certain fanciful and fantastic ideas regarding the possible transmutation of metals, which led to the growth of alchemy in practice.

Even long before this, in the beginning of the second century B.C., one Bolos (Democritus), an Egyptian practitioner in occult sciences, wrote a treatise on dyeing divided into four parts: gold, silver, precious gems and purple. Fragments of this treatise have been recovered from a tomb at Thebes. Bolos has been identified with Pseudo Democritus, the author of the alchemical text, *Physica et Mystica*. This was the earliest alchemical book of Hellenistic Egypt. But it contains merely recipes for tinting, varnishing, gilding and alloying of metals. Nevertheless, according to some authorities, Bolos might be viewed as the father of Alexandrian alchemy, as he established the alchemical canon of opposite qualities like sympathy and antipathy residing in substances, which lead to their combinations and separations in the physical world. It is said that he also believed in the unity of matter and hence in the possible change of one substance into another.

The most well-known alchemical author of the Hellenistic Egypt was Zosimos (A.D. 300). He wrote an encyclopaedia of twenty-eight books on subjects containing laboratory directions, chemical processes, apparatus and methods, and mystical symbolism and allegories. Another notable name in Greco-Alexandrian alchemy is that of Mary, the Jewess, who described apparatus for distillation and sublimation. Most of the alchemical writers of Hellenistic Egypt were of Egyptian or Jewish origin.

The Greco-Alexandrian alchemical philosophy was materially derived from Aristotle's view of cosmogony and the constitution of matter, which he developed after summarizing those of the earlier thinkers like Pythagoras, Plato and others. According to this view, the basis of the material world is a prime matter (*materia prima*), *hyle*, of potential existence unless impressed with 'forms'. 'Forms' represent fundamental properties or primary qualities of a body. These are four in number, generally expressed in two pairs of contrary character, viz. hot and cold, dry and moist. By combining in pairs they give rise to the four elements—earth, water, air and fire, each element having been endowed with two such 'forms' or primary qualities, but not of opposite character. This is clear from the following scheme :



One element can change into another through the addition and removal of appropriate primary qualities. Every substance is made up of these four elements, but differing in their proportions. One substance can, therefore, be changed into another by changing these proportions. Aristotle postulated the existence of a fifth element, ether, representing empty space. This four- or five-element theory of matter in the Greek philosophy is somewhat analogous to those found in the contemporaneous Indian philosophy of the Nyāya-Vaiśeṣika and the Sāṃkhya-Pātañjala systems. Aristotle, however, discarded the atomic theory of Democritus.

Aristotle's philosophy led to the view that there is a harmony or unity in the universe, due to a common or a universal spirit (*hyle*) permeating the world. This means 'All is One and One is in All'. It formed the basis of the alchemical philosophy and was at the back of the belief that by pressing this universal spirit into service somehow, either through the influence of stars or by concentration in a stone (philosophers' stone), one could change the proportions of different elements in a body and thereby transform it into another, i.e. base metal could be converted into a precious one.

The concept of the existence of a universal spirit is very much similar to that of Brahman in the Vedas and Upaniṣads developed in India nearly a millennium earlier and that of Tao in China in the fifth or fourth century B.C. Reference may be made here to the hymns of the *Rgveda* and the *Chāndogya Upaniṣad* :

*Ekaṃ sat viprā vahudhā vadanti*¹²

[There is only *One* who exists, but the learned call *Hīṃ* by various names.]

*Sarvaṃ khalvidaṃ Brahma*¹³

[Brahman is all-pervading.]

This theory of a universal spirit permeating the world led to the assumption that every object is endowed with life and sex. Thus a rational outlook was mingled with an animistic or mystic belief. In fact, in the Greek alchemical writings of the later ages, we find that the descriptions of alchemical processes are largely mixed up with rhetorical, allegorical, poetical, symbolical and religious expressions.

Aristotle's theory of metals also contributed in no small measure to the development of alchemical ideas. This holds that metals and minerals in the womb of the earth are made up of two kinds of exhalations, vaporous (moist) and smoky (dry). Metals are rich in vaporous and the minerals in smoky exhalations. It gave rise to the sulphur-mercury theory of metals at a later date by the Arabian alchemists.

The early Greco-Alexandrian alchemists developed experimental processes for the possible transmutation of base metals into silver and gold on the basis of their observations on the germination and growth of a plant from the seed. These observations led to the assumption that the essential materials and conditions for plant-growth are: a seed, soil, a gentle fostering warmth from the sun's rays and a breath from heaven to initiate or impart the vital force (life). The alchemists tried to initiate and fulfil these requirements for the production and growth of gold.

The soil was prepared by fouling a base metal, e.g. converting copper into black sulphide of copper, by heating the metal with sulphur or by treating it with a solution of a poly-sulphide.

Gentle warmth was provided by heat from a cow-dung oven or from water-bath.

Breath from heaven or life, it was assumed, could be imbibed by working under auspicious stars or suitable planetary conditions, or in suitable seasons, or more generally by carrying out the operations in a vessel open to the atmosphere. Atmosphere was believed to be a reservoir of the world soul, which could impart *pneuma* (Greek) or *spiritus* (Latin) or *prāna* (Sanskrit) or *chi* (Chinese) to all other bodies. A similar idea is found to occur in the *Caraka Saṃhitā* and the *Suśruta Saṃhitā* where the embryo is said to be endowed with *prāna* (life) through the vehicle of air.¹⁴

A piece of native gold, which is already fertilized by *pneuma*, served as the seed.

Following Aristotle, the Alexandrian alchemists thought in terms of matter and form, symbolizing body and soul respectively. Hence their scheme of transmuting a base metal like copper into gold consisted in the removal of 'form' (soul) from copper (the process signifying the death of copper and its corruption) and then introducing into the purified copper (body) a new 'form' (soul), that of gold (a process symbolizing resurrection).

The ideas depicted above formed the basis of what was known as the Hermetic Philosophy.

It is worthy of note that the early alchemy of Hellenistic Egypt was primarily concerned with the transmutation of base metals into gold and made little reference to any drug of immortality, or to cinnabar and mercury.

Thus the mere physical transmutation of base metals into precious ones is viewed in the alchemistic philosophy as a symbol of the regeneration and

transformation of man to a nobler, moral and higher spiritual state. Similar ideas are found to occur also in the Chinese, the Indian, the Islamic and the European alchemy.

ALCHEMY IN CHINA

Chinese sources indicate that alchemy was first practised in China in the fourth century B.C. by a Chinese notability Dzou Yen by name. There is also a record of an Imperial Edict of 144 B.C., penalizing the practice of alchemy in China with execution.

The *Shih Chi* (Historical Memoirs), which deals with history of China from the earliest times to 122 B.C., mentions a magician and alchemist, Li Shao Chien, in the court of the Han Emperor, and Wu Ti (133 B.C.) who affirmed his ability for making gold from cinnabar, possessing miraculous properties. The use of vessels made out of this gold for drinking and eating, it was claimed, would prolong a man's life or enable him to attain immortality.

In 60 B.C. Emperor Suan engaged the alchemist Liu Hsiang for making gold for the prolongation of his life.

The earliest Chinese alchemical writer was Wei-Po-Yang (A.D. 140). His text, *Tsan Tung Chi*, deals exclusively with alchemy along with *Tao*, *Yang* and *Yin*. He describes some chemical operations like crystallization in typical alchemistic manner, using rhetorical and allegorical language.

The Chinese alchemists were mostly followers of Lao Tzu (fourth century B.C.), the founder of Taoism. *Tao* signifies 'the way of the universe', the first and last cause of existence. *Tao* created everything, beginning with *Yang* (the active or male principle) and *Yin* (the passive or female principle). *Yang* and *Yin* then gave rise to the five elements (Chinese): earth, water, fire, wood and metal. *Tao* is immanent in everything.

By bringing the body in perfect harmony with *Tao* one can attain immortality. But this is possible only for a few spiritually gifted persons by means of meditation, control of breathing, frugality of diet, austerity and special physical exercises. For ordinary persons this is possible by the use of *lien tan*, elixir of life, or the drug of transmutation and immortality.

The philosophy of Taoism is comparable to the *Yoga* system of Indian philosophy by Patañjali.

According to Taoism all substances are made of *Yang* and *Yin*. Substances rich in *Yang* impart longevity and life, e.g. cinnabar, sulphur and gold. Alchemical gold was described as a divine or esoteric drug of immortality (elixir of life).

The Chinese alchemists mostly experimented upon the conversion of cinnabar into gold, as they both contained *Yang* in a large measure. The idea of *philosophers' stone* is believed to be of Chinese origin. For, in their process for making gold, the Chinese alchemists affirmed the necessity of adding a catalyst (elixir) for effecting the transmutation.

The most celebrated Chinese alchemist was the Taoist Ko Hung (fourth century A.D.). He was mostly concerned with *chin tan*, the elixir of immortality. He prepared mercury by heating *tan sha* (cinnabar) and described its reconversion into cinnabar. He described the preparation of gold by placing *tan* over a hot fire, the production of gold being a sign of the completion of elixir.

The efforts for the preparation of an elixir, or a medicine of immortality, constituted the chief feature of the earliest Chinese alchemy. In this respect it resembles more or less closely the Indian alchemy as practised particularly during the period when the Tāntric cult flourished in the country.

ISLAMIC ALCHEMY

During the fifth and the sixth century A.D. the learned sects of the Nestorian and other Christians on their expulsion from Constantinople migrated to, and settled in, Syria and Persia and formed an active centre of Greek learning at these places. In those days Syria was the meeting ground of many cultures and languages: Greek, Latin, Syriac, Persian, and, after the rise of Islam, of Arabic. Many Greek works of philosophy and science were translated into Arabic under the Abbasid Caliphs of Baghdad. The Arabs began to take interest in learning and translated many Greek works from their Syriac version into Arabic. Alchemical books formed a large number of them. It is also well known that under the patronage of the Caliph Harun-al-Rashid many Indian treatises on medicine, astronomy, astrology, mathematics and philosophy were also translated from Sanskrit into Arabic. Arabian alchemy had, therefore, its root in the Greek alchemy and also derived some nourishment from the Indian and Chinese sources. The Chinese influence is particularly noticeable in the use of the word elixir (Al-Iksir in Arabic). Its origin can be traced to the Chinese word *Chi*¹⁵ meaning breath, which becomes *I-Chi* (one or universal breath). The latter assumed the form *Yik-Chi* in Yangchou dialect and became *Ik-Sei* and finally *Ik-Seer* in Arabic with the addition of the article *al*, *Ik-Seer* changed into *Al-Iksir*, whence Elixir (the transmuting agent).

The most prominent name among the Arabian alchemical authors is that of Abu Musa Jabir b. Hayyan (Latin Geber), who flourished during about A.D. 720–813. But the book attributed to him has now been shown to be a compilation of the works of several writers of a much later period (c. A.D. 960), who belonged to a secret religious sect—Brethren of Purity—believing in the power of science to purify the soul. Its basic ideas were, however, Greek in origin. This book attributed to him is an encyclopaedic work, dealing with medicine, cosmology, alchemy, astrology, astronomy, mathematics, music, philosophy, etc.

Jabir classified substances with three groups: (1) 'Spirits', which are volatile and, therefore, evaporate or sublime completely when heated, e.g. sulphur, mercury, arsenic, ammonia and camphor; (2) 'metals', substances which are fusible and malleable; (3) 'bodies' or minerals, substances which are fusible or infusible, non-malleable and pulverizable. Unlike Aristotle, Jabir did not stress upon the perceptible qualities of substances such as hot and cold or dry and moist, but on their operational qualities like volatility, fusibility, malleability and pulverizability—in short, by physical factors.

Jabir's sulphur-mercury theory of metals, on the other hand, resembles that of Aristotle's vaporous and smoky exhalations. In the light of Aristotle's view, mercury is rich in vaporous or moist exhalations and sulphur is rich in smoky or dry exhalations. Jabir's theory of metals may be regarded as the progenitor of Stahl's *phlogiston* theory of combustion, which dominated chemistry in the eighteenth century.

According to Jabir base metals are diseased or imperfect and they can be made perfect or precious by treatment with suitable *elixirs*. Elixirs are pure single substances prepared by repeated distillation of an ordinary element. In the case of water, for instance, the elixir of single pure element water was obtained as a result of the repeated distillation of water for 700 times. Pure single elements are endowed with only one of the primary qualities (forms) instead of the usual two, as defined by Aristotle. Jabir's theory of elements follows that of Aristotle.

Jabir's view that base metals are diseased or imperfect finds a parallel in that of the Indian alchemist Nāgārjuna (eighth to ninth century A.D.) in his well-known treatise *Rasaratnākara*. In a dialogue with his disciple Ratnaghōṣa, the great sage Nāgārjuna says:

*Kathayāmi na sandehostattvayā pariprechyatām
Balipalitanaśāñca tathā kālasya dhvañsanam |
Yathā lohe tathā dehe kṣamate nātra saṁśayaḥ ||*

[I shall convey to you all that you want to know, namely the remedies for warding off wrinkles, grey hair and other signs of old age. Mineral preparations act with equal efficacy on the metals as on the body (human system)].¹⁶

Al-Razi, commonly known as Rhases (A.D. 866–925), was another important figure in the Arabian alchemy. He, however, made a somewhat more positive contribution to science by his reliance upon experiments and apparatus involved. His ideas were more scientific and practical in approach and were devoid of mysticism and allegory.

Ibn-Sina, commonly called Avicenna (A.D. 980–1037), was a critic of alchemy, though he wrote a book on the same. He contributed to almost every branch of science, particularly to medicine. His ideas were basically

Aristotelic. This most extraordinary and versatile scholar of acute mind did not believe in alchemical transmutations.

Al-Biruni (A.D. 913–1048), who was also an eminent scholar, discussed about alchemy in one of his books and rejected all facts that could not be verified by practical investigation.

Because of their comparatively more practical and scientific approach, alchemy in the hands of the Arabian scholars developed into chemistry, and the European chemistry of the later Middle Ages may be said to have been derived from them.

The chief contributions of the Arabian school of alchemists may be summarized as follows:

(1) Transmission of Hellenistic ideas and Greek learning to Western Europe after the conquest of Spain, which inspired the growth of European alchemy and chemistry.

(2) Clarification of the transmutation theory, elixir doctrine, and the significance of the philosophers' stone.

(3) Formulation of the sulphur-mercury theory of metals.

(4) A number of practical discoveries; description of technique and instruments, preparation of mineral acids like nitric and hydrochloric acids.

(5) Ridding alchemy largely of its esoteric and mystical aspects and questioning the validity of the idea of transmutation.

ALCHEMY IN EUROPE

In the beginning of the twelfth century A.D., Western Europe turned its interest from theology to science and philosophy as a result of its contact with the Arabs after the conquest of Spain. Works of many Greek authors were translated into Latin from their Arabic versions. This led to the revival of Greek learning and at the same time the development of alchemical ideas and practices in Europe.

The basic ideas of European alchemy were mostly Greek and Arabic in origin and were concerned more or less with the making of gold. Nevertheless, it was not free from mysticism and allegories, as Divine Grace was believed to be essential for success in gold-making experiments. At the same time increasing interest in the technique and practical results with the development of technology led to a sordid desire for acquiring wealth by gold-making, and alchemy suffered a progressive degradation into chicanery and fraudulent practices until the scientific chemistry emerged out of it in the eighteenth century.

The two well-known figures in the European alchemy were Arnald de Villanova (A.D. 1235–1313) and Raymund Lully (A.D. 1235–1315), also known as Ramon Lull.

Arnald de Villanova was the author of several medical treatises and some alchemical works. He was a convinced experimentalist, though indulging in mystical beliefs.

Raymund Lully, as is well known, did not believe in alchemical transmutation of metals, though the authorship of several alchemical books is attributed to him without any authenticity. These were possibly written by his followers. Of these, the *Testament of Lullius* presents a systematic account of alchemical ideas and practices prevailing at the time. The book is divided into three parts: theoretical, practical and codicil. The alchemical philosophy, as expounded in this book and named as Lullian doctrine, stipulates that God first created the thing, *argentum vivum* (quicksilver, i.e. mercury). This original matter gave rise to all other things. Its finest part formed the bodies of the angels, the less finer part produced the heavenly bodies, planets, stars, etc., and the coarsest part formed the terrestrial bodies.

A part of this *argentum vivum* in the terrestrial bodies formed the four elements: earth, water, air and fire, and a fifth element named *quintessence*. In every terrestrial substance, therefore, there is a common stuff as in the heavenly bodies. It is through this common stuff that the heavenly bodies could influence changes in terrestrial matters. The activity of a body resides in this fifth element, *quintessence*. Alchemical practices consisted in multiplying this *quintessence* in a body leading to the production of philosophers' stone.

Though a mystic, Raymund Lully was a rationalist and a man of remarkable activity. In another book attributed to him there are numerous intelligible accounts of chemical and alchemical processes. It is named *Experiments of Raymund Lully of Majorca, the most learned philosopher*.

The preparation of almost anhydrous alcohol, and that of nitric acid, and aquaregia has been described in the *Testamentum*. The alcohol was rectified and dehydrated over potassium carbonate (salt of tartar). The anhydrous alcohol was first used only for medicinal purposes because of its stimulating action when taken. It was believed to be the *elixir of life* so eagerly searched for by the alchemists. In the Lullian text it was represented as the *quintessence*, isolated in a more or less pure state.

It might be noted here that the use of distilled liquor for convivial purpose came into use in Europe only towards the end of the sixteenth century. In this connection it might be of interest to refer to the preparation of distilled wine described in the *Arthaśāstra* of Kauṭilya, *Caraka Saṃhitā* and *Suśruta Saṃhitā*, long before the Christian era. Particular mention may be made here of *āsava*, distilled wine for general use; *ariṣṭa*, distilled wine for medicinal use; and *madirā*,¹⁷ distilled wine containing the least amount of water (highly concentrated alcohol).

A significant achievement of European alchemy is the preparation of phosphorus by Brandt in A.D. 1674. This was obtained by igniting the residue of evaporated urine.

ALCHEMY IN INDIA

Having given an account of the origin and tradition of alchemy in Greco-Alexandria, China, Islamic and European countries, we shall now proceed to discuss its rise and growth in India.

If the preparation of, or search for, a medicine of rejuvenation or prolongation of life, apart from the use of gold obtained by transmutation for the purpose, be considered as one of the objectives of alchemy, then the dawn of Indian alchemy may be traced to the beginning of the Vedic Age (1500 B.C.).

In a number of hymns in the *Rgveda*, *soma* (juice of *Soma* plant) is highly extolled as it was believed, when taken as a drink, to increase vitality and promote longevity. The fermented *soma* juice was even worshipped and invoked as representative of the Divine Power.¹⁸

In the *Atharvaveda*, *soma* was hailed as *amṛta* (ambrosia) or the nectar, the drink of the immortal gods. The *Atharvaveda* also attributes to natural gold, when worn as an amulet, the virtue of maintaining health, preserving youth and prolonging life. It also deals largely with charms, spells, incantations, magic, demonology, sorcery and witchcraft for the cure of diseases, besides the use of many herbs. It classifies the medicinal herbs into two categories: *āyusyāni* (promoting longevity) and *bhaiṣajyāni* (curing diseases): At a later age in the Āyurvedic period the term *āyusyāni* gave place to *rasāyana* (meaning literally 'path or course of the *rasa* or body-fluid'). *Rasāyana*, therefore, represents drugs which improve the course or circulation of the body-fluids and thus helps the prolongation of life. In the Tāntric treatises of the later ages the word was employed as a general term for mercurial drugs having power to serve as agents for the promotion of vitality and longevity. *Rasa* then came to signify mercury. Mahdihassan¹⁹ has interpreted *rasāyana* as 'gold-making plant juice' with little justification. For, in the Vedic literature and even in the Āyurvedic treatises like *Caraka* and *Suśruta Saṃhitās* we do not find any mention of gold-making or transmutation process though the word *rasāyana* occurs repeatedly.

The Vedas, earliest literature of the world on record, being the sacred scriptures of the ancient Hindus, enjoyed a high canonical sanctity. They were viewed more as revelations than as human composition. It has been stated before that the conception of a universal spirit or soul (*Brahma*) which, as we have seen, formed the basis of alchemical philosophy of the Alexandrian school, was postulated in the Vedas and Upaniṣads much earlier than anywhere else.

We thus find that the alchemical notions, so far as they relate to a drug of longevity, gathered round the *soma* juice, and some medicinal herbs,

associated with religious mysticism and magic,²⁰ in India as early as the Vedic Age (c. 1500 B.C.). But no idea of gold-making or transmutation is found anywhere in the Vedic literature.

In the *Arthaśāstra* of Kauṭilya²¹ (c. fourth century B.C.), there occurs a passage in connection with the description and use of certain gold ores, which seems to indicate, according to some commentators, the transmutation of copper and silver into gold. The passage runs as follows:

Suvarṇadhātavapravivāpanārthastāmrrarūpya-vedhanāḥ, etc.

The exact interpretation of the passage evidently hinges upon the meaning of the word *vedhanā*, which literally means 'piercing or permeating' and technically, 'transmuting'. The passage may, therefore, be translated as:

'Melting or alloying with copper and silver for obtaining or recovering the gold'; and alternatively 'for converting copper and silver into gold'.

We, however, consider the first interpretation to convey the correct meaning. For, nowhere else in the *Arthaśāstra* we find any reference to such transmutation processes. Besides, we find in the *Arthaśāstra* itself that in Kauṭilya's time there were laws imposing heavy penalty for debasing gold. This obviously suggests that the idea of transmutation must have been unknown in those days. Moreover, the entire text of the *Arthaśāstra* has been composed with a more or less scientific and remarkably rational outlook, free from obscure or unintelligible mystical expressions. The alchemical idea of transmutation, it thus appears, was unknown in those days.

In a Tantra, known as *Mātrkā-bheda Tantra*, there is a recipe for the conversion of copper into silver. The age of the Tantra is not definitely known, though the editor is of opinion that it was composed during the fourth century A.D.^{22(a)}

The earliest mention of transmutation of copper into gold with the aid of mercury, along with other alchemical processes, is found in the *Kubjikā Tantra*, belonging to the extinct school of Kubjikā Mātā. The manuscript of this Tantra was discovered in the famous manuscript collection of the Maharaja of Nepal. This was written in Gupta script in about the sixth century A.D.^{22(b)}

In the *Kādambarī* of Bāṇabhaṭṭa (early seventh century A.D.) there is a story in which Chandrāpiḍa, a prince of Ujjain, while on tour in South India, visited a Drāviḍa Brahmin whom he described as:

*Avirbhūta nidhivāda vyādhinā sañjāta dhātuvāda vāyunā*²³

[Inflicted with the mania of gold-making born of the disease of making money...]

The text also refers to the conversion of iron into gold. A similar reference is also found in the *Harṣa-carita* by the same author.

Alchemy in all its aspects, namely, transmutation of base metals into silver and gold, with the use of the latter (gold) as a medicine of immortality

and the preparation of mercury (*rasa*) and mercury compounds (sulphide) for use as a drug for rejuvenation and longevity, flourished in all its power and glory in India as an adjunct to the Tāntric cult. The religion of Tantras, with alchemy as its integral part, came into vogue in India on the decline of Buddhism and dominated the Indian society for several centuries from c. A.D. 700–1300. It included among its adherents both Hindus and Buddhists. The Tantras offered an easy liberation for all even in this life through the performance of certain religious rites and ceremonies, for the fulfilment of which the preservation of the body in a healthy state was considered essential. According to the Tantras, the body can be made undecaying and immortal by the use of mercury (*rasa*) and its preparation, by *Yogic* breathing and exercises, as well as by use of gold prepared by the transmutation of base metals. Tāntric treatises, therefore, abound in alchemical recipes and medicaments for longevity. The Tāntric cult is thus characterized by a curious admixture of alchemy, spells, incantations, magic, superstitious beliefs, grotesque and revolting rites on the one hand and by speculative, metaphysical and esoteric phases of spiritual aspirations on the other. All these are centred round the worship of Śiva and his consort Pārvatī as recorded in the Tāntric treatises of Hindu origin, or of Buddha, Avalokiteśvara and Tārā Prajñāpāramitā in the case of those by Buddhistic authors. We thus find that alchemy in India had its origin and growth in religion, as a means to an end—the attainment of ‘Divine freedom beyond the needs and bounds of human nature’.

The philosophy of the Tāntric cult may be compared to that of Chinese Taoism, both of which are interwoven with alchemical ideas and practices.

The number of Tāntric alchemical treatises is legion, and a large number of manuscripts of Tantras, dealing with alchemy, can be found in different libraries of India, which have not yet been fully explored. P. C. Rây²⁴ in his *History of Hindu Chemistry* has given a list of some 32 Tāntric alchemical treatises with the names of their authors besides discussing the contents of a few important ones.

The most prominent figure among the Indian alchemists is the Buddhist monk Nāgārjuna, the author of the renowned Tāntric treatise, *Rasaratnākara*, and the redactor of the famous Āyurvedic treatise, *Suśruta Saṃhitā*. There is much controversy about the age of Nāgārjuna. But from a variety of evidence, both external and internal, it can be reasonably assumed that he flourished during the eighth or ninth century A.D.²⁵ The *Rasaratnākara* gives a number of recipes for transmutation of base metals into silver and gold. It describes many chemical processes like extraction of zinc, mercury and copper, preparation of crystalline red sulphide of mercury (*svarnasindura* or *makaradhvajā*)—a medicament which is still used by the physicians following the indigenous system of medical treatment in India as a panacea for almost all diseases the human flesh is heir to. The text also mentions the names of

more than two dozen varieties of *yantras* (apparatus) for carrying out various physico-chemical processes like distillation, sublimation, extraction, calcination, digestion, evaporation, filtration, fumigation, fusion, pulverization, preparation of metals and metallic compounds, heating by steam, heating by sand, etc.

Another important treatise of the period is *Rasārṇava*, a Brahminical Tantra (twelfth century A.D.) of the Śaiva cult, dealing with alchemy and chemistry. The Tantras largely deal with mercury and mercurial preparations, the virtues of which are highly extolled in *Rasārṇava*, not only as powerful transmuting agents for the conversion of base metals into silver and gold, but also as medicaments for making the body undecaying and imperishable. In fact, the Tāntric treatise, *Rasahr̥daya* (eleventh century A.D.), speaks of *Rasa-siddhas* (alchemists) as those who have regained their youth (new body) by the use of mercury. The *Rasendrachūḍāmaṇi* by Somadeva (twelfth-thirteenth century A.D.), the *Rasaprakāśasudhākara* by Yaśodhara (thirteenth century A.D.) and the *Rasakalpa* (thirteenth century A.D.) are other important Tāntric treatises of the period, which deal largely with chemistry and alchemy.

The alchemical ideas and treatises of India also found their way to China and Tibet. It is stated that Amoghavajra, a *śramaṇa* (Buddhist priest) of Northern India, travelled to China and resided in Peking for several years during the eighth century A.D. and under his influence the Tāntric doctrine of India gained currency there.

After the invasion of the country by the Mohammedans in A.D. 1200 the monasteries at Udaṇḍapura and Vikramaśilā were destroyed and the monks, who escaped death, fled to other countries like Tibet, Nepal, Burma, Camboj, etc. Many went to Orissa and South India. They carried with them many Tāntric treatises to those places.²⁶

Some of the Tāntric alchemical treatises have now been traced from their Tibetan translations, recorded in the great Tibetan scriptures, *Kanjur* and *Tanjur*. These represent immense collection of works, translated primarily from the Sanskrit and subsidiarily from the Chinese language between the seventh and thirteenth centuries.²⁶

That the Tāntric cult and the worship of Śiva in a pure form also flourished in South India is evident from the Tamil poetical compositions of the *Sittars* (Sanskrit *siddhas* or perfect ones). These deal mainly with medicine, alchemy and *yoga* and, as usual, associated with magic, exorcism and propitiations.

In the Tamil literature there occur two Chinese names among those of the *sittars*. These are Bogar and Pulipani. It is stated that Bogar came to India in the third century A.D. and visited Patna, Gaya and then South India, and learnt alchemy from the Tamil savants. It is believed that he also taught the Tamils the doctrine of Chinese alchemy. Many medical and alchemical works appear under the name of his authorship. He returned

to his own country, China, after several years. Pulipani came to India with Bogar and settled in the Tamil land. There are many Tamil works on medicine, alchemy and magic in his name. The age of the Tamil *sittars* has not been definitely decided; but they cannot possibly be assigned a date earlier than the tenth century A.D. Inclusion of the names of Bogar and Pulipani among those of the *sittars* is, therefore, not genuine and made with a view to lending dignity and weight to the works by the authors of inferior merit.

In the Tāntric alchemical works there are numerous recipes for the transmutation of base metals into gold; the process is called *hemakriyā* (literally gold-making). Most of these recipes are unintelligible and convey little sensible meaning. Some can, however, be interpreted as giving rise to a product with a colour resembling that of gold, such as brass, orpiment, mosaic gold (crystalline stannic sulphide), etc. A reference to a few of these recipes in some of the Tantras will serve as typical examples.

In the reputed Tāntric treatise *Rasaratnākara* by Nāgārjuna we find the following recipes in verse : 27

*Kīmatra citraṃ yaḍi rājavartakaṃ
S'irīṣapuspāgrarasena bhāvitam |
Sitaṃ suvarṇaṃ taruṅārkaśannibham
Karoti guṅjāsūtamekaguṅjajyā ||*

[What wonder is it, if *rājavartaka* (lapis lazuli or ultramarine), digested with the juice of the flowers of *Albizzia lebbek*, converts one *guṅja* (*rati*—a kind of seed weighing 1.9 grains approx.) of silver into hundred times its weight of gold of the lustre of the rising sun ?]

The product is possibly a yellow-coloured silver ultramarine.

*Kīmatra citraṃ yaḍi pītagandhakaḥ
Palāśaniryāśarasena śodhitāḥ |
Āraṇyakairutpalakaistu pācitāḥ
Karoti tāraṃ triputena kāñcanaṃ ||*

[What wonder is it that yellow sulphur, purified with the juice of *Butea monosperma* and digested with the juice of wild lillies, converts silver into gold by roasting thrice over the fire of cow-dung cakes ?]

The meaning is obscure and the reaction inexplicable.

*Kīmatra citraṃ rasako rasena
Krameṇa kṛtāmbudhareṇa rañjitaḥ
Karoti śulvaṃ triputena kāñcanaṃ ||*

[What wonder is it that calamine, painted with plant juices, converts copper into gold when roasted thrice over the fire of cow-dung cakes ?]

The reaction obviously leads to the formation of brass—an alloy of copper and zinc.

*Kīmatra citraṃ daradaḥ subhāvitāḥ
Payanamesyā vahuś'amlavargaiḥ |
Sitaṃ suvarṇaṃ vahugharmabhāvitam
Karoti sākeḍvarakumkumaprabham ||*

[What wonder is that cinnabar digested several times with the milk of ewe and the acids (vegetable acids) imparts to silver the lustre of gold glowing as saffron ?]

The reaction is inexplicable and the passage conveys no sensible meaning in the light of our modern knowledge.

On the other hand, the methods described in the text for the extraction of mercury, copper and zinc are perfectly rational and scientific. The extraction of zinc from calamine, for instance, is quite comparable to our modern method.

*Kṣāra snehaśca dhānyāmlai rasakaṃ bhāvitaṃ vahu
Ūrṇālākṣā tathā pathyā bhūlatā dhūmasaṃyutaṃ |
Mūkamūṣāgataṃ dhmātaṃ taṅkaṇena samanvitaṃ
Sattvam kuṭila saṅkāṣaṃ patate nātra saṃśayah ||*

[*Rasaka* (calamine), digested repeatedly, with fermented paddy water, natron and clarified butter, and mixed with wool, lac, *Terminalia chebula* and borax, and heated in a closed crucible, yields an essence of the appearance of tin: of this there is no doubt.]

It might be noted here that in those days the metal zinc was exported to Europe from India, China and East Asia.

The following extracts from *Suvarṇatantra*, a work of much later age (c. sixteenth century), illustrate the absurdity of alchemical recipes for the so-called transmutation of base metals into gold.²⁸

A kind of oil exuded from the bulbous root of a plant is mixed with mercury along with the bulb. The mixture is ground in a mortar and then heated in a crucible. The mercury is *killed* at once and acquires the property of converting one hundred thousand times its weight of base metals into gold.

Pure orpiment, rubbed with this oil for 20 days, is *killed* and loses its vitality. The prepared orpiment thus acquires the power of converting base metals into gold. The oil itself turns molten copper into gold of beautiful lustre; tin and bell-metal similarly treated are turned into silver; and iron, brass and silver, under the same conditions, turn into gold.

Mercury, when placed in a crucible with *saṅkhadrāvaka* (aquaregia) and heated, is *killed*. This killed mercury can convert eight base metals into gold. A man partaking of this mercury becomes immortal; even his urine and faeces can convert copper into gold.

The reaction can give rise to mercurous chloride (calomel) or mercuric chloride (corrosive sublimate) only, as the case may be.

Similar queer and absurd statements and observations, in the gold-making recipes, are found in the alchemical treatises of all other countries. But the Indian alchemy, unlike that of Alexandria, China and Arabia, does not recognize any mystical relation between the planets and the metals. Another distinguishing feature of Indian alchemy is that, unlike the Greek and the

Chinese tradition, it did not formulate any philosophy or theory of transmutation, though unity of all matter and life constitutes a basic idea of the Indian philosophical system.

It can, however, be concluded that alchemy in India had a continuous evolutionary growth from the early Vedic Age to the end of the sixteenth century, though the belief in the transmutation of base metals into gold lingered further. It is, however, significant to note that alchemy in India suffered a natural death without any hope of resurrection or emergence into a rational scientific chemistry unlike the case of European alchemy, which laid the foundation of, and developed into, modern chemistry. The social and political environment of the country was not congenial for such a renaissance. Like medicine and other branches of science developed in ancient India, alchemy, too, was characterized by its close association with high religious and spiritual aspirations. Alchemy was, therefore, pursued in India not as an end by itself, but as a means to an end—the liberation of the human soul for its union with the Divine Spirit. In this, there is a close resemblance between the Indian and Chinese alchemy.

There is, however, one question about alchemy, which still remains unanswered. Why did the alchemists of all countries continue to persist in their belief and endeavour in spite of their repeated failures in the transmutation of base metals into gold, in spite of the heavy penalties imposed by the state for debasing gold and in spite of the methods for testing pure gold being known from a very early time? Moreover, preparation of various alloys, resembling silver and gold in colour, was also not unknown to them. Still, why were they deluded by colour change occurring in the materials on which they experimented upon? We need not, of course, consider the cases of fraudulent practices for personal gain, of which there was no dearth during the period when alchemy degenerated into chicanery.

We are concerned only with the case of genuine and devoted alchemists. The answer to this can possibly come from a psychological consideration as already suggested by Jung (*op. cit.*), rather than from a mere scientific discussion.

In conclusion it might be stated that alchemy had independent origins in China and Greece-Alexandria, though there must have been some exchange of ideas among these countries in course of time. Alchemy in Arabia was basically Greco-Alexandrian in origin, though with some distinct influences from the Indian and Chinese sources. The Arabs, however, transmitted the alchemical ideas and Greek learning to Europe.

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