



On the Antiquity of the Chemical Art

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President's Opening Address to Chemical Section.

ON THE ANTIQUITY OF THE CHEMICAL ART.

By JAMES MACTEAR, F.C.S., F.C.I.

THE PRESIDENT'S OPENING ADDRESS TO THE CHEMICAL SECTION.

On the Antiquity of the Chemical Art. By JAMES MACTEAR, F.C.S., F.C.I., Member of the International Jury, Paris, 1878, and Medalist of the Society of Arts.

[Read before the Section, December 8th, 1879.]

The study of the History of Chemistry as an art, or as a science, is one which possesses peculiar fascination for its votaries. It has been the subject of deep research and much discussion, much has been written upon the subject, and many theories have been broached to account for its origin. We have had laid before us by Professor Ferguson, in his papers on this subject of Chemical History, very clearly and fully the generally-accepted position as regards the origin of the science, and in the last of these papers, entitled "Eleven Centuries of Chemistry," he deals with the subject in a most complete manner, tracing back through its various mutations the development of the science to the time of Geber, in or about the year A.D. 778.

Of Geber, as a chemist, Professor Ferguson writes, "He was the first—because, although he himself speaks of the ancients, meaning thereby his forerunners, nothing is known of these older chemists."

Rodwell, in his "Birth of Chemistry," after a careful examination of the question, comes to the conclusion that, "in spite of all that has been written on the subject, there is no good evidence to prove that alchemy and chemistry did not originate in Arabia not long prior to the eighth century, A.D.," bringing us again to the times of Geber.

He is not alone in this opinion, and it seems to be generally accepted that chemistry originated in the Arabian schools about this period.

In dealing with the question of the antiquity of chemical art, it has been too much the habit to look at the question with a view of discovering when and who it was that first brought forth, fully clothed as a science, the art of chemistry.

Let us look at the definition of the science given by Boerhæve, about 1732. He describes chemistry as "an art which teaches the manner of performing certain physical operations, whereby bodies cognizable to the senses, or capable of being rendered cognizable, and of being contained in vessels, are so changed by means of proper instruments as to produce certain determinate effects, and at the same time discover the causes thereof, for the service of the various arts."

Now, it is amply evident that, long before the various known facts could be collected and welded into one compact whole as a science, there must have existed great store of intellectual wealth, as well as mere hereditary practical knowledge of the various chemical facts.

I do not think it will be disputed that, until comparatively recent times, technical knowledge has constantly been in advance of theory, and that it is not too much to conclude that, no matter where we first find actual records of our science, its natal day must have long before dawned. Even in our day, when theoretical science, as applied to chemistry, has made such immense strides, how often do we find that it is only now that theory comes in to explain facts, known as such long previous, and those engaged in practical chemical work know how much technical knowledge is still unwritten, and what may even be called traditionary.

I purpose taking up the subject from this point of view, and attempting, with what little ability I can, to follow

back to a still more remote period than that of Geber and the Arabian school of philosophers the traces of what has often been called the divine art.

An aspect of the question that has often presented itself to me is this, that the history of what we call our world extends over some 4000 years before Christ and 1878 years since, so that, according to the usually accepted idea, if chemistry originated in Arabia in the eighth century, it was not known during say the first 5000 years of the world's history, but has advanced to its present high position amongst the sciences in the last 1000 years.

I hope to be able to show that, while the Arabian school of philosophy get the credit of originating most of the sciences, that it is as undeserved in the case of chemical science as in that of astronomy or mathematics. At the same time let us not undervalue the services rendered to science by this school: it is to them we owe the distribution of the knowledge of most of our sciences, and the Arabic literature of most of these was widely spread abroad over all the known world of their time.

The central portion of Baghdad between the eastern and western portions of the Old World, and the wise and enlightened policy of its rulers, which welcomed to its schools, without reference to country or creed, the wise and learned men of every nation, drew to it as to a centre the accumulated wisdom and knowledge of both the rising and the setting sun. Long ere this time, however, we find, as regards the Greeks, that they constantly travelled eastward in search of learning, while we know that the expedition of Alexander the Great, about B.C. 327, in which he traversed a considerable portion of India, had already opened up the store-houses of Indian lore to the minds of the West.

In connection with this, the following extract from an old book: called *The Gunner*, dated 1664, is interesting:—

"In the life of Apollonius Tyanæus, written by Philostratus 1500 years ago, we find, in reference to the Indians called Oxydra: These truly wise men dwelled between the rivers Hyphasis and Ganges; their country Alexander the Great never entered, being deterred, not by fear of the inhabitants, but, as I suppose, by, religious considerations, for had he passed the Hyphasis, he might doubtless have made himself master of the country all round him; but their cities he could never have taken, though he had led a thousand as brave as Achilles or ten thousand such as Ajax to the assault. For they come not out into the field to fight those who attack them; but these holy men, beloved of the gods, overthrow their enemies with tempests and thunder-bolts shot from their walls.

"It is said that Egyptian Hercules and Bacchus (Dionysius), when they overran India, invaded this people also, and having prepared warlike engines, attempted to conquer them. They made no show of resistance, but upon the enemy's near approach to their cities they were repulsed with storms of lightning and thunder hurled upon them from above."

May we not here have the original of the Greek fire, that was in its day so celebrated and so destructive?

Beginning then at the period of Geber, about 776 A.D., let us try to work backwards and trace, if we can, the progress of chemical knowledge down the stream of time.

While the Western Roman Empire had fallen, the Eastern still held its sway as far as the rivers Tigris and Euphrates, and continued the contest with the Persian power for the supremacy in Asia. At this time the various creeds and beliefs of the Arabian tribes—which had been much influenced by the settlement amongst them of Jews who had been dispersed at the time of the destruction of Jerusalem, and many of the sects of Christians who had been driven from the Roman empire by the more orthodox—were deeply stirred by the new doctrine of Islam, preached by Mahomet, A.D. 622, proclaiming the Koran as the rule of life, and the destruction of the ancient Arabian worship of the stars and sun and moon.

The religion of "the one God and Mahomet his prophet" took deep root, and the injunction to pursue the unbelieving with fire and sword was followed out with such unrelenting vigour that, within less than a century from the death of Mahomet, the Arabian power had extended its sway amongst nearly every tribe and nation that had owned the rule of the Roman or Persian empires, and had reached from Spain to India, from Samarcand to the Indian Ocean.

Egypt and Syria were conquered between A.D. 632–39, and Persia about A.D. 632–51. Their attempts to take Constantinople by siege failed both in A.D. 673 and 716. But they were more successful on the African shores of the Mediterranean, which they swept along till they crossed the Straits of Gibraltar and entered Spain in A.D. 709. Their further progress—through France—was stayed by their defeat in a great battle fought at Tour's, when the Gauls, under Charles Martel, forced them to retire ultimately across the Pyrenees.

Internal dissension had, however, arisen amongst them, and the ruling dynasty of the Ommiades was overthrown in A.D. 750 by the Abassides, who established themselves at Damascus; and with them began that cultivation of the arts and sciences which has thrown such lustre on the Arabian school.

One of the princes of the Ommiades who had escaped made his way to Spain and there re-established the power of his family, with Cordova as a centre, about A.D. 755. Thus it was that the Saracenic power was divided into an Eastern and a Western Caliphate.

It was under the prosperous rule of the Abassides that such an impulse was given to learning of every kind, and that the Arabian school of philosophy, which has left behind it such glorious records of its greatness, was founded. The Caliph Al-Mansour was the first, so far as we know, who earnestly encouraged the cultivation of learning; but it was to Haroun Al-Raschid, A.D. 786–808 (?), that the Arabians owed the establishment of a college of philosophy. He invited learned men to his kingdom from all nations, and paid them munificently; he employed them in translating the most famous books of the Greeks and others, and spread abroad throughout his dominions numerous copies of those works.

His second son, Al-Mamoon, while governor of the province of Kohrassan, we are told, formed a college of learned men from every country, and appointed as the president John Mesue, of Damascus. It is said that his father, complaining that so great an honour had been conferred on a Christian, received the reply—"That Mesue had been chosen, not as a teacher of religion, but as an able preceptor in useful arts and sciences; and my father well knows that the most learned men and the most skilful artists in his dominions are Jews and Christians."

That this was the case can scarcely be doubted when we consider that the Jews had always been familiar with many arts and sciences, and that, as is well known, at the destruction of Jerusalem in A.D. 70, when the Jews were dispersed in every direction, they spread over, not alone the countries under the Roman rule, but to Greece, Egypt, and the Mediterranean coast, as well as great part of Asia Minor, carrying with them, not only their peculiar religious traditions, but also their arts, which, we know, especially as regards the working of metals, were of no mean order, and their sciences, of which the so-called magic and astrology had been assiduously cultivated.

In Asia the dispersed Jews established patriarchates at Tiberias in the west, and at Mahalia, and afterwards at Baghdad, for the Jews who were beyond the Euphrates.

Seminaries were founded at these centres for the rabbis, and constant intercourse was kept up between them. It was in these schools that the Talmud was compiled from the traditionary exposition of the Old Testament, between A.D. 200 and A.D. 500, when it was completed, and received as a rule of faith by most of the scattered Jews.

That the cultivation of science was not neglected we may be sure from the keen interest taken in all ages by

the Jews in magical and astrological inquiries. We read in Apuleius, in his defence on the accusation of magic brought against him, that of the "four tutors appointed to educate the princes of Persia, one had to instruct him specially in the magic of Zoroaster and Oromazes, which is the worship of the gods." Apuleius wrote about 200 A.D., and his works teem with references to magic and astrology.

The fact that Jews and Christians were looked on as learned men will not surprise us, when we find that the Jews had established schools so long anterior to the foundation of the college of Baghdad. The rapid progress made by the Arabians, and the wise policy of the Abasside Caliphs, under whose judicious rule learning was so liberally encouraged, aided by the position of Baghdad, which formed, as it were, a centre to which the wisdom of both eastern and western minds gravitated, attracted to their schools all those of every nation who boasted themselves philosophers.

The first translations from the Greek authors are supposed to have been made about A.D. 745, and are known to have been on the subjects of philosophy, mathematics, astronomy, and medicine. These translations are understood to have been made by Christian or Jewish physicians.

As we have seen, the Jews had already established themselves at Baghdad, and had founded schools of their own previous to the formation of the college under Caliph Al-Mansour; but further than this we find the Christians spread widely over the countries of Asia Minor, and we are told, on the authority of Cosmo-Indicopleustes, that so early as A.D. 535 there was in almost every large town in *India* a Christian Church under the Bishop of Seleucia.

With these facts before us—1st, that Christian physicians were the leaders of the Arabian school in the eighth century; 2nd, that large numbers of Christian churches were actually in existence in India at least two hundred years previously to the establishment of the college at Baghdad; and 3rd, that Baghdad was almost, as it were, the central point of the great caravan route which from time immemorial had been the course of communication between the East and West, can we doubt that an extensive intercourse must have taken place, and should we not expect to find some traces, if not the effects, of Indian science on the teaching of the Arabian school.[1]

[Footnote 1: As to communication, the case of Saggid Mahmud (given in Bellew's *Indus to the Tigris*), who, merely to pray for the recovery of his sick son, travelled with him from Ghazni by way of Kandahur and Shikarpur to Bombay, thence by way of sea to Baghdad, from there to Karbola, and back to Baghdad; and then by Kirmanshah and Kum to Teheran, on his way home to Ghazni, gives an indication of the long journeys taken under the most frightful difficulties. This long journey had occupied six months only, and we read that in former times twelve years were sometimes taken in trading journeys.]

In Vol. VIII. of the Journal of Education we find a notice that "Professor Dietz, of the University of Königsberg, who had spent five years of his life in visiting the principal libraries of Germany, Italy, Switzerland, Spain, France, and England, in search of manuscripts of Greek, Roman, and Oriental writers on medicine, is now engaged in publishing his 'Analecta Medica.'

"The work contains several interesting papers on the subject of physical science among the Indians and Arabians, and communicates several introductory notices and illustrations from native Eastern writers. Dietz proves that the late Greek physicians were acquainted with the medical works of the Hindus, and availed themselves of their medicaments; but he more particularly shows that the Arabians were familiar with them, and extolled the healing art, as practised by the Indians, quite as much as that in use among the Greeks.

"It appears from Ibn Osaibe's testimony (from whose biographical work Dietz has given a long abstract on the lives of Indian physicians), that a variety of treatises on medical science were translated from the Sanscrit into Persian and Arabic, particularly the more important compilations of Charaka and Susruta, which are still held in estimation in India; and that Manka and Saleh—the former of whom translated a special treatise on poisons

into Persian—even held appointments as body-physicians at the Court of Harun-al-Raschid."

As the age of the medical works of Charaka and Susruta is incontestably much more ancient than that of any other work on the subject (except the Ayur Veda)—as we shall see when we come to consider the science of the Hindoos—this in itself would be sufficient to show that the Arabians were certainly not the originators of either medical or chemical science.

We should not forget that it is only to their own works and their translations, chiefly by the Greeks, we owe our knowledge of the state of Arabian science, and that it is only in rare cases that we have given a list of works consulted, so that we can gather the sources from which their knowledge was derived. It would scarcely be imagined, from reading the works of Roger Bacon, or of Newton, that they had derived some, at least, of their knowledge from Arabian sources; and yet such is known to have been the case with them both.

Let us now glance backwards from the Arabians to the Greeks.

It is supposed that the first translations from the Greek authors were made for the Caliphs about 745 A.D., and were first translated into Syriac, and then into Arabic. The works of Aristotle, Euclid, Ptolemy, Hippocrates, Galen, and Dioscorides are known to have been translated under the reign of Al-Mansour.

Granting for the moment that the first knowledge of the sciences was obtained by the Arabians from the Greeks, we are at once face to face with the question. From whence did the Greeks obtain their knowledge? To any careful reader it will be clear that Grecian science and philosophy, like Grecian theology, was not of native birth. It is comparatively well known that the Greeks were indebted to the Egyptians for much of their theology as well as science. The great truths which really underlay the mysterious religious rites of Egypt seem to have been altogether lost when the Greeks wove their complicated system of theology; and we read that the Egyptian priests looked on the Greeks as children who failed to understand the great mysteries involved in their religious rites, disguised as they were in symbolic form. But, besides their indebtedness to Egypt, we will find that they also owed much to Persia, and through it again to Indian sources of knowledge.

There was constant communication between the Grecian and Persian nations. We learn that it was not uncommon for Grecian generals to take service under the Persian Satraps, tempted by the liberal recompense with which their services were rewarded. About the year 356 B.C. this system of Greeks accepting service under Persian Satraps nearly caused the outbreak of war between Greece and Persia—Chares, a Grecian commander, having assisted with his fleet and men, Artabanus, the Satrap of Propontis, who was then in revolt against the Persian king. But before this, during the great plague which desolated Athens in 430 B.C., and which also extended to Persia, Hippocrates was invited to go to the Persian Court; and it is on record that Ctesias was for seventeen years physician at the Persian Court about 400 B.C., during which period he wrote his history of Persia, and an account of India, which Professor Wilson, in a paper read to the Ashmolean Society of Oxford, has shown to contain notices of the natural productions of the country, "which, although often extravagant and absurd, are, nevertheless, founded on truth."

There were, too, Grecian soldiers employed as paid auxiliaries, and a colony of Greeks who had been taken prisoners of war was founded within a day's journey of Susa.

The great expedition to Persia, and the graphic description of the retreat of the "ten thousand" Greeks, given by Xenophon in his *Anabasis*, must have been well known to Alexander the Great when he set out on his career of conquest. He overthrew the Persian empire in 331 B.C., having destroyed Tyre and subdued Egypt in the previous year and carried his triumphant progress to the banks of the Indus, and there he "held intercourse with the learned sages of India." On Alexander's death Seleucus succeeded to the throne of Persia in 307 B.C., and not long after he forced his way beyond the Indus, and ultimately as far as the sacred river Ganges. He formed an alliance with the Indian king Sandrocottus (otherwise known as Chandra-gupta), which was maintained for many years, and it is said, also, that he gave his daughter in marriage to the Indian

king, and aided him with Grecian auxiliaries in his wars.

He sent an expedition by sea, under the command of Patrocles his admiral, who visited the western shores of India, and a little later he despatched an embassy under Megasthenes and Onesicrates, the former of whom resided for some years at the "great city" of Palibothra (supposed to be Patna).

Not long after Megasthenes was at Palibothra, Ptolemy Philadelphus sent an expedition overland through Persia to India, and later Ptolemy Euergetes, who lived between 145–116 B.C., sent a fleet under Eudoxius on a voyage of discovery to the western shores of India, piloted, as is said, by an Indian sailor who had been shipwrecked, and who had been found in a boat on the Red Sea. Eudoxius reached India safely, and returned to Egypt with a cargo of spices and precious stones.

The proof of very ancient communication between Greece and India is quite clear, both by way of Persia and Egypt, and we find that the Greeks, who were in the habit of calling all other nations barbarians, speak constantly with respect of the gymnosophists—called "Sapientes Indi" by Pliny. We read also of the Greek philosophers constantly travelling eastward in search of knowledge, and on their return setting up new schools of thought. Thales, it is affirmed, travelled in Egypt and Asia during the sixth century B.C., and it is said of him that he returned to Miletus, and transported that vast stock of learning which he had acquired into his own country.

He is generally considered as the first of the Greek philosophers. Strabo says of him that he was the first of the Grecian philosophers who made inquiry into natural causes and the mathematics.

The doctrine of Thales, that water was the first elementary principle, is exactly that of the ancient Hindoos, who held that water was the first element, and the first work of the creative power. This idea was not completely exploded even up till the 18th century. We find Van Helmont affirming that all metals, and even rocks, may be resolved into water; and Lavoisier, so lately as 1770, thought it worth while to communicate an elaborate paper "On the nature of water and the experiments by which it has been attempted to prove the possibility of converting it into earth."

Pythagoras, perhaps the greatest of all Greek philosophers, it is known, travelled very widely, spending no less than twenty–two years in Egypt. He also spent some considerable time at Babylon, and was taught the lore of the Magi.

In the famous satire of Lucian on the philosophic quackery of his day (about 120 A.D.), "The Sale of the Philosophers," we have a most interesting account of the system of Pythagoras.

Scene—A Slave Mart. Jupiter, Mercury, philosophers_, in the garb of slaves, for sale. Audience of buyers._

Jupiter.—Now, you arrange the benches, and get the place ready for the company. You bring out the goods and set them in a row; but trim them up a little first, and make them look their best, to attract as many customers as possible. You, Mercury, must put up the lots, and bid all comers welcome to the sale. Gentlemen,—We are here going to offer you philosophical systems of all kinds, and of the most varied and ingenious description. If any gentleman happens to be short of ready money he can give his security for the amount, and pay next year.

Mercury (to Jupiter).—There are a great many come; so we had best begin at once, and not keep them waiting.

Jupiter.—Begin the sale, then.

Mercury.—Whom shall we put up first?

Jupiter.—This fellow with the long hair—the Ionian. He's rather an imposing personage.

Mercury.—You, Pythagoras, step out, and show yourself to the company.

Jupiter.—Put him up.

Mercury.—Gentlemen, we here offer you a professor of the very best and most select description. Who buys? Who wants to be a cut above the rest of the world? Who wants to understand the harmonies of the universe and to live two lives?

Customer (turning the philosopher round and examining him).—He's not bad to look at. What does he know best?

Mercury.—Arithmetic, astronomy, prognostics, geometry, music, and conjuring. You've a first-rate soothsayer before you.

Customer.—May one ask him a few questions?

Mercury.—Certainly—*(aside)*, and much good may the answers do you.

Customer.—What country do you come from?

Pythagoras.—Samos.

Customer.—Where were you educated?

Pythagoras.—In Egypt, among the wise men there.

Customer.—Suppose I buy you, now, what will you teach me?

Pythagoras.—I will teach you nothing—only recall things to your memory.

Customer.—How will you do that?

Pythagoras.—First, I will clean out your mind, and wash out all the rubbish.

Customer.—Well, suppose that done, how do you proceed to refresh the memory?

Pythagoras.—First, by long repose and silence, speaking no word for five whole years.

Customer.—Why, look ye, my good fellow, you'd best go teach the dumb son of Croesus! I want to talk and not be a dummy. Well—but after this silence, and these five years?

Pythagoras.—You shall learn music and geometry.

Customer.—A queer idea, that one must be a fiddler before one can be a wise man!

Pythagoras.—Then you shall learn the science of numbers.

Customer.—Thank you, but I know how to count already.

Pythagoras.—How do you count?

Customer.—One, two, three, four——

Pythagoras.—Ha! what you call four is ten, and the perfect triangle, and the great oath by which we swear.

Customer.—Now, so help me, the great ten and four, I never heard more divine or more wonderful words!

Pythagoras.—And afterwards, stranger, you shall learn about Earth, and Air, and Water, and Fire—what is their action, and what their form, and what their motion.

Customer.—What! have Fire, Air, or Water bodily shape?

Pythagoras.—Surely they have; else, without form and shape, how could they move! Besides, you shall learn that the Deity consists in Number, Mind, and Harmony.

Customer.—What you say is really wonderful.

Pythagoras.—Besides what I have just told you, you shall understand that you yourself, who seem to be one individual, are really somebody else.

Customer.—What! do you mean to say I'm somebody else, and not myself, now talking to you?

Pythagoras.—Just at this moment you are; but once upon a time you appeared in another body, and under another name; and hereafter you will pass again into another shape still.

(After a little more discussion of this philosopher's tenets, he is purchased on behalf of a company of professors from Magna Græca for ten minæ. The next lot is Diogenes, the Cynic.)

Apuleius says in the Florida, Section XV., in reference to Pythagoras, that he went to Egypt to acquire learning, "that he was there taught by the priests the incredible power of ceremonies, the wonderful commutations of numbers, and the most ingenious figures of geometry; but that, not satisfied with these mental accomplishments, he afterwards visited the Chaldæans and the Brahmins, and amongst the latter the Gymnosophists. The Chaldæans taught him the stars, the definite orbits of the planets, and the various effects of both kinds of stars upon the nativity of men, as also, for much money, _the remedies for human use derived from the earth, the air, and the sea_ (the elements earth, air, and water, or all nature).

"But the Brahmins taught him the greater part of his philosophy—what are the rules and principles of the understanding; what the functions of the body; how many the faculties of the soul; how many the mutations of life; what torments or rewards devolve upon the souls of the dead, according to their respective deserts."

There is ample evidence, therefore, that the Greeks had communication with, and borrowed the philosophy of, both Persia and India at a very early date.

That there was intimate intercourse with India in very ancient times there can be no doubt. In addition to the classical sources of information collected chiefly by the officers of Alexander the Great, Seleucus and the Ptolemies, and which was condensed and reduced to consistent shape by Diodorus, Strabo, Pliny, and Arrian, within the first century before and the first century after Christ, we have the further proof of the fact by the constant finds of innumerable Greek coins over a large portion of north-western India, and even at Cabul. These, so far as yet known, commence with the third of the Seleucidæ, and run on for many centuries, the inscriptions showing that the Greek characters were used in the provinces of Cabul and the Punjab even so late as the fourth century A.D. The consideration of these coins of the Græco-Persian empire of the Seleucidæ naturally leads us to the consideration of the Persians.

I have already shown that the Greeks and Persians held intimate relations with each other as early as the fourth century B.C., and from the speech of Demosthenes against a proposed war with Persia, delivered in 354 B.C, we may well believe that they had already had a long and intimate connection with each other. The passage reads thus:—

"All Greeks know that, so long as they regarded Persia as their common enemy, they were at peace with each other, and enjoyed much prosperity, but since they have looked upon the King (of Persia) as a friend, and quarrelled about disputes with each other, they have suffered worse calamities than any one could possibly imprecate upon them."

The Persian empire was founded by Cyrus, about B.C. 560, and rapidly rose to be perhaps the greatest power of the world of that age. The rise of the Persian empire is not unlike that of the Arabian power in regard to the wide range of conquest achieved in a very limited period. Its actual existence, from the foundation of the empire by Cyrus in B.C. 560 to the death of Darius III., was barely two centuries and a half.

Previous to the Persian empire there existed three principal powers in Asia—the Medes, the Chaldæans or Babylonish, and the Lydian. Of these the Medes and Chaldæans were the most ancient, and their joint power would seem to have extended eastward as far as the Oxus and Indus.

Of these nations the Babylonians were the most highly civilized, and, did time permit, we might find much that would interest and instruct in examining the various facts relating to the arts and sciences amongst these nations. We know that arts and sciences must have been diligently cultivated amongst them, and that magic and astrology were held in high repute.

That the Persians were well acquainted with other nations is shown clearly from the remains of their great city of Persepolis, where the sculptured figures represent many types of mankind—the negro, with thick lips and flat nose, and with his crisp, woolly hair, clearly cut; and the half-naked Indian, with his distinguishing features, being easily singled out from many others.

Persia held sway over a huge district of India—the limits of this are not known; but, in addition, they were well acquainted with a large portion of the north-western part of India.

The traditions and historical records of the Persians are contained in the famous series of writings called the Zend-avesta. These writings are, it is thought, of an age even before the Persian dynasty was established; and it has been shown by the researches of M. Anguétel and Sir W. Jones that there is indeed a great probability of the Zend having been a dialect of the ancient Sanscrit language. In the vocabulary attached to M. Anguétel's great work on the Zend-avesta no less than 60 to 70 per cent. of the words are said to be pure Sanscrit.

As the oldest known language of Persia was Chaldæic, we are again thrown back on Indian sources for the origin of the great book of the ancient Persians. Even the name of the priests of the Persian religion of Zoroaster, Mag or Magi, is of Sanscrit derivation.

The Persians kept up an enormous army, which was spread through all the various provinces and Satrapies, and consisted in great part of paid auxiliaries. In at least the later period of Persian power the Greeks were preferred to all others, and in the time of Cyrus the Younger they composed the flower of the Persian army, and were employed in garrisoning most of the chief cities of Asia Minor.

The description given by Herodotus of the vast army and fleet prepared for the expedition of Xerxes against the Greeks gives us an idea of the extent of the Persian power, and of the wide range of countries and nations over which they held sway. The review held on the Plain of Doriscus was perhaps the greatest military spectacle ever beheld either before or since. Herodotus enumerates no less than 56 different nations, all of them in their national dress and arms. Besides the Persians there were "Medes and Bactrians; Libyans in war

chariots with four horses; Arabs on camels; Sagartians, wild huntsmen who employed, instead of the usual weapons of the time, the lasso; the nomadic tribes of Bucharica and Mongolia; Ethiopians in lions' skins, and Indians in cotton robes; Phœnician sailors, and Greeks from Asia Minor." All these and many others were there assembled by the despotic power of the Persian king.

The system of government employed by the Persians, and the constant reports and tributes sent from every province to the central court of the king, were well calculated to bring to it, as to a focus, the curious lore of the various nations who came in contact with or were subdued by them.

The Persians were famed for their knowledge of astronomy and astrology, and were said "to have anciently known the most wonderful powers of nature, and to have therefore acquired great fame as magicians and enchanters."

The close relation between the Persian religious traditions and those of the Hindoos is very striking. According to Mohsan, "The best informed Persians, who professed the faith of Hu-shang as distinguished from that of Zeratust, believes that the first monarch of Iran, and, indeed, of the whole world, was Mahabad (a word apparently Sanscrit), who divided the people into four orders,—the religious, the military, the commercial, and the servile, to which he assigned names unquestionably the same as those now applied to the four primary classes of the Hindoos."

They added, "that he received from the Creator and promulgated amongst men a *sacred book in a heavenly language*, to which the Musselman author gives the *Arabic* title of *Desatir*, or Regulations, but the original name of which he has not mentioned; and that *fourteen Mahabads* had appeared, or would appear, in human shapes for the government of this world."

"Now when we know that the Hindoos believe in *fourteen Menus*, or celestial persons with similar functions, the *first* of whom left a book of *regulations*, or divine ordinances, which they hold equal to the *Veda*, and the language of which they believe to be that of the gods, we can hardly doubt that the first corruption of the purest and oldest religion was the system of *Indian* theology invented by the *Brahmins* and prevalent in those territories where the book of Mahabad, or Menu, is at this moment the standard of all religious and moral duties."

Having established, then, the long and intimate nature of the Persian intercourse with India, let us see how it bears on our more immediate subject.

The works on medicine which are known to exist, and to have been written in Persian, are not very many in number, but they cover a period of time of nearly 400 years. The oldest of them is of the year 1392 A.D., and in it and its successors there are long lists of Arabian authors whose works had been consulted, and also various Indian works.

Greek physicians were in great request at the Persian court, and when the daughter of the Emperor Aurelian was sent in marriage to the Persian monarch, Sapor II., she had a number of Greek physicians in her train. This king founded a new city called Jondisabour in honour of his Queen, and owing to the settlement here of a number of Greek physicians, who had, on account of religious differences, retired into Persia, this city became celebrated as a medical school. Dr. Friend gives the names of these as "Damascius the Syrian, Simplicius of Cilicia, Diogenes of Phœnicea, Isidorus of Gaza, and others, the most learned and greatest philosophers of the age." It is thought by some authors that many of the Arabian writers who belonged to the college of Baghdad were educated at Jondisabour.

The district of Jondisabour is even yet one of the most nourishing in Persia, and contains mines which still yield turquoise, salt, lead, copper, antimony, iron, and marble.

During the reign of the Persian king Nooshirwan, his physician Barzoueh made various journeys into India, one of which was specially for the purpose of obtaining copies of Indian literature, and another to obtain medicaments and herbs.

How to account for the strange fact that all schools of medicine which have risen, flourished, and disappeared, have left some trace in historical records, with the exception of that of India, is most difficult, unless under the hypothesis that the language in which the science and philosophy of India was recorded has been almost a sealed book to the world, and is even now quite unintelligible to the people of India itself, generally speaking, and that thus the only way in which the results of the long ages of philosophic study, which unquestionably have had a place in India, have only been known by this dark reflection from the writings of Greek and Arabic writers, which were scattered broadcast over the ancient world. The Greeks, we know, borrowed their science largely from the Egyptians, both in respect to theology and philosophy; and we might, with much profit, pursue the examination of our subject amongst the records of that highly civilized amongst the ancient nations.

Many authors have attempted to show that there is a wonderful resemblance between the Egyptians and the Hindoos, the sculptures on the monuments of the former are most wonderfully like those of India, and the features, dress, and arms are all as like as may be.

Both nations had the various arts of weaving, dyeing, embroidering, working in metals, and the manufacture of glass, and practised them with but little difference in their methods. The fine muslins of India find their counterparts as "woven wind" in the transparent tissues figured on the Egyptian temples. The style of building, the sciences of astronomy, music, and medicine were assiduously cultivated by both nations, and there was direct intercourse between them, perhaps even before historical time begins.

Rameses the Great (III.), called also Sesostris, fitted out not only war ships but merchant vessels for the purpose of trading with India, in B.C. 1235, and Wilkinson in his book on the Ancient Egyptians, tells us that in 2000 B.C. there were no less than 400 ships trading to the Persian Gulf. There is, after all, nothing surprising in this when we remember the fact, which is, however, not generally known, I am afraid, that under the reign of Pharaoh Necho, a fleet of his ships safely circumnavigated Africa, from the Red Sea to the Mediterranean, this being in advance of the celebrated voyage of Diaz and Vasco da Gama by no less than 2100 years.

No less than seven centuries before Thales went to study in Egypt, astronomical calculations were inscribed on the monuments at Thebes, so that we can see how modern by comparison the Greek philosophy appears.

In a note Wilkinson says that "The science of Medicine was one of the earliest cultivated in Egypt. Athothes, the successor of Menes of the first dynasty, is said to have written on the subject, and five papyri on the subject have survived.

"They are of the period of the eighteenth and nineteenth dynasties.

"One known as the Papyrus Ebers, from its discoverer, is attributed to the age of Kherperes or Bikeres.

"The second, that of Berlin, found in the reign of Usaphais of the first dynasty, was completed by Senet or Sethenes of the second line.

"The third, that of the British Museum, contains a receipt said to have been mysteriously discovered in the reign of Cheops of the fourth dynasty.

* * * * *

"The curatives employed were ointments, drinks, plasters, fumigations and clysters, and the drugs employed were taken from vegetables, minerals, and animals.

"Those for each draught were mixed together, pounded, boiled, and strained through linen.

"The doctors belonged to the sacred class, and were only permitted to practice their own particular branch.

"These were oculists, dentists, those who confined their practice to diseases of the head, and those again who only attended to internal diseases; they were paid from the public treasury, and were compelled, before being permitted to practice, to study the precepts laid down by their predecessors."

Homer, in the *Odyssey*, describes Egypt "as a country whose fertile soil produces an infinity of drugs, some salutary and some pernicious, where each physician possesses knowledge above all other men."

The mixing of various drugs and minerals must have produced effects which could not be lost on such observant men as the doctors must, from their training, have been, and it would be absurd to suppose that some, at least, of the simpler chemical decompositions and combinations were not known to them.

The manufacture of glass would seem to have been very ancient amongst the Egyptians, and the insufficiency of the old fable, of its discovery by the fusing of blocks of stone in the fire is quite clear; besides, Egyptian glass has been found which contains potash, and nothing is more probable than that the nitrate of potash, found so plentifully in the soil of India, was imported for this manufacture.

Precious stones or amulets with Sanscrit inscriptions have repeatedly been found in tombs, which must date back to at least B.C. 1400.

In tracing back the history of Chemistry, we constantly find reference to Hermes, Trismegistus, who would seem to be the god Thoth, or Taaut of the Egyptians. The famous inscription of the Emerald table ascribes to him the possession of three parts of the philosophy of the whole world. I have been much struck with the resemblance of this god Taaut with the Menu of the Hindoos, who also was credited with saving from destruction by the flood the three Vedas, which were supposed to contain all that was required for man's direction here below.

There would appear to have been also other Hermes, but if we look at the condition of things which obtained in Egypt when the Pyramids of Memphis are supposed to have been erected, within 300 years of the supposed date of the deluge, and that the Beni Hassan tombs, about 300 years later, depict the manners and customs of what we cannot help admitting, was a highly civilized nation, we must be struck with the fact that the distance of time between the deluge and the building of these pyramids and tombs is so short, that it might be represented by a comparison of our own date with those of Queen Elizabeth and Henry the Third.

Jackson in his "Antiquities" tells us that, Sanchoniatho states that the most ancient Phoenician records show that letters were invented soon after the dispersion of mankind, by Tsaut, the son of Mizor or Misraim, who was the first Egyptian Hermes or Thoth. He went out of Phoenicia, and first, with a colony of Mizrites, settled and reigned in Egypt, and, according to Cicero, gave both laws and letters to the Egyptians.

This Hermes was born in the second generation after the flood, and was not only the inventor of letters and writing, but he is also said to have delineated the sacred characters or symbols of the elements and planets, viz.,—sun, moon, earth, air, fire, water, &c.

These symbols are without doubt of very ancient origin, and Boerhæve in his *Theory of Chemistry* explains them hieroglyphically as follows:—

[Transcriber's Note: The listed symbols are included in the "images" directory accompanying the html version of this file.]

[Symbol: plus] Denotes anything sharp, gnawing, or corrosive; as vinegar or fire: being supposed to be stuck around with barbed spikes.

[Symbol: sun] Denotes a perfect immutable simple body, such as gold, which has nothing acrimonious or heterogeneous adhering to it.

[Symbol: first quarter moon] Denotes half gold, whose inside, if turned outward, would make it entire gold, as having nothing foreign or corrosive in it; which the alchemists observe of silver.

[Symbol: mercury] Denotes the inside to be pure gold, but the outer part of the colour of silver and a corrosive underneath, which, if taken away, would leave it mere gold, and this the adepts affirm of mercury.

[Symbol: female/venus] Denotes the chief part to be gold; whereto, however, adheres another large, crude, corrosive part, which, if removed, would leave the rest possessed with all the properties of gold, and this the adepts affirm of copper.

[Symbol: male/mars] Likewise denotes gold at the bottom, but attended with a great proportion of a sharp corrosive, sometimes amounting to a half of the whole, whence half the character expresses acrimony; which, accordingly, both alchemists and physicians observe of iron, and hence that common opinion of the adepts that the aurum vivum, or gold of the philosophers, is contained in iron, and that the universal medicine is rather to be sought in this metal than in gold itself.

[Symbol: jupiter] Denotes half the matter of tin to be silver, the other a crude corrosive acid, which is accordingly confirmed by the assayers; tin proving almost as fixed as silver in the cupel, and discovering a large quantity of crude sulphur well known to the alchemists.

[Symbol: saturn] Denotes almost the whole to be corrosive, but retaining some resemblance with silver, which the artists very well know holds true of lead.

[Symbol: earth] Denotes a chaos—world, or one thing which includes all: this is the character of antimony, wherein is found gold, with plenty of an arsenical corrosive.

The symbols, or at least some of them, may be traced even in the Chinese characters for gold, silver, &c.

The connection of Egypt with India shortly after the Christian era is distinctly indicated in the works of Apuleius. He lived in the early part of the second century after Christ, and was educated first at Carthage, then renowned as a school of literature. He then travelled extensively in Greece, Asia, and Egypt, and became initiated into many religious fraternities and an adept in their mysteries. He was admitted a priest of the order of Æsculapius, and describes the ceremony of the offering of the first-fruits by the priests of Isis, when the navigation opened in spring. The vessel, which was to be set adrift upon the ocean freighted with the offering, was splendidly decorated and covered with hieroglyphics, and after having been "_purified with a lighted torch, an egg, and sulphur_" was allowed to sail away into the unknown as a sacrifice to procure the safety of the convoy of ships which would soon after start upon their voyage. These rites were of great antiquity.

He speaks, in his first tale, of a witch who, by means of her magic charms, made not only her fellow-countrymen love her, but "_the Indians even_" and in his initiation into the mysteries of Isis, his robes "bore pictures of Indian serpents."

From what I have now laid before you, in what must necessarily be a very imperfect manner, you will see that

there is good reason to believe that in the study of science and philosophy the Indian races were much in advance of the Western nations. The age of science amongst them is very great; we fail utterly in trying to find its beginning, unless we accept the tradition which ascribes to Menu, their great lawgiver (who is supposed to have been Noah), the saving of three out of the four divine books or Vedas from the deluge. This would carry us back to the Antediluvian times for the beginning of our investigations; but without taking any such extreme view of the subject we will find traces of science clearly marked out for us in the history of the Indian races.

The picture of the Brahmins, drawn by Apuleius in the second century, shows how little they have changed in historical times. He says:—

"The Indians are a populous nation of vast extent of territory, situated far from us to the east, near the reflux of the ocean and the rising of the sun, under the first beams of the stars, and at the extreme verge of the earth, beyond the learned Egyptians and the superstitious Jews and the mercantile Nabathæans; and the flowing robed Aracidae, and the Ityraeans, poor in crops, and the Arabians, rich in perfumes.

"Now, I do not so much admire the heaps of ivory of the Indians, their harvests of pepper, their bales of cinnamon, their tempered steel, their mines of silver, and their golden streams, nor that among them, the Ganges, the greatest of all rivers,

'Rolls like a monarch on his course, and pours His eastern waters through a hundred streams, Mingling with ocean by a hundred mouths,'

"nor that these Indians, though situated at the dawn of day, are yet of the colour of night, nor that among them, immense dragons fight with enormous elephants, with parity of danger to their mutual destruction, for they hold them enwrapped in their slippery folds, so that the elephants cannot disengage their legs or in any way extricate themselves from the scaly bonds of the tenacious dragons. They are forced to seek revenge from the fall of their own bulk and to crush their captors by the mass of their own bodies.

"There are amongst them various kinds of inhabitants. I will rather speak of the marvellous things of men than of those of nature.

"There is among them a race who know nothing but to tend cattle, hence they are called neatherds; there are races clever in trafficking with merchandise, and others stout in fight, whether with arrows, or hand to hand with swords.

"There is also among them a pre-eminent race called Gymnosophists.

"These I exceedingly admire, for they are men skilled not in propagating the vine, nor in grafting trees, nor in tilling the ground. They know not how to cultivate the fields, nor to wash gold, or to break horses, or to shear or feed sheep or goats.

"What is it, then, they know? One thing instead of all these. They *cultivate wisdom*, both the aged professors and the young students. Nothing do I so much admire in them as that they hate torpor of mind and sloth."

This does not look as if the Indians had been unknown or unappreciated in the second century A.D.

Apuleius is not alone in his respect for the Brahmins. Many of the Greek writers speak of them under the names of Brahmins or Gymnosophists, but always with great respect.

Strabo states, on the authority of Megasthenes (who it will be remembered was Ambassador from Persia, and lived for some years at Palibothra, about 307 B.C.), that "there were two classes of philosophers or priests, the

Brachmanes and the Germanes, but the Brachmanes are best esteemed." Towards the close of his account of the "Brachmanes" he says:—

"In many things they agree with the Greeks, for they affirm that the world was produced, and is perishable, and that it is spherical; that God, governing it as well as framing it, pervades the whole; that the principles of all things are various, but water is the principle of the construction of the world; that besides the four elements there is a fifth, nature—whence heaven and the stars; that the earth is placed in the centre of all.

"Such, and many other things are affirmed of reproduction and of the soul. Like Plato, they devise fables concerning the immortality of the soul, and the judgment in the infernal regions, and other similar notions. These things are said of the Brachmanes."

Clemens Alexandrinus, after saying that philosophy flourished in ancient times amongst the barbarians, and afterwards was introduced amongst the Greeks, instances the prophets of the Egyptians, the Chaldees of the Assyrians, the Druids of the Gauls (Galatæ), the Samauæans of the Bactrians, the philosophers of the Celts, the Magi of the Persians, and the Gymnosophists of the Indians. The Greek authors distinctly speak of the Brahmins as the chief of the castes or divisions of the Indian people from the time of Megasthenes, who wrote of them in the fourth century B.C.

Sir William Jones, in a paper on the philosophy of the Asiatics, pointed out that "the old philosophers of Europe had some idea of centripetal force, and a principle of universal gravitation," and affirms that "much of the theology and philosophy of our immortal Newton may be found in the Vedas."

"That *most subtle spirit* which he suspected to pervade natural bodies, and lying concealed in them, to cause attraction and repulsion, the emission, reflection and refraction of light, electricity, calefaction, sensation, and muscular motion, is described by the Hindus as a *_fifth element_*, endowed with these very powers; and the Vedas abound with allusions to a force universally attractive, which they chiefly ascribe to the sun, thence called 'Aditya, or the attractor,' a name designed by the mythologists to mean the child of the goddess Aditi. But the most wonderful passage on the theory of attractions occurs in the charming allegorical poem of 'Shi'ri'n and Ferhai'd, or the Divine Spirit, and a human soul disinterestedly pious,' a work which, from the first verse to the last, is a blaze of religious and poetical fire.

"The whole passage appears to me so curious that I make no apology for giving you a faithful translation of it:—

"_There is a strong propensity which dances through every atom, and attracts the minutest particle to some peculiar object; search this universe from its base to its summit, from fire to air, from water to earth (the four elements!), from all below the moon to all above the celestial spheres, and thou wilt not find a corpuscle destitute of that natural attractability. The very point of the first thread in this apparently tangled skein is no other than such a principle of attraction, and all principles beside are void of a real basis: from such a propensity arises every motion perceived in heavenly or in terrestrial bodies; it is a disposition to be attracted which taught hard steel to rush from its place and rivet itself on the magnet; it is the same disposition which impels the light straw to attach itself firmly on amber; it is this quality which gives every substance in nature a tendency towards another, and an inclination forcibly directed to a determinate point._"

In Sir W. Ainslie's *Materia Medica of India* the opinion of an old Hindoo author is given as to the qualifications required in a physician.

"He must be a person of strict veracity, and of the greatest sobriety and decorum: he ought to be skilled in all the commentaries on the 'Ayur-Veda,' and be otherwise a man of sense and benevolence: his heart must be charitable, his temper calm, and his constant study how to do good.

"Such a man is properly called a good physician, and such a physician ought still daily to improve his mind by an attentive perusal of scientific books.

* * * * *

"Should death come upon us while under the care of a person of this description, it can only be considered as inevitable fate, and not the consequence of presumptuous ignorance."

The knowledge of the Hindoos may be all said to be contained in their sacred books called the Vedas, which, although perfect as a whole, are actually divided into four parts, each in itself constituting a separate Veda under a special title. These are the Rig-Veda, the Yajur-Veda (white and black), the Sama-Veda, and the Atharva-Veda, or Ayur-Veda. Although the last is admitted to be as a whole not so ancient as the other three, still there are portions of it that are probably as old as any of the others. Even in the oldest epic poems of the Hindoos mention is made of four Vedas as already in existence and as of great antiquity. Sir William Jones estimates the date of its compilation as certainly not after B.C. 1580.

These Vedas are considered by the Hindoos to contain the groundwork of all their philosophy, as well as of their arts and sciences, and they contain treatises on music, medicine, the art of war, and architecture.

Sir William Jones, in referring to the Ayur-Veda, says that, to his astonishment, he found in it an entire Upanishad on the internal parts of the human body, enumerating the nerves, veins, and arteries.

The Ayur-Veda was considered by the Brahmins to be the work of Brahma—by him it was communicated to Dacsha, the Prajapati, and by him, the two Aswins, or sons of Surya—the sun—were instructed in it, and thus became the medical attendants of the gods. A legend that cannot but recall to our mind the Greek myth of the two sons of Æsculapius and their descent from Apollo.

In the case of immortal gods the practice was confined to surgery, in treating the wounds received in the conflicts which were constantly described as occurring amongst the gods themselves, or between the gods and the demons. Of course they performed many miraculous cures, as would be expected from their superhuman character.

Professor Wilson published in the *Oriental Magazine*, in 1823, some notices on early Hindoo Medicine, and he points out that the tradition is, that the above "two Aswins instructed Indra in medical and surgical art, that Indra instructed Dahnwantari; although others make Atreya, Bharadwaja, and Charaka prior to the latter:—Charaka's work, which goes by his name, is extant. Dahnwantari is also styled Kasi-rajah, or Prince of Kasi, or Benares. His disciple was Susruta, his work also exists."

The Ayur-Veda, as the oldest medical writings of the Hindoos are collectively called, was divided into eight divisions. These are described by Professor Wilson as follows:—

"1st. *Salya*.—The art of extracting extraneous substances, violently or accidentally introduced into the body, with the treatment of the inflammation and suppuration thereby induced.

"The word *Salya* means a dart or arrow, and points clearly to the origin of this branch of Hindoo science.

"2nd. *Salakya*.—The treatment of external affections or diseases of the eyes, nose, ears, &c.

"3rd, *Kayao Chikitsa*.—The general application of medicine to the body, or the science of medicine, as opposed to surgery under the two first heads.

"4th. *Bhutavidya*, or demonology: the act of casting out demons, which we may take to mean the treatment of

insanity, such as it was.

"5th. *Kaumara bhritya*, or the treatment of the diseases of women and children.

"6th. *Agada*.—The administration of antidotes.

"We do not appreciate this as an eastern nation would when poison was only too common an instrument of ambition or revenge.

"7th. *Rasayana*.—Is chemistry, or perhaps it were better to say alchemy, as its chief aim was the study of combinations of substances mostly metallurgic, with a view of obtaining the universal medicine or elixir which was to give immortal life.

"8th. *Bajikarana*.—Was connected with the means of promoting the increase of the human race."

One of the articles of Hindoo medicine was *Kshara* or alkaline salts,—these are directed to be obtained by burning different substances of vegetable origin, boiling the ashes with five or six times their measure of water and filtering the solution, which was used both internally and externally. Care is enjoined in their use, and emollient applications are to be used if the caustic should occasion great pain.

I have already spoken of the fact of Indian physicians having been at the Court of Persia, and also at that of Haroun al Raschid, and also that the ancient writers on medicine were known to the Arabs of the time of the schools of Baghdad and Cordova. There is no manner of doubt concerning this fact, as in Serapion's works we find Charak actually mentioned by name; under the head *De Miobalanis* we find "*_Et Xarch indus dixit;*" and again, in another section "*Xarcha indus;*" there being no corresponding sound to che in Arabic, there is a slight change in the name, but it is quite clear what it is intended for. In Avicenna, again, we find reference to "*Scirak indum.*" Rhazes, again, who was previous to Avicenna, has "*Inquit Scarac indianus,*" and again "*_Dixit Sarac;*" in another place an Indian author is quoted, who has not as yet been traced, "*Sindifar,*" or, as it is in another place, "*_Sindichar indianus._*"

Professor Wilson, in a notice on the medical science of the Hindoos, published in the *Oriental Magazine*, examines into the distinctive qualities of the various sorts of leeches, and shows that the description given in Avicenna, in the section "*De Sanguisugis,*" is almost identical with the Hindoo author's description of the twelve sorts of leeches, in distinguishing the appearance and properties of the various sorts.

That this is more than a mere coincidence is clear from the fact that Avicenna says "*Indi dixerunt.*"

I do not think it will be seriously disputed that the Arabs had access to the Hindoo works of and before their time, and we will find, if we carefully examine the subject, that the science of medicine as distinguished from surgery, and of chemistry as a part of that science of medicine, was much more ancient than we have been prepared to admit.

It would be incredible to believe that amongst a people so observant and highly cultured as the Brahmins must have been, that medicine and the changes occurring in mixtures of various substances should have been unstudied, and there is no doubt that this subject was far from being neglected by them.

Many natural productions of the country, such as nitrate of potash, borax, carbonate and sulphate of soda, sulphate of iron, alum, common salt, and sulphur, could scarcely escape the notice of even ordinary men; but Dr. Ainslie has shown, from the evidence of old Indian medical works, that they were not only acquainted with ammonia (which they made by distilling salammoniac one part, and chalk two parts), but that they prepared sulphuric acid by burning sulphur and nitre together in earthen pots, calling it *Gunduk Ka Attar*, or "attar of sulphur." Nitric acid, which was prepared, not by the process described by Geber, but by mixing

saltpetre, alum, and a portion of a liquor obtained by spreading cloths over the common gram plant, and leaving them exposed to the dew, when they were found to absorb the acid salt so abundantly secreted by the plant on the surface of its leaves, and which, when examined by Vauquelin, was found to contain both oxalic and acetic acids.

Muriatic acid was also made by distilling alum and common salt, dried and pounded with the above acid liquor.

Arsenic was used by them for the cure of palsy, and also for venereal diseases, and is still used by them for this purpose, and in intermittent fevers.

It would occupy too much time to go further into this subject at the present time, but there are many chemical compounds which are still made and sold in the Indian bazaars which have been used from time immemorial, and which require a knowledge of chemical manipulation in the arts of subliming, distilling, &c.

Mr. Rodwell says, "that the distillation of cinnabar with iron, described by Dioscorides, is the first crude example of distillation, which afterwards became a principal operation among the alchemists and chemists for separating the volatile from the fixed."

That this is an assumption which has no foundation in fact is evident, when we find in the Institutes of Menu many enactments against the drinking of distilled spirits, and these made of various kinds and distilled from molasses (or sugar-cane juice), rice, and the madhuca flowers.

"A soldier or merchant drinking arak, mead, or rum are to be considered offenders in the highest degree," and "for drinking spirits are to be branded on the forehead with a vintner's flag," rather a summary way of treating a drunkard, and one which would indicate that the ill effects of over-indulgence in spirituous liquors had been long known, when such severe enactments were made against it.

The method of distilling described by Mr. Kerr in the Asiatic Researches, vol. 1, is so simple that it is almost certain that it was employed in very ancient times for the purpose of distilling spirits, and also attars of various sorts, which, from time immemorial, would seem to have been a special production of India.

"The body of the still is a common large unglazed earthen water jar, nearly globular, of about 25 inches diameter at the widest part of it, and 22 inches deep to the neck, which neck rises 2 inches more, and is 11 inches wide in the opening; this was filled about a half with fermented mâhwah flowers, which swam about in the liquor to be distilled.

"This jar they placed in a furnace, not the most artificial, though not seemingly ill adapted to give a great heat with but very little fuel. This they made by digging a round hole in the ground, about 20 inches wide and full 3 feet deep, cutting an opening in the front sloping down to the bottom, perpendicular at the sides, about 9 inches wide and about 15 inches long, reckoning from the edge of the circle: this is to serve to throw in the wood and to allow a passage for the air; at the other side a small opening about 4 inches by 3 inches is made to serve as an outlet for the smoke, the bottom of the hole thus made was rounded like a cup.

"The jar was placed in this as far as it would go, and banked up with clay all round to about a fifth of its height, except at the two openings, when all was completed so far as the furnace was concerned.

"Fully one third of the still or jar was exposed to the heat when the fire was lighted; the fuel was at least 2 feet from the bottom of the jar.

"On to this jar there was now fitted what is called an adkur, this being made of two earthen pans with their bottoms turned towards each other, and a hole of about 4 inches diameter in the middle of each of them, the

lower of these pans fitted the hole in the jar, and was luted with clay, the upper was luted to the lower one, and had a diameter of about 14 inches, the juncture formed a neck of about 3 inches, the upper pan was about 4 inches deep, with a rim round the central hole, this formed a gutter, and by means of a hollow bamboo luted to this, the spirit, as it condensed, ran off into the receiver.

"The arrangement was now completed by luting on a small copper pot or vessel about 5 inches deep, 8 inches wide at mouth, and about 10 inches at bottom, with its mouth downwards.

"The cooler was formed by placing on a support at the back of the furnace an earthen vessel containing a few gallons of water, from which, by means of a bamboo tube, the water was allowed to run on to the centre of the copper pot, from where it collected in the clay saucer, and ran off by a small hole and bamboo tube for use again.

"In about three hours' time from lighting the fire, they draw off fully fifteen bottles of spirits."

Comparing this simple form of apparatus with those described by Geber, we must admit that there is no doubt of the earlier date of this simple apparatus; and, as we have seen, distilled spirit is expressly mentioned in the Institutes of Menu, we are bound to admit that distillation was in use long ere the Arabian times and that of Dioscorides.

Many such examples might be examined, but I will take one for illustration—that of the manufacture of common salt.

Let us take this manufacture as a typical one.

We find in Jackson's Antiquities and Chronology of the Chinese that, 2500 B.C., Shin-nong invented the method of obtaining salt from sea-water. He also gets credit for having composed books on medicine.

In George Agricola's *De Re Metallica* (1561) there is a curious set of woodcuts representing the manufacture of salt, and in the first, in which the whole process of evaporating sea-water by the sun's rays is shown most completely from the raising of the sluices to allow the water to flow into the various evaporating ponds, to the packing of the finished salt in barrels—it is a curious fact that the trees which are introduced are *palms*, and the figure in the distance is dressed in *Oriental costume*, while even the ship seems to partake of this character.

A more advanced state of things is shown in the third drawing of the 12th book, where a pan is shown, made of iron plates riveted together so as to form a flat sheet, which forms the bottom of the pan, of which the sides are composed of thick wood, strengthened with plates of iron at the corners.

The bottom of the pan has a series of iron eyes or loops, and these, when it is fixed over its furnace, are attached to iron rods, which are hung from a network of wooden bars, so that the whole bottom of the pan is supported securely at a considerable number of points.

The furnace is very simple, being simply a wall surrounding an oblong space, a little smaller than the pan, so that the sides of the latter may rest on the walls all round, except for a small space in front where the fuel is introduced, which apparently burns on the ground alone.

The method of manufacturing salt in Japan is almost identical with that figured in Agricola. There is the same arrangement of salt garden or series of ponds and ditches, and the dirty salts mixed with sand are again lixiviated, and the filtered liquid is boiled down in curiously formed pans or boilers.

Of these there are two chief forms, the first being a tank or pan formed of large pieces of slate, with the joints

made with clay, and surrounded with a mud wall. The whole is covered with an arch or vault and is filled with the brine, which is then evaporated by surface heat, the fire being placed at one end and the flue at the other.

The other form is very curious and interesting, and is almost identical in its principle of construction with the pan I have referred to as figured in Agricola, only in this case the materials are very different, being, instead of wood and iron, nothing more than clay or mud.

It was described officially by the Japanese, in their publications at the Philadelphia Exhibition in 1876. The Japanese description of this apparatus is highly interesting. It is as follows:—

A low wall is built, enclosing a space of about 13 feet by 9 feet, the bottom forming a kind of prismatical depression, 3 feet deep in the centre line. An ashpit, 3 feet deep, is then excavated, starting from the front wall, and extending about 4 feet into this depression at its deepest place; it communicates with the outside by a channel sloping gradually upwards, and passing underneath the front wall. The ashpit is covered by a clay vault, with holes in its sides, so as to establish a communication between the ashpit and the hollow space under the pan. This vault is used as a fire grate, the fuel (brown coal and small wood) being inserted by the fire-door in the front wall. The air-draught necessary for burning the fuel enters partly by the fire-door, partly through the ashpit and the openings left in the vaulted grate. Through these same openings the ashes and cinders are from time to time pushed down into the ashpit, for which purpose small openings are left in the side-wall of the furnace, through which the rakes may be introduced. A passage in the back wall supporting the pan leads off the products of combustion and the hot air into a short flue, sloping upwards, and ending in a short vertical chimney. At the lower part some iron kettles are placed in the flue for the purpose of heating the lye before it is ladled into the evaporating pan.

With reference to the pan, it is made in a way that requires a great deal of skill and practice. In the first place, beams reaching from the one side to the other are laid on the top of the furnace walls, and are covered with wooden boards, forming a temporary floor. Two or three feet above this floor a strong horizontal network of poles of wood sustains a number of straw ropes, with iron hooks hanging down, and of such a length that the hooks nearly touch the wooden floor. The floor is thereupon covered with a mixture of clay and small stones, 4 to 5 inches thick, the workman being careful to incrustate the iron hooks into this material. It is allowed to dry gradually, and when considered sufficiently hardened, the wooden beams and flooring are removed with the necessary precautions. The bottom of the pan remains suspended by means of the ropes. The open spaces left all round between the bottom and the top of the furnace walls are then filled up, and the border of the pan, 9 inches to 10 inches high, is made of a similar mixture. It is said that this extraordinary construction lasts from 40 to 50 days when well made, and that it can be filled 16 times in 24 hours, with an average of 500 litres of concentrated lye at each filling; but the quantity depends upon the weather, and is less in winter than in summer. During the cold season one pan yields 140 litres (of salt) each time it is filled, and in the hot season from 190 to 210 litres. The average consumpt of fuel is said to be 1500 kilos. in 24 hours.

In Persia, near Ballakhan, salt is still made, and has been made from time immemorial, in a very primitive way, which is described by Bellen, in his description of his journey in 1872 from the Indus to the Tigris, as follows:—

"For several miles our road led over a succession of salt pits and ovens, and lying about we found several samples of the alimentary salt prepared here from the soil. It was in fine white granules massed together in the form of the earthen vessel in which the salt had been evaporated. The process of collecting the salt is very rough and simple. A conical pit or basin, 7 or 8 feet deep and about 12 feet in diameter is dug, and around it are excavated a succession of smaller pits, each about 2 feet diameter by 1½ feet deep. On one side of the large pit is a deep excavation, to which the descent from the pit is by a sloping bank. In this excavation is a domed oven with a couple of fireplaces. At a little distance off are the piles of earth scraped from the surface and ready for treatment. And, lastly, circling round each pit is a small water-cut led off from a larger stream running along the line of pits.

"Such is the machinery. The process is simply this:—A shovelful of earth is taken from the heap and washed in the basins (a shovelful to each) circling the pit.

"The liquor from these is, whilst yet turbid, run into the great central pit, by breaking away a channel for it with the fingers. The channel is then closed with a dab of clay, and a fresh lot of earth washed, and the liquor run off as before; and so on till the pit is nearly full of brine. This is allowed to stand till the liquor clears. It is then ladled out into earthen jars, set on the fire and boiled to evaporation successively, till the jar is filled with a cake of granular salt. The jars are then broken, and the mass of salt (which retains its shape) is ready for conveyance to market.

"Large quantities of this salt are used by the nomad population, and a good deal is taken to Kandahar. The quantity turned out here must annually be very great. The salt pits extend over at least ten miles of the country we traversed, and we certainly saw some thousands of pits."

From what I have laid before you, it will be seen that I am strongly of opinion that we must go far beyond the time of Geber or the Arabian school for the origin of our science. The study of the question of its antiquity leads up to such remote times that there is little probability of any date being assigned to its beginning, and to some it may appear but a waste of time to indulge in researches upon the subject; but it has a fascination peculiar to itself, and, in addition, brings before our minds so many phases in the philosophical thought of the world, that it will no doubt long continue to exercise the minds and attract the attention of chemists.

In the course of my own study of the subject, I have felt much dissatisfied with the derivation of the name chemistry or alchemy, as it is given in all works to which I have had access. It is said to be derived from a word meaning dark, hidden, black, and from the ancient name for Egypt, but to my own mind this is an unsatisfactory explanation, and seeking for another more consonant with the character of the science, I think I have found it in quite a different direction.

It is well known that in the old Hindoo philosophy there were recognized five elementary bodies or rather types. These were Water, Fire, Ether, Earth, and Air, and the system of Menu, of which the antiquity is enormous, recognizes as the greatest conception of the universe—

1st, God. 2nd, Mind. 3rd, Consciousness. 4th, Matras. 5th, Elements.

(matras being the invisible types of the visible atoms which compose the five elements previously named—viz., Water, Fire, Ether, Earth, and Air).

Now, these elements, with the sun and moon, composed the attributes of the dual deity Iswara and Isi, representing the male and female natural powers, and, applying this to the famous Pythagorean triangle, we find that the upright symbol or male, which was the number or power 3, when combined with the female prostrate symbol, which was the number or power 4, gives a product in the Hypotenuse of 5, which is the number of the typical elements of the oldest known Hindoo philosophy. It is also the product of the first male and female numbers, and was anciently called the number of the world—repeated anyhow by an odd multiple it always reappears.

If now we consider chemistry as that science which has to deal with the changes and combinations of the five elements, and if we call it—

The science of the five parts or elements, should we not, when we find that the Arabic word for five is *khams*, rather refer the name of our science to this word *khams*, and read it as

Al-Khams, The five-part science?

I am inclined, however, to go yet a step further, and remembering that the *fifth* element or Ether of the most ancient Hindoo philosophy, was in reality an expression for active force, or, that emanating from the central sun caused the natural phenomena of attraction and repulsion, the emission and refraction of light, and other sensible changes of condition, would read the compound word

Al-Khamis (The fifth),

as the grand and simple title of our ancient science, meaning

The force—

that which causes the changes in the elementary types and their combinations—than which no more descriptive title could be assigned to it, even in the present enlightened age.

* * * * *

Errors and Anomalies

Apollonius Tyanæus [*text reads "Appolonius"*]

Hercules and Bacchus (Dionysius) [*text reads "Dionsyius"*]

Omniades ... Abassides [*standard spellings for this text*]

Ibn Osaibe's testimony [*text reads "Ibu"*]

body-physicians at the Court of Harun-al-Raschid [*spelling as in original, but elsewhere spelled "Haroun"*]

Xenophon in his Anabasis [*text reads "Zenophon"*]

Megasthenes [*text reads "Megesthenes"*]

the first of the Grecian philosophers [*text reads "philosphers"*]

the Hindoos believe in *fourteen Menus* [*and six further occurrences of "Menu"*] [*standard spelling in this text: correct form is "Manu"*]

Libyans in war chariots with four horses [*text reads "Lybians"*]

under the reign of Pharoah Necho [*spelling as in original*]

from the Red Sea to the Mediterranean [*text reads "Mediterreanean"*]

Jackson in his "Antiquities" tells us that, [*comma in original*]

Indra instructed Dahnwantari; Dahnwantari is also styled Kasi-rajah [*correct form is "Dhanwantari"*]

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