

days held to be indispensable for the basis of any hypothesis. They were very much more free with the imagination than are the scientists of today. Though they were entirely without experimental data, this did not deter them from speculating upon the nature of the universe. Instead of drawing conclusions from accurately observed facts, they infinitely preferred to call speculation to their aid by which they did not hesitate to attempt an explanation of the ultimate reasons of all things. This lack of the gift of observation, says Von Meyer, this disinclination to go to the root of any phenomena, in fact, a certain indifference with regard to the natural events, are characteristic of the ancients with respect to nature. The most mischievous errors crept in as a consequence. The most superficial observations gave rise to opinions, which, when uttered by high authorities, obtained to the dignity of dogmas. How otherwise than from an utter lack of observation can one explain Aristotle's assertion that a vessel filled with ashes will hold as much water as one which is empty? A further instance of the credulity of that time is given in the conviction expressed by Pliny, and universally held, that air can be transformed into water, and vice versa, that earth is produced from water, and that rock crystal proceeds from the latter.

Now if substances so unlike one another as air and water change one into the other, how natural it is to suppose that one metal can be changed into another, since metals do not differ from one another, apparently, as much as do air and water. And, as said before, the ancients considered that the change of water into air was a matter of every day observation. What else could it be than air being changed into water when clouds were formed from the invisible atmosphere and were condensed into water and fell as rain. Further, water left in a vessel exposed to the summer sun disappeared, and clouds were seen to vanish from view. Were these not cases of water being changed into air? And in regard to their belief that earth is produced from water, it may be said that this idea was proved to be erroneous only a little more than a hundred years ago. It has been observed that when even the purest water was heated for some time in a glass vessel and finally boiled to dryness that an earthy residue was found in the bottom of the vessel. This seemed to be ample proof that some of the water at least had changed into earth. And it was not until about 1772 that the true explanation of this phenomenon was given, when the great French chemist Lavoisier proved that this earthy residue was due to the water dissolving some of the glass.

Although the ancient Greek philosophers did not themselves teach that metals may be transmuted one into another, yet this doctrine was readily deduced subsequently from what they did teach that substances change into other substances. Yet aside from any speculations of this nature there were superficial observations of a practical kind which appeared to give a strong support to the belief in such transmutations. Among such accidental observations was that of the deposition of copper, from the water which accumulated in the copper mines upon iron utensils left therein. What more natural than to conclude that a transmutation of

iron into copper had occurred? We now know, however, that a compound of copper was in solution in the water, and that the iron simply displaced the copper in its compound, leaving the copper to be deposited upon the remaining iron. The experiment is easily tried. If a clean iron nail is put into a solution of blue vitriol, a compound of copper, a deposit of the latter metal, is seen to form on the nail. Chemical analysis enables us to learn that for every particle of copper deposited upon the nail one of iron has gone into solution to displace the copper from its compound. No change of iron into copper, consequently, has occurred, for there is just as much iron after the change as before, only some of it exists in a different condition, namely, in combination dissolved in the water.

Again, for the production of gold or silver from copper, the transformation of the latter into yellow or white alloys by fusion with earthy substances, such as calamine or arsenic, appeared to give warrant. Finally, the fact that a residue of gold or silver remained behind when an alloy with lead or an amalgam with mercury was strongly heated, indicated the generation of those noble metals. Thus a residue of silver is nearly always found when galena, the chief ore of lead, is heated sufficiently. The ancients believed that these noble metals resulted from the actual transmutation of the lead. It is now known, however, that galena is seldom found entirely free from them.

But when and where were the first efforts made to effect the transmutation of the base metals into the noble? As we have seen, the idea of the possibility of one thing changing into another essentially different was prevalent in very early times, at least as early as the fifth century B. C. But we have no definite information as to when and where the first attempts were made to transmute the base metals into gold and silver. It is common, however, to think of ancient Egypt as the motherland of alchemy. Yet the beginnings of this art, as the beginnings of other branches of knowledge of ancient date, are associated with mythical and mystical traditions. But we find among various nations distinct signs of alchemy having been practiced as a secret art and having been held in honor.

When it is remembered that ancient Egypt was a center for the higher culture, and that it was a country where the few chemical processes known were practiced, it is natural to look there for the earliest reliable records of alchemy. And there we find them. But these earliest records, few and incomplete, do not go back evidently to the time when the first alchemistic efforts were made. The earliest historical proofs we have of the origin of alchemy came to us through the Layden papyrus and the writings of the Alexandrians from the third to the fifth century, A. D. In some of these writings of the fourth century the word *chemi* first occurs as the name of the art which treats of the production of gold and silver artificially. But Plutarch states that the old name for Egypt was *chemi*, a name given to it on account of the dark color of its soil. The same word was also used to designate the black of the eye as the symbol of the dark and mysterious. It is certain, therefore, that *chemi*, now chem-

istry, originally meant Egyptian, or secret knowledge, as it was afterwards termed the secret or black art. The prefix "al" attached some centuries later, making the word alchemy, is due to the Arabians of the seventh century.

According to a tradition universally diffused in the first centuries of our era, the art of ennobling the metals with other knowledge was brought from heaven to earth by demons. In the writings of Zosimos, an Alexandrian author of the fifth century, is found the name of the mystical book brought from heaven, containing the coveted knowledge. Later there were traditions among the alchemists of the middle ages referring the origin of their art back to a time before the flood. Of course it was supposed that a special sanctity would accrue to the art by reason of this great age; moreover, on the supposed authority of certain passages in Holy Writ, certain biblical characters were written down as alchemists; for instance, Moses and the Evangelist John. When ideas such as then gained credence in the middle ages, in a time when blind fanaticism was looked upon as a virtue, it is no wonder that the false doctrines of alchemy were so enthusiastically accepted and that so many gifted men gave themselves up to a pursuit of its illusory hopes.

The first personality with which the Egyptians associated the origin of alchemy is that of Hermes Prismegiston, "the three times great," who was said to have been the author of books upon the holy art, as alchemy was called. This same mythical personage, in whom the idea of strength was personified, was generally revered as the discoverer of all the arts and sciences. In Egypt pillars were erected in his honor upon which alchemistic inscriptions were cut in hieroglyphics.

Another source of inspiration to early alchemists flowed from the belief in the analogy of the earth to an animal. From this came the theory of the development of metals in the womb of the earth under the influence of the planets, the pregnant earth spontaneously producing gold and silver from baser things after a definite number of lunations. But it was soon recognized that to nature time is nothing, to man everything. What is the lapse of a thousand years to nature? To man a half century covers the time of his intellectual activity. The aim then of those who cultivate the sacred art was to shorten the natural term in which nature transmuted baser things into gold. But how shorten this term? If a base metal were exposed to the proper amount of heat in a furnace for a certain season, would not the desired result be obtained? The Roman Emperor Caligula, who had tried to make gold from orpiment, a yellow ore of arsenic, by the force of fire, was only one of a thousand adepts pursuing a similar scheme. Many trusted to the addition of a material substance to aid the fire in purging away the dross of a base metal submitted to it. This material substance was subsequently known as the philosopher's stone.

Though there are no historical documents extant that teach us much about the alchemy of the first centuries of our era, there are evidences that the divine art was diligently practiced by the initiated among the Egyptians and others.