

of its combustibility, was regarded as being present owing to the alternation of many metals in the fire. Gold, and silver being unalterable in the fire, consist of almost pure mercury, which, however, cannot be identical with ordinary mercury since the latter is volatile, due, according to Geber, to the fact that it contains sulphur. Geber regarded gold as consisting of a very pure mercury and red sulphur, while silver consists of mercury and white sulphur. The color of each metal is due to the sulphur.

By an arbitrary alteration of the composition of metals, Geber believed that a transmutation could be effected; the ennobling of them, specially, consisting in a purification and fixation of the mercury. The idea of creating a metal anew, which is found firmly fixed in the minds of European alchemists of a later period, is not to be found in Geber's writings. On the contrary he says: "To assert that one substance can be produced from another which does not contain it, is folly. Since, however, all metals consist of sulphur and mercury, we can add to them the constituent in which they are deficient, or abstract the one present in excess. In order to achieve this, make use of the art; calcination, sublimation, decantation, solution, distillation, crystallization and fixation. The active agents are salt, alums, vitriols, borax, the strongest vinegar and fire." A chemical student of today would say that this is clear in comparison with the process here outlined. Is it any wonder that no one of Geber's disciples, of whom there were myriads, ever succeeded in making gold by following directions no more explicit than these?

But the wonder is how a theory of the composition of metals so far from the truth as that proposed by Geber should have dominated the minds of men so long. We cannot now understand why they did not try to prepare the mercury and the sulphur of which they supposed the metals to consist. Having prepared these elements in their purity, it would seem that no difficulty could be encountered in making gold by mixing them, in proper proportion. But the methods then were entirely different from those now in vogue. They formulated their theories without any real data whatever, and then tried to make all their observations agree with the hypotheses; while now, chemical theories are based only upon a long series of careful experiments and are formulated for the sole purpose of explaining the facts observed and enabling still greater development to be attained. With them, if an observation would seem to contradict a pet theory, they would try to warp the observation to make it fit the theory, or they would start some new hypothesis to explain the discrepancy. Now, however, if observed phenomena contradicts a hypothesis, the latter is rejected and something more rational sought for to take its place. It may be added, however, that most men simply accepted Geber's theory without ever asking themselves if there was a probability that it was wrong or making any experimental efforts to prove its correctness. It was results they were after. Regarding the ennobling of metals as a fact beyond question, Geber's theory offered the simplest explanation as to the reason why this could be done, and they de-

voted all their energies to the problem involved in the process of the transmutation.

For the solution of the possible problem of the transmutation of metals—possible, that is in the sense of the foregoing theory—so-called "medicines" are, according to Geber, requisite, these being of three orders, distinguished by their power and virtue. The medicines of the first order produce changes in the metals, but these changes are not permanent. Those of the second order partially alter the properties of the base metals into those of the noble ones, while transmutation proper is effected only by the medicine of the third order. The latter is variously designated as the philosopher's stone, the great elixir, or the magisterium [masterpiece]. But, as might be expected, Geber's directions for making this medicine are wholly unintelligible. It may be said, however, that he did not indulge in the incredible exaggerations as to the power of the philosopher's stone of which many later alchemists were guilty.

Geber had many disciples among the Arabians, some of whom were noted physicians and exerted a more or less permanent influence upon the science of that time, but these we must pass without further mention and proceed to a brief notice of some of the alchemists of the Christian nations of Europe.

The Arabians first obtained their alchemistic ideas from the Egyptians and Byzantine Greeks. These ideas, after being modified and developed, were propagated over western Europe from the Arabian universities as centers, so that by the middle of the thirteenth century the cultured men of Europe were in the thralls of the alchemists in Germany. But from the thirteenth century on, chemistry found a home in Germany, as well as other European nations, and men, famous for their learning, devoted themselves to a study of its principles.

The transmutation of the base metals into the noble by means of the philosopher's stone formed at that time the cardinal point to which all chemical efforts were directed. Men of the thirteenth century like Albertus Magnus of Germany, Roger Bacon of England, Arnaldus Villanovanus and Raymond Lully of France and Spain, all noted for their learning, regarded the transmutation of metals as an incontrovertible fact. These maintained that the philosopher's stone did exist and that it was endowed with the most marvelous powers. In their theoretical views upon the composition of metals they were disciples of Geber. We need no other proof that alchemy was universally accepted, when men such as these, the most learned of their time, so enthusiastically embraced its doctrines.

Roger Bacon, a man who was subjected to bitter persecution and penalties for opposing many of the orthodox beliefs of his day, but highly venerated by posterity for his marvelous and many-sided knowledge, held the most exaggerated views regarding the power of the philosopher's stone. He held that it would not only transform a million times its own weight of base metal into gold, but that it would cure diseases and prolong life. It seems, however, that he himself did not devote much time to practical alchemy.

Raymond Lully was a wandering priest, who gave himself up when some-

what aged to missionary work, undertaking several journeys to Africa, where he was stoned to death by the heathen in 1315. Shortly after his death, the object of traditional glorification, Lully possessed among all alchemists the fame of having attained to the highest which was in the power of their heart to achieve. Many alchemistic works are ascribed to him, but the most of them are impositions.

His alchemistic doctrines are very obscure; still more incomprehensive and hidden in mystic darkness are his recipes for the ennobling of the metals. Certainly none of his predecessors have ascribed to the philosopher's stone such powers as did he; for he was able to cry out presumptuously: "If the sea were of mercury, I would transform it into gold." And further, by means of this substance that highest good-health was to be obtained together with a long life.

To show the wild excesses to which he went, the following statements in reference to the power of the philosopher's stone may be cited. He says, "Take of this precious medicine a small piece, as large as a bean. Throw it upon a thousand ounces of mercury, and this will be changed into red powder. Put an ounce of the latter upon a thousand ounces of mercury, which will thereby be transformed into red powder. Of this, again, one ounce thrown upon a thousand ounces of mercury will convert it entirely into medicine. Throw an ounce of this upon a thousand ounces of fresh mercury, and it will likewise turn into medicine. Of this last medicine, throw an ounce upon a thousand ounces of mercury, and this will be entirely changed into gold, which is better than gold from the mines." Of course to carry out these directions, one must be in possession of the small amount of the precious medicine first used. It is needless to say, Lully did not give us explicit directions as to how to prepare it.

The history of alchemy during the fourteenth and first half of the fifteenth centuries contains no single name which will compare in eminence with those of the above mentioned philosophers, as the alchemists preferred to be called. But this must not be taken as meaning that the supposed art of making gold had died out. On the contrary, it bore its strangest fruits during this period. Its seductive problem, the making of countless stores of coveted gold, brought to its attempted solution all who had means and ability to devote themselves to it.

During this time alchemy was fostered and protected at many of the European courts, for nothing appeared to be more simple than to recuperate embarrassed finances by means of artificial gold. Those alchemists, who were reputed to be in possession of the secret means of making the philosopher's stone, were eagerly sought after by covetous princes, who spent handsome sums in providing means for these philosophers to apply their art. Yet, needless to say, frequent and bitter were the disappointments which came sooner or later from the failure of the alchemists to fill the coffers of their princely patrons. Then came decrees against the practice of alchemy, threats against those who engaged in it, and accounts of discoveries of the most impudent impositions.

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