Milestones in Chemistry

Egyptians Developed Early Ideas

By Ruth A. Sparrow

With this article, Librarian Ruth A. Sparrow continues her series on the Museum's collection of Milestones of Science. Chemical milestones are so numerous that the second half of her description of this group will appear in the next issue.
—Editor's Note.

● ● ● The world's earliest knowledge of chemistry came from Egypt. It was largely the result of the practical experiences of workers in metal, glass, pottery, tanning, and dyeing. The early Greeks spent much time in speculation and philosophizing but little on experimentation. They did, however, have a conception of the composition of the world in four elements. Pliny writes of these in *Historia Naturalis* (Venice, 1476): "I do not find that any one has doubted that there are four elements. The highest of these is supposed to be fire, and hence proceed the eyes of so many glittering stars. The next is that spirit, which both the Greeks and ourselves call by the same name, air. It is by the force of this vital principle, pervading all things and mingling with all, that the earth, together with the fourth element, water, is balanced in the middle of space. These are mutually bound together, the lighter being restrained by the heavier, so that they cannot fly off; while, on the contrary, from the lighter tending upwards, the heavier are so suspended, that they cannot fall down."

Pliny also recounts the story of the beginnings of glass: "The story is, that a ship, laden with nitre, being moored upon this spot (Candebis, Syria), the merchants, while preparing their repast upon the sea-shore, finding no stones at hand for supporting their cauldrons, employed for the purpose some lumps of nitre which they had taken from the vessel. Upon being subjected to the action of the fire, in combination with the sand of the sea-shore, they beheld transparent streams flowing forth of a liquid hitherto unknown: this, it is said, was the origin of glass." And Pliny writes further on the experimentations which followed this accidental discovery in order to produce a more perfect product: "In the process of time, as human industry is ingenious in discovering, it was not content with the combination of nitre, but magnet-stone began to be added as well, from the impression that it attracts liquefied glass as well as iron. In a similar manner, too, brilliant stones of various descriptions came to be added in the melting, and at last, shells and fossil sand. Some authors tell us, that the glass of India is made of broken crystal, and that, in consequence, there is none that can be compared to it."

The next period in the history of chemistry was that of the alchemical school. The original idea and aim of alchemy was the production of a substance supposed to have the power of transmuting base metals into gold, commonly called the Philosopher's Stone. Another ambition of the alchemist was to find the Elixir of Life or a universal cure for diseases and a means of indefinitely prolonging life. Its progress as a science was retarded by the very nature of its aims as well as by much mystification and hocus-pocus. Yet for centuries the most important work in chemistry was done by these men, and many important discoveries were made which incidentally led the way to modern chemistry.

Among the best-known of the early alchemists was Albertus Magnus (c. 1193), a Dominican monk. His *De*

Mineralibus (Padua, 1476) describes the medicinal properties of minerals, no doubt the result of his chemical inquiries.

The greatest of all alchemists was Roger Bacon (1214-1294), an Englishman. He spent much time in the study of the properties of natural bodies, and aided by early mathematical training he acquired a good knowledge of mechanics and optics. He believed in the Philosopher's Stone and the application of chemistry to the extension of life. His *Opus Majus* (Venice, 1733) is one of the greatest scientific and philosophical works of the Middle Ages. It contains the results of his researches, and it summarizes what was then known in physical science and lays down the principles on which it, as well as philosophy and literature, should be studied. Being opposed to the scholasticism of his time, he was a forerunner of experimental and inductive science and was much in advance of his time, generally, in scientific and critical insight and clearness.

The fourteenth and early fifteenth centuries brought to light many alchemists who were supposed to be in possession of the Philosopher's Stone. It had reached high favor in the courts of Europe, and many fakers sprang up professing to possess this charm. The sixteenth century brought about a reform and was a period of further discovery. It was Paracelsus who began the reform which led the science from alchemy to iatro-chemistry. This new era was dominated by him for a period of over one hundred years. Paracelsus was himself an alchemist and believed that gold could be made chemically. However, he did not believe that the process was one accomplished by occult powers existing in the soul of man. He taught that true science should be more interested in healing the ills of man than in making gold. Thus he placed chemistry, not in the field of an occult science, but with medicine.

Georgius Agricola (1490-1555), a German scholar and the "father of mineralogy," was a pioneer in the field of technical chemistry. He was a noted physician with a practice in a large mining and smelting locality and became deeply interested in the study of mineralogy and metallurgy. His *De Re Metallica* (Basel, 1556) is a rare first edition of a classic not only in mining and metallurgy, but it also gives for the first time a full account of the chemistry of metals. For over one hundred and eighty years it was the standard textbook on the subject, and it was important enough to have passed through ten editions in three languages. The work contains two hundred and sixty-nine magnificent woodcuts which are of a remarkably high quality. As a companion volume we have a splendid translation of this book by Lou Henry and Herbert Clark Hoover. An earlier work of Agricola, *De Ortu et Causis Subterraneorum* (Basel, 1546), while chiefly a work in scientific geology, contains several interesting passages on alchemy and astrology.

Sir Francis Bacon (1561-1626) exerted a great influence on the thinking of his time. He was a great reformer of scientific investigation and one of the chief founders of modern inductive science. His *Instauratio Magna, Novum Organum* (London, 1620) is his greatest work.