3

From Alchemy to Chemistry

The seventeenth century was the period in which modern science began to emerge, and its evolution from its mediaeval precursor is usually termed the *Scientific Revolution.* Like most revolutions in human history, it was not a sudden or simple process. If we are to attempt to understand the activities and beliefs of the alchemists and chemists of this period, we must view their work against the background of this revolution. By the end of the seventeenth century the new science of chemistry was providing fresh explanations for the properties of materials and their transformations, and the alchemist's dream of making gold was beginning to fade.

THREE TRADITIONS

The Scientific Revolution can be regarded as a battle between three different ways of looking at the natural world. These can be termed the Aristotelian, the magical and the mechanical. All three traditions had their origins in either the Greek or the Hellenistic periods. It was the ultimate triumph of the mechanical philosophy which was to result in the birth of modern science.

We have seen how Arabic alchemical works began to appear in translation in Europe in the twelfth century. At the same time, translations of other works on the science and philosophy of the ancient world were made. This new learning, principally of Aristotle in the physical sciences, Galen (AD 129–199) in medicine and Ptolemy (AD 90–170) in astronomy, initially presented a challenge to the Church, but it was gradually assimilated into Christian orthodoxy. The most prominent cleric in this movement was Thomas Aquinas (1226–1274), and by 1500 the process was complete. According to the Aristotelian view, change was continually occurring in the sub-lunar world, and was controlled by final causes. The heavens were constant and unchanging, and the earth was situated at the centre of the universe with the moon and planets rotating around it, and the stars held on a fixed sphere. Substances were supposed to possess properties of two types: elementary and hidden (or *occult*). Elementary properties were those such as colour, density, taste, etc., and were supposed to depend upon the nature of the substance. Occult properties were those which were not understood, and were held to be incapable of explanation. They were supposed to be the arbitrary decision of

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the Creator, and could not be influenced in any way. Examples were the medicinal properties of substances and magnetism. Chemical change was explained in terms of the four-element theory, and every chemical reaction was viewed as a kind of transmutation.

Some writings of the ancients only became known in Europe after the fall of Constantinople in 1453. Among these were a collection of works originally attributed to Hermes Trismegistos, which were thought to be an exposition of Egyptian thought from the time of Moses. Hermes Trismegistos was supposed to have received divine revelations about the nature of the physical world. About 100 years after the Hermetic writings became known in Europe they were shown to date from about the third century AD, and to be the work of the neo-Platonists under whose influence Alexandrian alchemy had become more mystical in character (Chapter 2).

The Hermetic writings formed the basis of the magical tradition in European science. The revival of these mystical and magical ideas received some sympathy from Christian theologians, as miracles were much easier to explain than under the Aristotelian system. The renewed interest in neo-Platonism exerted an influence on many of the later European alchemists and iatrochemists.

In the period leading up to the Scientific Revolution, a third way of looking at the universe began to emerge. This was the mechanical philosophy, which became popular partly as a result of the appearance in the mid-sixteenth century of a printed edition of the works of Archimedes (287–212 BC), who had not only been a great mathematician, but had also been fascinated by mechanical analogies. As a result of the revival of interest in Archimedes's work, some philosophers began to view the universe as a giant mechanism governed by unchanging scientific laws, which were capable of mathematical expression. In this tradition, God acquired the attributes of an engineer.

Prominent among early adherents to the mechanical philosophy was Galileo Galilei (1564–1642). For his mechanistic explanations, Galileo drew upon the atomistic views of Democritos (Chapter 1). Another influential mechanist who attempted to explain the properties of matter in atomic terms was Pierre Gassendi (1592–1655), who made a careful study of the works of Epicurus (Chapter 1). Not all mechanists accepted the atomic hypothesis. René Descartes (1596–1650), in his *Principia philosophiae* of 1644, maintained that matter was infinitely divisible. Space was filled with a very fine, subtle, continuous matter, which by its whirling motion carried planets around the sun. Robert Boyle (1627–1691) was to come down on the side of the atomic theory of matter in what he called his *corpuscular philosophy*. However, explanations of certain physical phenomena (e.g. the propagation of light) were to be advanced in terms of a subtle, continuous matter, or *aether*, right up to the beginning of the twentieth century.

NEW IDEAS

The seventeenth century saw the rise of experimental science. The notion of making observations and performing experiments was not, of course, a new one in