

Alchemists

Now considered a pseudoscience, alchemy began as an early form of rigorous scientific study, evolving from the combined practices of metalworking, dyeing, fermentation, and the making of glass and pottery. Kings and merchants sponsored investigators who sought a chemical way to transmute common base metals such as copper, mercury, or lead into gold. While some alchemists were charlatans, taking their sponsors' money and producing nothing, others succeeded in discovering basic principles of modern chemistry and inventing laboratory equipment that is still common today.

In ancient China, Greece, and India, natural philosophers independently espoused the doctrine that combinations of only four elements—air, water, fire, and earth—constitute all matter. Considering manual labor beneath them, the ancient Greek philosophers developed their ideas without actually performing experiments to test them. Nevertheless, the system developed by Aristotle in the 4th century B.C. provided the basis for scientific thought for centuries.

Aristotle postulated that only four qualities in all matter—heat, cold, moisture, and dryness—could combine in various ways to create the four elements. For instance, water is a combination of cold and moisture; fire is heat and dryness. Altering the proportions of these qualities, then, could change elements into each other. This hypothesis provided the theoretical foundation for alchemy.

While the philosophers in Greece postulated theories without conducting experiments, those in Egypt, particularly around Alexandria, were of a more practical bent. Alexandrian alchemists were artisans and engineers who discovered what worked through trial and error. Alexandrian artisans had long been expert workers in metals and in the dyeing of cloth, which gave them techniques for tinkering with alchemy. They fashioned silver and gold objects for the wealthy, and they also made cheaper imitations for the less wealthy. Recognizing the inferiority of the imitations, they attempted to make them appear as close to gold or silver as possible, which led to basic alchemical techniques.

These practical or esoteric (as opposed to esoteric) alchemists invented many laboratory procedures and paraphernalia still used today—beakers, flasks, stills, furnaces, and water baths. As artisans of their time, though, they shrouded their work in secrecy to keep their competitors from learning their discoveries.

Alexandrian alchemists devised many strange symbols and code names for the materials they worked with. They associated metals with the known heavenly bodies—gold with the sun, silver with the moon, mercury with Mercury, copper with Venus, iron with Mars, tin with Jupiter, lead with Saturn. Some of their catalysts or reagents were given bizarre names, such as "bile of the tortoise." As alchemy spread, these mysterious names grew so convoluted that even alchemists had difficulty understanding their own works.

The astrological connection, brought primarily from Mesopotamian influences, grew stronger, leading Alexandrian alchemy into esoteric studies. About the 4th century A.D., a great split took place between the practical and the esoteric alchemists. The esoteric alchemists wrote books and treatises, which became widely known. The practical alchemists continued to work in

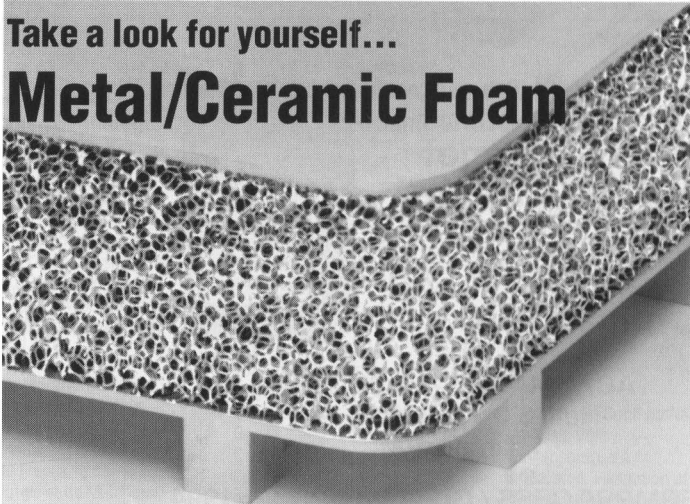
their laboratories, but their unsuccessful attempts gradually faded into obscurity.

To the East, Chinese alchemists were not so much concerned with creating gold for its own sake, to increase their wealth, but because they believed gold, the "perfect metal," was a crucial component of an elixir of immortality. They sought a special substance or "medicine" that, when added to base metals, would cure imperfections and turn the base metal into gold. This idea became the seed for the "Philosopher's Stone" long sought throughout the Middle Ages in Europe.

Despite a great deal of practical work, Chinese alchemy also became obsessed with esoteric ideas and superstitions and gradually abandoned actual chemistry in favor of astrology.

Around the 8th century, Arabic alchemy became a mixture of other studies, incorporating some elements of Chinese alchemy because Arab explorers and merchants had direct contact with China. They adopted and brought to Europe the Chinese concept of a medicine to transmute other met-

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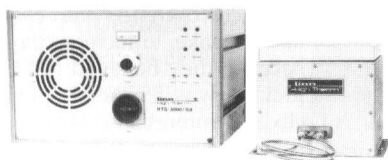
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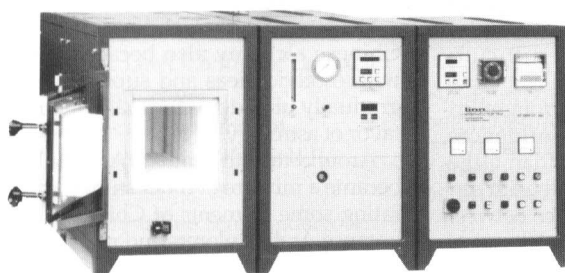
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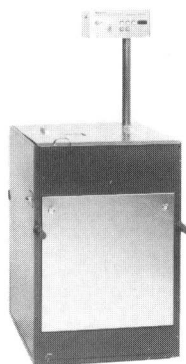


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als, sparking a centuries-long quest for a magical material that would act as a catalyst in the creation of gold.

The practical Arabic alchemists spent much time in the laboratory, achieving many discoveries such as the caustic alkalis and refined techniques of distillation. By the 11th century, though, Arabian interest in alchemy began to decline; others in Europe, particularly in Spain and Italy, picked up the investigations.

In the 14th century, the Spanish alchemist Geber (a Latinized form of the Arabic name "Jabir," an earlier alchemist) published four detailed volumes describing common processes. Geber's theory was that metals were composed of sulfur (representing combustibility or rusting) and mercury (representing melting or fluidity). The key to turning base metals into gold, then, was to adjust the proportions of the mercury and sulfur until one discovered the recipe for gold. Geber's work contained much practical knowledge, and his books survived for the next three centuries as accepted handbooks of metallurgy.

As kings and nobles attempted to increase their treasure stockpiles, many charlatans offered their services as alchemists. Gullible monarchs such as James IV of Scotland and Emperor Rudolf II surrounded themselves with court alchemists and paid them exorbitant sums. Impatient nobles, however, often imprisoned, exiled, or executed alchemists who could not follow through on their promises. Medieval alchemists were often accused of dabbling with the black arts, and even Roger Bacon (~1214-1294) was accused of necromancy. Dr. Faustus, of the *Faust* legend dramatized by Goethe, was an alchemist.

Medieval alchemists can be credited with important chemical discoveries that include the alcohols and mineral acids, and also with the start of a thriving offshoot of alchemy that became medical chemistry or pharmacy.


During the Renaissance, physicists and chemists took another look at the accumulated data and began to discount the possibility of the transmutation of elements. Greek atomism underwent a revival in philosophical discussions. The widespread reinterpretation of alchemical principles formed the foundation for modern chemistry. By the end of the 18th century, when Antoine Lavoisier established modern chemistry, scientific evidence conclusively contradicted the possibility of chemical gold-making.

For the most part, though, alchemy was in strict accordance with the scientific understanding of the day. The earliest practical alchemists were simply trying to carry out the processes predicted by their theories.

Modern nuclear physics has finally allowed the actual transmutation of elements, though in a vastly different manner than anything imagined by the ancient alchemists.

KEVIN J. ANDERSON

FOR FURTHER READING: F.S. Taylor, *The Alchemists* (1949) and S. Hutin, *The History of Alchemy* (1963).



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