TopFoto

Left: *Two early sixteenth-century alchemists standing behind alchemical apparatus designed to distil liquids*

Mercury, a liquid metal, was named 'hydrargyrum', 'water-silver'; hence the symbol Hg.

Ben Jonson, a contemporary of Shakespeare, wrote his play *The Alchemist* in 1610. Its plot involved fake alchemists.

Practical chemists

Alchemists were the chemists of their time. They used the same methods of extraction and purification as you will have encountered in the laboratory: filtration, distillation and crystallisation, for example. Like you, they heated and mixed substances to see what would happen. They used acids and alkalis, dissolved things in water, and ground solids up into powders to make them react more efficiently. Their pieces of apparatus may look rather odd, but the alembic (see Figure 1), for example, was basically for distillation.

Alchemists did thousands of experiments and then recorded their observations. However, the language they used was often deliberately obscure so it is difficult for us to understand.

Their desire to get at the **essence** of things led alchemists to distil plant and animal products. The essences they produced might be oils, perfumes, or liquids with medicinal properties known as **elixirs**. One such liquid was **alcohol**, which was thought to be in some way a **spirit**. Hence the modern use of the word 'spirits' to indicate a drink with a high alcohol content, like whisky or brandy.

Alchemists invented furnaces for heating mixtures strongly and melting metals, and the water bath, or **bain-marie** (named after a famous female alchemist, Mary the Jewess), for gentle heating over a long period. They invented pieces of apparatus which were the forerunners of modern laboratory glassware, and they discovered many useful chemicals, like the three mineral acids.

Robert Boyle and Isaac Newton were alchemists as well as scientists.

Table 1 *Astrological symbols for metals*

Substance	Planet	Symbol
Gold	Sun	☉
Copper	Venus	♀
Mercury	Mercury	☿
Iron	Mars	♂

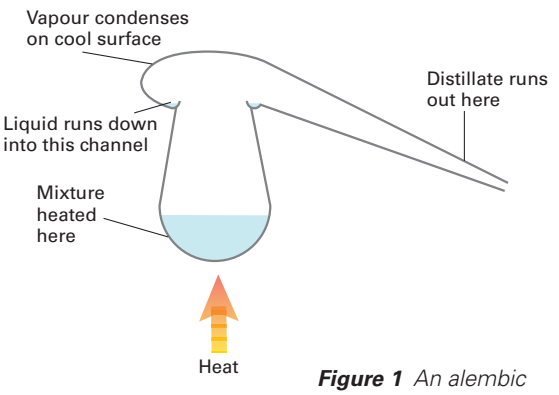

Figure 1 *An alembic*

Key substances discovered or refined by the alchemists include glass, the three mineral acids (hydrochloric, nitric and sulphuric), 'sal ammoniac' (ammonium chloride), alcohol, alum, phosphorus and alkalis.

Victoria & Albert Museum, London, UK/Bridgeman Art Library

Above: *'The Alchemist' by William Fettes Douglas*

During the Second World War, the top secret Los Alamos project built the USA's first atomic bombs.

In Britain, it was not unusual for a clergyman to be a secret alchemist. Very likely he would have inherited wealth and could subcontract curates to do his parish duties, leaving him with plenty of time to pursue the 'Divine Art', as it was known.

Alchemy was not a science

Alchemy was not a science with a rational set of theories tested against the experimental evidence. Alchemists certainly had theories, but they tended to try to make the experimental facts fit them rather than the other way round. They made little progress because they stuck to a pre-existing set of theoretical ideas and were reluctant to communicate their findings publicly. These two failings, as we would see them, were to them the whole point of alchemy.

Alchemical authorities

Alchemy looked backward to the ideas of 'authorities': learned men and women who, it was thought, had possessed a knowledge lost long ago. This could only be recovered by devotion to their ideas and attempts to rediscover their 'secret'. Present-day expressions like, 'The secret of successful revision is…' hark back to this attitude of mind. By 'secret' or 'art' we mean a technique passed on by word of mouth, or perhaps by apprenticeship to a more experienced and wiser person.

Box 2 The lure of gold

Being an alchemist was expensive: there were all those unusual pieces of glassware to be paid for as well as rare, highly priced chemicals from the Orient. To be one, you needed either a wealthy patron or a private income. The famous painting by William Fettes Douglas shows an old man explaining the significance of a flask of gold-coloured liquid to a rich nobleman or merchant.

The lure of unlimited quantities of gold allowed conmen to swindle greedy people by a variety of simple tricks. One scam was to coat a small piece of gold in black wax so that it resembled an ordinary metal. During a long ritual, this black lump was put into a crucible in the furnace, along with the last few drops of the all-important elixir. The wax would melt, of course, and burn away, leaving the 'miraculous' piece of gold. Such charlatans gave alchemy a bad name; although it did not help matters that genuine alchemists sometimes resorted to similar frauds.

Box 3 Alchemy websites

Look up the following websites to find out more about alchemy:
http://en.wikipedia.org/wiki/Alchemy
www.levity.com/alchemy/index.html
www.pbs.org/wgbh/nova/newton/legacy.html

Alchemical secrets

Alchemists thought there was a bright and wonderful secret at the heart of alchemy. This secret was not to be revealed to ordinary people who might not have the strength of character or nobility to stop them from abusing that knowledge.

It is worth noting that in the twentieth century many of the scientists who worked on the Los Alamos project were worried about the potential evil uses of atomic energy. Today, we are concerned about the potential misuses of genetic engineering. The difference is that these are, more or less, openly debated and that publication and peer review allow scientists to share knowledge and keep each other up to the mark. Thousands of alchemical experiments were needlessly repeated time and again.

Alchemy and chemistry

Was alchemy the beginning of chemistry? Opinions vary, but although alchemy contributed nothing to the all-important theoretical basis of modern science, it did produce or isolate a number of key substances for the first time. Alchemists also developed practical techniques which are still being used in the twenty-first century.

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