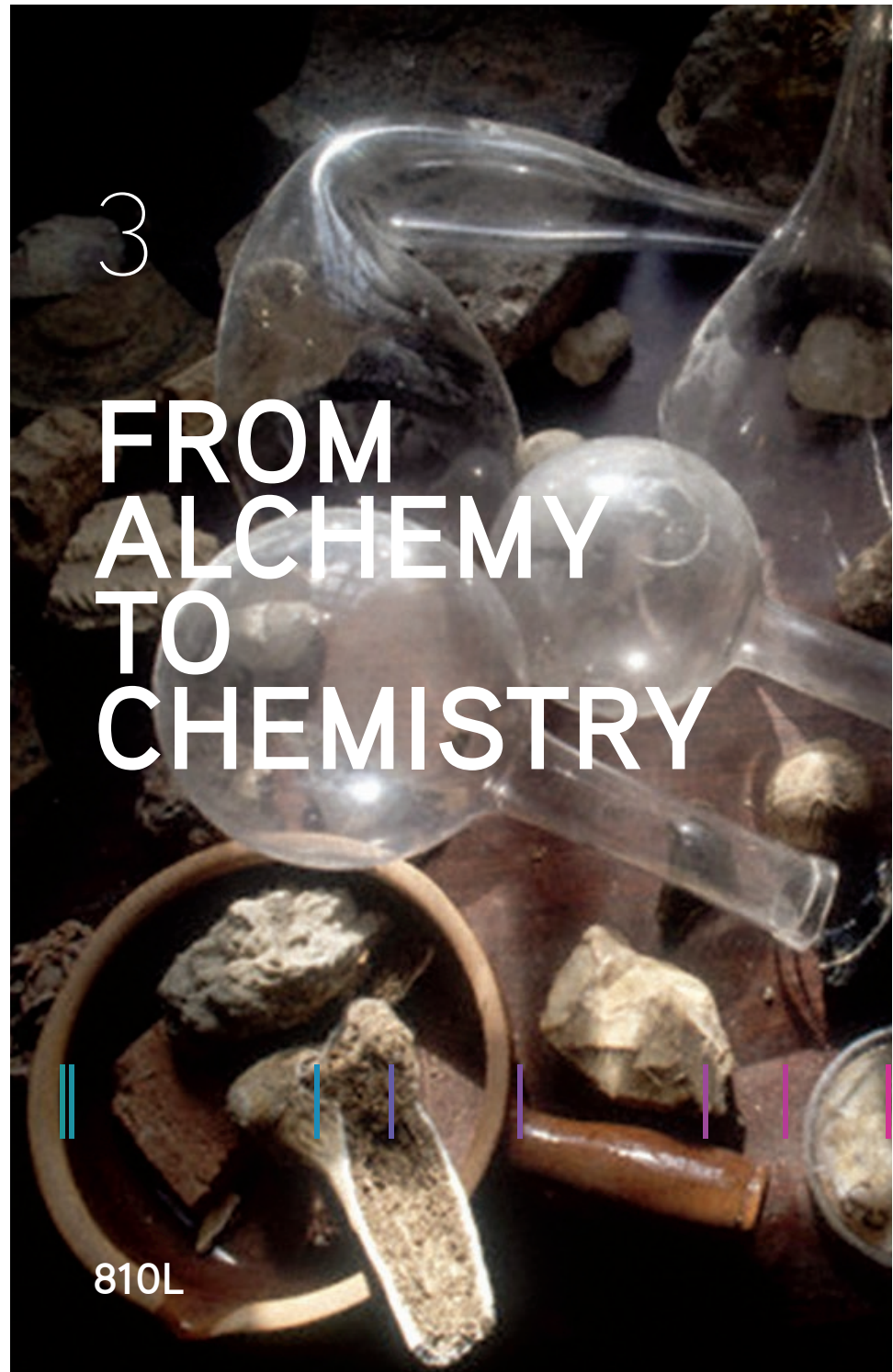


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FROM ALCHEMY TO CHEMISTRY



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FROM ALCHEMY TO CHEMISTRY

THE ORIGINS OF TODAY'S
CENTRAL SCIENCE

By Michelle Feder, adapted by Newsela

Many of the first
chemists, doctors,
and philosophers
were also alchemists.

The word “alchemy” brings to mind witches stirring a boiling pot, or sorcerers in smoky labs. Despite these magical images, alchemy led to how science is practiced today.

Alchemy was an early philosophical and spiritual field of study. It combined chemistry with metalwork. But it also explored how nature works. Alchemy brought together physics, medicine, astrology, mysticism, spiritualism, and art.

The goals of alchemy were:

- to find the “elixir of life.” It was thought that this magical potion would bring wealth, health, and eternal life;
- to find or make a substance called the “philosopher’s stone.” Alchemists thought gold was the purest form of matter. They believed if they combined the “stone” with copper or iron it would create gold; and
- to discover the relationship of humans to the cosmos. With that knowledge, alchemists wanted to improve the human spirit.

Alchemy was scientific, but it was also spiritual. Some who practiced it had good hearts. Alchemists wanted to learn the secret of “purifying” copper or iron into gold. If they could accomplish this, they thought they might be able to purify the human soul. At the same time, alchemists were often seen as fakes. But many alchemists were in fact serious about their work. What they accomplished helped lay the building blocks for modern chemistry and medicine.



The central science

Alchemy began as a quest to know the world around us. That quest for knowledge required an understanding of how chemicals worked. Alchemy itself died out during the 1700s with the rise of modern science. Yet, the quest it began continues today in chemistry. Chemistry is sometimes called “the central science.” It connects sciences like physics, geology, and biology. To understand the field of chemistry, we must start at the beginning.

Alchemists contributed to many future uses of chemicals like metalwork, paints and cosmetics. These contributions enriched the societies in which alchemists lived. They even helped advance civilization.

But alchemists often saw no difference between their work with chemicals and what we might call magic. They borrowed symbols and words from the Bible and myths. Even the simplest formula read like a magic spell. And although there were commonly used practices, alchemists had no standards that they all used.

Roots in the ancient world

The origins of alchemy are difficult to track down. In India and China, alchemy started sometime before the Common Era (CE). It began with meditation and medicine designed to purify the spirit and body. Its goal was to achieve immortality, or eternal life. In the West, alchemy probably evolved from Egyptian metalworking as far back as 4000 BCE.

Greek thinker Aristotle (384 – 322 BCE) believed all matter was made of four “elements.” He thought that earth, air, fire, and water were the essential parts of all things. These ideas influenced alchemy. His student Alexander the Great (356–323 BCE) established the city of Alexandria in Egypt as a great center of learning. The field of alchemy advanced in Alexandria.

Islamic Arabs took over Alexandria in the seventh century CE. They shifted the center of learning to Baghdad. Alchemical books were translated from Greek to Arabic. A famous figure of that time was Jabir ibn Hayyan (721 – 815), a royal alchemist in Baghdad. Jabir’s writings were the first to mention compounds made of metals. Like Aristotle, Jabir believed metals grew in the Earth.

But Jabr came up with something new. He thought that the key to the differences between metals was how much mercury and sulfur they contained. If those two ingredients could be purified, Jabr thought gold could be made. Scholars in Europe first learned about alchemy in roughly the 1100s and 1200s. They translated Arabic texts on alchemy into Latin and learned from them. Science in Europe during Medieval times was still dominated by the ideas of Aristotle.



Robert Boyle is often considered the father of modern chemistry

Alchemy after the Middle Ages

Among the most important of the European alchemists was Paracelsus (1493 – 1531). He was the first toxicologist, a person who studies poisons. Paracelsus believed that the body's organs worked alchemically. That is, their function was to separate the impure from the pure. He proposed that a balance of three substances (mercury, sulfur, and salt) was necessary for maintaining health.

Paracelsus treated the plague and other diseases with alchemy. He gave salts, minerals, and metals to patients. But he had no interest in metals, writing, "Many have said of Alchemy, that it is for the making of gold and silver. For me such is not the aim, but to consider only what virtue and power may lie in medicines."

In 1662, Robert Boyle (1627 – 1691) came up with what we call Boyle's Law. It states that the volume of a gas decreases as the pressure on it increases — and vice versa. For this discovery and others, Boyle is sometimes called the father of modern chemistry. But he was not a scientist as we think of them. Rather, he was a natural philosopher. These early scientists studied nature and the Universe. But their approach wasn't truly scientific. After the period of the natural philosophers, advances in technology changed everything. They revolutionized how scientists investigated questions about nature and led to modern science.

Boyle studied how elements changed forms. He claimed to have changed gold into mercury by means of "quicksilver." But, he didn't reveal the ingredients of his concoction. Boyle's work caught the attention of Isaac Newton, another enthusiastic alchemist. Like Boyle, he was motivated in his research "by the good it may do in the world."

At the center of Boyle's efforts was his "corpuscularian hypothesis." Boyle believed that all matter consisted of arrangements of corpuscles. These were tiny, identical particles. Transforming copper to gold seemed to be just a matter of rearranging the pattern of its corpuscles. Then, presto, you'd have gold.

Aristotle's four-elements theory was still being used. Boyle wanted to put an end to that. He studied how certain substances decompose, or fall apart. He noticed that some decompose into other substances. At some point though, there are substances that cannot be broken down any further. For instance, if you shoot electricity through water it decomposes into hydrogen and oxygen. But hydrogen and oxygen can't be broken into anything smaller. Fundamental substances that can't be broken down further he called elements.

Boyle was a constant experimenter. He kept accounts of both his failures and successes. Boyle pioneered the scientific method, a way of making observations and doing experiments. He endlessly repeated experiments. He would vary them slightly to achieve better results. Boyle always published the details of his work in terms that could be widely understood. This was unheard of among earlier alchemists.

A new framework

By the late 1700s, the field of chemistry had separated from alchemy. Yet chemistry was trying to answer the same questions alchemy once did. Early alchemists were the first to experiment based on the scientific method and publish their research. They began the search for new elements and compounds. And they tried to apply their findings to medicine to help mankind. Now modern science was doing all of these things.

Among the most significant of the post-alchemical chemists were the Frenchman Antoine-Laurent Lavoisier (1743 – 1794) and Russian chemist Dmitri Mendeleev (1834 – 1907). In 1789, Lavoisier wrote the first true chemistry textbook. Like Boyle, he is often called the father of modern chemistry. Lavoisier agreed with Boyle that Aristotle's four-elements theory was wrong. In his textbook, he made a list of elements.

Then Mendeleev came along. He organized those elements into the periodic table. In 1869, he showed that the elements could be arranged in relationship to each other based on their atomic weights. His periodic table also predicted the properties of elements that hadn't even been discovered. Mendeleev's table is still used today.

Chemical questions: Our best hope for tomorrow

Just as alchemy touched on many crafts, chemistry is at the center of the sciences. It's a field of study that looks for answers to big questions.

Chemists around the world are developing new techniques and inventions. Like alchemists, sometimes they separate or purify substances. They also develop new compounds.

Some recent research:

- University of California biochemists found a memory-boosting chemical in mice. One day it may be used in humans to improve memory.
- Clean-energy could be made cheaper thanks to a new discovery by a chemistry professor at Penn State University.
- The Duke Cancer Institute found that a drug meant to prevent the weakening of bones actually stopped the growth of breast cancer cells. It even works in tumors that have resisted treatment.

These are just a few examples of how modern chemistry carries on the alchemical quest for the elixir of life.

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