



## Pure Metal: Jābir ibn Ḥayyān

By Trevor Getz

Jābir ibn Ḥayyān's work with metals was groundbreaking. It inspired and guided the later creators of chemistry.

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## The original transformer

Chemistry is the *modern science* that deals with the structure and properties of substances. A substance is just a particular type of matter. Chemistry looks at how substances are transformed, or changed, from one state or substance to another. But modern chemistry didn't just happen. It grew out of a long history. For thousands of years, curious humans had used trial and error to answer questions like:

- How do you make uncooked foods edible?
- How do you turn ash and fat into soap?
- How do you turn mineral-bearing rocks into iron?

“Trial and error” just means trying different things until you find something that works. The “errors” are the things that do not work. Throughout history, most trials ended in error. But when they succeeded, people passed on the ideas to later generations. This helped expand our collective learning. However, these ideas were not studied in a scientific way.

Between the days of trial and error and the arrival of modern science was something called *alchemy*. What was alchemy? It was not exactly science and not exactly magic. It mixed experimentation, religion, and spirituality. Its aim was to study the properties of natural substances, especially metals.

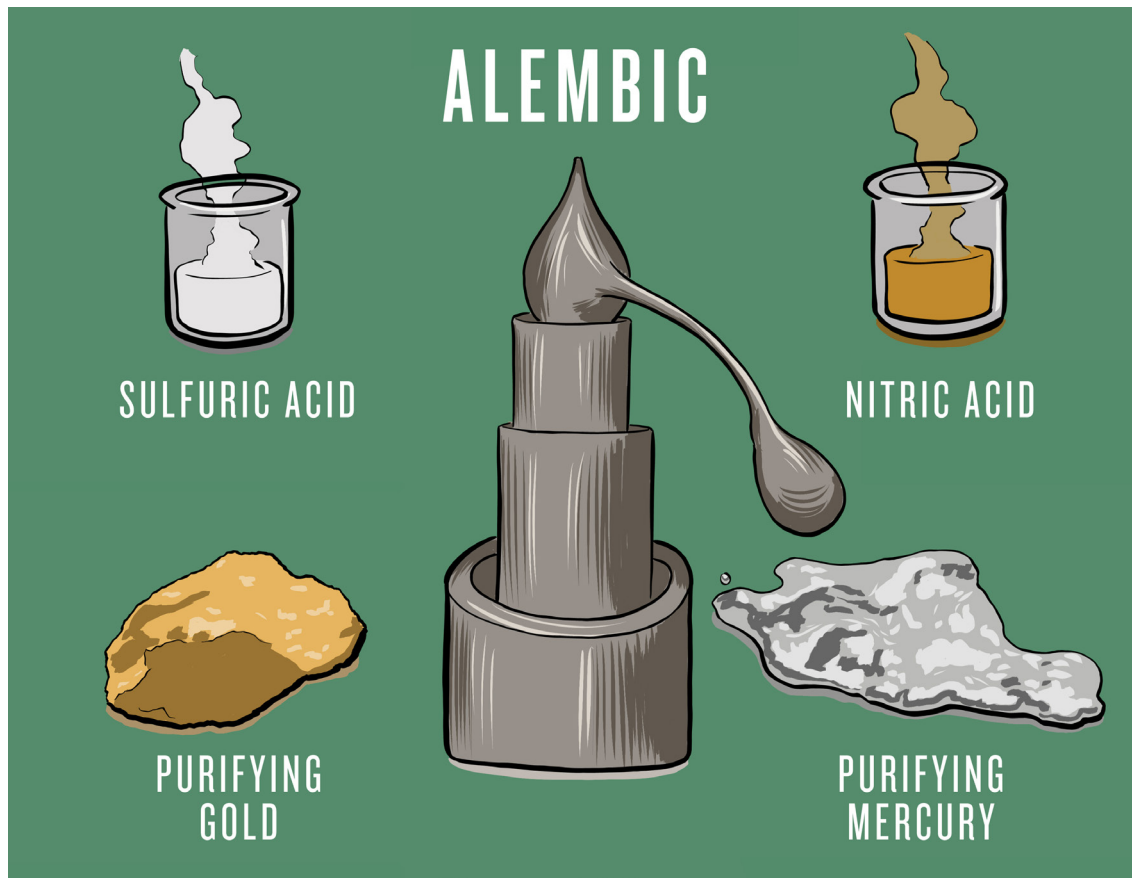
Jābir ibn Ḥayyān was perhaps the greatest of all alchemists. A Muslim Persian, he wrote more than 3,000 texts on alchemy. These included:

- A list of all the tools and equipment used by Greek and Muslim alchemists.
- Histories of the progress made by earlier alchemists.
- Perhaps most importantly, studies of the characteristics of different metals.

You see, ibn Ḥayyān was one of the first people to describe the qualities of different metals. He had a good reason for doing so. Alchemists wanted to know how to transform one metal into another. Well, what they *really* wanted to do was to turn a cheap metal into an expensive one. They wanted to turn lead into gold. To try to do that, they had to study the qualities of each metal. Then they had to figure out how you could change those qualities.

Ibn Ḥayyān studied how mixing substances could change them. To create changes, he used heat, acid, and other methods and tools. This was probably his most important contribution to later scientists. The processes he used included:

- Distillation – Purifying something by boiling it and then capturing the steam.
- Filtration – Putting a substance through a filter to remove impurities.
- Amalgamation – Mixing two substances together so they become a new substance.



*Jābir ibn Ḥayyān's experiments resulted in achievements that included the isolation of sulfuric acid and nitric acid and the purification of gold and mercury. These experiments were recorded and shared with others, and helped inform future generations of scholars. By BHP and Peter Quatch, CC BY-NC 4.0.*

Ibn Ḥayyān learned how to purify gold and mercury. He also discovered that certain substances could be used to transform metals. Among these substances are sulfuric acid and nitric acid.

## A man or a school?

Who was this brilliant man who wrote 3,000 texts and invented new ways to transform substances? It's still a mystery. There probably was a real man named Jābir ibn Ḥayyān. He was probably born in the city of Tus, in Persia, around 721 CE. And he probably wrote some of the 3,000 texts linked to his name. But it's likely that many of them were written by other people. Many of these people were probably his students.

It could be that ibn Ḥayyān did not work alone. Maybe many people worked together in a laboratory or workshop. Maybe there was even a whole *school* of alchemists in one location!

## Inspiring future scientists

If it was a school, what an important school it was! The work of Jābir ibn Ḥayyān spread across the Islamic world and beyond. It influenced a great number of people. The ibn Ḥayyān texts were translated into Latin, the language used by scholars throughout Europe. By the twelfth century, the texts were found in Spain, Italy, and England. The great English scientist Sir Isaac Newton studied ibn Ḥayyān. He even repeated some of ibn Ḥayyān's experiments.

Ibn Ḥayyān's work looked quite different from the work of modern scientists. Yet, it helped to pave the way for future scholars who used the scientific method. His work featured many methods that later scientists would adopt. He was one of the first to create a list of qualities that compare one metal to another. He also invented both new tools and new liquids. Finally, he recorded everything very carefully.

Ibn Ḥayyān was an important step between the trial and error of everyday work and the carefully recorded and studied science of chemistry.

## Sources

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## Image credits

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**Jābir ibn Ḥayyān's experiments resulted in achievements** that included the isolation of sulfuric acid and nitric acid and the purification of gold and mercury. These experiments were recorded and shared with others, and helped inform future generations of scholars. By BHP and Peter Quatch, <http://peterquach.com>, CC BY-NC 4.0.



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