Alchemy: History of Science #10

Crash Course: History of Science
https://youtube.com/watch?v=gxiLuz9kHi0
https://nerdfighteria.info/v/gxiLuz9kHi0

===== (00:00) to (02:00) =====

These days, alchemy gets a bad rap. In fantasy stories, charlatans in fancy robes promise to turn lead into gold. But real alchemists weren't just mystical misers, they were skilled experimentalists, backed by theories of matter; and they played a huge role in the development of knowledge about one of our fundamental questions:" what is stuff?".
Do chemists today spend a lot of time trying to turn lead into gold? No, but in part, they are inheritors of a wealth of knowledge created by alchemists; who were trying to turn lead into gold.
Why did they keep doing that?
Did they all really think that it would work?
Was it some science experiment? or a religious ritual?
Yes! all of those things. Today, we're going to meet some alchemists and consider just what the heck they were doing all day with their metals, and how they sought to understand stuff.
[Crash Course History of Science intro]
The word "Alchemy"; which is where we get the word chemistry from, is a bit of a mystery. It might mean " the black earth," symbolizing Egypt; but it might not. Either way, all of these words were used in Europe before 1600 to describe the same system. Let 's define alchemy as a way of thinking philosophically about stuff by changing it. This included older astrological ideas alongside new ones derived from experiments and observation. Alchemy parallels the Scholastic medical tradition we looked at last time. Both systems spanned across Eurasia and relied on books. But the alchemists had different social norms or ideas about how someone creating knowledge should act. Alchemists did publish books, but typically they encoded their philosophies in complete allegories or stories wherein the characters and actions stand for something other than what they appear. this essentially rendered whole alchemical systems secret except to their own friends. they used code words called Decknamen; so"tin" might literally mean the metal tin

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In one book, but serves as a code word for silver in another. The books were illustrated, but many of the images were symbols masking their true meanings. The good and the bad about the Decknamen system was that anyone could read any proto-scientific treaties on "what is stuff?" and come away with almost any conclusion. Good thing today we have the internet to help anyone agree on scientific questions based on evidence, right?
A lot of alchemical books focused on Transmutation; changing metals into other metals. In theory-all the way back to Aristotle-Transmutation mimicked a natural process: metals were compounds formed deep in the earth when different quantities of Sulfer and Mercury were crushed together. Miners have been working with metal for years; digging them up and then heating them to purify them. The difference for alchemists was that Transmutation meant "hacking" this whole process by doing it artificially. But the alchemical metals are not compounds of anything; they're elements. So how did the alchemists take the non-compounds and read them as compounds?
The alchemists had problems obtaining pure samples. When they heated up chunks of metals, these would bubble and change color based on impurities; meaning tiny bits of other elements. But alas, metals; when isolated, don't actually break down into Sulfur and Mercury. They were two kinds of alchemical metals; the noble metals were gold; which represented the sun and the silver which represent the moon. The base metals included Mercury; which represented the planet Mercury, Copper for Venus, Iron for war-like Mars, Tin for Jupiter, and Lead for slow, sad Saturn. In fact, our name for the planet Mercury comes from this alchemical association with the Greek messenger God. Agents of Transmutation also fell into two categories: Particulars; which only did one thing, for example, change Copper into silver, and Universals; meaning the philosopher's stone. That's philosopher's stone, no sorcerers involved, American harry potter. This mysterious stone could change any base metal into gold. the quest for the universal Transmutation agent was called "Chrysopoeia," or literally

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"make into gold." to get started, a " Chrysopoeian" would combine the right ingredients in an egg-shaped vessel called an "Alembic," and then heat the mixture up for a long time. What were the right ingredients to make the philosopher's stone?
Alchemists disagreed. The fact that they didn't even agree on what the philosopher's stone actually was, pretty much symbolizes the whole system.

Chrysopoeia required fine-tuning the practice of Metallurgy; alchemists had to heat ingredients for days on end, controlling the temperature precisely, without the aid of modern lab equipment, or even a thermometer. It was difficult, sweaty work. Eventually, the mix of ingredients would turn black, then white, then, and finally red. At this point, if your oven hasn't exploded, you won! You now have a lump of red substance that, when heated with base metals, changed them into gold; supposedly. The search for the philosopher's stone produced new alchemical theories and felt like a wonder, inspiring generation of experiments, even if it never quite worked.

Alchemy persisted because Transmutation clearly produced something, including new compounds. The problem is that we don't always know what is produced, because of the whole secret code thing. "Luna Fixa" for example, was a dense white metal, that was corrosion resistant, had a high melting point and was pretty soft. Was, is platinum, white gold, or something else entirely? But alchemy was never only about metals. The human body, for example, was understood as an alchemical workshop: chemical reactions happened in the organs, transmuting one kind of stuff into another. This is still pretty amazing! We eat stuff that is not at all human; at least hopefully, and then that stuff somehow becomes us. In an alchemical framework, illnesses were reactions gone wrong. So while the alchemists included metallurgists, mine directors, goldsmiths, and natural philosophers, they were often physicians; interested in making efficacious compounds called pharmaceuticals, or Chematria. in fact, alchemy was a system for producing useful materials from Chematria to alcohol, alloys, pigments, perfumes, and cleaning products.

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Noblewomen alchemists, tasked with caring for the health of the workers in their husband's manors, played a major role in producing therapeutics. These noblewomen set up production facilities; proto-labs and expanded the repertoire of alchemical products which could be sold. And the systems itself was heavily gendered, metaphorically, which we can see in many gorgeous illustrations of allegorical kings and queens of heaven, the kings, and queens of stuff. One of the wackier life-sciency practices that came out of the ancient and medieval search to understand therapeutic compounds was "Palingenesis" or "life again"; the idea that you could bring things back to life by burning them and then freezing their ashes. Alchemists spent a lot of time burning and freezing leaves.
Did Palingenesis work? Why don't you go try it and see if you get better results then they did? At least, it might make you pay careful attention to living things and what stuff they seem to be made out of. On second thought, I'm not going to encourage you to go and burn stuff. Just as there are multiple sciences today, there were multiple 'Alchemies" in medieval Eurasia. Chinese alchemy was tied into ideas about the earth itself. Remember how, in Chinese natural philosophy, the earth was one living organism? Chinese alchemists

detected its vital channels of energy transmission using magnets, formalizing that system of earth magic called "Feng Shui." this work eventually led to the invention of gunpowder. Chinese alchemy also included a search for immortality called "Waidan." but still no sorcerers, sadly. Mostly, "Waidan" was about self-experimentation and diet. Indian alchemy focused on medicine, on forms of Mercury, and on how to preserve health and hopefully create an un-decayable body. We've talked before about how an Ayurvedic textbook or Samhita had a whole chapter on Aphrodisiacs and another on Toxicology. Alchemy supplied a way of developing these love potions and poisons. Islamicate alchemy, meanwhile, blended Aristotelian, Chinese, and Indian alchemical practices.

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Jabir Ibn Hayyan, born in Persia in 721, and known in Europe as Geber, was credited with offering 3,000 texts these included a version of the emerald tablet, a supposedly ancient Greek text that included a guide to creating the philosophers stone.

Hayyan also worked on mineralogy, transmutation, and medicinal elixirs, and invented new equipment. Like many Alchemists, Hayyan often wrote allegorically, trying in his own words to intentionally baffle most readers except those whom God loves.

But the person most famous today for his work on alchemy is the Swiss physician and iconoclast Paracelsus, born in 1493, who was also called Theophrastus Bombastus von Hohenheim. Think Gregory House meets Viktor Frankenstein meets Miss Cleo. In addition to his general irascibility, Paracelcus's famous today for the phrase 'the dose makes the poison'. Paracelsus also believed that the philosopher's Stone was a universal solvent called the alkahest which was derived from lime, alcohol and carbonate of potash and could theoretically dissolve anything, even gold.

And most radically Paracelcus introduced salt and a third element that made up all metals. Paracelcus was a critic of university natural philosophers and physicians. He saw these scholastic as likely to mistake textual generalization as truths. He admonished his alchemical colleagues not to trust the words of the ancient masters but then he became a master himself. Someone you could write books in the style of.

You could say that alchemy, like other knowledge making systems, was torn between text and experiment. That is between loyalty to tradition and iconoclasm, and a return to basic observation. Thus even if alchemical books were often secret concealing gibberish they were important in supporting the long term rational debate about the true nature of stuff.

In fact, the most famous product of alchemy was a wondrous invention that most people don't think of a alchemical at all.

Help us out thought bubble.

Johannes Gensfleisch zur Laden sum Gutenberg, born in Germany in 1468,

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was a metallurgist who invented a process for mass producing movable type. Gutenberg made his type from an alloy of lead, tin, and antimony, creating a more durable system. He also pioneered working with oil-based ink and made tweaks to the common cheese press to make his printing press. His real achievement though, was bringing all of these together into a system that made printing books economical, and I mean, way more economical than having rooms full of monks hand-copying manuscripts.

Economical printing meant better duplicated texts with fewer errors. Knowledge circulated not simply thanks to personal travel, which was slow and somewhat random, but as discrete knowledge. Some of this knowledge was intentionally secret code, which presents a problem for historians today. How do we figure out what the alchemists meant when they wrote things like "The wind blows over the marriage of the moon and Saturn"? How do we interpret alchemical recipes encoded entirely in pictures? Thanks, ThoughtBubble.

So, what happened to alchemy? Parts of it became chemistry, which of course we'll get to later, but alchemy also became increasingly seen as dirty, dangerous, unsavory, low-class and lacking a classical pedigree, unlike say, astronomy, and in Europe, alchemy was tied to a geocentric cosmology that goes out of fashion in the 16th century. Still, there were notable alchemists in the 17th century, including Isaac Newton, but by this time, chemists wanted a more scientific society. Publicly, alchemy was attacked as superstition, even as practitioners kept doing it in private. Alchemy went underground for most of the 18th century, maintained in secret societies before dying out. The once famous book, De Re Metallica, or Concerning the Nature of Metals, was first translated into English by classicist Herbert Hoover, who was also a president, and his wife Lou Henry Hoover, in 1912. Fascinating!

Next time, pack your mortarboard hats and masonry tools--we're gonna track the rise of the university and the cathedral.

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Crash Course: History of Science is filmed in the Dr. Cheryl C. Kinney Studio in Missoula, Montana and it's made with the help of all of these nice people, and our animation team is Thought Cafe.

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