

# **Transforming the Alchemists**

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Historians of science are taking a new and lively interest in alchemy, the often mystical investigation into the hidden mysteries of nature that reached its heyday in Europe in the 16th and 17th centuries and has been an embarrassment to modern scientists ever since.

There was no place in the annals of empirical science, beginning mainly in the 18th century, for the occult practices of obsessed dreamers who sought most famously and impossibly to transform base metals into pure gold. So alchemy fell into disrepute.

But in the revival of scholarship on the field, historians are finding reasons to give at least some alchemists their due. Even though they were secretive and self-deluded and their practices closer to magic than modern scientific methods, historians say, alchemists contributed to the emergence of modern chemistry as a science and an agent of commerce. “Experimentalism was one of alchemy’s hallmarks.” “You have to get your hands dirty, and in this way alchemists forged some early ideas about matter.”

Bent over boiling crucibles in their shadowy laboratories, squeezing bellows before transformative flames and poring over obscure formulas, some alchemists stumbled on techniques and reactions of great value to later chemists. It was experimentation by trial and error, historians say, but it led to new chemicals and healing elixirs and laid the foundations of procedures like separating and refining, distilling and fermenting. “Most chemists are interested not so much in theory as in making substances with particular properties. The emphasis on products was the same with some alchemists in the 17th century.”

Yet on the whole, historians say, the widespread practice of alchemy impeded the rise of modern chemistry. While physics and astronomy marched slowly but inexorably from Galileo to Kepler to Newton and the Scientific Revolution, chemistry slumbered under alchemy’s influence through what historians call its “postponed scientific revolution.” A few practicing alchemists, it seems, may have been certifiably mad — probably, like mad hatters, from sniffing the mercury they worked with. One notable alchemist of the 16th century, a Swiss named Paracelsus, was not mad, but cantankerous and iconoclastic. “He was equal parts metallurgist, pharmacist, physician.

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Historians have found that Paracelsus made some advances in the detection of disorders by analyzing urine and claimed marvelous cures through alchemy.

In his chemical cosmology, he saw the world as a great distillation vessel and its changes as parallel to the operations carried out in a laboratory. But he recorded his material and spiritual ideas in the deliberately opaque writing typical of many alchemists, who expressed themselves in codes, symbols and emblems to conceal their findings from the uninitiated.

Other alchemists were outright charlatans or fools, ridiculed in contemporary art and literature. On display in a gallery at the conference hall were several 17th-century paintings by Flemish and Dutch artists, who depicted alchemists toiling in the disorder of dark workshops and the poverty of futile quests. The paintings were said to be popular among Dutch burghers as a caution to anyone contemplating a life in alchemy instead of steady trade. But many an alchemist drew support from royal courts where visions of newfound wealth and power danced in crowned heads. It was not always a happy alliance.

In 1601, Hans Heinrich Nüschler signed a contract with his patron, Duke Friedrich of Württemberg in Stuttgart, to demonstrate his process for extracting a substantial amount of gold from a sample of silver. The duke, keen on mining technology, promised a generous reward. Nüschler agreed to conduct the experiments at his own expense. After several months of failure and mounting debt, the desperate alchemist resorted to fraud. He asked his brother to help by surreptitiously adding gold to the alchemical sample. His ploy exposed, Nüschler was tried, convicted and hanged.

At the turn of the 17th century, King Henry IV of France surrounded himself with alchemists who sought to resurrect plants from their ashes and experimented with ways to extend the monarch's life. Even the diplomats had orders to seek out the cryptic methods of alchemists in other countries.

An alchemist in the court of a German prince scored a profitable success quite by accident. Looking for materials for creating precious metals, Johann Friedrich Böttger analyzed a "white earth" that duplicated the ingredients for imported Chinese porcelain. The discovery was the beginning of the Dresden china industry.

Even geniuses of the first order, like Isaac Newton, found alchemy irresistible. It was an accepted method of seeking knowledge — or confirmation of received truth — in early modern history.

Newton, whose laws of gravity and optics ushered in modern physics, also delved into alchemy with relentless energy. His notebooks contain thousands of pages on alchemic thoughts and experiments over 30 years.

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In these notebook entries, Newton cited the ideas of German alchemists for imitating the processes by which metals were generated in nature, deep inside the earth. These involved the familiar alchemical theory of metallic generation through interactions of sulfur and mercury. But Newton, expanding on the theory, wrote: "These two spirits

above all wander over the earth and bestow life on animals and vegetables. And they makes stones, salts and so forth.”

So it seems that Newton was no ordinary alchemist interested in making gold. He apparently aspired to a theory of alchemy more comprehensive than even his laws of gravity. But it could be said, in a paraphrase of Newton’s famous expression of modesty, that the giants on whose shoulders he stood in this endeavor did not measure up to his antecedents in physics and astronomy. Newton’s alchemical bent was not out of character. “He was drawn to the occult,” “Gravity for him was an occult force, and so was alchemy as an explanation of how things transform into other things.”

The British chemist Robert Boyle, a Newton contemporary, also had a foot on each side of the alchemy-modern science divide. He dabbled for years in an alchemical obsession, the search for the philosopher’s stone — the long-sought agent for transmuting lead to gold and unlocking other material and spiritual secrets. The stone was the unified theory of everything in that time. Boyle wrote enviously in 1680 that “there exists concealed in the world” a group of chemists “of a much higher order able to transmute baser Metals into perfect ones.”

At the same time, Boyle hurled harsh criticism at alchemists, particularly Paracelsians and the obscurity of their language and concepts. His purpose, he wrote, was to draw “the Chemists Doctrine out of their Dark and Smoky Laboratories into open light” and to engage in “better Experiments and Arguments.” Citing Boyle’s “swinging critique” and even earlier attacks on alchemical practices, Stephen Clucas, a University of London historian, raised questions that he said require deeper research by historians: Why did a “scientific revolution” in experimental chemistry not occur earlier in the 17th century? Why was a clear separation of alchemy and exact chemistry delayed until the 18th century?

In everyday life, grapes were turned to wine and wheat to bread. A sour green apple grew into a sweet red one. It was in the nature of things to change, even metals. Miners and refiners already knew that lead ore almost always contains some silver, and silver ore almost always contains some gold. This implied that the metals changed one into the other over time. It was noted in 1600, chemists knew of just seven metals — gold, silver, iron, copper, tin, lead and mercury. (Since then scientists have discovered another 60.) The original seven known metals had properties in common. They were shiny and, except for the liquid mercury, could be hammered, shaped and cast.

“The commonality of properties implied to early thinkers a commonality of composition,” Dr. Principe wrote., “And thus it was theorized that all the metals were composed of the same essential ingredients in different proportions and degrees of purity.” “Even if in the modern view alchemy is all nonsense or very spiritual,” Dr. Moran said, “many people drawn to it for whatever reasons were actually creating

very useful, practical chemistry and bringing to it an artisan know-how.”

They also remarked, somewhat conspiratorially, over parallels between the misguided certainties and self-delusion of alchemy and today’s political and religious attacks on modern science. Of Boyle’s efforts to replicate experiments from alchemical writings, Joseph E. Early, a retired Georgetown University professor who studies the philosophy of chemistry, said, “He couldn’t do it any more than we could find the weapons of mass destruction in Iraq.”

The conference on the history of alchemy opened with a program of chamber music called “The Philosophers’ Tone.” The scholars delighted in Handel’s transmutation of Ben Jonson’s “The Alchemist” into pure gold. Over coffee between sessions, they pondered new directions of research and topics for dissertations. They said, for example, that more attention should be paid to alchemy’s role in the history of medicine.