Good as Gold

What alchemists got right

By Stephen Heuser
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THREE HUNDRED YEARS ago, more or less, the last serious alchemists finally gave up on their attempts to create gold from other metals, dropping the curtain on one of the least successful endeavors in the history of human striving.

Centuries of work and scholarship had been plowed into alchemical pursuits, and for what? Countless ruined cauldrons, a long trail of empty mystical symbols, and precisely zero ounces of transmuted gold. As a legacy, alchemy ranks above even fantasy baseball as a great human icon of misspent mental energy.

But was it really such a waste? A new generation of scholars is taking a closer look at a discipline that captivated some of the greatest minds of the Renaissance. And in a field that modern thinkers had dismissed as a folly driven by superstition and greed, they now see something quite different.

Alchemists, they are finding, can take credit for a long roster of genuine chemical achievements, as well as the techniques that would prove essential to the birth of modern lab science. In alchemists' intricate notes and diagrams, they see the early attempt to codify and hand down experimental knowledge. In the practices of alchemical workshops, they find a masterly refinement of distillation, sublimation, and other techniques still important in modern laboratories.

Alchemy had long been seen as a kind of shadowy forebear of real chemistry, all the gestures with none of the results. But it was an alchemist who discovered the secret that created the European porcelain industry. Another alchemist discovered phosphorus. The alchemist Paracelsus helped transform medicine by proposing that disease was caused not by an imbalance of bodily humors, but by distinct harmful entities that could be treated with chemicals. (True, he believed the entities were controlled by the planets, but it was a start.)

"We've got people who are trying to make medicines, which are pharmaceuticals; we've got people who are trying to understand the material basis of the world - very much like a modern engineer, or someone in technology," says Lawrence Principe, a professor of chemistry and the history of science at Johns Hopkins University who is a leading thinker in the revival of alchemy studies.

The field has begun to coalesce as its own academic specialty. Last fall, alchemy scholars gathered at their second academic conference in three years, and in January, Yale University opened an exhibit of rare alchemical manuscripts. For the first time, the leading academic journal of scientific history is planning to publish a special section on alchemy.

To Principe and his colleagues, there is a larger goal. Beyond rehabilitating the reputation of the historical thinkers who considered themselves alchemists, they hope to encourage a broader view of science itself - not as a starkly modern category of human achievement, but rather as part of a long and craftsmanlike tradition of trying to understand and manipulate nature.

Alchemists might have been colossally wrong in their goals, but they were, in some fundamental way, part of the story of science, these scholars say. Robert Boyle and Sir Isaac Newton, fathers of modern chemistry and physics, were also serious students of alchemy. And the fact that alchemists have been marginalized as hand-waving mystics says less about alchemists themselves than about modern society's need to separate itself from the supposedly benighted past.

The roots of alchemy appear to touch nearly every developed culture - alchemists worked in the Far East, India, and the Islamic world. But it was in Europe in the 16th and 17th centuries when alchemy reached its peak of influence, a network of respected and often well-paid specialists laboring in the towns and princely courts of Germany and Italy, as well as in Britain and France. Some alchemists were independent operators, perhaps an assayer in a mining town who hoped to create a little gold on the side; some ran workshops with a dozen apprentices under the patronage of aristocrats. "It's really a surprising range of people who got involved in alchemy in the 16th century," says Tara Nummedal, a historian of alchemy at Brown University. "Alchemy was really part of the popular culture."

What they all shared was a belief that one natural substance could be transmuted into another. An ancient theory of nature held that all matter was in a process of slow but constant change, and the mission of alchemy was to nudge that process along. The highest and purest state of matter was gold, and gold is what alchemists prized most. But even a partial success could yield a valuable material like tin, copper, or silver.

In many ways the alchemists made it easy for later scientists to dismiss them as tall-hatted cranks. Their notebooks are deliberately cryptic; they wrote under arcane pseudonyms and invented fictional authorities. They assumed vast, secret connections between planets and the spiritual world; they saw metals as an expression of the divine.

Even their most serious research was infused with beliefs and terms that sound more like wizardry than like modern lab science - the Philosopher's Stone, the Chemical Wedding, an invisible "vegetative spirit" that suffuses the earth. It is hard to imagine a modern scientist choosing to express his lab findings, as the distinguished German alchemist Michael Maier once did, in a set of 50 musical fugues for three voices, in which mythological characters represented the interacting elements.

That might seem impossibly distant from the idea of modern science, a world of hard data about discrete physical problems, ruled by observable and reproducible fact. But as scholars reexamine the roots of chemistry, they are now seeing less of a clean break than a subtle evolution from one craft to another. Alchemists tried and discarded theories, like scientists did; despite their occult reputation, they often saw themselves less as conduits to the supernatural than as analytical thinkers trying to accelerate and manipulate real physical processes.

"They were essentially pursuing philosophy and pursuing the investigation of nature in a way that makes sense in the context of the time," says Bruce Moran, a science historian at the University of Nevada at Reno who has become a leading scholar in the reconsideration of alchemists.

It is alchemists who gave Europe some of its key discoveries. Alchemists discovered zinc and metallic arsenic. A German alchemist named Hennig Brand isolated phosphorus in 1669. The alchemist Johann Bottger, working for the Dresden court, stumbled on a material that allowed German workshops to make their own porcelain and break China's monopoly on one of the world's most lucrative industries.

If alchemy's achievements can sometimes seem accidental, its practices and their approach were deliberate, and often notably scientific in spirit. "We see for example some wonderful cases when an alchemical writer is really observing a laboratory phenomenon - some reaction, some operation - and racking his brains, trying to figure out what's going on under the surface," says Principe. "And that, in a way, is what chemists do."

Without alchemy, it's unlikely chemistry could have happened at all. Influential early chemists, such as Georg Ernst Stahl and Robert Boyle, were either practicing alchemists or former alchemists. A chemistry lab in the 18th century would have been almost indistinguishable from an alchemist's workshop.

Principe and Indiana professor William Newman found a deeply scientific mind at work when they edited and published the notebooks of George Starkey, a Harvard-educated alchemist whose teachings influenced Boyle. The federal government has allocated nearly $1 million in grants for Newman to translate and publish Sir Isaac Newton's immense body of alchemical writings, which are slowly being put online.

These scholars have occasionally been taken to task by historians who see them as apologists for alchemy, saying they ignore its shortcomings in the effort to reclaim it as a close cousin of modern science. The British historian Brian Vickers recently published a harsh critique of both Principe and Newman, saying their new published histories of alchemy willfully "airbush out of the record" alchemy's embarrassing qualities - its obsession with the occult; its long history of public failures. Unlike experimental scientists, he says, alchemists were unwilling to abandon their opaque ancient texts; and even in their own time, alchemists were derided as charlatans.

Newman says such criticism overemphasizes alchemists' occult interests, mistaking one piece of their belief system for the whole field. The evidence leaves no doubt that alchemists were practicing science, he says, and many early chemists were alchemists who had simply renounced the quest for gold.

Principe, for his part, says that trying to find crisp distinctions between material science and alchemical beliefs is just a modern preoccupation. "Alchemists, like everyone else in the pre-enlightenment world, didn't separate studies that were going on in the laboratory from larger issues in philosophy and theology," he says.

Bringing alchemy under the tent of science does more than illuminate a turning point in a distant history, however: It suggests a different way to think about science in our own time. Science might be the most productive tool ever invented for understanding the world, but despite its claims on truth, it is still just that: a tool, and a man-made one.

Alchemy is an important reminder that modern science has a context, says Bernard Lightman, a historian and editor of the science-history journal Isis, and to grant scientists an exclusive claim on truth only ensures that our view of the world is limited to the scientific prejudices of the day.

"Science is a human creation, like a lot of other human creations. It's like art, it's like literature," says Lightman.

The early chemists often drew conclusions no more accurate than those of the alchemists who had preceded them. Georg Stahl, for instance, renounced alchemy but then explained fire by proposing that a fanciful substance called "phlogiston" infused all combustible objects.

Science in the modern era can still be seduced by a reigning metaphor - the tree of evolution, the wave theory of light, the "selfish gene," all deeply influential ideas whose limits have been exposed. Science is also no stranger to alchemy's immensity of ambition. Isaac Newton, the first great physicist, reached for alchemy when he tried to formulate a theory of the universe that could account for everything from plant life to gravity. Albert Einstein tried, and failed, to cap his career by formulating a single theory that explained all the universe's forces. And at the cutting edge of modern physics, string theory purports to offer a complete but possibly unprovable explanation of the universe based on 11 dimensions and imperceptibly tiny strings.

Alchemists wouldn't recognize the mathematics behind the theory. But in its grandeur, in its claim to total authority, in its unprovability, they would surely recognize its spirit.

Alchemy: the gathering

HISTORIANS AREN'T THE only ones resuscitating alchemy. A 40-year-old organization called the International Alchemy Guild attracts people who purport to be practicing alchemists, and holds an annual conference where speakers share wisdom on herbal elixirs, life extension, and the "psyche-matter continuum." Its catalog (online at crucible.org) sells alchemical distillation equipment and helpful scrolls. Last year, the "Complete Idiot" line of guidebooks released a how-to volume on alchemy aimed at much the same constituency.

This revival of hands-on alchemy may seem profoundly New Agey, or at best a Harry Potter mania gone overboard, but it has its own history. The Victorian fad for the occult, which gripped much of Europe and America in the late 19th and early 20th centuries, claimed alchemy for itself, appealing to people who saw alchemy's mystical transformations as a metaphor for the purification of the soul, and who wanted to find a font of deep wisdom outside the science of the time.

How does a historian see today's practicing alchemists? Says Lawrence Principe, a trained chemist who researches historical alchemy at Johns Hopkins University: "You can just put me down as a groan."

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