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Alchemy to Chemistry: Pseudoscience to Science

Part II

by Kristine Danowski

This is the conclusion of Alchemy to Chemistry. Here we examine some famous alchemists, the development of chemistry, and modern alchemy.

Regarded as the first modern chemist, Robert Boyle (1627-1691 CE) is perhaps best known as the discoverer of Boyle's Law, which states that the pressure of a gas multiplied by its volume is a constant. He is considered the founder of analytical chemistry, the science of chemical measurements. Boyle developed many techniques and widely published his findings. In 1660 he published *On the Springiness of Air and Its Effects* in which he documented his experiments with gases. He published *The Sceptical Chymist* in 1661 in which he emphasized rigorous experimentation. He actively and scientifically investigated the new element phosphorus after it was discovered. However, Boyle remained a dedicated alchemist. He believed in the transmutation of metals to gold and spent most of his time in vain to accomplish it. In fact, his experiments with gases were only a small fraction of his total (al)chemical output. When he died, his laboratory contained a library of alchemical texts and his own original alchemical writings, all of which were eventually sold. Unfortunately, most of his papers were lost, and modern chemists feared Boyle would be discredited if his alchemical studies were discovered. Boyle was an eccentric character, and some modern historians have speculated that Boyle suffered from mercury poisoning. His alchemical work involved heating copious amounts of mercury so that he was regularly exposed to mercury vapor.

Sir Isaac Newton, 1642-1727 CE, one of the greatest scientific minds who ever lived, regarded his alchemical studies as more important than his mathematical studies. In fact, he strongly influenced the decriminalization of alchemy in England. His work in the English mint was alchemical – he firmly believed in transmutation and was trying to make gold. Newton's alchemical studies were suppressed until 1936 when his

EVENTS CALENDAR

September Program

Saturday, 8 September 2007
2 p.m.

Center for Nonprofit
Management
2900 Live Oak Street in Dallas

Conspiracy

Did it really happen? John
Brandt will discuss 9-11, 3-11,
and 7-7 conspiracy theories.

Social Dinner/ Board Meeting

Saturday, 15 September 2007
7 p.m.

Good Eats
6950 Greenville Avenue in
Dallas

Let us know if you are coming.
We need to reserve a table.
214-335-9248

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papers were auctioned at Sotheby's. Some scientists feared that the inventor of calculus and the formulator of the laws of motion and gravitation would be discredited if his alchemical work were discovered. Some scholars have speculated that Newton, like Boyle, suffered from mercury poisoning since Newton displayed many of the symptoms.

Despite the efforts of Boyle, Newton, and other prominent (al)chemists, contemporary scientists could not adequately explain combustion. Until the late 1700s CE, the phlogiston theory of combustion prevailed. Phlogiston theory was chemistry's first scientific theory, and it came directly from alchemy. The word "phlogiston" actually means "Sophic Sulfur." Phlogiston was a particle, Sophic Sulfur, or an Element present in combustible matter. Air contained phlogiston, acids contained a form of phlogiston, and metals that form calxes (oxides) contained phlogiston. Unfortunately, the acceptance of phlogiston theory delayed modern chemistry by 100 years.

When chemist Joseph Priestley (1733-1804 CE) discovered oxygen in 1774, he called it dephlogisticated air. (Karl Scheele independently discovered oxygen in 1771, but did not report his discovery until 1777.) Priestley theorized that oxygen attracted phlogiston from metals so they combust. He did not realize that oxygen alone is responsible for combustion in air. Despite this, however, the discovery of oxygen was a chemical milestone. The American Chemical Society named its highest award the Priestley Medal, and the Chemical Heritage Foundation named Priestley's laboratory a Chemistry Landmark.

The chemist who disproved phlogiston theory was Antoine Laurent Lavoisier, 1743-1794 CE. Lavoisier is rightly regarded as the founder of modern chemistry. Lavoisier demonstrated that both combustion and calcination (formation of oxides) arise from the combination of atmospheric oxygen with inflammable substances, including metals. He disproved Aristotle's Four Elements by showing that water can be decomposed into two gases, hydrogen and oxygen. He invented calorimetry, the science of measuring heat flow. And if these accomplishments were not enough, Lavoisier wrote a number of enormously influential chemical texts. His *Traité Élémentaire de Chimie* (1789) is an extraordinary book. In it Lavoisier defined a chemical element as a substance that cannot be further decomposed. He classified the known elements into four categories: gases, nonmetals, metals, and earths (inert oxides that could not be decomposed at that time.) Lavoisier standardized nomenclature from its arcane alchemical origins by proposing that chemical names should contain the letters or names of the elements that composed them. Instead of "oyl of vitriol," "calx of mercury," "butter of antimony," or "lunar caustic," for example, these compounds were called sulfuric acid, mercury oxide, antimony chloride, and silver nitrate, respectively. His insight demystified chemistry from alchemy and further advanced it as a science. Lavoisier was not an alchemist. He rejected the idea of transmutation.

After Lavoisier, chemistry was unequivocally established as a science and the rest, as they say, is history.

Alchemists throughout history discovered and developed the techniques that would evolve into modern chemistry. Alchemists

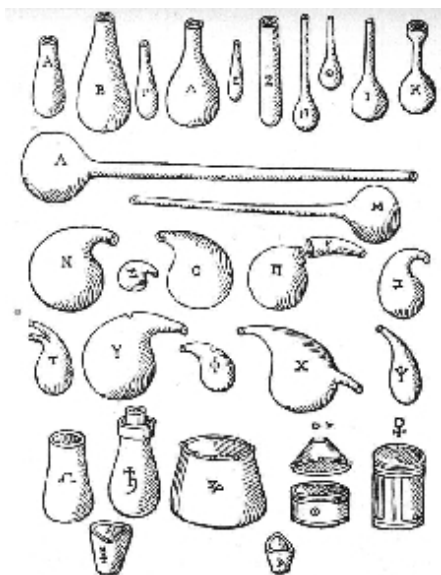


Figure 2. Chemical utensils from Andreas Libavius, *Alchymia...*, 1606

performed essential wet chemistry, i.e., chemical reactions, that transformed matter. They recorded their reaction conditions and procedures. They invented the glassware and equipment that later chemists would refine; a few examples are shown in Figure 2. Anyone who has taken high school chemistry will surely recognize test tubes, beakers, volumetric flasks, round-bottom flasks, and crucibles. Alchemists invented the first analytical methods, especially gravimetry and assays for precious metals, which later chemists would improve and use as the foundation of analytical chemistry. Alchemists also synthesized drugs and poisons. Alchemists grouped known substances by their properties, inspiring the periodic table. They used symbols for known substances, inspiring Lavoisier and others to do the same. Most importantly, alchemy demonstrated that humans could manipulate matter and improve it for their own benefit. Far from being a pseudoscience, ancient alchemy was a pre-science.

Many vestiges of ancient alchemy remain with us today. In addition to the words listed in Part I, the word “alcohol” came from Arabic *al kuhul*, inspiring the names aqua vitae (“water of life”), aquavit, whiskey, eau-de-vie, and vodka. The word “elixir” came from Arabic *al esker* and was used extensively in alchemical literature. The phrase “hermetically sealed” was derived from the deity Hermes. The word “gibberish” described the occasionally incomprehensible writings of Jabir/Geber. The “quintessence” is not the Philosopher’s Stone, rather the epitome, embodiment, ideal, or perfect example. However, words are not ancient alchemy’s only remnant. The American Chemical Society logo is shown in Figure 3. It contains two alchemical motifs. The phoenix was a symbol of the Philosopher’s Stone and the *kaliappar* beneath it revolutionized organic analysis. The Dallas-Fort Worth section

newsletter is called *The Retort*, a pun on the name of a piece of alchemical glassware. Figure 4 (on page 4) shows the caduceus, the symbol of health professions. The caduceus originated in alchemy. The female and male snakes are entwined around the golden staff of the deity Hermes; the four loops symbolize copulations.

Not only vestiges of ancient alchemy remain. Alchemy still has its adherents, the majority of whom do not seek to make gold. Modern alchemy has mostly transmuted into an “inner” discipline equivalent to historical mystical alchemy. It emphasizes a holistic view of the world and the seekers’ quest for perfection. Modern alchemy also contains much pseudoscience and is equivalent to historical practical alchemy. Pseudoscientific alchemy claims that quantum physics allows transmutation of metals into gold and that alternative medicine is efficacious. Modern pseudoscientific alchemy makes testable claims while mystical alchemy does not.

Modern mystical alchemy derives much from psychologist Carl Jung. A non-chemist, Jung believed that ancient alchemists accidentally made psychological discoveries. To Jung, alchemical processes and imagery were products of a universal or collective unconscious. They also revealed stages of individual’s psychic growth. Jung considered alchemical experimentation not as scientific but rather as “active imagination” that resulted in the projection of the unconscious in the form of visual hallucinations. Today scholars regard Jung’s views as clichéd. However, modern mystical alchemists regard Jung’s views as essential. These practitioners seek to achieve harmony with the universe or oneness with nature by meditating on alchemical symbols. Modern mystical alchemy is frequently associated with astrology, newage, Wicca, or Paganism.



Figure 3. The American Chemical Society Logo



Figure 4. The Caduceus

Claiming to be scientific, modern pseudoscientific alchemy comprises a variety of decidedly unscientific practices. Alternative medicine seems to be a large component of pseudoscientific alchemy. Homeopathy, “energy medicine,” the memory of water, and the quest for immortality are phrased in alchemical terms. For example, practitioners prepare alchemical remedies by allegedly separating the Sophic Salt, Sulfur, and Mercury of a substance by heating, then reuniting them to give a “powerfully charged medicine,” whatever that means. Deepak Chopra is very popular among pseudoscientific alchemists, a small number of whom still attempt to make gold via transmutation of metals. They claim that quantum mechanics makes transmutation possible, and they have convoluted theories about the mechanism. Since the observer influences the experiment, they say, if we fervently *believe* we can make gold then we *will* make gold. They claim that some ancient alchemists, especially the Flamels, did transmute metals into gold but concealed their success for obvious reasons. Despite its claim of scientific respectability, modern pseudoscientific alchemy seems to be a backlash against modern science. The writings of pseudoscientific alchemists seem almost angry with real chemistry, physics, and medicine. They seem to want it both ways. Instead of modern chemistry leaving them behind, they want to be real scientists while taking pseudoscientific shortcuts and clinging to obsolete theories.

If you want to be a modern alchemist of either variety, you can study at several schools around the world. The Paracelsus Research Society has branches in the USA, Australia, and Germany. Its founder is one Albert Riedel, who prefers the moniker Frater Albertus. The Society has existed since 1960 and focuses on medical alchemy. In 1984 Riedel founded Paracelsus College that claims to bestow academic degrees in alchemy. L.P.N., or Le Petit Philosophe de la Nature, was founded by one Jean Dubois in 1979. L.P.N. began in France

then spread to the USA. The International Alchemy Guild claims to teach acolytes alchemy’s secrets via the Internet. The Guild sponsors the International Alchemy Conference; this year it will be held in from October 5-7, 2007, in Las Vegas, in case you would like to attend.

But wait – there’s more! Transmutation *is* possible! The alchemists are correct!

In 1980, University of California, Berkeley, scientists realized alchemists’ ancient dream. They used a particle accelerator to bombard a tiny sample of bismuth with neutrons to change it into gold. The process cost \$10,000 and made one-billionth of one penny worth of gold. Once again, the ancient alchemists were correct, but in a way they could have never imagined. Here’s the catch: transmutation of one chemical element to another involves *nuclear* reactions, not chemical reactions. The number of protons in the nucleus must change; no chemical reaction will accomplish this. Chemical reactions involve the movement of electrons, not nucleons. So unless modern pseudoscientific alchemists can demonstrate a cold-fusion or cold-fission type of transmutation, they will never succeed in their quest.

So we must ask the question: Is the neutron the Philosopher’s Stone?

Kristine Danowski is Vice-President of the North Texas Skeptics.



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Web News

by John Blanton

Creationism's Trojan Horse

By Barbara Forrest and Pall R. Gross

I got my copy, and I am mostly through it. Skeptics, TJH is tough sledding. Lots of words and not any pictures. It's not for creationists.

Forrest and Gross have compiled a detailed review of the Intelligent Design movement, with an emphasis on the word *detailed*. The book spends 338 pages explaining the chronology of "The Wedge," and it follows up with 72 pages of notes—with many links to original sources.

When I'm finished there will be a short review of *CTH*, but for now I will present just a short item of interest: Are

creationists interested in real science, or are they interested in "getting their word out?" Let's see.

When Congress considered the president's *No Child Left Behind Act*, Republican senator Rick Santorum from Pennsylvania consulted with Intelligent Design's godfather, Phillip Johnson and introduced the "Santorum Amendment" to the bill. I have one version of the amendment's wording:

http://www.biosurvey.ou.edu/oese/SANTORUM_AMENDMENT.html

"The conferees recognize that a quality science education should prepare students to distinguish the data and testable theories of science from religious or philosophical claims that are made in the name of science. Where topics are taught that may generate controversy (such as biological evolution), the curriculum should help students to understand the full range of scientific views that exist, why such topics may generate controversy, and how scientific discoveries can profoundly affect society."¹

The senator's language seemed so enlightened that even liberal senator Ted Kennedy commented favorably and voted for the amendment.

It came to pass, Skeptics, that sanity prevailed, and the Santorum language was not included in the final bill passed by Congress. Many, I am sure, recognized that picking biological evolution signaled the thumbprint of the Discovery Institute, Intelligent Design's intelligent base. Good news for creationists, however. The Santorum language was captured and retained in the conference report of the joint committee that ironed out the details of the final bill.

Did this present an obstacle to creationists? Let's see.

By early 2002 creationists in Ohio were attempting to influence public education, and they picked up on the "Santorum Amendment" of the new education bill. To this effort Senator Santorum contributed the following in a *Washington Times* column:

Supporters for a change in teaching standards want the [Ohio] board to include the idea that living things could have been "designed" in some meaningful way. Sen. Ted Kennedy, Massachusetts Democrat, approves of having alternate theories taught in the classroom. He believes children should be "able to speak and examine various scientific theories on the basis of all information that is available to them so they can talk about different concepts and do it intelligently with the best information that is before them."²

Forrest and Gross believe Santorum “overplayed his hand” at this point. Senator Kennedy objected to having his congressional prestige exploited in this manner. As *CTH* reports, Kennedy responded in a letter:

The March 14 Commentary piece, “Illiberal education in Ohio schools,” written by my colleague Sen. Rick Santorum, Pennsylvania Republican, erroneously suggested that I support the teaching of “intelligent design” as an alternative to biological evolution. That simply is not true.

Rather, I believe that public school science classes should focus on teaching students how to understand and critically analyze genuine scientific theories.³

When is a United States senator an authority on biological evolution? When he seems to support creationism, as Senator Santorum seems to think. And when is a United States Senator just a lawmaker with no expertise in science and having no business meddling in the business of science and education. Well, when the creationists say so.

Forrest and Gross show us how this works. Immediately creationist William Dembski fired back with a press release.

Edward Kennedy — Expert on Science?

By William Dembski

In today’s *Washington Times* (<http://www.washingtontimes.com/op-ed/20020321-76780268.htm#2>), Sen. Edward Kennedy takes exception to Sen. Rick Santorum’s March 14 Commentary piece, “Illiberal Education in Ohio Schools” (<http://asp.washtimes.com/printarticle.asp?action=print&ArticleID=20020314-50858765>). Santorum, who supports intelligent design, argues that Ohio public schools should be open to teaching it. Kennedy, who has publicly supported the teaching of alternate scientific theories when there is diversity of opinion among scientists, nevertheless rejects Santorum’s argument. Yes, alternate scientific theories should be taught. But, as Kennedy puts it, “intelligent design is not a genuine scientific theory and, therefore, has no place in the curriculum of our nation’s public school science classes.”

Kennedy is no scientist or philosopher of science, so presumably he has spoken to the experts, who assure him that intelligent design is not science. Indeed, Kennedy himself offers no argument for why intelligent design fails to be a scientific theory. So, is that how the public debate over intelligent design’s role in public school sciences classes will end? Experts on one side will say that it is a genuine science and experts on the other will say it isn’t? And

politicians will then take their cues from their preferred experts?⁴

I am glad we got straightened out on that point.

For the full story read the book. You can buy it from Amazon.com (we get a commission). Here are links for the hardcover and paperback issues:

<http://www.amazon.com/exec/obidos/ASIN/0195157427/thenorthtexaske>

<http://www.amazon.com/exec/obidos/ASIN/0195319737/thenorthtexaske>



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- 3 <http://www.washingtontimes.com/commentary/20020321-76780268.htm>
- 4 Access Reach Network at <http://www.arn.org/docs2/news/kennedyexpertonscience032102.htm>

What’s new

By Robert Park

[Robert Park publishes the *What’s New* column at <http://www.bobpark.org/>. Following are some clippings of interest.]

THE SOUL: EXPERIMENTAL INDUCTION OF OUT-OF-BODY SENSATIONS.

(WN 24 Aug 07) The journal *Science* today reports new results on this curious experience, more often associated with the tabloid media. You may recall a *New York Times* story by Sandra Blakeslee about a year ago (3 Oct 06) in which a Swiss neurologist induced the effect by mild electrical stimulation of the angular gyrus, a region of the brain in the parietal lobe involved in a number of processes related to language and

Skeptic Ink

by Prasad Golla and John Blanton.
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cognition. The effect is attributed to discrepancy between the actual position of the body and the mind's perceived location. The Swiss group has now induced the out-of-body effect without brain stimulation or hallucinogenic drugs by fitting the subject with display goggles that show a video image of the person from a different perspective. It is important in part because out-of-body experiences, particularly when associated with near-death, are often cited as evidence of a soul. The odd belief that the half-million embryonic stem cells left over from in-vitro fertilization have souls is behind objections to using them in research rather than sending them to the autoclave.

THE BRAIN: WHY EMPATHY COMES NATURALLY TO HUMANS.

(WN 17 Aug 07) A frequent theme in mail I get from fundamentalists is that without religion there would be no reason for people to be good. I find this shocking. Do these people long to rape and pillage, but refrain only because God is watching? The *Wall Street Journal* today has an article by Robert Lee Hotz on the discovery of "mirror" cells in the motor cortex that reflect the actions and intentions of others as if they were our own. They cause us to identify with the characters in a novel, or suffer when we watch others suffer on the evening news. If we are good, it is because we see ourselves as part of the human race and the happiness of others makes us happy.

THE AMYGDALAE: IF WE HAVE A SOUL, THIS MUST BE IT.

(WN 24 Aug 07) I consulted with two Catholic theologians on the faculty of a nearby seminary, who explained that the soul is the "spiritual essence" of a person. After much discussion, "spiritual essence" seemed to be associated with empathy (see last week's WN), though Catholic priests use different words. Our emotional response to sensory input is determined by the amygdalae, two almond shaped groups of neurons located deep within the medial temporal lobes. Embryos, I note, don't have amygdalae.

THE RESEARCH: JAPANESE STEM CELL SCIENTIST MOVES TO U.S.

(WN 24 Aug 07) Also reported today, Shinya Yamanaka, one of Japan's leading stem cell scientists, will join the Gladstone Institute of Cardiovascular Disease in San Francisco, where his work will be funded in part by California's stem cell initiative. This is good news, of course, but we note that he's recognized for persuading skin cells from mice to behave like stem cells. We've lost years while stem-cell research has been diverted to circumventing religious objections to the use of human eggs or embryos.

EMF: ARE WE IN FOR A NEW WAVE OF EMF INDUCED HYPOCHONDRIA?

(WN 24 Aug 07) The Alaska Supreme Court upheld a compensation board ruling awarding disability to an equipment installer as a result of workplace exposure to RF radiation. The worker was exposed to a six gigahertz signal, which was found to be slightly over the RF safety limit set by the FCC but well below the FCC's recognized level of thermal harm. The decision was not entirely unreasonable: the Court felt it was up to the Board and not the courts to decide which witnesses to believe, but it was accepted that the only danger is thermal heating, so it does not take us back to power lines, or even cell phones.

THE MEMORY OF WATER: EARMARK FOR "INFORMATION BIOLOGY."

(WN 10 Aug 07) I'm told the defense spending bill earmarks \$2 million for the Samueli Institute for Information Biology. Its Director Wayne Jonas, is author of *Healing with Homeopathy*. Jonas believes water remembers the stuff you diluted away. My water comes from the Potomac River; I would prefer that it not remember.

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