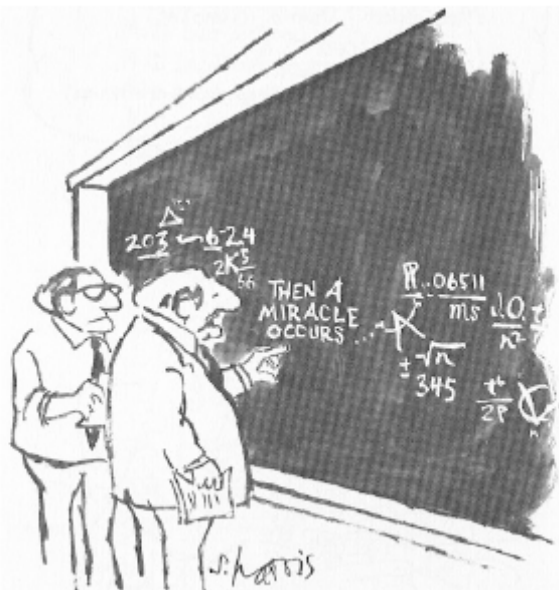


EVOLUTION AS ALCHEMY

By William A. Dembski

In its heyday alchemy was a comprehensive theory of transmutation describing not only transformations of base into precious metals but also transformations of the soul up and down the great chain of being. Alchemy was not just a physics but also a metaphysics. Alchemy as metaphysics attracts interest to this day, as in Carl Jung's writings about the soul and personal identity. As he noted, "The alchemists sought for that effect which would heal not only the disharmonies of the physical world but inner psychic conflict as well, the 'affliction of the soul,' and they called this effect the *lapis philosophorum* [i.e., the philosopher's stone]. In order to obtain it, they had to loosen the age-old attachment of the soul to the body and thus make conscious the conflict between the purely natural and the spiritual man." [1]

Alchemy's metaphysical pretensions aside, to include alchemy as part of the natural sciences is nowadays regarded as hopelessly misguided. The scientific community rejects alchemy as superstition and commends itself for having successfully debunked it. For scientists the problem with alchemy is that it fails to specify the processes by which transmutations are supposed to take place. An overused Sidney Harris cartoon illustrates the point. The cartoon shows two scientists viewing a chalkboard. The chalkboard displays some fancy equations, a gap, and then some more fancy equations. In the gap are written the words: "Then a miracle occurs." Pointing to the gap, one scientist remarks to the other, "I think you should be more explicit here." This is the problem with alchemy. To characterize a transformation scientifically, it needs to be specified explicitly. Alchemy never did this. Instead it continually offered promissory notes promising that some day it would make the transformation explicit. None of the promissory notes was ever redeemed. Indeed, the much sought after philosopher's stone remains to be found. [2]



"I think you should be more explicit here in step two."

Officially, the scientific community rejects alchemy and has rejected it since the rise of modern science.[3] Unofficially, however, the scientific community has had a much harder time eradicating it. Indeed, I will argue that alchemical thinking pervades the fields of chemical and biological evolution. This is not to deny that biological systems evolve. But unless the process by which one organism evolves into another (or by which nonliving chemicals organize into a first living form) is specified, evolution remains an empty word. And given that such specificity is often lacking, much (though not all) of what currently falls under evolutionary theory is alchemy by another name.

Alchemy followed a certain logic, and it is important to see the fallacy inherent in that logic. The problem with alchemy was not its failure to understand the causal process responsible for a transformation. It is not alchemy, for instance, to assert that a certain one-dimensional polypeptide will fold into the three-dimensional conformation thereby yielding a functional protein. How polypeptides fold to form proteins is an open problem in biology. Three-dimensional proteins "evolve," one might say (in the literal etymological sense of the word as in *unfurling the potentialities already inherent in a thing*), from suitably sequenced one-dimensional polypeptides in suitable cellular contexts. This happens repeatedly and reliably. We can describe the transformation, but as yet we cannot explain how the transformation takes place. Ignorance about the underlying mechanism responsible for a transformation does not make the transformation alchemical.

Things transform into other things. Sometimes we can explain the process by which the transformation takes place. At other times we cannot. Sometimes the process requires an intelligent agent, sometimes no intelligent agent is required. Thus, a process that arranges randomly strewn Scrabble pieces into meaningful English sentences requires a guiding intelligence. On the other hand, the process by which water crystallizes into ice requires no guiding intelligence -- lowering the temperature sufficiently is all that is needed. It is not alchemy that transforms water into ice. Nor is it alchemy that transforms randomly strewn Scrabble pieces into meaningful sentences. Nor, for that matter, is it alchemy that transforms a one-dimensional polypeptide into a functional protein, and that despite our ignorance about the precise mechanisms governing protein folding.

What, then, is the problem with alchemy? Alchemy's problem is its lack of causal specificity. Causal specificity means specifying a cause sufficient to account for an effect in question. Often we can specify the cause of an effect even if we cannot explain how the cause produces the effect. For instance, I may know from experience that shaking a closed container filled with a gas will cause the temperature of the gas to rise. Thus, by specifying the causal antecedents (i.e., a closed container filled with gas and my shaking it), I account for the container's rise in temperature. Nonetheless, I may have no idea why the temperature rises. Boltzmann's kinetic theory tells me that the temperature of the gas rises because temperature corresponds to average kinetic energy of the particles constituting the gas, and by shaking the container I impart additional kinetic energy to the particles. Boltzmann's theory enables me to explain why the temperature goes up. Even so, I do not need Boltzmann's theory to specify a cause that accounts for the temperature

going up. For that, it is enough that I specify the causal antecedents (i.e., a closed container filled with gas and my shaking of it).

Alchemy eschews causal specificity. Consider the standard example of alchemical transformation, the transmutation of lead into gold. There is no logical impossibility that prevents potions and furnaces from acting on lead and turning it into gold. It may just be that we have overlooked some property of lead that, in combination with the right ingredients, allows it to be transformed into gold. But the alchemists of old never specified the precise causal antecedents that would bring about this transformation. Consequently, they lacked any compelling evidence that the transformation was even possible. Note, modern-day particle physicists can, in principle, transform lead into gold with their particle accelerators, smashing the lead into more elementary constituents and then reconstituting them as gold. But here the causal antecedents are specified and differ plainly from those considered by the alchemists (particle accelerators were not part of the alchemists' tool chest).

Causal specificity was evident in the examples considered earlier: Water cooled below zero degrees Celsius is sufficient to account for it turning to ice. A random collection of Scrabble pieces left in the hands of a literate, nonhandicapped English speaker is sufficient to account for the Scrabble pieces spelling a coherent English sentence. A given sequence of l-amino acids joined by peptide bonds within a cellular context is sufficient to account for it folding into a functional protein, say cytochrome c. In each of these cases the causal antecedent is specified and accounts for the effect in question. We may not be able to explain how the cause that was specified produces its effect, but we know that it does so nonetheless.

But how do we get from causal antecedents like lead, potions, and furnaces and end up with gold? The alchemists' conviction was that if one could find just the right ingredients to combine with lead, lead would transform into gold. Thereafter the transformation could be performed at will and the alchemist who discovered the secret of transmutation would be rich (until, that is, the secret got out and gold became so common that it too became a base metal). Discovering the secret of transmutation was the alchemist's deepest hope. The interesting question for this essay, however, is the alchemist's reason for that hope. Why were alchemists so confident that the transmutation from base into precious metals could even be effected? From our vantage, we judge their enterprise a failure and one that had no possibility of success (contemporary solid state physics giving the coup de grace). But why were they unshaken in their conviction that with the few paltry means at their disposal (particle accelerators not being among them), they could transform base into precious metals? Put another way, why, lacking causal specificity, did they think the transformation could be effected at all?

Without causal specificity, one has no empirical justification for affirming that a transformation can be effected. At the same time, without causal specificity, one has no empirical justification for denying that a transformation can be effected. There is no way to demonstrate with complete certainty that Dr. Jekyll cannot transform into Mr. Hyde by some unspecified process. Lack of causal specificity leaves one without the means to

judge whether a desired transformation can or cannot be effected. Any conviction about the desired transformation being possible, much less inevitable, must therefore derive from considerations other than a causal analysis. But from where?

Enter metaphysics. It is no secret that the motivation behind alchemy was never scientific (as we use the term nowadays) but metaphysical. Alchemy is a corollary of Neoplatonic metaphysics. Neoplatonism held to a great chain of being in which all reality emanates from God (conceived of as the One) and ultimately returns to God. The great chain of being is strictly hierarchical, so that for any two distinct items in the chain one is higher than the other. Now consider lead and gold. Gold is higher on the chain than lead (lead is a base metal, gold is a precious metal). Moreover, since everything is returning to God, lead is returning to God and on its way to God will pass through gold. Consequently, there is a natural pull for lead to get to gold on its way to God. The alchemist's task is therefore not to violate nature, but simply to help nature along. All lead needs is a small suitable catalyst to achieve gold. The modest means by which alchemists hoped to achieve the transformation of lead into gold thus seemed entirely reasonable (in particular, no particle accelerators would be required).

Here, then, is the fallacy in alchemy's logic. Alchemy relinquishes causal specificity, yet confidently asserts that an unspecified process will yield a desired transformation. Lacking causal specificity, the alchemist has no empirical grounds for holding that the desired transformation can be effected. Even so, the alchemist remains convinced that the transformation can be effected because prior metaphysical beliefs ensure that some process, though for now unspecified, must effect the desired transformation. In short, metaphysics guarantees the transformation even if the empirical evidence is against it.

Alchemy continues to flourish to this day in the fields of chemical and biological evolution. Whereas classical alchemy was concerned with transforming base into precious metals, evolution is concerned with transforming batches of chemicals into organisms and then organisms into other organisms. Now, I do not want to give the impression that evolution is a completely disreputable concept. The concept has applications that are entirely innocent. Consider, for instance, finches evolving stronger beaks to break harder nuts or insects developing insecticide resistance. Evolution in such cases is nonproblematic. Why? Because of causal specificity. Microevolutionary changes like this happen repeatedly and reliably. Given certain organisms placed in certain environments with certain selective pressures, certain predictable changes will result. We may not understand the precise biochemical factors that makes such microevolutionary changes possible. But the causal antecedents that produce microevolutionary changes are clearly specified. So long as we have causal specificity, evolution is a perfectly legitimate concept

But what about evolution without causal specificity? Consider, for instance, chemical evolution as an explanation for the origin of life. For much of the scientific community, the presumption is that life organized itself via undirected chemical pathways and thus apart from any designing intelligence. Yet, unlike the causal specificity that obtains for microevolutionary processes, origin-of-life researchers have yet to specify the chemical

pathways that supposedly originated life. Despite a vast literature on the origin of life, causally specific proposals for just what those chemical pathways might be are sorely absent. Which is not to say that there have not been any proposals. In fact, there are too many of them. RNA worlds, clay templates, hydrothermal vents, and numerous other materialistic scenarios have all been proposed to account for the chemical evolution of life. Yet, none of these scenarios is detailed enough to be seriously criticized or tested. In short, they all lack causal specificity.

In the absence of causal specificity, the logic of evolution parallels the logic of alchemy. Evolution, like alchemical transformation, is a relational notion. Alchemy never said that gold just magically materializes. Rather, it said that there are antecedents (lead, potions, furnaces) from which it materializes. So too evolution does not say that organisms just magically materialize. Rather, it says that there are antecedents (in the case of the origin of life, it posits RNA worlds, clay templates, hydrothermal vents, etc.) from which life materializes. Thus, to say that something evolves is to say what it evolves from: just as for the alchemist gold "evolves" (again, in its literal etymological sense) from lead plus some other (unspecified) things, so for the contemporary origin-of-life researcher organisms "evolve" from suitable (albeit unspecified) batches of prebiotic chemicals.

"X evolves" is therefore an incomplete sentence. It needs to be completed by reading "X evolves from Y." Moreover, the claim that X evolves from Y remains vacuous until one specifies Y and can demonstrate that Y is sufficient to account for X. Lowering the temperature of water below zero degrees Celsius is causally specific and adequately accounts for the freezing of water. On the other hand, a complete set of the building materials for a house does not suffice to account for a house -- additionally what is needed is an architectural plan (drawn up by an architect) as well as assembly instructions (executed by a contractor) to implement the plan. Likewise, with the origin of life, it does no good simply to have the building blocks for life (e.g., nucleotide bases or amino acids). The means for organizing those building blocks into a coherent system (i.e., a living organism) need to be specified as well.

Given the pervasive lack of causal specificity in origin-of-life studies, why are so many origin-of-life researchers supremely confident that material causes are even up to the task of originating life? (By a material cause I mean, in contradistinction to Aristotle, a cause reducible to matter, energy, and their law-determined interactions, with these interactions being, in principle, describable by physics and chemistry.) The singular lack of success of science in elucidating the origin-of-life problem makes this overweening confidence all the more puzzling if we try to understand it light of the skepticism and tentativeness with which the scientific method tells us to approach hypotheses.

On the other hand, if, as I am suggesting, there is a precise parallel between evolution and alchemy, then this confidence is perfectly understandable, because in that case it flows from a prior metaphysical commitment that is both inviolable and nonnegotiable. What prior metaphysical commitment ensures that material causes, though for now unspecified, must effect the desired evolutionary transformations? In the case of alchemy, the prior metaphysical commitment was Neoplatonism. In the case of chemical and biological

evolution, the prior metaphysical commitment is, obviously, materialism. Materialism is the view that material causes at base govern the world. Given materialism as a prior metaphysical commitment, it follows that life must evolve through purely material causes. But that commitment, like the alchemists' commitment to Neoplatonism, is highly problematic.

Proponents of materialism are, at this point, apt to note that life is here, life was not always here, and so some transformation from nonlife to life had to occur. Life has come about by a process of chemical evolution even if we cannot quite spell out the precise causal antecedents for life. The origin of life is a great unsolved problem, and origin-of-life researchers are valiantly trying to resolve it. For me to compare chemical evolution with alchemy will therefore strike the committed materialist as misconceived if not churlish.

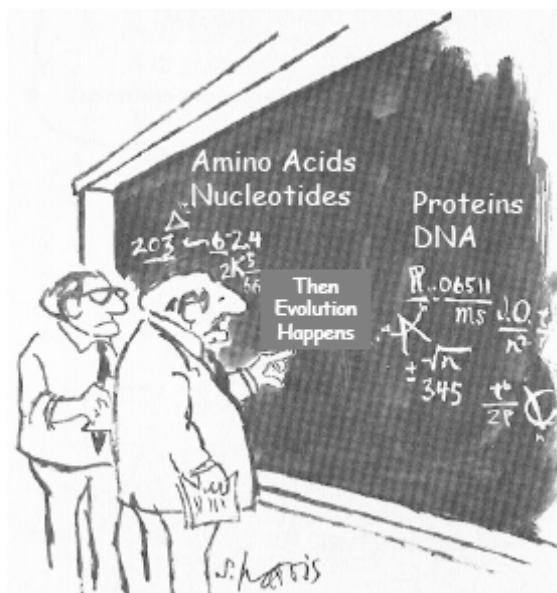
To see why this dismissal of my position is itself misconceived, consider what it means to say that life has, as the materialist claims, originated from purely material causes. Because the origin of life is an open problem, the reference to "purely material causes" lacks, to be sure, causal specificity. But there is a deeper problem, and that is the imposition of an arbitrary restriction. The problem with claiming that life has emerged from purely material causes is not that it admits ignorance about an unsolved problem, but that *it artificially restricts the range of possible solutions to that problem*; namely, it requires that solutions limit themselves to purely material causes. This is an arbitrary and metaphysically driven restriction. Life has emerged via purely material causes. How do we know that? In general, to hypothesize that X results from Y remains pure speculation until the process that brings about X from Y is causally specified. Until then, to impose restrictions on the types of causal factors that may or may not be employed in Y to bring about X is arbitrary and certain to frustrate scientific inquiry.

In this respect evolution is even more culpable than alchemy. Alchemy sought to transform lead into gold, but left open the means by which the transformation could be effected (though in practice alchemists hoped the transformation could be effected through the modest technical means at their disposal). Evolution, on the other hand, seeks to transform nonlife into life and then organisms into very different organisms, but -- when biased by materialism -- excludes any place for intelligence or teleology in the transformation. Such a restriction is gratuitous given evolution's lack of causal specificity in accounting not only for the origin of life but also for the macroevolutionary changes supposedly responsible for life's subsequent diversification.

Perhaps materialism will eventually be vindicated and the great open problems of evolution will submit to purely materialistic solutions. But in the absence of causal specificity, there is no reason to let materialism place such restrictions on scientific theorizing. It is restrictions like these -- typically unspoken, metaphysically motivated, and at odds with free scientific inquiry -- that need to be resisted and exposed. Science must not degenerate into applied materialistic philosophy, which is exactly what it does at the hands of today's alchemists -- the materialistic evolutionists who hold their views not on the basis of empirical evidence but because of a prior metaphysical commitment to

materialism. Science needs to be a free inquiry into all the possibilities that might operate in nature. Design, therefore, needs to be kept as a live possibility in scientific discussions of biological origins.

The origin of life is just one instance of evolution without causal specificity. The evolution of human consciousness and language from the neurophysiology of primate ancestors is another. The most widely debated instance is the evolution of increasingly complex life forms from simpler ones. Although the Darwinian mutation-selection mechanism is supposed to handle such cases of evolution, it encounters the same failure of causal specificity endemic to alchemy (see, for instance, my forthcoming book *The Design of Life*). The lesson of alchemy should be plain: Causal specificity cannot be redeemed in the coin of metaphysics, be it Neoplatonic or materialistic.



"I think you should be more explicit here in step two."

NOTES

[1] Carl G. Jung, *Mysterium Coniunctionis: An Inquiry into the Separation and Synthesis of Psychic Opposites in Alchemy*, in *Collected Works of C. G. Jung*, vol. 14 (Princeton: Princeton University Press, 1963). On page 114 Jung writes: "The alchemists sought for that effect which would heal not only the disharmonies of the physical world but inner psychic conflict as well, the 'affliction of the soul,' and they called this effect the lapis philosophorum [i.e., the philosopher's stone]. In order to obtain it, they had to loosen the age-old attachment of the soul to the body and thus make conscious the conflict between the purely natural and the spiritual man."

[2]Not only has alchemy failed as a scientific project, but also alchemy as a metaphysical project seems not to be in much better a state. Consider the following admission by Carl

Jung toward the end of his life (apparently alchemy had not enabled him to resolve the connection between body and soul -- see previous note): "I observe myself in the stillness of Bollingen, with the experience of almost eight decades now, and I have to admit that I have found no plain answer to myself. I am in doubt about myself as ever, the more I try to say something definite. It is even as though through familiarity with oneself one became still more alienated." Quoted in Gerhard Wehr, *Jung: A Biography*, trans. D. M. Weeks (Boston: Shambhala, 1987), 416. According to Jung's biographer (407), Jung regarded it as speaking well for the honesty of alchemists that "after years of continuing toil they were able to produce neither gold nor the highly praised philosopher's stone and openly admitted this. To these men, failures in the popular sense, Jung compared himself. He too had in the end been unable to solve the riddle of the *mysterium coniunctionis*."

[3]Even so, it is worth remembering that Isaac Newton devoted a full half of his writings to theology and alchemy. See the introduction by Brad Gregory to Baruch Spinoza, *Tractatus Theologico-Politicus*, trans. S. Shirley, intro. B. S. Gregory (1670; reprint, Leiden: Brill, 1989), 9.