

Even if Wallis and Webb are on some level talking past each other, I would argue for the appropriateness of a dialectical review. Both authors make claims about the same social phenomenon (with different names), sometimes using the same strategies and tropes (e.g., stalled mainstream vs. productive fringe), and with similar second-order goals in mind (i.e., making the epistemic world safe for particular kinds of diversity). And, curiously, both books fail to shed much direct light on the nature or practices of the various shamanisms they treat—no surprise, because their heads are elsewhere.

Considering the authors' expressed intent to move readers turned off by a mainstream scientific view of the world, I would further argue we can make assessments of their comparative successes both in presenting a compelling argument and in reaching their target audiences. As noted above, Webb's book has certain advantages over Wallis's in how it tailors price and style to its market niche. Wallis may want his book to reach that niche, too, but I fear it will not travel far from university library shelves, as handsome and well-crafted as it is. Within the fractured landscape of academia, it should find a congenial, if restricted audience that appreciates (quite legitimately) its contribution to the reassessment of shamanism and of the social sciences. Yet, for reasons Wallis's critique makes clear, Webb's book solidifies but does not substantively advance the extra-academic treatment of (neo)shamanisms.

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A Sense of the Mysterious: Science and the Human Spirit by Alan Lightman. Pantheon Books, 2005. 222 pp. \$23.00 (cloth). ISBN 0-375-42320-6.

Making Truth: Metaphor in Science by Theodore L. Brown. University of Illinois Press, 2003. 226 pp. \$32.50 (cloth). ISBN 0-252-02810-4.

The most recent books by Theodore L. Brown and Alan Lightman are important contributions to two related, interdisciplinary and growing topics of inquiry. Brown addresses the role of metaphor and metaphorical reasoning in scientific theory and practice, whereas Lightman muses over the delicate boundary between scientific and artistic creation. Each topic directly or indirectly involves the other, however. Lightman includes an essay on metaphor in science, and Brown's argument implicitly points toward a consideration of the personal, human and creative dimensions of scientific practice considered in *A Sense of the Mysterious*. In markedly contrasting approaches, and with different interests in mind, these authors both wonder about the nature of scientific and human creativity.

A Sense of the Mysterious is a thought-provoking, genuine, deeply felt personal reflection about the heart of scientific practice from the point of view of the practitioner. Alan Lightman, an adjunct professor at the Massachusetts Institute of Technology (MIT) with the only cross-appointment between humanities and sciences, received his PhD in theoretical physics from the California Institute of Technology. For years he has written and lectured on topics in both physics and creative writing, having felt at home in both domains.

The book is a collection of eleven essays (many previously published) that contemplate topics ranging from the exhilaration of mathematical discovery to the realities of science as a career choice. Many of the anecdotes are drawn from the history of theoretical and quantum physics, pure mathematics and astronomy. The first four essays move from the apparent contradictions between science and art toward the unity beneath all human knowledge. The fourth of these, "Inventions of the Mind," begins with a consideration of the rationalism/empiricism duality and its role in the production of knowledge, and moves toward the relationship between pure and applied math before finally discussing the foundations of math and their interface with mind and nature. Essays five through eight are biographical sketches of Einstein, Richard Feynman, Edward Teller and Vera Rubin, an astronomer at the Carnegie Institute in Washington, D.C., who is credited with the discovery of dark matter. The final three essays return to the autobiographical ruminations of the first. In "A Scientist Dying Young" and "Portrait of the Writer as a Young Scientist" (with obvious reference to James Joyce), Lightman considers what it means to turn 35 in his field, the average age at which most Nobel prizes in physics have been won and younger than the age at which physicists tend to be the most productive. So he lists the things he misses, about his life as a scientist, but also youth in general. Finally, in "Prisoner of the Wired World," Lightman moves to broader questions concerning the accelerating pace of technological life and the increasing importance of silence.

Lightman weaves a wistful path through the myriad of social, political and historical dimensions to his subject matter, as though he and the reader are turning the pages of a photo album of moments of truth about humanity. There is no singular argument or point to be taken from the collection, but rather the

string of insights and tidbits the reader may happen upon within each of these snapshots: how two teenagers made a light-borne communication device (p. 6); the author's admission as a student that "I would save my math problems for last, right before bedtime, like bites of chocolate cake awaiting me after a long and dutiful meal of history and Latin" (p. 9); or the aphorism in "Words": "the scientist tries to name things and the artist tries to avoid naming things" (p. 45). In "Inventions of the Mind," the reader will find Euclid's proof for the continuation of prime numbers to infinity (p. 74). Then there are glimmering bits such as "Richard Feynman was the Michael Jordan of physics" (p. 113), and the fact that the word *technology* entered public discourse only as late as 1861, with the founding of MIT (p. 193).

Similar themes and tones recur in each of the essays. The tension between apparent contradictions and unities, and the experience of change and loss itself, are serious points of reflection. As Lightman puts it in "A Scientist Dying Young," "in a way, I have gotten an unwanted glimpse of my mortality. The private discoveries of new territory are not as frequent now." (p. 177) It seems to be with the realization of the finitude of individual existence that Lightman turns at the end to the broader social question of the effects of an increasingly wired, connected life on personal well-being: "somehow, each of us must figure out how to measure the 'life,' our personal life, our inner self, that we exchange for each piece of technology or scheduled project or public connection." (p. 208)

The obvious drawback to this collection is that it offers less for readers already familiar with Lightman's writing. Only the eighth essay, "Dark Matter," has been written for this book. On the other hand, the essays have been gathered from a period spanning more than twenty years and different academic and literary journals and magazines, so even the average reader very familiar with Lightman probably would not have read all of these. Indeed, the published format works well. *A Sense of the Mysterious* is an apt title for this collection, encapsulating an attitude running through each of the essays and recalling Einstein's supposed remark that "the most beautiful thing we can experience is the mysterious. It is the source of all true art and all science." This is a light, enriching, accessible read that I would recommend for anyone unfamiliar with Lightman or who is at all interested in the way art and science stem from the same creative source.

Brown also is ultimately concerned with the creative aspects of human cognition, although *Making Truth* betrays a more specific and pressing agenda. A professor emeritus of chemistry at the University of Illinois at Urbana-Champaign, Brown also served as director of the interdisciplinary Beckman Institute for Advanced Science and Technology from 1987–1993, where he collaborated with faculty residents of cognitive science—Ken Forbus, Dedre Gentner, Jerry Morgan and Andrew Ortony. Brown reveals that through Jerry Morgan, he was introduced to Lakoff and Johnson's *Metaphors We Live By*. Brown took these ideas and wrote *Making Truth*. It is quite the straightforward

read, and Brown does precisely what he sets out to do: to show that "metaphor plays a central role in the development of a scientific subject, from its very beginnings through to its full development as a mature body of knowledge and understanding." (p. x)

Brown gets off to a slow start, with chapters introducing science, metaphor and the theory of conceptual metaphor. The subsequent six chapters apply Lakoff and Johnson's theory to foundational and developmental concepts in the history of physics, chemistry, biology and climatology, considering the metaphorical status of the atom, molecules and models, proteins, cells and global warming. Brown ends with "Science's Metaphorical Foundations," a chapter that dutifully reiterates—as much as it introduces—exciting issues and ideas one wishes had been dealt with more extensively throughout the text.

Brown's central argument is that science, from hypothesis to model to theory, is through and through a product and an example of metaphorical reasoning. In this, science does not differ from any other mode of human knowledge or inquiry. In order to speak about the abstract and intangible aspects of reality, concepts such as time, quantity, electrons or energy, we construct mappings of analogous characteristics from our experiences in the concrete, macroscopic field of embodied experience. Thus, we conceptualize heat, an entity that cannot be observed in itself, as flowing from a hotter object to a cooler one, due to analogous properties it shares with our more primary, physical experience of water and other liquids. As Alan Lightman puts it (and it is not apparent that he is familiar with Lakoff and Johnson at all), "in doing science . . . it is almost impossible not to reason by physical analogy." (p. 50) After describing Thomas Young's double slit experiment, Lightman remarks that "one cannot imagine how Young would have interpreted his observations without having seen ripples in a pond." (p. 52)

Some of the more salient assertions that Brown makes include many straightforward and seemingly "literal" scientific concepts, such as protein folding or global climate models, that are already inherently pure metaphors. Cells, for example, were so named by Robert Hooke in his 1665 *Micrographia* "because they reminded him of the small rooms, or cells, occupied by monks in monasteries. Thus, one of the most fundamental units of biology, the cell, received its name through a metaphorical association with a social institution." (p. 146) Models are extended metaphors; the more complex ones contain multiple metaphors. Even mathematical expressions and equations are metaphorical, because they refer to the model. The more complex a phenomenon is, such as the cell, the less we model it after physical embodied experience and the more it is modeled after experience in the more complex social domain. Brown discusses the "chaperone metaphor" in cellular biology, which "suggests a function for the newly discovered nucleosome assembly protein and even points toward how that function might be carried out." (p. 153) Successful metaphors create the ability to interpret new information and to follow new lines of research. "A very large number and variety of proteins have now been

identified as chaperones." (p. 153) Moreover, "a newly established metaphor not only stimulates research that gives rise to an elaboration of the original idea but also can initiate a reinterpretation of earlier work." (p. 154) Other important observations are that a given metaphor does not represent all the known facts about a given entity; it hides some and highlights others. This is an important epistemological and ethical entailment of metaphor choice. For this reason multiple metaphors may be needed to conceptualize all of the entity's parts or functions. Further, individual metaphors take on new roles as they are appropriated by public discourse. Most important, they lose their epistemological value and take on ethical value.

As with any useful metaphor, global warming maps onto aspects of the observational world in ways that make for a coherent story ... when these metaphors are used in public discourse, however, their character changes. In this larger arena the term *global warming* does not bring to mind the underlying scientific ideas. Instead, it has become the name for something that resonates because of its commonly held, or folk, beliefs. (p. 179)

Brown also contends that metaphor—be it a singular concept, a model or a theory—is a more accurate way of understanding the reality of scientific practice and a more effective exploratory, pedagogical and communicative tool than the pure induction of logical empiricism (p. 158). After all, "in themselves the data tell us nothing; only through the agency of models and theories can we convert raw observational data into something that makes sense." (p. 184)

There is no need to review the various models and metaphors that Brown discusses in painstaking detail in chapters four to nine. It is enough for the reader of this review to simply think of some prototypical scientific concepts and then to refer to them as metaphors. Indeed, sometimes this is all that Brown does, but it is also precisely his point. The macroscopic ones are obvious once considered: talking about the cell as a factory, city or hospital (as in "protein processing is triage"), or the application of the chaperone concept to heat shock proteins, prions or metallochaperones. Metaphors in the microscopic domain may be less easy to recognize, because concepts here are usually taken in a literal sense. All that is known about atoms, for instance, is based on models constructed according to different observational criteria and standpoints, and is thus metaphorical to its core.

Overall, *Making Truth* is a good book with many merits. For one thing, not many scholars could have written about this topic, which requires the accuracy, depth and breadth of knowledge and expertise in the various fields of science demonstrated by the author. Brown is able to explain complex scientific processes simply and succinctly without compromising on important details. More importantly, this topic is a fascinating, original and invaluable contribution to the cognitive study of metaphor as well as the philosophy of science, even though Brown makes explicit that his intention in writing it was not to involve himself in certain long-standing philosophical debates (p. 186).

So I would recommend *Making Truth*, but it is not for everyone. It is not for

readers looking for a deeply theoretical or speculative investigation of metaphor. It is more of an introductory science text. In fact, it seems the ideal reader would be someone with as little background in the humanities as not to know Lakoff and Johnson's conceptual metaphor theory, but also someone with as little scientific knowledge as not to tend to skip over the textbook discussions of the discovery and structure of atoms, electrons and cells. On the other hand, scientists interested in exploring the metaphorical and cognitive aspects of their own discipline, but who aren't willing to crack open the mighty *Philosophy in the Flesh* or *Metaphors We Live By*, may find this book a handy introductory reference.

One disappointment about this book, in fact, is just that Brown doesn't venture much beyond Lakoff and Johnson. It is true that these cognitive scientists were the pioneers of this way of thinking about metaphor and cognition, but there have been many other pieces published on metaphor in science throughout the twentieth century in journals for the history and philosophy of science. It would have made for a more enlightening read, I think, had Brown attempted to engage his argument with the rest of the discussion that has been unfolding concerning this topic.

It also seems to me that Brown affords too much emphasis on the basic intricacies and operations of physical nature—Brown himself says at one point that "the following is just what scientists would read in an introductory text on this topic"^v—and not enough discussion of what the book purports to be about if one pays attention to its title. Even the topic of metaphor is not treated with much substance until the later chapters, where Brown begins to synthesize the whole idea into something of a bigger picture. In particular, a lengthy excursion into the minutiae of the identity and order of amino acid bonds grossly outweighs the requirements for demonstrating the metaphoric origins in language and folding. It is as though Brown is arguing that what we have been staring at all along is not a door that opens up into another world, it is a *bleghsta* (portal) that makes us feel like that if we walk through it. And to prove this, he proceeds to describe all the features of the door: how it moves, what it is made of, its size and so on. In other words, the book is simply about science as usual, plain and simple, its method merely referred to by another name. One wonders, if models and theories are extended, intricate metaphors, and this is how science has always proceeded and continues to proceed, then what difference to science does this recognition make? Brown does not substantially elaborate on this.

Perhaps it is with knowledge of the contentiousness of his assertions that Brown is at such pains to walk the reader through all the evidence of metaphor at work in science. Brown concedes he is advancing a somewhat controversial view of the cognitive processes behind scientific progress. Brown's socio-historical approach, along with the book's title, index the text within a social constructivist view of science. Despite sporadic traces of Kuhn, and Brown's emphasis on the theory-ladenness of most scientific observations (p. 183),

Brown is not an anti-realist, but a more modest scientific realist. His view "lies somewhere between the strongly objectivist stance of some scientists on one hand and a strongly social constructivist view on the other." (p. 191) Following Lakoff and Johnson's footsteps, Brown calls this weaker scientific realism "embodied realism." Indeed, Brown emphasizes the real, independent existence of the world and the stability and reliability of our knowledge of nature. How is it then that we "make truth?" Models and theories "are shaped by our particular capacities for observation and reasoning, and their truth content is judged in terms of correspondence with knowledge gained through those capacities, not by correspondence with a mind-independent reality." (p. 187)

So, considering the prevailing philosophies of science Brown is up against, it is understandable to have gone to such lengths to prove the existence of metaphor in science, although it could be argued that fact does not need much proof. What is worse is that Brown fails to explore a number of more interesting questions until the final chapter, where he argues that there should be a greater emphasis on the creative use of metaphor in science education and makes a call for a new philosophy of science grounded in a theory of embodied reasoning. He also reaches the interesting conclusion that we should give up on the idea of a theory of everything because, even if possible, it would prove "useless in accounting for nearly everything that matters" (p. 195). But Brown does not make it to the questions that seem most to matter to him until the last page and a half. Here he concludes that:

When we recognize that scientific reasoning is based on the same kinds of thought processes used in other arenas of thought . . . science is really not so mysterious after all. What is mysterious and wonderful is the power of metaphorical thought . . . (p. 196)

Well, because Brown has just proven that metaphor is at the heart of science, that means science is still mysterious. Hence Lightman's continuing fascination, after 35 years, with the source of this process:

I miss the exhilaration of seeing brilliant people at work, watching their minds leap right in front of me, not the brooding intelligence of writers, but an immediate mental agility, pole vaults and somersaults and triple axels on the ice. Richard Feynman once walked into my tiny office at Caltech and, in twenty minutes at the blackboard, outlined the basic equations for the quantum evaporation of spinning black holes, an ingenious idea that had just occurred to him on the spot. (p. 179)

Both books thus point toward the role of metaphor in negotiating this relationship between mystery and creativity. Brown concludes that because "there is no special kind of rationality that separates science from other kinds of thought" (p. 188), scientists are like anyone else who aspires to be creative. "In modeling the sea, the scientist uses metaphors that highlight one set of its properties without touching at all on aspects that capture the attention of Herman Melville or Joseph Conrad." (p. 196) Lightman says as much when he considers that "a mathematical proof is a beautiful painting in which the viewer is not

Now, it is true that soon after presenting his doubts about induction, Hume ignores them and expresses full confidence in the regularity of nature and the persistence of natural law without seeming to offer anything in the way of a suggestion on how to remove those doubts. He sometimes states his confidence in very strong language. Despite reason's inability to prove the conformity of the unobserved to the observed, it is, in some sense, reasonable to rely on natural laws and not to expect miracles. That does not mean that the probability of future violation of natural law is flatly 0. Hume repeats this pattern in which he undermines our common notions (causality, self identity, existence of the external world, and so forth), and then ignores the conclusions of his own arguments and goes on to theorize using those very notions. Here is an interpretative puzzle with which Earman does not deal at all. He is surely aware of Hume's famous skeptical arguments about induction and the other notions, but he is too narrowly focused on the essay on miracles to take anything into consideration from Hume's other writings. Earman does an admirable job of setting Hume's essay within the seventeenth and eighteenth centuries' debate on miracles and even reprints some key essays of the period on the topic as the second part of his book. But for all his contextualizing of Hume's essay, Earman makes no effort to set Hume's treatment of miracles within Hume's overall philosophical project. Had he done that, he may have seen that for Hume, being fully confident about a statement is not the same as assigning that statement the probability of 1 and its negation 0. Though Hume provides definitions for natural law and miracles and never genuinely doubts the regularity of nature, he never puts forth the first argument Earman attributes to him. Indeed close to the end of his essay, Hume explicitly rejects its conclusion and admits the possibility of violations of natural law. He admits that miracles may be proven by testimony. He writes:

I beg the limitations here made may be remarked, when I say, that a miracle can never be proved, so as to be the foundation of a system of religion. For I own, that otherwise, there may possibly be miracles, or violations of the usual course of nature, of such a kind as to admit of proof from human testimony. (EHU 127)

Hume goes further. He even accepts Earman's claim that the evidence from testimony can amount to more than that of uniform experience. He continues:

[t]he decay, corruption, and dissolution of nature, is an event rendered probable by so many analogies, that any phenomenon, which seems to have a tendency towards that catastrophe, comes within the reach of human testimony, if that testimony be very extensive and uniform. (EHU 127)

If testimony supporting a miracle is more "extensive and uniform" than the experience confirming the supposed law it violates, Hume cannot disallow the

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supposed to see the brushstrokes of the artist." (p. 76) We might say that Brown examines metaphor from the outside, whereas Lightman's book approaches it from the inside, embodying as he does the *experience* of metaphor (a *crossing over* or *transference* between art and science). But why is metaphor so mysterious? If part of it is because it has long been subordinated to logic as a method of human reasoning, I think that each of these books goes a long way to definitively correcting such a vision.

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Hume's Abject Failure: The Argument against Miracles by John Earman. Oxford University Press, 2000. xi + 217 pp. \$29.95 (paper). ISBN 0-19-512738-2.

A Defense of Hume on Miracles by Robert Fogelin. Princeton University Press, 2003. xii + 101 pp. \$35.00 (cloth). ISBN 0-691-11430-7.

John Earman is as suspicious of specific miracle claims as he is of philosophical attempts to rule them out of hand. As Earman reads it, Hume's celebrated essay on miracles, a version of which was written in 1737 but did not appear in print until 1748 as section X of his *Enquiries Concerning Human Understanding*, aims to show that there is never enough reason to believe reports of miracles. Earman finds two arguments in Hume's essay: one that considers the evidence against miracles alone and a second that weighs the evidence for and against miracles.

A miracle is, by definition, a violation of a law of nature, which is a generalization based on uniform experience. Because uniform experience provides us with the best proof experience can furnish, a belief in any miracle always has against it the best proof experience can possibly provide. A belief in miracles is, therefore, never warranted. This is the first argument Earman reads in Hume. Against it he argues that because even completely uniform experience cannot establish natural law with absolute certainty (the probability of 1), ruling out violations of natural law is dogmatic. A natural law is confirmed by observing a regularity in nature, but there is nothing to ensure that unobserved cases will continue to conform to the observed regularity. No matter how low the probability, the possibility of a law-violating event will always remain.

Wanting to distance himself from the dogmatism of this argument, Hume, on Earman's reading, retreats and provides a second argument in which he also weighs the evidence in favor of miracles. Uniform testimony is, in the best case, the evidence in favor of a miracle. Because miracles are violations of natural