Book Review

Making Truth. Metaphor In Science, Theodore L. Brown (University of Illinois Press, 2003) 215 pp, ISBN 0-252-02810-4; $32.50 (hardcover)

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Some time ago, during an interdisciplinary discussion of the relation between science and theology, a humanities col- league referred admiringly to scientists "going into the laboratory to discover Truth" (the capital T being clearly implied). That made me uncomfortable, since, though I believe firmly that what we scientists uncover through our investigations is certainly true, I think of our goals as somewhat more modest than the implication of a near-Platonic "Truth" suggests. Peter Medawar remarked that if a scientist said he was going into the laboratory to apply the Scientific Method to discover Truth, his colleagues would think he was overdue for a vacation. The opposite, of course, is the postmodernist view that what passes for truth is just a social construct. So which is it: do we discover truth or manufacture it?

Making Truth. Metaphor In Science, by Theodore L. Brown, professor emeritus at University of Illinois (known primarily – at least to the reviewer – as the author of a successful general chemistry text) charts an intelligent course between the two extremes by making the case that scientific knowledge is mediated, requiring metaphor to describe the external reality being studied. Not that scientific truth is invented, or that the properties of matter, and the laws describing them, are the product of arbitrary human consensus, as post-modernists argue. Brown sides with the realists in the culture wars, believing, as virtually all scientists do, that there is an "out there" out there waiting to be explored and discovered, but he argues that humans' ability to envision that reality depends on concepts derived from fundamental sensory experiences, like movement through space, enclosure, temporal change, interactions, transactions, and relationships. Those experiences provide the categories for our thinking and language, with less direct experiences necessarily described in terms of them. Our ability to think about anything beyond the pale of direct sensory observation is unavoidably metaphorical, like the languages of poetry and spiritual experience.

In outlining the role of scientific metaphor, Brown points out that theories involve a mapping between a more abstract *target domain* (experimental observations) and a *source domain* (ideas drawn from direct experience to describe the relevant properties of the target domain). This mapping constitutes a metaphor whose utility depends upon the closeness of the mapping, and on the hearer's familiarity with the properties of the source domain used to describe the observations. In addition to an inevitable approximation, there is also a social or cultural component to theories, since a hearer must be familiar with the source domain experience. (Thomson's "Plum Pudding" description of the atom is meaningless to someone unfamiliar with plum pudding, as is description of the Doppler effect in terms of changing pitch for someone deaf from birth.) On the other hand, the power of metaphors is that, in addition to organizing observations, they may guide future thinking by suggesting additional perspectives not originally intended in the original description.

Later chapters explore the role played by scientific metaphors at increasing levels of complexity, from the development of the classical notion in ancient Greece by of Thales of Miletus and his successors, through its resuscitation and extension by Dalton, to its final triumph in the early twentieth century. Experiences drawn from life ("embodied experiences") employed as metaphors to describe the properties of atoms included causation, space as container, motion of objects, and application of force. While one might expect that the importance of metaphors would decrease or eventually disappear as theories evolve from verbal descriptions to ones based on mathematical descriptions, as with Bernoulli's model of gas behavior based on the laws of physics and the idea of molecular motion (the ancestor of the kinetic theory of gases), Brown argues that a mathematical model based on a metaphor is also metaphorical, a proposition that some scientists, especially mathematicians and philosophers of science, might challenge.

Brown next looks at how the understanding of atomic structure evolved, from the work of Thomson, Rutherford and others, to the eventual development of quantum theory. Here again, familiar metaphors can often lead to misapprehensions, from the idea of orbitals as containers for electrons, to thinking of energy changes in terms of changes in vertical position, as I have sometimes seen students do.

Later chapters deal with molecular models in chemistry and biology, from van't Hoff and Lebel's introduction of the ideas of molecular shape and chirality, to the development of molecular models, to the eventual extension of the container metaphor to encompass the idea of molecular cages. Powerful computers with advanced graphic capabilities have now liberated scientists from the constraints of mechanical models, allowing us to visualize and manipulate structures, and even dynamic processes, of hitherto unimaginable complexity in 3-dimensional hyperspace, depicting them in a wide range of different ways, making molecules more palpable and "real" than ever before. One might

argue that this ease and immediacy of visualization has had the unfortunate effect of further obscuring the role of metaphor.

Brown issues this cautionary remark: “First we must remember that any model we might use to characterize the atom is metaphorical, whether it be that of a billiard ball, a plum pudding, a miniature solar system, a cloud of negative charge surrounding a positive center, or a densely mathematical description based on quantum theory. Our experimental attempts to *see* the atom [emphasis mine] as it is all involve approaches that relate observables to the atom via one or more mod- els. Thus, the images they yield are necessarily metaphorical. We don’t ever ‘see’ atoms. The images we obtain are indeed based on a stable mind-independent reality ... One is moved to think ‘Surely we are really seeing the atoms here!’ What we see are constructs that at their best represent reliable models of reality, with sufficient verisimilitude to serve as productive metaphors. They facilitate correlations, predictions, and interpretations of other data and stimulate the creative design of new experiments. That is all we can hope for.” (p. 99)

Succeeding chapters focus on systems of interacting molecules and processes in cells, and ultimately global warming. Here the metaphors move away from simple embodied experiences to more social ones, like transactions and factories. For example, the metaphor of “chaperone molecules”, initially proposed to describe the role of small proteins in preventing incorrect interactions between histones and DNA, progressively broadened as it was extended far beyond its original context – an illustration of metaphors’ power not only to describe, but also to direct future thinking. An interesting question, which Brown does not address, is the extent to which the ability of socially based metaphors to con- vey meaning and to suggest extensions is transferable across widely different cultures. He makes a compelling case for the view that all scientific knowledge is ultimately metaphorical, therefore limited. Thus, the scientific grail of developing a “theory of everything” is illusory and ultimately futile. R.T. Sanderson made a similar point in the introduction to *Simple Inorganic Sub- stances: A New Approach*, Krieger Publishing Co. (Malabar, FL, 1989):

“It seems to me that nature consists of an elaborate intercommingling of marvelous simplicities with infinite complexities. I believe that the ultimate in truth and understanding is forever unattainable, but that human beings can deliberately create the illusion of understanding by recognizing and applying the simplicities in a useful way. We need not be embarrassed at the illusory nature of our understanding as long as it serves a useful purpose and we do not indulge in self-deception. More power to those who prefer to challenge their intellects by attempting to unravel the infinite complexities, but I think they should be careful neither to expect to win nor to convince themselves they have won.” (p. xxiii)

To quote Brown again (speaking of atoms and molecules), “What we see are constructs that at their best represent reliable models of reality, with sufficient verisimilitude to serve as productive metaphors. They facilitate correlations, predictions, and interpretations of other data and stimulate the creative design of new experiments. That is all we can hope for.”

That is also not all that bad. Brown has a fluid and accessible writing style, and whether or not you find his thesis convincing, *Making Truth* makes for thought-provoking and worthwhile reading.