METAPHORS IN THE HISTORY OF PSYCHOLOGY

EDITED BY

DAVID E. LEARY

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Preface

This volume reflects at least three trends that have become increasingly apparent over the past several decades: the development of interest in the history of psychology; the development of interest in the nature of cognitive processes, particularly those underlying creative activity; and the development of interest in the nature of language, especially the incidence and functions of metaphor. Although these trends overlap in various regards, the chapters in this volume tighten their association by explicating the role of metaphors in the thinking and behavior of psychologists. As a whole, this volume should raise the consciousness of psychologists, historians of science, students, and interested laypersons regarding the uses – and abuses – of metaphor in the history of psychology.

As the book's progenitor and editor, I am particularly grateful for the cooperation, diligence, and scholarship of my collaborators; for the interest and support of the director, staff, and my fellow fellows (in 1982–3) at the Center for Advanced Study in the Behavioral Sciences, Stanford, California; for the encouragement and feedback of many persons who attended a series of symposia entitled "Metaphors in the History of Psychology" that were held at the annual meetings of the American Psychological Association between 1983 and 1986; for the intellectual and financial assistance of the Department of Psychology, Dean Stuart Palmer of the College of Liberal Arts, and the Research Administration Office of the University of New Hampshire; for the reference checking and proofreading done by Trey Buchanan and Linda Pertsch; for the patience and secretarial help of Shirley Norton, Donna Hardy, and especially Anna Moses; for the expert and timely editorial work of Helen Wheeler and

Mary Nevader of Cambridge University Press; and for the forbearance of all those, from collaborators to strangers, who kept asking, "When is that book on metaphor going to come out?" Finally, I would like to acknowledge a very personal debt to my wife, Marge, and to my children, Emily, Elizabeth, and Matthew. I would not have had the satisfaction of being associated with this work if they had not continually supported my scholarly efforts.

Perhaps a few words about the chapters in this volume are in order. My introductory chapter, "Psyche's Muse," is meant simply to draw you, the reader, into the subject and concerns of this volume by presenting a brief, preliminary discussion on metaphor and by pointing to illustrative instances of its historical role in fields other than psychology as well as in psychology itself. The objective of this introductory chapter is simply to set the scene for the subsequent chapters in such a way that no reader will put down this volume with the idea that psychology is somehow alone in its reliance on metaphor. However unique its particular uses of metaphor, psychology has had no monopoly on metaphorical thinking. As a result, even though this volume focuses primarily on the role of metaphors in psychology, its analyses are relevant to an understanding of intellectual life in general, both inside and outside the domain of science.

Whereas my introductory chapter seeks to elicit your interest and to set wider boundaries for your thoughts, my concluding chapter briefly summarizes the major metaphors and sources of metaphors covered in each chapter, sharpens an important point that is not emphasized in the foregoing chapters, and indicates the scholarly work that remains to be done. Since the chapters of this volume provide in each case something akin to initial reconnaissance, I have resisted the impulse – and the weight of custom – to "tie it all together." Such considerable unity as this volume enjoys inheres in its common subject and in the common objective toward which the chapters point. There is no need to hasten closure at this time.

As for the chapters between my introduction and conclusion, you will discover that they are the heart and soul of this book. They describe in considerable detail the uses of metaphor in different areas of psychology. Other areas might have been represented, either instead of or in addition to those actually chosen. But those surveyed herein constitute a very reasonable selection from among the many subspecialties encompassed by the contemporary discipline of psychology. In any case, by offering such a rich and varied diet, the contributors to this volume have provided plenty of food for you to digest, with profit, for a good long time.

This book is intended primarily for those whose interests intersect one or more of the trends listed at the beginning of this preface. But even if you

are not among these many individuals, I join my fellow collaborators in hoping that you will be informed, stimulated, and challenged by this volume.

As for ourselves, the authors of this volume, we have enjoyed producing this book, and if anything, we are now more conscious than before that our topic is important – and that our contributions are all too preliminary. As Philip Wheelwright once noted in a similar context, we can only murmur with the Hindu sages of the Upanishads, "*Neti neti*," which is to say, "Not quite that! Not quite that!"

We thank those who have been patient as we traveled toward this milestone in our efforts to comprehend the role of metaphor in the history of psychology, and we are grateful in advance to those who will read this volume with tolerance as well as vigilance. However fallible our analyses and arguments may be, we are convinced that they deal with topics and concerns that deserve – and will repay – the effort of sustained attention.

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Psyche's muse: the role of metaphor in the history of psychology

DAVID E. LEARY

Ever since Aristotle asserted that "the greatest thing by far is to be a master of metaphor," numerous scholars have studied and written about the nature and functions of metaphor.[1] The vast majority of these scholars have focused on metaphor as a distinctive use of language that has various rhetorical functions.[2] Recently, however, some scholars have begun to dig deeper into the topic, investigating the possibility that metaphor is not only a form of *speech*, but more fundamentally a form of *thought*, having basic epistemological functions.[3] With regard to science, for instance, such scholars as Arbib and Hesse (1986), Barbour (1974), Black (1962, 1979), Bohm and Peat (1987), Boyd (1979), Farber (1950), Gerschenkron (1974), Gould (1977a,b, 1983), Hesse (1955, 1966, 1980), Hoffman (1980, 1984b), R. S. Jones (1982), Kuhn (1979), Leatherdale (1974), MacCormac (1976, 1985), Martin and Harré (1982), Nisbet (1976), North (1980), Oppenheimer (1956), and Temkin (1977) have begun to study the ways in which metaphorical thinking, broadly conceived, has helped to constitute, and not merely reflect, scientific theory and practice.[4] Following upon such work, this volume has been organized with the intention of raising and answering questions about the role of metaphor in the history of psychology, while also providing analyses of some of the major metaphors that have guided – and sometimes preempted – investigation in selected areas of psychology.

My own orientation, as organizer and editor of this volume, should bear some preliminary scrutiny, though my views about metaphor and its role in the history of psychology do not necessarily reflect those of other contributors to this volume. (No contributor had to sign an oath of

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allegiance in order to participate in this intellectual venture.) The purpose of this introductory chapter, therefore, is to describe the orientation underlying my involvement in this collaborative project, to provide a brief opening discussion on metaphor (as it is generally understood in this volume), and to give a historical survey of selected uses of metaphor in various disciplines of thought, including but not limited to psychology. This survey will occupy most of the chapter and will provide a running start into the chapters that follow. I hope it will also obviate a conclusion that might be reached on the basis of the title and coverage of this volume, namely, that metaphor plays a role in psychology but not necessarily in other disciplines. It would be indefensible if this volume invited or left room for the impression that psychology stands alone in its reliance on metaphorical thinking.

Preliminary distinctions and discussions

My own thesis

To start things off, I shall state my own thesis as baldly as I can: All knowledge is ultimately rooted in metaphorical (or analogical) modes of perception and thought. Thus, metaphor necessarily plays a fundamental role in psychology, as in any other domain. In other words, the inspiration of psychological thought, which I have symbolized as "Psyche's Muse" in the title of this chapter, derives from the comparative, relational mode of understanding that I presume to be fundamental to human cognition.

The simplest and most appropriate way to elucidate this thesis is by means of an analogy. If I am confronted with a word that I do not understand, I will either ask someone what it means or look it up in a dictionary. In either case, I will keep asking and searching until the word is defined in terms of other words that are better known to me. This simple example can serve as a paradigm for the many ways in which we confront and come to understand "reality." When any aspect of our experience strikes us as worth understanding, either for the first time or in a new way, we begin to search for "similar instances," as William James (1890) called them (chaps. 13, 19, and 22). Only when we have found an apt "peg" or "pigeonhole" for this aspect of our experience do we feel the subjective satisfaction that brings our search to an end.[5] It is my contention that the similar instances that serve as our pegs and pigeonholes – as our categories of understanding – are either explicitly or implicitly metaphorical in nature and function.

To express this contention in slightly different terms, I would say that just as we turn to a dictionary for the definition of unknown words in terms of more familiar words, so we look to phenomena of other sorts,

whether natural or artificial, for analogs of things, qualities, and events – including aspects of our own experience and activity – that we wish to comprehend. And conversely, we often look to our own experience and activity for analogs of other natural and artificial phenomena. For instance, Aristotle (ca. 330 B.C./1931) explained mental functioning through the use of biological metaphors, while recent cyberneticists (e.g., Wiener, 1961) have revised our notion of biological organisms through the use of mechanical and cognitive metaphors. Thus, to Aristotle the mind is a *living thing,* whereas to cyberneticists living things are information-processing *machines.* Consequences of both a moral and an aesthetic nature result from such conceptual differences.

This general contention regarding the fundamentally metaphorical nature of human thought seems obvious to me, but it is nevertheless worth stating and considering, since forgetting the metaphorical nature of our concepts invites "hardening of the categories" and the various sorts of myths and cults – such as the myth of objectivity and its associated cult of empiricism – that have characterized so much of twentieth-century thought, in the social and behavioral sciences as elsewhere (see Toulmin & Leary, 1985).

Of course, I am far from the first to propose that human language and thought are ultimately metaphorical. Indeed, I have some very good company. If Aristotle is not foursquare among this company (see Levin, 1982; Lloyd, 1987), he at least started the ball rolling by pointing out that "it is from metaphor that we can best get hold of something fresh" (Aristotle, ca. 330 B.C./1924a, l. 1410). Still, it is only in modern times, beginning with the etymological, rhetorical, and historical analyses of Giambattista Vico (1744/1948), that many scholars have come to share the view that metaphor characterizes human thought and language in a truly fundamental way. This view, which usually presupposes that analogy is included in the broader category of metaphor, has been held by many theorists of various persuasions – by empiricists and pragmatists as well as by idealists and intellectual anarchists: by David Hume, Jeremy Bentham, Alexander Bain, and Charles Peirce (for instance) as well as by Immanuel Kant, Friedrich Nietzsche, Hans Vaihinger, and Ernst Cassirer.[6] In point of fact, this view has become so widespread and has been expressed by theorists of so many orientations that the twentieth-century psychologist Kenneth Craik seems to have uttered a mere commonplace when he suggested that "the brain is a machine for making analogical models."[7] This view has been reinforced in recent years by a host of studies conducted by investigators from many disciplines (e.g., Holland, Holyoak, Nisbett, & Thagard, 1986). In sum, the postulate that metaphorical or analogical thinking plays a fundamental role in the acquisition and extension of knowledge has been broadcast far and wide.

Nonetheless, this view is not unanimously held. The contention that all

language and thought is ultimately metaphorical or analogical is controversial, even though it is common. To give the critics their due, two major distinctions must be acknowledged and addressed: (1) the distinction between metaphor and other figures of speech and thought and (2) the distinction between metaphorical as opposed to literal language and thought. These distinctions can and, in some contexts, certainly should be made, but in relation to my thesis, I believe that by and large they can be ignored. In the following sections I shall try to justify this belief by arguing (1) that metaphor is not simply one among many figures of speech and thought, but rather, that it can be reasonably considered to be the primary figure of speech and thought and (2) that there is no absolute chasm between metaphorical and literal language and thought.

The definition of metaphor and its relation to other figures of speech and thought

Consistent with my thesis, metaphor has been defined through the use of comparisons – indeed, *many* comparisons: Metaphor has been likened to a filter, a fusion, a lens, a pretense, a screen, a tension, a displacement, a stereoscopic image, a form of linguistic play, a false identity, a semantic fiction, a contextual shift, a translation of meaning, a twinned vision, and an incongruous perspective, to mention only a few of its common metaphors. This range of images and their correlative definitions is so great that one student of metaphor, Janet Martin Soskice (1985), has commented that "anyone who has grappled with the problem of metaphor will appreciate the pragmatism of those who proceed to discuss it without giving any definition at all. One scholar claims to have found 125 different definitions, surely only a small fraction of those which have been put forward" (p. 15). Still, even allowing for alternatives, it will be useful for me to provide a general definition, if only to move our discussion along.

Soskice's own "working definition" is that "metaphor is that figure of speech whereby we speak about one thing in terms which are seen to be suggestive of another" (p. 15, italics deleted). This definition is similar to that of Richard Brown (1977), who asserts simply that "metaphor is seeing something from the viewpoint of something else" (p. 77). Like most definitions of metaphor, these reflect Aristotle's (ca. 330 B.C./ 1924b) definition, according to which metaphor is constituted by giving to something "a name that belongs to something else" (l. 1457). Following Soskice and so many others, I shall stay within Aristotle's ambit by offering the following, slightly modified definition: Metaphor consists in giving to one thing a name or description that belongs by convention to something else, on the grounds of some similarity between the two. In considering this definition, one should realize that the thing metaphorized need not be a material object. Qualities, events, and any other aspect of

experience are included among the innumerable "things" that can be rendered through metaphor. This definition also suggests that Aristotle's "denomination" theory is inadequate, if understood in a restricted sense. Metaphor often involves more than the mere transfer of a *name* from one object to another. As Paul Ricoeur (1977, 1979) has noted, metaphor can also involve the transfer of predicates or descriptions. Indeed, anything associated with the metaphorical term, in its original context, can be implied of its new referent. Thus, when Aristotle treated the mind as a living thing, he invited the inference that it can develop and change over time, and when cyberneticists make information central to biological functioning, they set the stage for questions about the relationship between the "noise" and "messages" involved in the regulation of living bodies.

This definition of metaphor also highlights the fact that convention – one's understanding of the "normal" usage of language – plays a role in the creation of metaphor. I will say more about this in the next section. Finally, this definition suggests that similarity – or analogy – is the bond between the two things compared in a metaphor. As Aristotle (ca. 330 B.C./1924b) said, "A good metaphor implies an intuitive perception of the similarity in dissimilars" (l. 1459). Thus, the notion of similarity or analogy is included in the concept of metaphor. To say that the mind is a living thing or that a living thing is a machine – as also to say that emotions are forces, or that the senses are signal detection devices, or that behavioral problems are illnesses – is to suggest a set of resemblances between the members of each of these pairs of terms.

The inclusion of analogy in the concept of metaphor underscores the fact that I am proposing a broad definition of "metaphor" that encompasses a variety of other figures of speech. Indeed, according to the above definition, metaphor can hardly be distinguished from trope (figure of speech) in general.[8] Furthermore, a consequence of this definition is that such things as fables, parables, allegories, myths, and models, including scientific models, can be seen, by implication, as "extended and sustained metaphors" (Turbayne, 1970, pp. 11–20; see also Barbour, 1974, pp. 42–5; Black, 1962, p. 237; Shibles, 1974, p. 27).

Others before me have argued for giving this sort of generous sway to the concept of metaphor. Traditional rhetoricians, for instance, have allowed metaphor to stand for figure of speech in general as well as for one particular figure of speech among others (see, e.g., Fogelin, 1988, p. 28; Hawkes, 1972, p. 2; Lanham, 1968, pp. 123–4; Perelman & Olbrechts-Tyteca, 1959/1969, pp. 398–9).[9] This does not mean, of course, that nothing could be gained by using the term, in a study like the present one, with a narrow rather than broad signification. Future studies might well investigate the role that metaphor, as *distinct* from analogy, simile, metonymy, synecdoche, and so on, has played in the history of psychology. However, I believe that there is good reason to proceed here with a

broader view, not only because of scholarly precedent, but because the evidence (as I see it) supports David Cooper's (1986) conclusion that "usually one gains rather than loses by employing 'metaphor' in a generous way" (p. 196). I believe that this is surely the case in an admittedly preliminary study like the present one. At the start, it is critical to make certain that there is a general phenomenon of some interest and import, however blunt our means of identification and exploration. As a result, I am quite content that the contributors to this volume, for the most part, have assumed a broad rather than narrow definition of metaphor and that some have felt free to use analogy as virtually equivalent to metaphor. In my judgment, that is as it should be.[10]

Metaphorical versus literal language and thought

The key to the relationship between the metaphorical and the literal is provided by the concept of conventionality. Metaphor is constituted, I claimed in my definition, by the attribution to one thing of a name or description that belongs *by convention* to something else. Although the problem of reference is a thorny one, it is nevertheless commonly assumed that descriptions as well as names are *assigned* to things by social practice rather than *discovered* through some sort of raw experience, as if they were somehow embedded for all time in their objects. What counts as literal language, in the now standard account, is language usage to which a particular linguistic community has grown accustomed. Thus, when English speakers refer to the "leg" of a chair, they need not worry that other skilled English speakers will think their expression rather oddly metaphorical. However, as in so many instances, it is nonetheless true that the term of reference – in this case *leg* – was originally an imaginative metaphor. It is only with repeated usage over time that such terms are transformed by custom into "literal" terms with virtually unanimously understood referents. The implication, as Ralph Waldo Emerson (1836/1983a, 1837/1983b, 1844/1983c) noted more than once, is that metaphor is the fertile soil from which all language is born, and literal language is the graveyard into which all "dead metaphors" are put to rest.[11]

What this means is that there is no sharp division between metaphorical and literal language. At the opposite ends of a single continuum, relatively clear instances of metaphorical and literal language are fairly easy to recognize, but – except in truly dead languages – there is continual commerce between these two poles, as metaphorical concepts become more common (i.e., literal) through use and as literal concepts are used in unexpected (i.e., metaphorical) ways. In this manner, the metaphorical concept of "cognitive input" has lost most of its novelty and awkwardness over the past decade, and the once literal (physiological) concept of "neural connections" has taken on an entirely new (cognitive) meaning, at least for many members of the psychological community.

This contention about the permeable boundaries between the metaphorical and the literal is hardly new. In 1927, for instance, Mortimer Adler noted that "the distinction between literal and metaphorical statements cannot be defended when the symbolism of all language is revealed" (p. 94). His claim is consonant with a great deal of recent scholarship. Carol Kates (1980) epitomized this scholarship when she said that "narrowly semantic theories of metaphor are unable to distinguish metaphorical structures from ordinary literal (empirical) statements" and that the distinction between the metaphorical and literal "can only be captured by a pragmatic model of the metaphorical function" (p. 232). "Captured" may be too strong a metaphor: The most Kates feels able to claim is that "one is *intuitively* aware of a difference between a metaphorical utterance and a literal empirical statement, or between a living and a dead metaphor" (p. 233, italics added). To say that the distinction between the metaphorical and literal depends on "intuition" is to say that it depends on a very subtle, acquired sense or taste – that one "knows" what is metaphorical and what is literal because one has become a sensitive connoisseur of the language. This supports my argument, though it might not represent the entire story behind the ability to "intuit" the distinction between metaphorical and literal statements. Sensitivity to a speaker's *intention* may be as important as sensitivity to linguistic *usage* in this regard (see Gibbs, 1984). In any case, a good deal of recent research suggests that the distinction between the metaphorical and literal is relative rather than absolute and that the distinction has "little psychological reality" (Gibbs, 1984, p. 275).

Be that as it may, the distinction does have the sort of *practical* reality that is born of repetition and ritualization. As Cynthia Ozick (1986) has put it, metaphor "transforms the strange into the familiar" (p. 67) – and sometimes into the *all too familiar*. The problems that may result from such familiarization, or literalization, will be discussed later in this chapter and at various places throughout this volume. For now, I hope we can simply agree that the distinction between the metaphorical and literal need not stand in the way of my central thesis that human language and thought are fundamentally metaphorical.[12] In any case, it is time to move on to the selective historical survey that I promised to provide.

A selective and illustrative historical survey: metaphor in the history of Western thought and science

Thoughts about metaphor in early Greek philosophy

To get a running start, I shall go back to the ancient Greeks and begin with Plato, who is important in the history of metaphor, particularly for installing a deep ambivalence about it at the very core of the Western intellectual tradition. It was Plato (ca. 375 B.C./1961a, ca. 360 B.C./

1961b), you will recall, who said that the true essences of things are pure ideas that we can and should strive to attain (or, rather, to remember), but that in practice will remain (for most of us) forever beyond our complete grasp (or recall). All that we can know empirically, said Plato, are the reflections of these ultimate essences – reflections that are embedded in the material objects accessible to our senses. Since these reflections are only copies or likenesses of true reality, what we take to be our knowledge of things is actually only opinion. At best, our theories – and he referred in the *Timaeus* (ca. 355 B.C./1961c) specifically to our scientific theories – are "likely stories." In other words, they are myths, or extended metaphors.[13]

Thus, Plato degraded the only kind of knowledge we are likely to have in this finite world of ours. Setting the framework for the views of knowledge and science that were to come, he established the heuristic goal of certain truth and placed beside it the ineluctable actuality of tentative stories. In so doing he besmirched the reputation of the very sort of knowledge he so astutely analyzed, and so beautifully exemplified in his own work (e.g., see Bambrough, 1956).

Aristotle, Plato's student, served in his own way to delay the consideration of metaphorical thinking as fundamental to all knowledge. For all his importance as the first serious student and most enduring figure in the history of research on metaphor, Aristotle focused primarily on the role of metaphor in poetry and rhetoric, and thus helped establish the several-millennium emphasis on metaphor as a mere rhetorical device (see Kennedy, 1980). Typically overlooked has been the fact that metaphor can also serve as a means of discovery. Although Aristotle himself pointed toward this fact, it was not until the work of Giambattista Vico (1744/1948) that it received any significant attention – and not until the work of Samuel T. Coleridge (1817/1975), I. A. Richards (1936), and others that it was more fully explored.[14] Thus, only in relatively recent times has the study of metaphor begun to move back into the central place it occupied, at least implicitly, in Plato's pragmatic philosophy of science.

Metaphor and the rise of modern science

Of course, when we think about the philosophy of science, we naturally think of modern science, not of Plato, Aristotle, Vico, Coleridge, or I. A. Richards. As is commonly known, the emergence of modern science in the seventeenth century coincided with a good deal of antimetaphorical rhetoric (see R. F. Jones, 1963). Thomas Sprat captured the tone of this rhetoric in his *History of the Royal Society of London* (1667/1702), when he wrote that the members of this new scientific society had "endeavor'd, to separate the knowledge of *Nature* from the colours of *Rhetorick,* the devices of *Fancy,* [and] the delightful deceit of *Fables*" (p. 62). In their

place, he said, they had substituted "a close, naked, natural way of speaking" (p. 113).[15]

Thomas Hobbes (1651/1968) expressed the same attitude when he compared "metaphors, and senslesse and ambiguous words" to "*ignes fatui.*" Reasoning with metaphors, he said, "is [like] wandering amongst innumerable absurdities"; and the end of metaphorical thinking is "contention, and sedition, or contempt" (pp. 116–17).

It is instructive that all this antimetaphorical talk was rhetorical in the extreme, its goal being to reapportion the strictures on thought and discourse. Indeed, it is a delicious irony that the "new language" of both Sprat and Hobbes was thoroughly infused with metaphors – about the "colours" of rhetoric, the "devices" of fancy, the "deceit" of fables; about metaphors being "foolish fires" (*ignes fatui*); and about metaphorical thinking being a path to strife, treason, and all sorts of woe.[16]

Even more to the point, Hobbes's own physiological and social theories were based on metaphors, the central ones being mechanical in nature, thus reflecting his fascination with artificial automata and in particular his love affair with clocks (see McReynolds, 1980). On the very first page of his masterpiece, for instance, Hobbes (1651/1968) laid out the metaphoric assumptions underlying his way of thought – and that of so many other adherents of the "mechanical philosophy" that accompanied the Scientific Revolution:

> Seeing life is but a motion of Limbs, the begining whereof is in some principall part within; why may we not say, that all *Automata* (Engines that move themselves by springs and wheeles as doth a watch) have an artificiall life? For what is the *Heart*, but a *Spring;* and the *Nerves*, but so many *Strings*; and the *Joynts*, but so many *Wheeles*, giving motion to the whole Body, such as was intended by the Artificer? ... [So too] by Art is created that great LEVIATHAN called a COMMON-WEALTH, or STATE, (in latine CIVITAS) which is but an Artificiall Man ... in which, the *Soveraignty* is an Artificiall *Soul*, as giving life and motion to the whole body; The *Magistrates*, and other *Officers* of Judicature and Execution, artificiall *Joynts; Reward* and *Punishment* ... are the *Nerves* [and so on]. (p. 81)

Of course, when we think of the "clockwork universe," we think almost immediately of Sir Isaac Newton, even though Newton's perspective was thoroughly mathematical rather than mechanical. Indeed, the central concept in his system of thought – universal gravitation – is far from mechanistic (Newton, 1687/1974; see Cohen, 1980). In fact, the history of this concept, which is one of the most fundamental in modern science, illustrates neatly how natural philosophers and scientists often utilize metaphors from the social world.[17] When Newton first pondered the fact that no detectable mechanical force accounted for the tendency

of masses of matter to move toward one another, he conceptualized this mysterious movement as analogous to the "attraction" of human persons toward one another. In his early notebooks he even used the term "sociability" in addition to "attraction" (Manuel, 1968, p. 68). Later, he preferred to speak of "gravity," despite its mechanistic connotation, on the assumption that this metaphor could be used neutrally, which is to say, in a purely descriptive manner. But though "gravity" was certainly less anthropomorphic than "sociability" or "attraction," its subsequent history shows that it was rarely taken neutrally.[18] Indeed, as I have already suggested, no term, no sign, no metaphor is so translucent that it can convey a pure idea without some sort of clothing. Numbers may come closest to being translucent, but even they, as we now know, bring along a wardrobe of assumptions that shroud their objects, however sparely, in one fashion or another.[19]

In sum, we need not select a Neoplatonic mystic like Johannes Kepler in order to illustrate the impact of metaphorical thinking in the history of the physical sciences (see Koestler, 1959). Quite the contrary. It would be easy to provide examples ad nauseam of the constitutive and regulative metaphors of modern physical science, accompanied by extended analyses of and quotations from the works of such respectable scientists as James Clerk Maxwell, William Thomson (Lord Kelvin), and Albert Einstein. For the sake of preserving the necessarily selective character of my historical survey, however, I shall simply refer to the works of Hesse (1966), Hoffman (1980), Leatherdale (1974), MacCormac (1976), and North (1980), which provide many lucid and compelling examples of the contributions of metaphorical thinking to the development of the natural sciences.

Metaphor in biological science

If there was a Newton of biology, that person was Charles Darwin, whose published works (despite his sometimes positivist rhetoric) are replete with metaphors, often – indeed generally – social in origin: metaphors of struggle, competition, organization, and division of labor; metaphors regarding the economy and polity of nature; and so on.[20] But more significant than the mere abundance of metaphors in Darwin's writing is the essential role that metaphors played in the conceptual development of his thinking, as clearly shown in his notebooks (see, e.g., Barrett, 1974; De Beer, 1960–1, 1967; Herbert, 1980; Vorzimmer, 1977). Far from being merely illustrative, Darwin's metaphors constitute the very foundation of his theory (see Evans, 1984; Gruber, 1974, 1980; Manier, 1978).

Most fundamental, of course, is Darwin's metaphor of natural selection. Does *Nature* – with a capital *N*, as he typically had it – really *select*?

Not really, but Darwin's articulation of evolutionary theory was dependent on his sustained analogical – and rhetorical – comparison between the so-called artificial selection (or breeding) of animals as controlled by humans, on the one hand, and the putatively natural selection of variants carried out by Nature, on the other. Thus, the human metaphor (as nicely analyzed by Robert Young, 1971) was central and critical to Darwin's thought, in this as in other ways. And it is worth noting that Darwin was no more able to forestall unintended, sometimes even teleological readings of his metaphor than Newton was able to keep the mechanists at bay (see Glick, 1974; D. Hull, 1973; Vorzimmer, 1970). If I may use a current Darwinian metaphor, I would say that the history of Darwinian thought suggests that ideas (like offspring of a different sort) develop according to their own genetic endowments, environments, and life histories, tending to move in directions unanticipated (and sometimes even vigorously opposed) by their parents.[21]

Also important in Darwin's creative thinking was the role of imagery, which often initially took the form of visual metaphor and was soon articulated into verbal metaphor. I am thinking primarily of the image of an irregularly branching tree, although other examples could be cited as well. As Gruber (1978) has shown, the metaphor of a tree helped Darwin at a crucial point to make sense of a good deal of untidy and problematic data regarding the evolutionary history and relationships of various species. The tree metaphor did not, and does not, work perfectly. Darwin (1859/1964) himself claimed only that it *"largely* speaks the truth" (p. 129, italics added).[22] And yet, whatever its imperfections, the tree metaphor continues to this very day – like imperfect metaphors in other disciplines – to provide a cognitive framework for both scientists and laypersons alike.

Before turning from the biological to the social sciences, I want to say a few words about one aspect of the physiological theory of Herbert Spencer, whose life and work overlapped significantly with Darwin's. I wish to do so in order to focus attention briefly on the relationship between metaphors and empirical research. To account for the multiplicity of neural functions, which clearly outnumber the finite number of the nervous system's organic parts, Spencer (1870) suggested that the brain (with its neurological extensions) resembles a piano. Though the piano has fewer than one hundred keys, its potential combinations of notes are so numerous that it can produce a virtual infinitude of sounds. So it is (Spencer said) with the brain, whose extensions and parts can be "played" in innumerable ways (pp. 562–3). To be sure, this is an innocent-seeming metaphorical comparison, but it inspired some of the important neurological work of John Hughlings Jackson, and through Jackson its impact was felt by Sigmund Freud and many others (see

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